OTHER ENVIRONMENTAL ISSUES

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13.0 Soils and Groundwater

This section provides an assessment of the potential impacts of the proposed modification on soil and groundwater, particularly pertaining to contamination.

13.1 Existing Environment

13.1.1 Soils

The Wollongong – Port Hacking 1:100 000 Geological Sheet 9029-9129 (Geological Survey of NSW, 1985) indicates that the Port Kembla region is underlain by melanocratic, coarse grained porphyritic latites of the Shoalhaven Group. These units are overlain by Quaternary sediments consisting of alluvium, gravel and marine or dune sands.

Extensive reclamation and filling activities have occurred within the Port Kembla Harbour region since the early 1900's with much of the original shoreline buried under various fill materials and dredged sediments from the bed of the harbour.

Soils in the landside portion of the proposed modification therefore generally consist of imported fill underlain by Quaternary sediments. Fill materials across the site are variable and include gravelly sand with minor clay, shallow sandy fill, coal wash fill, highly plastic clays, building material and road base. Fill material in areas excluding the initial reclamation area off the central portion of the multi-purpose terminal are variable and extend to depths of up to approximately 4 metres below ground surface (bgs). Soil investigations undertaken as part of the previous Environmental Assessment encountered natural sands, likely aeolian, marine or dune sands, and estuarine sediments below the fill.

Fill material consisting of uncrushed blast furnace slag was used for initial reclamation of the central portion of the multi-purpose terminal. A stockpile of rock fill material is currently located east of the Darcy Road Drain. The stockpile occupies an area of approximately 1 hectare and is up to 10 metres in height. It is understood that this material is to be used for reclamation works associated with the Outer Harbour expansion (ERM, 2012).

Acid Sulphate Soils

Limited investigations into the presence of Acid Sulfate Soils (ASS) have been undertaken in the landward areas near the site of the proposed modification. The *NSW Acid Sulfate Soil Risk Maps* (DNR, 2002) for Wollongong show that all landward soil in the area of the proposed modification is 'Disturbed Terrain' to depths of greater than 4 metres. However, the CEMP prepared for the CGM cited a geotechnical and contamination assessment prepared by Coffey in 2010, which identified alluvial/marine sand to depths of greater than 3 metres. The assessment reported that darker coloured clayey sand soils were identified at depth that could potentially be indicative of ASS. The report also stated that nearby test pit locations have identified estuarine sand and clayey sand soils at depths between 1.9 metres and 2.4 metres bgs which may potentially be indicative of ASS.

The results of previous investigations therefore suggest that ASS may occur in the footprint of the proposed modification at depths greater than 1.9 metres, and could be disturbed during earthworks.

Previous Soil Investigations

Numerous soil investigations have been conducted across and in the vicinity of the proposed modification area to date. The previous investigations date back to 1993, with the more recent reports considered more relevant. **Figure 13-1** shows the sample locations for the more recent contamination investigations (post 2004) within the proposed modification area. The previous soil investigations are summarised in the following paragraphs with reference to the recently adopted soil assessment criteria (SAC). The SAC comprise the:

- Health-based investigation levels for commercial/industrial sites (HIL_D) and health based screening levels for commercial/industrial land use (HSL_D) in Schedule B (1) Investigation Levels for Soil and Groundwater of the National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure (NEPM)* 1999 (ASC NEPM [2013]) as amended and in force 15 May 2013; and
- CRC CARE Technical Report no. 10 Health screening levels for petroleum hydrocarbons in soil and groundwater (CRC CARE, 2011).

CMPS&F Environmental, 1993 (Area between the Rail loop and Proposed Truck unloading/loading zone)

Camp Scott and Furphy (CMPS&F) Environmental carried out a Site Assessment Investigation for the Illawarra Ports Authority (IPA), on the property located at the intersection of Old Port Road and Christy Drive (adjacent to Jetty No.6 and near the northern part of the rail loop) in August 1993.

The objective of the investigation was to identify the type and extent of potential soil contamination and included the excavation of 28 test pits to depths ranging between 1 and 3 m bgs. Samples of fill were collected and analysed from a depth interval of 0 and 0.5 m bgs in all test pits. All samples were analysed for TPH by infrared (IR) spectrophotometer, heavy metals (Cu, Pb, Zn, Cd, Cr and As) and pH. Selected samples were analysed for TPH by gas chromatography (GC), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

Relatively uniform subsurface conditions existed at the site. The site geology comprised of up to 2.5 metres of fill material which was underlain by poorly graded coarse sand. The following elevated results were reported:

- Soil pH ranged from 4.9 to 8.2
- Elevated heavy metal soil contamination was detected in samples collected from test pits TP3 and TP25 (located near the State Rail Authority rail corridor in the centre of the study area). The concentrations of lead (3040mg/kg – TP25/0.5m) and of total chromium (55,000 mg/kg - TP25/0.5m) exceeds the recently adopted SAC (HIL_D from the ASC NEPM [2013]) of 1,500 mg/kg for lead and 3600 mg/kg for chromium VI. It is noted that chromium IV was not analysed for.
- Elevated concentrations of PCBs (60 mg/kg) were detected in test pit TP21, located near the Old Port Road railway bridge which exceeds the recently adopted SAC (HIL_D from the ASC NEPM [2013]) of 7 mg/kg.
- Petroleum hydrocarbons detected in the samples analysed did not exceed the HSL_D from the ASC NEPM (2013) or the CRC Care (2011) HSL_D for direct contact or intrusive maintenance workers.
- Total PAHs were detected at concentrations greater than the LOR in three test pits; TP01 (7.78 mg/kg), TP04 (6.21 mg/kg) and TP05 (8.75 mg/kg).These concentrations do not exceed the HIL_D from the ASC NEPM (2013).

The report concluded there was insufficient data to define the physical extent of soil contamination and that an assessment of the most appropriate options available to remediate the contaminated soil which were both practicable and suited to the site specific characteristics should be undertaken. Subsequent contamination investigations (AECOM, 2009) have been conducted in the vicinity of this area.

CMPS&F Environment, 1994 (Southern Shores of Port Kembla)

Subsurface investigation was undertaken on the southern shores of Port Kembla by CMPS&F Environment in 1994. The investigation comprised the excavation of 41 test pits across the site, part of which included the proposed multi-purpose terminal (to the west of the Darcy Road Drain) and the area proposed for the bulk unloader facilities. Soil samples were collected from each test pit.

The subsurface conditions encountered, generally comprised a layer of fill overlying alluvial / dune sands. Fill type was variable across the site and comprised varying proportions of slag, rubble and building waste, and coal wash.

Select samples were analysed for Heavy Metals, Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAHs).

Elevated concentrations of heavy metals (arsenic, lead, copper, chromium and zinc), TPH and PAH were detected in the fill materials. Heavy metal contamination was generally attributed to the fill type (i.e. the presence of slag).

The analytical results for contaminants that exceed the recently adopted SAC are listed below.

- Lead: concentrations exceeded the SAC (HIL_D from the ASC NEPM [2013]) of 1,500 mg/kg in four locations (TPA2/1.3m-1950 mg/kg, TPA10/0.5m-3660 mg/kg,TPA14/1.6m - 8930 mg/kg and TPB20/0.5m – 1630 mg/kg).
- Total PAHs: concentrations exceeded the SAC (HIL_D from the ASC NEPM [2013]) of 4000 mg/kg in TPB18/1.6m – 11,387 mg/kg
- Carcinogenic PAHs (as BaP TEQ): concentrations exceeded the SAC (HIL_D from the ASC NEPM [2013]) of 40 mg/kg in TPB18/1.6m – 1306.5 mg/kg

CMPS&F Environment recommended that further investigation of the identified contamination be conducted. Subsequent contamination investigations (ERM, 2013) have been conducted in this area and are discussed later.

SKM, 2004 (Lot 201 Old Port Road, Port Kembla)

Sinclair Knight Merz Pty Ltd (SKM) completed a Preliminary and Detailed Site Investigation of the former rail maintenance centre at Lot 201, Old Port Road, Port Kembla, in the area of the North Yard and northern part of the rail loop. The report identified the following potential contaminating activities:

- Imported fill including slag and ash from the former railway operation sand steel works
- Fuel and oil spills from railway operations
- Storage of oil and grease and compressor in unbunded areas
- Spills of limestone and copper ore concentration
- Refuelling of locomotives
- Pesticide and herbicide spray residues.

A total of 39 boreholes (BH1 to BH39) and six hand augers (HA1 to HA6) were sampled during the intrusive soil investigation. The subsurface was described as consisting of 3 to 5 m of slag and coal wash fill, underlain by high plasticity black and brown/green clays. Soil samples were analysed for TPH, BTEX, PAH, OCPs, SVOCS and VOCs. All results reported from the investigation are less than the recently adopted SAC (HIL_D from the ASC NEPM [2013]).

URS, 2004 (Foreshore Area of the Outer Harbour)

URS Australia Pty Ltd (URS) was commissioned to undertake a Phase 2 Environmental Site Assessment (ESA) at parts of the Port Kembla Inner and Outer Harbour foreshore areas. The investigation included the installation of six groundwater monitoring wells (OHMW21-25 and OHMW30) in the Outer Harbour and were located within the expanded multi-purpose terminal area and extended road alignment of the proposed modification. **Figure 13-1** shows the locations of the monitoring wells.

Two soil samples were collected from OHMW30 (at 0.3-0.4 and 2.9-3.0 m bgs) and analysed for heavy metals, TPH, BTEX and PAHs. Reported concentrations were all less than the recently adopted SAC (HIL_D from the ASC NEPM [2013]).

Douglas Partners, 2009 (southern and western shoreline of the Outer Harbour)

Douglas Partners was commissioned by PKOPL to undertake a groundwater investigation in the Outer Harbour Lands (OHLs) of the Port Kembla Harbour. The objectives of the report were to provide up to date data set for groundwater in the OHL and assessment of soil contamination at new well locations. Soil samples from new and reinstalled boreholes were collected and analysed for metals (Pb, Hg, Ca, As, Cu, Zn, Sn, Cr and Ni), TPH, BTEX, PAHs, OCP, OPP, PCB and asbestos.

Soil samples collected and analysed during the installation of wells indicated the contaminant concentrations were less than the SAC (HIL_D from the ASC NEPM [2013]) with the exception of one location where asbestos was detected between 0.5-1.0 m bgs.

AECOM, 2009 (Proposed road link from Christy Drive to the multi-purpose terminals)

Subsurface investigations were undertaken by AECOM in 2009 as part of the previous Environmental Assessment with a focus on the Major Project (Stage 1) area and in particular, the proposed road link from Christy Drive to the multi-purpose terminals (AECOM, 2010). Eleven boreholes (BH01 to BH11) were advanced across the location of the proposed road corridor to a maximum depth of 1.5 metres bgs corresponding with the maximum anticipated excavation depth required for the proposed road (refer to

Figure 13-1). Soil samples were collected from each location and analysed for the identified contaminants of potential concern (CoPC) including:

- Heavy Metals, Petroleum Hydrocarbons, Monocyclic Aromatic Hydrocarbons (MAHs), PAHs, Phenols, Organochlorine Pesticides (OCPs), Organophosphorus Pesticides (OPPs), Polychlorinated Biphenyls (PCBs) and asbestos

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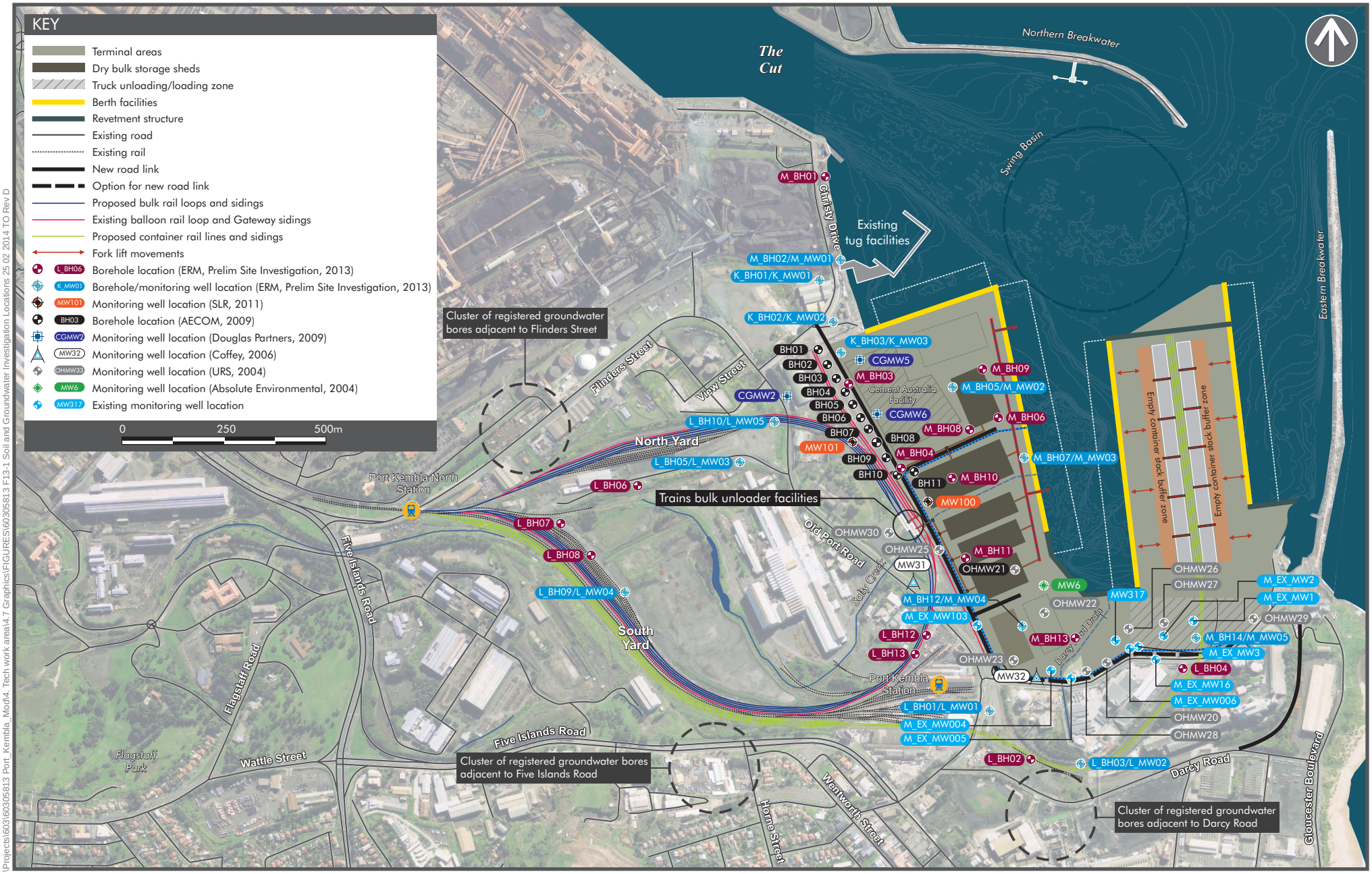

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AECOM

SOIL AND GROUNDWATER INVESTIGATION LOCATIONS

Port Kembla Outer Harbour Development
Environmental Assessment

Note: Locations showing 'clusters' of registered groundwater bores are approximate only and were interpreted from a search for registered groundwater bores on the NSW Natural Resource Atlas website.

FIGURE 13-1

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The CoPC were identified based on historic site activities and previous environmental investigation results in the Port Kembla Harbour region.

The CoPC in all the samples analysed during this investigation were less than the site assessment criteria adopted by AECOM (2010), with the exception of:

- An elevated copper concentration (12,900 milligrams per kilogram (mg/kg) relative to the site assessment criteria (5,000 mg/kg) adopted by AECOM (2009) was reported in one sample (BH08) at 0.2 to 0.3 metres bgs (collected from fill comprising dark brown and black sand and coarse gravel with some ash). It is noted that this concentration does not exceed the recently adopted SAC (HIL_D [240,000 mg/kg] from the ASC NEPM [2013]); and
- Chrysotile asbestos fibres were identified in one sample (BH10) from 0.5 to 0.6 metres bgs (collected from fill comprising dark brown and black sand and coarse gravel with some ash).

The assessment concluded that fill materials encountered during the investigation would likely be classified as 'General Solid Waste' in accordance with the NSW DECC (2008) Waste Classification Guidelines. Fill materials may therefore be suitable for re-use as part of the new road link from Christy Drive (i.e. commercial / industrial land use) with the exception of the impacted soils located at BH10.

Given that the elevated concentrations of copper are below the recently adopted SAC, AECOM considers that the soils are unlikely to require remediation and/or management assuming continued commercial/industrial use of the land. It was recommended that disturbance of fill materials be controlled by a Site Management Plan (SMP) as part of relevant CEMPs for the project for the management of asbestos impacted soils. The SMP would establish a suitable management framework for excavation works, which would include identifying contamination impacts based on visual observations and through detailed soil sample analysis, if required.

ERM, 2012

In December 2012, ERM reported on desktop and subsurface investigations undertaken as part of the proposed 99-year lease of port lands to private investors in a *Vendor Environmental Due Diligence Report* (ERM, 2012). For the purpose of their investigation, ERM identified the various areas within the port as areas 'A' though 'O'. Areas M and K of the *Vendor Environmental Due Diligence Report* (ERM, 2012) are relevant to the proposed modification area. Results for these areas are summarised in the following sections. For ease of interpretation, sample locations associated with the investigation of areas M and K are shown on **Figure 13-1** with the prefix 'K_BH01' or 'M_BH01' (as appropriate).

ERM, 2012 (Area K) (Northern portion of the proposed multi-purpose terminal)

In December 2012, ERM conducted desktop and subsurface investigations in the area which forms the northern part of the multi-purpose terminal (ERM, 2012) (refer to **Figure 13-1**). At the time of their investigation, the land was leased by Port Kembla Gateway Pty Ltd (herein referred to as Port Kembla Gateway) from the then PKPC. Port Kembla Gateway reportedly utilised the site as a storage and loading facility for bulk goods (primarily copper concentrate and soda ash) and for the unloading and storage of "break bulk" goods such as mining equipment.

The Phase 1 investigation of the site identified several potentially contaminating activities associated with the contemporary land use, in particular, the storage and handling of copper concentrate. Additionally, historical use of the south west portion of the site (in the footprint of the current copper concentrate shed) as a power station was identified as an activity which had a high potential for contamination. The power station was in operation from 1914 to the 1980's (when it was demolished) and was then owned by the NSW Government. The remainder of the site was used as a storage and distribution facility for various materials since the 1950's. Although exact details are unknown, ERM reported that materials such as timber, sugar, pylons, steel, shipping containers and possibly metal concentrates and coal/coke were stockpiled on the site. In addition to historical industrial operations at the site, historical filling (reclamation) of the site with materials of an unknown origin is likely to have occurred over several decades and could represent a source of contamination.

Following their Phase 1 investigation, ERM undertook subsurface investigations in the northern portion of the proposed modification area. Three soil bores (K_BH01 to K_BH03) were advanced across the site (refer to **Figure 13-1**) to target the identified CoPC including:

- Total Recoverable Hydrocarbons (TRH), Volatile Organic Compounds (VOCs), PAHs, Heavy Metals and Metalloids, OCPs, OPPs, Phenols, PCBs and asbestos.

The CoPC were considered to be a result of historical filling activities, surrounding industrial land uses which may have impacted on the site, and the historical demolition of buildings (asbestos only). Each of the boreholes (K_BH01 – K_BH03) were converted to groundwater monitoring wells. Groundwater data obtained from these wells is discussed in **Section 13.1.2**. Note that borehole K_BH01 was located in the area immediately north of Christy Drive, (north east of the proposed road link) and was not in an area likely to be directly impacted by the proposed modification. Soil data and ground conditions encountered at K_BH01 are therefore indicative only.

ERM submitted seven primary samples for laboratory analysis for the CoPC (from K_BH01 to K_BH03). An elevated concentration of copper was reported in a soil sample collected at K_BH01 (75,000 mg/kg). Note however, that this concentration does not exceed the recently adopted SAC (HIL_D [240,000 mg/kg] from the ASC NEPM [2013]). Asbestos fibres were not detected in the three samples analysed (for asbestos). All other CoPC were less than the laboratory Limit of Reporting (LOR) or SAC.

ERM, 2012 (Area M) (Central and southern portions of the proposed multi-purpose terminal)

Concurrently, in December 2012, ERM conducted desktop and subsurface investigations in the central and southern portions of the proposed multi-purpose terminal area and near the train bulk unloader facilities (ERM, 2012) (refer to **Figure 13-1**). Note that ERM's investigation was not limited to these areas, but also included limited subsurface investigation of land to the north of Christy Drive and adjacent the BlueScope steelworks, and to the east of Darcy Road Drain (outside the area of subsurface disturbance proposed by the modification).

At the time of their investigation, there were no buildings present on the site (with the exception of the Survey Boat Shed located in the area to the north of Christy Drive). Part of the central portion of the proposed multi-purpose terminal was leased by PKPC to Cement Australia (refer to **Figure 13-1**) for the construction and operation of a new CGM. It is understood that at the time of ERM's investigation, Cement Australia's construction contractors had control of the site and had commenced piling for foundations. The remainder of the site is understood to have been used for the general storage and distribution of goods.

The Phase 1 investigation of the site identified two current potential sources of contamination from two off-site sources, a metal recycler and an Endeavour Energy owned and operated electrical substation both located immediately west of the site. Both are considered to be sources of PCB contamination. Fuel contaminants may also be sourced from leaking parts (e.g. cars and transformers) at the metal recyclers' scrap metal yard.

ERM indicated that the operation of a hydrocarbon storage facility and shipping jetty on and adjacent to the site from 1937 until the 1980's was considered to present a high potential for contamination. It is understood that historically these fuel storage tanks were associated with the Commonwealth Oil Refinery and the PWD Power Station sites located along Old Port Road. The Commonwealth Oil Refinery was serviced by the Inflammable Liquids Berth in the Outer Harbour. The ERM 2012 report suggests that fuels were transported across the port lands to a jetty located in the Outer Harbour. This may have been a possible source of hydrocarbon contamination caused by accidental leakage from transfer pipes or spills during loading.

Like the northern portion of the proposed multi-purpose terminal facility and much of the Port Kembla area, historical filling (reclamation) of the site with materials of an unknown origin is likely to have occurred over several decades and could represent a source of contamination.

Following their Phase 1 investigation, ERM undertook subsurface investigations in the central and southern portions of the proposed multi-purpose terminal and within the modification area. Fourteen soil bores (M_BH01 to M_BH14) were advanced across the site (refer to **Figure 13-1**) to target the identified CoPC including:

- TRH, VOCs, PAHs, Heavy Metals and Metalloids, OCPs, OPPs, Phenols, PCBs and asbestos.

The CoPC were considered to be potentially sourced from historical filling activities, former site industrial land use and surrounding industrial land uses. Five boreholes were later converted to new groundwater monitoring wells, supplementing the existing groundwater monitoring well network. Groundwater data obtained from these wells is discussed in **Section 13.1.2**.

ERM submitted 25 primary soil samples for laboratory analysis for the CoPC (from M_BH01 to M_BH14). The reported concentrations of all analytes were less than the recently adopted SAC in all samples, with the exception of the detection of asbestos in a single soil sample collected at 1.5 metres bgs (in fill) at M_BH02. Petroleum hydrocarbons were detected at borehole location M_BH14, and various PAHs were detected at M_BH13.

ERM, 2013 (Outer Harbour rail network)

In 2013, a preliminary soil and groundwater investigation was conducted in the area of the Outer Harbour rail network (ERM, 2013), which is within the area affected by the modification. A total of 13 bores (L_BH01 to L_BH13) were drilled and soil samples were collected and analysed for the identified CoPC (refer to **Figure 13-1**) including:

- Heavy Metals, Petroleum Hydrocarbons, Chlorinated Hydrocarbons (CHCs), MAHs, PAHs, VOCs and asbestos.

All soil analytical results were either less than the laboratory level of reporting or the recently adopted SAC. Concentrations of Heavy Metals, TRH in the C_{10} to C_{40} fractions (diesel fuel), and PAHs were detected in some soil samples, however, the analytical concentrations were less than the recently adopted SAC. The ERM report concluded that the soil contamination issues in the area of the Outer Harbour rail network are unlikely to require remediation or management assuming continued commercial/industrial use of the land.

Summary of Contamination Impacts in Soil

Previous investigations conducted by CMPS&F in 1993 and 1994 at the property adjacent to the modification of the northern rail loop, and at the proposed multi-purpose terminal (to the west of the Darcy Road Drain), including the bulk unloader facilities, reported concentrations of lead, chromium, PCBs and PAHs that would exceed the recently adopted SAC. Given the date of these investigations, the reliability of the data may be questionable. Subsequent investigations conducted in the vicinity of these areas identified concentrations of contaminants below the recently adopted SAC. Therefore, while these contaminants are considered potential contaminants of concern, it is considered that these areas do not warrant remediation works prior to development.

The recent soil investigations conducted across the modification area did not identify soil contamination issues, with the exception of asbestos, that are likely to require remediation or management assuming continued commercial/industrial land use. However there are some areas across the modification area that have not been adequately characterised, particularly the train bulk unloading facility and parts of the rail loop in the vicinity of the North Yard and South Yard.

Asbestos was identified in soils during both the AECOM (2009) and ERM (2012) (Area M) soil investigations. Both samples identified asbestos fibres in samples collected from fill, however samples were collected at different depths (0.5 and 1.5 metres bgs, respectively).

The AECOM (2009) investigation focussed on the proposed road link from Christy Drive to the multi-purpose terminals, adjacent to the area where the former power station had operated. The source of asbestos at this location is likely to be attributable to demolition rubble from the decommissioning of the power station in the 1980's. Note that the demolition details are unknown. Similarly, ERM's (2012) (Area K) investigation made reference to a Site Audit Report prepared by JBS (2005) for the same area. In their report, JBS indicated that asbestos containing materials (ACM) (fragments of asbestos cement sheeting) were observed across the site. Additionally, ERM also reported that ACM was identified in surface soils and was selectively removed from the same area by Coffey Geotechnics in 2005. AECOM has not reviewed the JBS (2005) or Coffey (2005) reports and are therefore reliant on the information provided by ERM (2012) (Area K). The observations made by JBS and works reportedly conducted by Coffey together with the AECOM (2009) analytical results suggest that asbestos (in the form of cement sheeting and fibres) may be more widespread in this area.

ERM's (2012) (Area M) asbestos fibre detection was from a sample collected from a location adjacent to Christy Drive, immediately to the north of the proposed multi-purpose facility. Although this location is just outside the area of the proposed modification, the presence of asbestos in fill at this location is indicative of the potential presence of asbestos fibres in fill at other locations within the modification area.

13.1.2 Groundwater

Registered Groundwater Bores

A search for registered groundwater bores located at and in the vicinity of the proposed Outer Harbour development was undertaken using the NSW government NSW Natural Resource Atlas (http://www.nratlas.nsw.gov.au/). No registered groundwater bores were identified within the area of the proposed modification. However, clusters of wells were located north of Flinders Street (nine) (and the North Yard of the modification), south of Five Islands Road (three) (and the South Yard of the modification) and south of Darcy Road (eight) (south of the southern portion of the proposed multi-purpose terminal). Approximate locations of the well clusters are shown in **Figure 13-1**.

A summary of the groundwater data obtained for registered bores located within approximately 500 m of the area of the proposed modification are as follows.

Flinders Street Bores

- Bores were installed to depths ranging from approximately 4 to 7 metres bgs indicating that groundwater levels are generally shallow at this location (i.e. less than 7 metres below top of casing (btoc).
- Groundwater standing water levels were not reported at all locations however, two locations reported standing water levels less than 1.5 metres below top of casing (btoc).
- Bores were installed on the property of Bendshaw Pty Limited for monitoring purposes.

Five Islands Road Bores

- Standing water levels at the three bores ranged from 3 to 4 metres btoc.
- Bores were installed on the property of Endeavour Energy for monitoring purposes.

Darcy Road Bores

- Standing water levels were recorded at four bore locations and were all less than approximately 2.1 metres btoc.
- Bores were registered by a private owner for monitoring purposes.

Numerous other groundwater bores are located within and in the vicinity of the proposed modification area. These bores may not be registered, or were registered but data for which is not yet publicly available. The following section describes groundwater conditions within the proposed modification area.

Previous Groundwater Investigations

Since publication of the previous Environmental Assessment, an update of the groundwater conditions across the Outer Harbour rail network and surrounding land has been provided in the documents *Groundwater and Soil Quality Assessment – Outer Harbour Lands Port Kembla* (SLR, 2011), *Vendor Environmental Due Diligence Assessment: Area K and M* (ERM, 2012) and *Preliminary Environmental Site Assessment – Port Kembla Port Corporation Outer Harbour Rail Network Port Kembla, NSW* (ERM, 2013).

The previous groundwater investigations are summarised in the following paragraphs with reference to the groundwater assessment criteria (GAC) comprising the ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) for protection of marine water aquatic ecosystems and CRC CARE Technical Report no. 10 Health screening levels for petroleum hydrocarbons in soil and groundwater (CRC CARE, 2011) as referred to in Schedule B(1) of the ASC NEPM (2013).

CMPS&F Environmental, 1995 - (Old Port Road and Christy Drive)

The groundwater study was undertaken by CMPS&F on the property located at the intersection of Old Port Road and Christy Drive, to the north of the Outer Harbour rail loop to assess if polychlorinated biphenyl (PCB) and heavy metal soil contamination identified in the 1993 CMPS&F investigation, was adversely impacting groundwater on the site and/or migrating offsite.

Five groundwater monitoring wells were installed and two rounds of groundwater sampling after different hydrological events. Groundwater levels ranged from 1.326 m bgs to 2.984 m bgs and were expected to be dominated by tidal influences rather than hydrological conditions. Samples were analysed for dissolved heavy metals and PCBs.

Copper (0.01 mg/L), lead (0.02 mg/L) and zinc (0.05 mg/L) were detected at concentrations greater than the laboratory LOR in MW1 and lead (0.02 mg/L) was detected in MW4. All other heavy metal results and PCBs were less than the laboratory LOR. It is noted that the laboratory LOR for copper and lead reported exceeds the ANZECC (2000) 95% marine trigger values.

Absolute Environmental, 2004 (Eastern Corner Old Port Road & Christy Drive)

Absolute Environmental installed four groundwater monitoring wells (MW6 to MW9) and undertook two groundwater monitoring events (GME's) at the property located at the eastern corner of Old Port Road and Christy Drive, Port Kembla. The investigation area was located adjacent to the rail siding. The objective of the program was to assess current groundwater conditions in the area of the site down hydraulic gradient of a previously identified area of heavy metals and PCB soil contamination.

The results of the GME's are summarised below. All other heavy metal results and PCBs were less than the laboratory LOR and/or the adopted criteria.

Table 13-1 Groundwater monitoring results in Outer Harbour lands

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection)	Exceedance of ANZECC (2000) Marine Water Quality Guideline
MW6	1.30 to 2.15	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.003 mg/L) Zinc (0.012 to 0.086 mg/L)
MW7	4.45 to 4.85	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.002mg/L) Zinc (0.036 to 0.046 mg/L)
MW8	4.36 to 4.62	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.004 mg/L) Zinc (0.03 to 0.120 mg/L)
MW9	4.31 to 4.59	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.002 mg/L) Zinc (0.010 to 0.039 mg/L)

SKM, 2004 (Northern section of rail loop – North Yard)

Sinclair Knight Merz Pty Ltd (SKM) completed a Preliminary and Detailed Site Investigation of the former rail maintenance centre at Lot 201, Old Port Road, Port Kembla.

Four groundwater monitoring wells were installed (GW1 to GW4). GW 1 and GW 4 were sampled and analysed for dissolved heavy metals (As, Co, Ca, Cr, Cu, Ni, Pb, Zn and Mn), hardness, TPH, BTEX, SVOCs and VOCs. All results were less than the laboratory LOR with the exception of cobalt (0.002 to 0.068 mg/L), copper (0.016 to 0.002 mg/L), nickel (0.010 mg/L), zinc (0.029 to 0.076 mg/L) and manganese (5.42 mg/L).

URS, 2004 (South eastern shoreline –southwest portion of proposed terminal area)

URS Australia Pty Ltd (URS) was commissioned to undertake a Phase 2 Environmental Site Assessment (ESA) at parts of the Port Kembla Inner and Outer Harbour foreshore areas. The investigation included the installation and sampling of six groundwater monitoring wells (OHMW21-25 and OHMW30), and sampling of three existing monitoring wells (MW6, MW7 and MW10) in the Outer Harbour and were located within the southwest portion of the proposed terminal area.

Groundwater samples from the nine wells sampled were analysed for dissolved heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn) and PAHs. The results are summarised in **Table 13-2** below.

Table 13-2 Groundwater monitoring results in Outer Harbour lands

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection)	Exceedance of ANZECC (2000) Marine Water Quality Guideline
MW6	2.435	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.015 mg/L) Zinc (0.022mg/L)
MW7	2.868	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.005 mg/L) Zinc (0.017 mg/L)
MW10	3.165	No exceedances	
OHMW21	3.488	No exceedances	
OHMW22	3.862	No exceedances	
OHMW23	4.142	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.002) Zinc (0.374 mg/L)
OHMW24	3.825	No exceedances	
OHMW25	4.386	Copper: 0.0013mg/L	Copper (0.003 mg/L)

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection)	Exceedance of ANZECC (2000) Marine Water Quality Guideline
OHMW26	3.404	Copper: 0.0013mg/L Nickel: 0.07mg/L Zinc: 0.015mg/L	Copper (0.011 mg/L) Nickel (0.14 mg/L) Zinc (1.12 mg/L)

Coffey, 2006 (Eastern Corner Old Port Road & Christy Drive)

Coffey Geotechnics Pty Ltd (Coffey) undertook a groundwater assessment for the portion of land located on the corner of Old Port Road and Christy Drive, Port Kembla, adjacent to the northern part of the rail loop. At the time of the investigation the site had recently been redeveloped into a copper concentrate storage facility comprising a large storage building and a conveyor.

Eight groundwater monitoring wells (CGMW1 to CGMW08) were installed and sampled. Groundwater samples were analysed for TPH, BTEX, PAH, heavy metals, PCBs and hardness as calcium carbonate. Heavy metal exceedances are summarised in **Table 13-3** below. TPH, BTEX, PAH and PCB compounds were not detected at concentrations greater than the LOR.

Table 13-3 Groundwater monitoring results (Coffey 2006)

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection)	Exceedance of ANZECC (2000) Marine Water Quality Guideline
CGMW01	2.657	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.002 mg/L) Zinc (0.090 mg/L)
CGMW02	2.753	Copper: 0.0013mg/L	Copper (0.002 mg/L)
CGMW03	3.252	Copper: 0.0013mg/L	Copper (0.002 mg/L)
CGMW04	4.262	Copper: 0.0013mg/L	Copper (0.004 mg/L)
CGMW05	4.981	Copper: 0.0013mg/L	Copper (0.004 mg/L)
CGMW06	5.161	Copper: 0.0013mg/L	Copper (0.002 mg/L)
CGMW07	3.378	No exceedances	
CGMW08	4.393	No exceedances	

URS, 2006 (South eastern shoreline –southwest portion of proposed terminal area)

URS undertook a GME in 2006 of existing groundwater monitoring wells (OHMW21-25 and OHMW30, MW6, MW7 and MW10), in the southwest portion of the proposed terminal area. All groundwater wells were sampled and analysed for heavy metals including hexavalent chromium. The results are summarised in **Table 13-4** below.

Table 13-4 Groundwater monitoring results (URS 2006)

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection)	Exceedance of ANZECC (2000) Marine Water Quality Guideline
MW6	2.435	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.015 mg/L) Zinc (0.022mg/L)
MW7	2.868	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.005 mg/L) Zinc (0.017 mg/L)
MW10	3.165	No exceedances	

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection)	Exceedance of ANZECC (2000) Marine Water Quality Guideline
OHMW21	3.488	No exceedances	
OHMW22	3.862	No exceedances	
OHMW23	4.142	Copper: 0.0013mg/L Zinc: 0.015mg/L	Copper (0.002) Zinc (0.511 mg/L)
OHMW24	3.825	No exceedances	
OHMW25	4.386	No exceedances	
OHMW26	3.404	Copper: 0.0013mg/L Nickel: 0.07mg/L Zinc: 0.015mg/L	Copper (0.013 mg/L) Nickel (0.163 mg/L) Zinc (1.14 mg/L)

Historical results for the older groundwater wells were graphed to assess temporal trends. Heavy metal results for MW6, MW7and MW7 showed fluctuations in concentrations between 1996 and 2006, with no distinct trend with the exception of a peak in concentrations in 2000, 2001 and in 2002 for zinc.

Douglas Partners, 2009 (southern and western shoreline of the Outer Harbour)

Douglas Partners was commissioned by PKPC to undertake a groundwater investigation in the Outer Harbour Lands (OHLs) of the Port Kembla Harbour, in the southern part of the proposed multi-purpose terminal near Darcy Road Drain and Foreshore Road. The aim of the investigation was to collect updated information for environmental and occupational health and safety purposes during re-development and reclamation of the OHL.

The scope of work included the reinstallation of wells MW16 and OHMW28, installation of two additional monitoring wells (MW31 and MW32).

A total of 16 groundwater monitoring wells were sampled and analysed for heavy metals (including speciated arsenic), TPH, BTEX and PAHs.

The report provides a summary and comparison of current and previous groundwater results from up and down gradient wells which suggested the following:

- Arsenic concentrations in MW15 (located close to Foreshore Rd) were consistently higher than at any other well in the network and this trend has continued through monitoring in the OHL;
- Cadmium, copper, nickel and zinc concentrations were generally higher in the up gradient wells; and
- Chromium and lead concentrations were generally consistent with down gradient wells.
- TPH, BTEX and PAH concentrations were not considered to pose a risk to the receiving waters of the Site;
- Arsenic (III) concentrations that exceeded the adopted site assessment criteria may bioaccumulate to some extent in some marine organisms. However, the report also states that its toxicity may be reduced by Iron (III), chromium (III) and barium and that sulphides may also remove Arsenic (III);
    - Arsenic (V) concentrations that exceeded the adopted site assessment criteria may bioaccumulate to some extent in some marine organisms. However, the report also states that its presence may also be reduced by clay; and
    - Cadmium, copper and lead concentrations marginally exceeding the guideline were not considered to be significant in terms of risk.

The following conclusions were made:

- Heavy metal concentrations are generally higher in the up gradient wells than down gradient wells with the exception of chromium and lead.
- The exceedances of the GILs and other reference values and comparison to Port Kembla water quality results, indicated that there may be a potential risk to the environment.

- Nickel concentrations, in wells where detected, had generally increased from previous sampling events.
- The number of sampling events varies between wells, and as such the limited data set restricts the interpretation of clear trends.
- The report recommended continued sampling of groundwater wells to monitor trends in groundwater contamination and that additional monitoring from all wells should be undertaken to allow better characterisation of groundwater quality and variation over time.

SLR (2011) (Outer Harbour lands)

Three groundwater monitoring wells (MW101 to MW103) were installed by SLR as part of their groundwater investigation in the southern part of the modification area. These newly installed wells were sampled in conjunction with twelve existing wells (CGMW2, CGMW5, MW6, MW16, MW31, MW32, MW317, OHMW20, OHMW25, OHMW27, OHMW28 and OHMW103) located across the Outer Harbour lands (refer to well locations on **Figure 13-1**). Samples were analysed for TPH, BTEX, PAHs and Heavy Metals.

A summary of results which were above the adopted GAC are presented in **Table 13-5** below.

Table 13-5 Groundwater monitoring results in Outer Harbour lands

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection	Exceedance of ANZECC (2000) Marine Water Quality Guideline
CGMW2	3.55	Copper: 0.0013mg/L	Copper (0.004 mg/L)
MW16	2.6	Cadmium: 0.0055mg/L Copper: 0.0013mg/L Nickel: 0.07mg/L Zinc: 0.015mg/L	Cadmium (0.088 mg/L) Copper (0.067mg/L) Nickel (0.27 mg/L) Zinc (2.2 mg/L)
MW32	2.6	Cadmium: 0.0055mg/L Copper: 0.0013mg/L Nickel: 0.07mg/L Zinc: 0.015mg/L	Cadmium (0.062 mg/L) Copper (0.19 mg/L) Nickel (0.037 mg/L) Zinc (31 mg/L)
MW317	3.6	Cadmium: 0.0055mg/L Nickel: 0.07mg/L Zinc: 0.015mg/L	Copper (0.16 mg/L) Nickel (0.26 mg/L) Zinc (0.880 mg/L)
OHMW23	2.9	Arsenic: 0.0023mg/L Zinc: 0.015mg/L	Arsenic (0.15 mg/L) Zinc (0.230 mg/L)
OHMW27	3.93	Cadmium: 0.0055mg/L Copper: 0.0013mg/L Selenium: 0.003mg/L Zinc: 0.015mg/L	Copper (0.095 mg/L) Nickel (0.24mg/L) Selenium (0.098mg/L) Zinc (1.3 mg/L)
OHMW28	2.45	Arsenic: 0.0023mg/L	Arsenic (0.058 mg/L)

Source: SLR, 2011

Notes:

Arsenic and Selenium are reported as a low reliability Environmental Concern Level (ECL) to be used as an interim working level.

Groundwater levels ranged from 2.45 (OHMW28) to 5.7 metres btoc (MW101). Groundwater levels at the nearest locations (MW100, OHMW25 and MW31) to the proposed train bulk unloader facility ranged from approximately 3.8 (MW100) and 4.34 (OHMW25) metres btoc.

Concentrations of TPH, BTEX and PAH compounds were reported below the adopted GAC in all sampled wells. Heavy metals (specifically arsenic, copper, nickel and zinc) were reported above the GAC in seven locations, as identified in **Table 5**. It is noted that concentrations of Heavy Metals did not exceed the GAC in the area of the proposed train bulk unloader facility.

ERM, 2012 (Area K) (Northern portion of the proposed multi-purpose terminal)

Three groundwater wells were installed by ERM as part of their 2012 Due Diligence assessment of the northern portion of the proposed multi-purpose terminal, to the north of the modification area. The three groundwater samples collected from the wells were analysed for the identified CoPC including TRH, VOCs, PAHs, Heavy Metals and Metalloids, OCPs, OPPs, Phenols and PCBs (refer to well locations on **Figure 13-1**).

A summary of the results are presented in **Table 13-6** below.

Table 13-6 Groundwater monitoring results in the northern portion of the proposed multi-purpose terminal facility

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)	ANZECC trigger values for marine water (95% level of protection	Exceedance of ANZECC Marine Water Quality Guideline 2000
K_MW01	4.98	Arsenic * Cadmium: 0.0055mg/L Copper: 0.0013mg/L Zinc: 0.015mg/L	Arsenic (0.003 mg/L) Cadmium (0.001 mg/L) Copper (0.002 mg/L) Zinc (1.48 mg/L)
K_MW02	4.308	No exceedances	
K_MW03	4.07	No exceedances	

Source: (ERM, 2012)

Notes:

*Arsenic and Selenium are reported as a low reliability Environmental Concern Level (ECL) to be used as an interim working level.

Note that monitoring well K_MW01 is located in the area immediately north of Christy Drive and so whilst not located in an area subject to modification as part for this Environmental Assessment, results are presented for indicative purposes.

With the exception of those Heavy Metals listed in **Table13- 6** above, all other CoPC were reported below the adopted GAC and/or the laboratory LOR.

ERM, 2012 (Area M) (Central and southern portions of the proposed multi-purpose terminal and near the train bulk unloader facilities)

Five groundwater wells (M_MW01 to M_MW05) were installed by ERM as part of their 2012 Due Diligence assessment of the central and southern portions of the proposed multi-purpose terminal, near the proposed train bulk unloaders. These newly installed wells were sampled in conjunction with twelve existing wells (OHMW21, OHMW23, OHMW25, OHMW27, OHMW30, MW16 and M_EX_MW001 to M_EX_MW006). Note that M_MW01 was found to be dry (during the sampling round) and so a sample could not be collected from this location.

Groundwater samples were analysed for the identified CoPC including TRH, VOCs, PAHs, Heavy Metals and Metalloids, OCPs, OPPs, Phenols and PCBs.

A summary of the results which were above the adopted GAC are presented in **Table 13-7** below.

Table 13-7 Groundwater monitoring results in the central and southern portions of the proposed multi-purpose terminal and near the bulk unloader facilities

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)*	ANZECC trigger values for marine water 95% level of protection)	Exceedance of ANZECC Marine Water Quality Guideline 2000
M_EX_MW006	3.493	Copper: 0.0013mg/L Cadmium: 0.0055mg/L Nickel: 0.07mg/L	Copper (0.016 mg/L) Cadmium (0.006 mg/L) Nickel (0.031 mg/L)
M_EX_MW16	2.623	Copper: 0.00163mg/L Zinc: 0.015mg/L Arsenic* Cadmium: 0.0055mg/L Nickel: 0.07mg/L	Copper (0.036 mg/L) Zinc (1.1 mg/L) Arsenic (0.013 mg/L) Cadmium (0.0029 mg/L) Nickel (0.133 mg/L)
M_EX_MW103	4.508	Arsenic*	Arsenic (0.003 mg/L)

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)*	ANZECC trigger values for marine water 95% level of protection)	Exceedance of ANZECC Marine Water Quality Guideline 2000
OHMW21	3.66	Arsenic*	Arsenic (0.003 mg/L)
OHMW23	4.285	Cadmium: 0.0055mg/L Nickel: 0.07mg/L Zinc: 0.015mg/L	Cadmium (0.001 mg/L) Nickel (0.01 mg/L) Zinc (0.531 mg/L)
OHMW25	4.57	Copper: 0.0013mg/L	Copper (0.01 mg/L)
OHMW27	3.215	Arsenic* Cadmium: 0.0055mg/L Copper: 0.0013mg/L Nickel: 0.07mg/L Lead: 0.0044mg/L Zinc: 0.015mg/L	Arsenic (0.036 mg/L) Cadmium (0.012 mg/L) Copper (0.116 mg/L)) Nickel (0.24 mg/L) Lead (0.01 mg/L) Zinc (1.23 mg/L)
OHMW30	5.9	Arsenic* Copper: 0.0013mg/L	Arsenic (0.005 mg/L) Copper (0.026 mg/L)
M_MW01	**	Arsenic*	Arsenic (0.012 mg/L)
M_MW04	3.86	Arsenic* Copper: 0.0013mg/L	Arsenic (0.003 mg/L) Copper (0.002 mg/L)
M_MW05	2.935	Arsenic* Nickel: 0.07mg/L Zinc: 0.015mg/L	Arsenic (0.21 mg/L) Nickel (0.196 mg/L) Zinc (0.115 mg/L)

Notes:

*Arsenic and Selenium are reported as a low reliability Environmental Concern Level (ECL) to be used as an interim working level.

**M_MW01 was reported to be dry by ERM (2012) in their Table M.1 (Well Constructing Details and Gauging Results). However, groundwater analytical results were presented for M_MW01 in ERM (2012) Table M.5 (Groundwater Results Summary). The data therefore appears to be inconsistent for this monitoring well. It is possible that ERM noted that only a small volume of water was present in the well and collected a sample of that water without purging.

With the exception of those Heavy Metals listed in **Table 13-7** above, all other CoPC were reported below the adopted GAC and/or the laboratory LOR. It is noted that groundwater in the vicinity of the proposed train bulk unloader facility reported concentrations of Heavy Metals (OHMW30 – Arsenic and Copper, and OHMW25 – Copper) greater than the GAC.

Groundwater levels ranged from 0.765 (M_EX_MW004) to 5.9 (OHMW30) metres btoc.

Note that several wells located at the site were gauged but not sampled as other existing wells were considered (by ERM) to provide adequate site coverage to meet the objectives of their investigation. The locations of all monitoring wells are shown on **Figure 13-1**.

ERM, 2013 (Outer Harbour rail network)

ERM (2013) installed five additional groundwater monitoring wells (L_MW01 to L_MW05) in the Outer Harbour rail network during this latter investigation.

Groundwater samples were collected from the new wells and were selectively analysed for the identified CoPC including TPH, BTEX, Heavy Metals, PAHs, VOCs, PCBs, OCPs, OPPs, Phenols and Nitrate.

A summary of the results are presented in **Table 13-8** below.

Table 13-8 Groundwater monitoring results in vicinity of existing Outer Harbour rail network

Groundwater Monitoring Well Identification	Depth to Water (metres below top of casing)*	ANZECC trigger values for marine water 95% level of protection)	World Health Organisation Guidelines for Drinking-water Quality (2008)	Exceedance of ANZECC Marine Water Quality Guideline 2000	Exceedance of Human Health Screening Criteria*
L_MW01	2.29	No exceedances			
L_MW02	1.775	Copper: 0.0013mg/L Zinc: 0.015mg/L	Not applicable	Copper (0.005mg/L) Zinc (0.122mg/L)	No exceedances
L_MW03	1.15	Copper: 0.0013mg/L	Not applicable	Copper (0.002mg/L)	No exceedances
L_MW04	2.266	Not applicable	Trichloroethene: 18 µg/L	No exceedances	Trichloroethene (37µg/L)
L_MW05	1.533	No exceedances			

Source: (ERM, 2013)

Elevated concentrations of copper (L_MW02 and L_MW03) and zinc (L_MW02) were reported in groundwater samples at two locations. The concentrations of all other CoPC were below the adopted GAC and/or the laboratory LOR with the exception of Trichloroethene (TCE) detected at L_MW04. To AECOM's knowledge, TCE has not been detected at concentrations above the laboratory LOR in any other soil or groundwater samples collected during subsurface investigations of the proposed modification area. The source of the TCE at L_MW04 is unknown and as such, warrants further consideration.

Summary of Groundwater Data

The previous Environmental Assessment concluded that the depth to groundwater in the area of the proposed road link (that extends from Christy Drive to the multi-purpose terminals) ranges between 4.2 and 4.3 metres bgs, and is approximately 2.6 metres bgs in the area of the proposed new road parallel to Foreshore Road to the container terminals. Review of additional data as part of this Environmental Assessment indicates that the depth to groundwater, in the vicinity of the Outer Harbour, ranges from approximately 0.765 to 5.9 metres btoc. At the nearest monitoring wells to the location of the proposed train bulk unloading facilities (MW31, MW100, OHMW25 and OHMW30), where the most significant excavation would take place, groundwater ranged from 3.8 (MW100) to 5.9 metres btoc (OHMW30). This variability in the groundwater level in the vicinity of the proposed train bulk unloading facilities warrants further investigation and is discussed in **Section 13.4** below.

Review of the available data indicates that Heavy Metal impacts in groundwater (specifically arsenic, cadmium, copper, nickel, lead and zinc) occur at several locations across the proposed multi-purpose terminal area and rail loop, and are likely to be attributable to the presence of fill of unknown origin across the Port. Heavy metal (namely arsenic, copper, zinc, lead, cadmium and nickel) impacted groundwater is considered a regional issue and is not specific to the Outer Harbour development area.
PAH, PCB and OCP groundwater contamination exceeding the adopted groundwater assessment criteria (GAC) have not been historically identified within groundwater (based on the available information), although there is potential for PAH and PCB impact due to potential contamination identified within existing fill and natural soils. TCE was identified in one monitoring well located in the South Yard. The source and extent of TCE impact is unknown. Where groundwater could potentially be intercepted by earthworks, further investigation is warranted and is discussed in **Section 13.4** below.

13.2 Methodology

Information contained in the previous Environmental Assessment, in addition to the results of recent investigations including the *Groundwater and Soil Quality Assessment – Outer Harbour Lands Port Kembla* (SLR, 2011), *Vendor Environmental Due Diligence Assessment: Area K and M* (ERM, 2012), *Preliminary Environmental Site*

Assessment – Port Kembla Port Corporation Outer Harbour Rail Network Port Kembla, NSW (ERM, 2013) and the CEMP prepared for the CGM were also reviewed and used to inform the impact assessment for the proposed modification.

The assessment considered the following DGRs relating to contaminated soils and groundwater:

- An assessment of the potential for contaminated land and groundwater on land that would be used as part of the modified development.
- A description of any disturbance, future emplacement and reuse of contaminated soil and groundwater, and identification of the need for remediation of any contaminated soil and groundwater.
- Where remediation is required, presentation of a remediation strategy in accordance with relevant EPA guidelines.

13.3 Impact Assessment

13.3.1 13.3.1 Construction

Construction activities associated with the proposed modification are expected to introduce similar impacts to those assessed in the previous Environmental Assessment. The following key aspects of the proposed modification to the Concept Plan and Major Project have the potential to disturb or impact soil and/or groundwater during construction:

- Train bulk unloading facilities;
- Additional surface rail infrastructure and rail sidings on the Outer Harbour rail loop;
- Rail crossing options on Old Port Road;
- Extension of the multi-purpose terminal and new port road further to the south; and
- Adjusted reclamation footprint.

Overview of Soil Impacts

As identified in the previous Environmental Assessment, soils may be impacted during these elements in a manner described below.

- Exposure and/or mobilisation of soils as a result of the movement and use of construction equipment.
- Sediment accumulation from earthworks in stormwater drains, drainage lines and natural surface depressions.
- Exposure of ASS during land-based construction activities such as construction of access roads, rail infrastructure and utility services, albeit that these activities involve excavation to a limited depth.
- Mobilisation of contaminated soils from excavation activities and on construction vehicles resulting in the potential redistribution of contaminated soils to other areas not previously impacted.

The previous Environmental Assessment determined that the greatest potential for soil exposure and mobilisation would occur during excavation and construction activities associated with construction of the road links, construction of utility services, extension of the rail siding and from stockpiles of spoil and fill material to be used for reclamation.

The proposed modification would require further alterations to rail infrastructure (additional bulk rail loops, an upgrade to the rail bridge over Old Port Road, additional sidings in the North and South Yards within the existing rail corridor, and provision of two train bulk unloading facilities which would increase the potential for soil exposure and mobilisation. Impacts to soil specific to each element of the modification are discussed below.

The potential impacts associated with soil mobilisation and contamination would be mitigated or managed by adopting the measures detailed in **Section 13.4** and documented in the Soil Water Quality Management Plan as part of the CEMP, consistent with the existing consent conditions and the commitments made in the previous Environmental Assessment.

Overview of Groundwater Impacts

Groundwater impacts relating to excavation works may present additional impacts, depending on the detailed design for the road and rail infrastructure. These issues are outlined below.

The previous Environmental Assessment outlined that there would be no impact on groundwater or groundwater quality considering the shallow depths of excavation (maximum 1.5 metres bgs) required for the original development associated with construction of the new port road and utility services. However, the modification would entail additional excavation for the train bulk unloading facilities, associated rail infrastructure upgrades and extension of the internal port road during Stage 1. Impacts to groundwater specific to each element of the modification are discussed below.

There is also the potential for construction activities to impact upon groundwater quality, if during excavation and construction, spills or leaks occur from machinery, plant or hazardous materials. Leaching of contaminants into groundwater would result in adverse impacts to the surrounding area, and could be carried into receiving waters if contaminants reach groundwater or are transported via surface water runoff.

The Construction Soil and Water Quality Management Plan would be designed in accordance with Condition C37 (c) which includes a contingency plan for a major fuel or other chemical spill.

Train Bulk Unloading Facilities

The excavation required for the bulk unloading facilities would be significant due to the length and depth of excavation required for installation of the bottom-dump and tippler unloaders and associated track hoppers. The excavation would be to depths of up to 10 metres for the bottom dump unloader and 16 metres for the tipper unloader.

Soil Impacts

The *Preliminary Environmental Site Investigation* (ERM, 2013) of the Outer Harbour rail network carried out in 2013 did not detect soil contamination in these areas. However due to the deep excavation required for the construction of the bulk unloaders, ASS is likely to be disturbed.

Groundwater Impacts

At this stage, the location of the bulk unloading facilities is indicative, and as such groundwater levels in the impact area cannot be confirmed as detailed design and geotechnical assessment has not yet taken place. However, the *Groundwater and Soil Quality Assessment – Outer Harbour Lands Port Kembla* (SLR, 2011) indicates that groundwater in the vicinity to the indicative location, at MW100 is approximately 3.8 metres bgs. Further, the *Vendor Environmental Due Diligence Assessment (Area M)* (ERM, 2012) indicates that groundwater at OHM30 was 5.9 metres btoc. In addition, the previous Environmental Assessment concluded that groundwater in the vicinity of the nearby western road corridor is approximately 4 metres bgs. Based on the assumption that these levels are representative of groundwater levels at the bulk unloader site, it is therefore likely that excavation for the bulk unloader facilities would intercept groundwater.

The closest borehole to the proposed excavation area (approximately 220 metres to the south) indicates that natural sand is present from a depth of 1.4 metres bgs to at least 3.9 metres bgs (the maximum borehole drilling depth). Given the close proximity of this area to the coastline (approximately 100 metres away), it is likely that this same unconfined sand aquifer exists at the indicative bulk unloader site. During construction works, the highly permeable natural sand could produce significant quantities of water which would require dewatering. Note however, that fill depths are known to be variable across the site and so fill may extend to depths greater than 1.4 metres bgs at the proposed bulk unloader facilities.

There is also the potential that groundwater below the train bulk unloader facility may be contaminated. Where present, contaminants in groundwater are likely to be sourced directly from fill materials or indirectly via the migration of contaminants to the area from surrounding industrial sites. Groundwater is expected to be relatively unconfined between the fill and underlying natural soil, and so mixing between these two units is expected.

Concentrations of heavy metals (arsenic and copper) were above the adopted GAC for protection of the marine ecosystem at OHMW30 near the train bulk unloader facilities where the water level was recorded to be 5.9 metres btoc. Groundwater at nearby MW100 did not identify contaminants above the GAC (SLR, 2011). Monitoring wells L_MW02 and L_MW03 (ERM, 2013) indicated the presence of heavy metals in groundwater, as did other wells in the Outer Harbour foreshore area (SLR, 2011).

In the instance that contaminated groundwater is encountered during construction works, there may be potential human health implications for workers if direct contact is made with the groundwater, however this is dependent on the contaminant concentrations present. Heavy metal contamination in groundwater can be managed through the use of appropriate PPE, standard practices and construction methods would be designed to ensure health impacts to workers are minimised.

If dewatering is required during excavation, PKOPL would apply for appropriate water licences from the NSW Office of Water. Dewatering and groundwater testing would occur during excavation, and contaminated groundwater would be managed appropriately through measures outlined in the CEMP, including discharge to stormwater if concentrations are below the ANZECC (2000) 95% marine trigger values or appropriate offsite disposal (for concentrations exceeding the ANZECC (2000) 95% marine trigger values)

Potential impacts to workers arising through contact with contaminated groundwater would be appropriately managed through suitable measures outlined in the CEMP (refer to **Section 13.4**). Additionally, design of the bulk unloading facilities would take into consideration the need to appropriately manage groundwater flows to be impacted by the facility, and would ensure that groundwater would follow preferential paths (such as utility conduits) in areas adjacent to the footprint of the facility.

Additional Surface Rail Infrastructure and Rail Sidings

Additional sidings in the North and South Yards and additional bulk rail loops within the existing rail corridor are proposed as part of the modification. The excavations required for these works may extend up to depths of 2 metres bgs, for the construction of footings and rail infrastructure.

Soil Impacts

The rail infrastructure upgrades required (bulk rail loops and sidings) in the area to the west of the multi-purpose terminal may potentially result in disturbance and mobilisation of impacted soils, as previous soil investigations in this area have indicated the presence of asbestos impacted soils. Construction of additional rail infrastructure in other areas and potential construction in the vicinity of the existing at-grade crossing on Old Port Road is not anticipated to result in disturbance and mobilisation of contaminated soils.

The *Preliminary Environmental Site Investigation* (ERM, 2013) of the Outer Harbour rail network carried out in 2013 did not detect soil contamination in these areas. It is possible however, that these activities could disturb ASS, particularly where excavation at depths greater than 2 metres and/or where excavation into the underlying natural soil is necessary (such as for the rail unloaders and the support structures for the upgraded road bridge over Old Port Road).

Groundwater Impacts

Based on the updated groundwater levels presented by SLR and ERM, groundwater may be intercepted in the broader rail construction works proposed as part of the modification, including construction of the bulk loops and sidings in the North and South Yards. If any excavation is required, it is likely to be relatively shallow, to level ground surfaces for the purposes of laying track evenly. If shallow excavation is required for the construction of footings and rail infrastructure, then excavation depths of 2 metres bgs may be anticipated and there is the potential that groundwater may be intersected, especially in the vicinity of shallower water levels (such as near L_MW03 and L_MW05, with depths to groundwater of 1.15 metres and 1.533 metres, respectively) (ERM, 2013).

Minimising impacts relating to groundwater containing Heavy Metal contamination would be managed in the CEMP and through the use of appropriate PPE as discussed above. If shallow excavation is required on the western side of the balloon loop, there is the potential that TCE-contaminated groundwater may be encountered, as a result of the presence of TCE in MW05 (ERM, 2013) at levels above the adopted GAC for the protection of human health, being the *Drinking Water Quality Guidelines* of the World Health Organisation (WHO) (2011). However, whilst TCE does exceed the criteria outlined in the WHO guideline, the concentration measured in this well is considered unlikely to present a significant risk to human health based on the current site use and configuration, assuming that groundwater is not abstracted for use (ERM, 2013).

The detailed design process would seek to avoid intersecting TCE-impacted groundwater where possible. In the instance that excavation would occur in this area, a Phase 2 soil and groundwater investigation would be undertaken, as per condition B22 of the Project Approval. Based on results from this investigation, if TCE is confirmed to be present and occurs at concentrations that pose a risk to human health, appropriate measures would be designed and would include an Occupational Health and Safety Plan and CEMP. These measures would likely include appropriate PPE and occupational hygiene procedures.

Rail Crossing Options on Old Port Road

Soil Impacts

The potential for soil exposure and mobilisation would increase as a result of treatment of the Old Port Road at-grade rail level crossing. Three options are being considered for treatment of the crossing. Option 1 would involve temporary closure of the crossing and the construction of vehicular turn-around facilities and automatic boom gates either side of the crossing. Option 2 would involve permanent closure of the crossing, with allowance to open the crossing at times when access is required by over dimensioned vehicles, with locked gates and turn-around facilities provided either side of the crossing. The construction of a road-over-rail bridge is Option 3.

Options 1 and 2 would require limited and relatively shallow excavation/levelling works to maintain the existing railway crossing however, the construction of turning bays may require more substantial earthworks (excavations likely to be less than 0.5 m). The construction of the road-over-rail bridge for Option 3 would require more significant excavation and soil disturbance, particularly for bridge footings. Imported soil materials are likely to be required for embankment construction. Limited lithological and soil contaminant data is available to fully assess the potential impacts. Further investigation of soil conditions will likely be required at the design stage for the preferred option, prior to any construction activities.

Groundwater Impacts

Due to the minimal extractions involved with Option 1 and 2, impacts to groundwater would not be considered to be significant. As Option 3 would require deeper excavations, groundwater is more likely to be impacted. There is limited groundwater data in the vicinity of the rail crossing. The closest monitoring well to this location is MW31 installed by Douglas Partners in 2009. The most recent data for MW31 indicated the standing water level was at 4.3 m (0.8 m AHD) and elevated heavy metals were not reported (ERM, 2012). Where groundwater is intercepted during construction, dewatering and groundwater testing measures would be implemented. In the instance that groundwater contaminated with Heavy Metals is encountered, appropriate management measured can be implemented through the use of PPE, standard practices and construction methods, to ensure health impacts to workers are minimised.

Extension of Multi-purpose Terminal and Old Port Road

Soil Impacts

Extension of the multi-purpose terminal including the new road link from Christy Drive further south (previously included in Stage 2 of the Concept Plan) has potential for soil exposure and mobilisation. As acknowledged in the previous Environmental Assessment, extension of the new road link also has the potential for exposure of contaminated soil which would be managed in accordance with procedures in the Site Management Plan (SMP). Construction of the hardstand areas and storage sheds could also give rise to greater levels of soil exposure and mobilisation compared to construction of hardstand areas for open stockpiles as originally proposed.

Groundwater Impacts

Additional construction relating to the extension of the terminal hardstand area and access road during Stage 1 would include excavation to a depth similar to that assessed in the previous Environmental Assessment, of approximately 1.5 metres bgs. The nearest groundwater wells to the southern portion of the access road (OHMW23, OHMW25, MW31 and MW32) (SLR, 2011 and ERM, 2012 (Area M) indicates groundwater ranges between approximately 2.9 and 4.6 metres btoc. Note that the groundwater level (in metres btoc) at OHMW23 was recorded to be 2.9 metres btoc (SLR, 2011) whereas it was recorded to be 4.285 metres btoc by ERM (ERM, 2012 (Area M)). It is unlikely that the well was gauged at the same time by both SLR and ERM. It is possible that the variability in the groundwater level at this location could be attributed to some tidal influence.

Based on the above information, groundwater may occur at depths greater than the proposed excavation depth and may not be impacted by road construction activities. In the instance that groundwater is intercepted, dewatering and groundwater testing measures would be implemented. Monitoring wells OHMW23 and OHMW25 (ERM, 2012) and MW32 (SLR, 2011) indicated the presence of Heavy Metals in groundwater in this area. In the instance that Heavy Metal contaminated groundwater is encountered during construction works, appropriate management measured can be implemented through the use of PPE, standard practices and construction methods, to ensure health impacts to workers are minimised.

Adjusted Reclamation Footprint

Soil Impacts

As described in the previous Environmental Assessment, sources of imported fill material used for reclamation would comprise waste materials from other industries (including coal washery refuse) and VENMs from other civil construction projects (including interburden rock and quarry overburden material), depending on the availability of material. The use of imported waste materials as fill would continue to be regulated by ensuring that there is a valid Resource Recovery Exemption under the POEO (Waste) Regulations 2005, to permit the use of the material. This material would be stored in the stockpile areas near the Darcy Road Drain prior to use and appropriate soil mobilisation controls implemented.

Groundwater Impacts

The previous Environmental Assessment outlined that the change to the groundwater flow regime as a result of the proposed reclamation area was likely to be insignificant. The majority of groundwater discharge is likely to be along the existing shoreline. The hydraulic conductivity of emplaced dredged sediment or imported fill material is likely to possess similar hydraulic conductivity to the existing foreshore. Therefore, the change in the groundwater flow regime would be negligible.

The minor alterations to the reclamation footprint as a result of this modification would not change the impact to the groundwater flow regime presented in the previous Environmental Assessment. Project Approval Condition B10 requires that the design of the berths and reclamation, and the characteristics of the associated reclamation material will not significantly alter groundwater flows and that a similar hydraulic conductivity to the existing Outer Harbour shorelines will be maintained. Verification would be submitted to the Director-General prior to the commencement of construction of any berth or reclamation.

13.3.2 Operation

Once operational, the extent of final hardstand including stormwater drainage systems, storage sheds, road and rail infrastructure and pavement would ameliorate the potential for disturbance to soils and groundwater during operation of the Concept Plan and Major Project.

13.4 Mitigation and Management Measures

The existing consent conditions for the Concept Plan and Major Project relating to soil disturbance, mobilisation and contamination are considered appropriate to ameliorate the potential impacts associated with the proposed modification given that the proposed activities are not expected to introduce different impacts to those assessed in the previous Environmental Assessment.

Consistent with the existing consent conditions and the commitments made in the previous Environmental Assessment, the following mitigation and management measures would be implemented:

- Contamination investigations would be conducted in accordance with the relevant guidelines, prior to the commencement of land-based excavation activities and would be documented in a Soil and Groundwater Contamination Report. The report would identify a remediation strategy, if required. If remediation is not required it would recommend measures to identify, handle and manage contaminated soil (Concept Plan Approval Condition 2.5 and Major Project Approval Condition B22). More specifically, future contamination investigations will focus on the following areas:
    - Train Bulk Unloader Facilities - Given the extent of excavation required for the proposed train bulk unloader facilities (maximum depth of excavation is 16 metres bgs), further soil and groundwater investigations would be required to understand ground conditions including contamination status and groundwater levels to inform the construction methodology and any safety measures for construction workers. As significant quantities of excavated soil may require disposal as part of the construction, investigations should consider in-situ soil classification for off-site disposal or beneficial reuse on-site.
    - Additional Rail Loops and Sidings - Drilling of additional soil bores at regular intervals in the footprint of proposed bulk rail loops and sidings between Port Kembla North Railway Station and L_MW05 (North Yard), and MW04 and BH13 (South Yard) (refer to **Figure 13-1**). Additionally, resampling groundwater at L_MW04 and the installation of select additional groundwater monitoring wells will assist with confirming the likelihood of groundwater ingress into excavations (should significant excavation be required), and possible human health risks associated with groundwater contamination during construction.

- Old Port Road / Rail Level Crossing -Should Option 3 (the construction of a road-over-rail bridge) be considered viable, additional soil and groundwater investigations would need to target locations where significant excavation is required (e.g. at the bridge footings). The purpose of these investigations would be to understand ground conditions including the depth to groundwater and any contamination likely to be encountered (in both soil and groundwater). Depending on the final design, additional soil and groundwater investigation may be required prior to earthworks associated with Options 1 and 2.
- Potential Areas of Acquisition - Two areas adjacent to the existing railway line, one adjacent to the North Yard and one adjacent to the South Yard, have been cited for possible future acquisition by PKOPL. The purpose of these acquisitions is to enable the widening of the railway line where it intersects Old Port Road in the North Yard, and to allow for proposed bulk rail loops and sidings near the existing Port Kembla Railway Station (refer to **Figure 9-4**). Should PKOPL proceed with the acquisition of these lands, further investigation including desktop assessment and limited soil investigation would likely be required, subject to the final design and excavation requirements for construction works.
- Proposed Road Link from Christy Drive to the Multi-purpose Terminals - The proposed road link from Christy Drive intersects an area where a former power station operated (the current location of the copper concentrate shed operated by Port Kembla Gateway). Previous investigations undertaken in this area are considered adequate for the purpose of identifying and delineating contamination in soils along the proposed road footprint. However, the identification of asbestos in this area during previous investigations warrants further consideration. Prior to construction commencing in this area, an inspection by an appropriately qualified asbestos contractor may be required to identify and remove any surficial ACM in accordance with the Work Health and Safety Act and Regulations 2011. Air monitoring as well as selective analysis of soil samples during earthworks may also be required.

- Management Plans - A CEMP would be prepared for the proposed modification which would include a Soil and Water Quality Management Plan (SWQMP) (Major Project Approval Conditions C36 and C37). Soil and sediment controls would be installed prior to construction and would be designed to minimise soil erosion. The controls would be designed with reference to the design and construction criteria in the Managing Urban Stormwater: Soils and Construction guidelines (Landcom, 2004) (Major Project Approval Conditions B9, C18 and C19). The SWQMP included in the CEMP would establish a suitable management framework for excavation works applicable to establishment of the new road link from Christy Drive, which would include identifying impacted soils based on visual and odour observations and through detailed soil sampling analysis, if required.
- An *Acid Sulfate Soil Management Plan* (ASSMP) would be prepared for the proposed modification. The ASSMP would ensure that any construction activities in identified areas of ASS risk are undertaken in accordance with the *Acid Sulfate Soil Manual* (ASSMAC) (Major Project Approval Condition C21).
- Given that asbestos impacted soils were identified in numerous areas of the modification area, an Asbestos Management Plan (AMP) in accordance with the *Work Health and Safety Act* 2011, would be prepared as part of the CEMP for the proposed construction works.
- Continued implementation of a groundwater monitoring program to the satisfaction of DPI and NSW Office of Water, to be implemented during construction and operation (Condition B11 of the Project Approval). PKOPL would also ensure that direct contact with groundwater is managed and minimised to reduce risks in relation to intrusive ground maintenance and construction workers (condition B12 of Project Approval).
- In the instance that detailed design for rail or road infrastructure determines that interception of groundwater would occur, PKOPL would apply for an appropriate licence from the NSW Office of Water for dewatering during construction, if deemed necessary.
- The reclamation and construction of the bulk unloading facilities would be designed to ensure that the existing groundwater flow regimes are not significantly altered and that there is no increased risk of harm associated with groundwater contamination.

13.5 Conclusion

The proposed modification would give rise to temporary impacts to soils and sediments of the Outer Harbour during construction and reclamation activities. A Soil and Water Quality Management Plan would be prepared detailing mitigation measures to be implemented to control soil erosion and prevent sedimentation of the Outer Harbour, Salty Creek and Darcy Road Drain. The rail infrastructure upgrades required (bulk rail loops, sidings and rail unloaders) in the area to the west of the multi-purpose terminal and extension of the new road link has the potential to result in disturbance or mobilisation of contaminated soils which would need to be managed according to procedures in the Soil and Water Quality Management Plan, as part of the CEMP, required by the Project Approval for Stage 1. There is potential for disturbance of ASS during construction and an ASSMP would be prepared to minimise and manage any potential impacts. The ASSMP would form part of the CEMP.

The storage sheds, areas of hardstand, and stormwater drainage systems would ameliorate potential for disturbance to soils during operation.

Based on the extensive previous soil investigations conducted to date across the area of the proposed modification, soil contamination issues, with the exception of asbestos, are not likely to require remediation or management assuming continued commercial/industrial land use.

Asbestos impacted soils have been identified at the proposed road link from Christy Drive to the multi-purpose terminals (BH10, AECOM [2010]) and north of the proposed multi-purpose terminal (M_BH02, ERM [2012]). Given the presence of asbestos impacted soils and the asbestos remediation works conducted at the former power station by Coffey Geosciences in 2005, asbestos (in the form of cement sheeting and fibres) impacts may be more widespread.

It is recommended that disturbance of fill materials be controlled as part of the CEMP by:

- the Construction Soil and Water Quality Management Plan which is required by the Project Approval for Stage 1 (refer Condition C37c) and which would include an ASSMP
- the Asbestos Management Plan (AMP) for the management of asbestos impacted soils.

The Soil and Water Quality Management Plan would establish a suitable management framework for excavation works, which would include identifying contamination impacts based on visual observations and through detailed soil sample analysis, if required.

This assessment has identified that there are some limited areas associated with the modification that have not been adequately characterised, particularly the train bulk unloading facility and some parts of the rail loop and sidings. Therefore it is recommended that soil and groundwater investigations be conducted in these areas prior to conducting excavation activities. There is already a condition within the existing Project Approval for Stage 1 which recognises that there may be circumstances that warrant undertaking additional Phase 2 contamination investigations prior to commencement of land based excavation activities (refer Condition B22).

Groundwater with elevated concentrations of heavy metals may be encountered during construction activities, particularly during the construction of the proposed train bulk unloader facility where the greatest subsurface excavation (up to 16 m depth) would be required. Further soil and groundwater investigations would be undertaken prior to determining a final design for the unloader facilities and before conducting any excavation work which has the potential to intercept groundwater. Potential to encounter contaminated groundwater would be managed in the context of the Soil and Water Quality Management Plan to be prepared for the site as required by the Project Approval for Stage 1 (refer Condition C37c)).

14.0 Surface Water Quality and Hydrology

This chapter provides an assessment of the potential impacts of the proposed modification on hydrology and water quality of surface water in the Outer Harbour and surrounding land.

14.1 Existing Environment

14.1.1 Existing Catchment Hydrology

Port Kembla Outer Harbour receives flows from two main industrial catchments, Salty Creek and Darcy Road Drain. The Outer Harbour also receives water from other sources such as stormwater runoff, and licensed industrial discharges.

Salty Creek

Salty Creek is an estuarine creek system located in Port Kembla between Five Islands Road and the Outer Harbour. Salty Creek is approximately 1.4 kilometres in length and is open intermittently to the Outer Harbour at Red Beach.

Salty Creek catchment area is approximately 125 hectares, bounded by Harry Morton Park to the south and the Port Kembla Steelworks to the north (Forbes Rigby, 2000). The catchment drainage flows eastward towards the Outer Harbour from an approximate maximum height of 51 metres PKHD near Flagstaff Park, to less than 5 metres PKHD close to the outlet to the Outer Harbour, east of Old Port Road (Forbes Rigby 2000).

The majority of land use within the Salty Creek catchment is industrial, which is estimated to be greater than 80 percent of the catchment. The remaining catchment land use is commercial and residential.

The Salty Creek catchment contains minimal existing water sensitive urban design (WSUD) or stormwater control devices. A porous wall barrier and detention pond, north of Red Beach, assists with surface water runoff infiltration and sediment and gross pollutant detention. A sediment erosion fence is located near the south of Red Beach. However, the majority of stormwater and other surface runoff is not treated prior to entering the creek system and ultimately the harbour.

A culvert through which Salty Creek flows is located beneath the railway, approximately 125 metres from the shore of Red Beach, and is shown in **Figure 14-1**.

Figure 14-1 Salty Creek between Old Port Road, Foreshore Road and rail line illustrating channel modifications (Source: AECOM, 2009)

Darcy Road Drain

Darcy Road Drain enters the Outer Harbour west of No. 3 Jetty, approximately 400 metres south of Salty Creek mouth. The Darcy Road Drain catchment, with an area of approximately 80 hectares, contributes stormwater and effluent from a number of adjacent commercial and industrial premises including Orica and the former Port Kembla Copper site.

The majority (approximately 60 percent) of the catchment land use consists of industrial activities located within the north eastern portion of the catchment adjacent to the Outer Harbour. Land use within the remaining catchment to the south west is commercial (approximately 10 percent) along Wentworth Street and residential (approximately 30 percent) to the west of Wentworth Street.

14.1.2 Existing Water Quality

Surface Water

Water quality in the Outer Harbour and associated waterways is affected by urban and industrial runoff which has in the past led to significant impacts to receiving harbour waters.

Water quality sampling of seven sites was undertaken between 2002 and 2005 by Port Kembla Environment Group, and between 2007 and 2008 by BlueScope Steel. This monitoring program was designed based on previous results from a short-term monitoring program conducted by a student at the University of Wollongong in the Port Kembla Harbour and monitored water quality in the vicinity of:

- The Cut.
- No. 6 Jetty.
- Darcy Road drain.
- Entrance to the Outer Harbour.

Water quality parameters measured during the monitoring program included pH, temperature, Dissolved Oxygen (DO), nitrate, nitrite, ammonia, cyanide, aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, tin and zinc.

A summary of the monitoring program results with regard to existing surface water quality is outlined below:

- No specific trends were observed for zinc, cadmium, or tin.
- Aluminium was found at all seven sites, generally fluctuating.
- Copper concentrations at all seven sites remained fairly consistent during the monitoring period.

AECOM undertook further water quality monitoring within the waters of the Outer Harbour as part of the original Environmental Assessment in 2009. This monitoring revealed that heavy metal concentrations in the harbour water samples were less than the adopted assessment criteria (ANZECC [2000] 95 percent Marine Water), with the exception of the following:

- Cadmium - concentrations in two harbour water samples (10,400 µg/L and 65,400µg/L, respectively) (both collected at high tide) exceeded the adopted assessment criteria (5.5 µg/L). These extremely high cadmium concentrations in two of the water samples were likely to be erroneous based on other harbour surface water, sediment and elutriate analytical results as part of this investigation, historical water quality data for the Outer Harbour and sampling undertaken in 2010 by SLR in the Outer Harbour (discussed below).
- Copper – concentrations in one harbour water sample (2 µg/L) (collected at high tide) exceeded the adopted assessment criteria (1.3 µg/L).

Baseline sampling was undertaken by SLR Consulting in 2010 for the construction of the tug berth facility. Sampling was carried out at four locations incorporating two different depths (the surface and two metres above the sea bed) within the Port Kembla Harbour. Five sampling events were completed during October and November 2010 and analysis was undertaken for heavy metals (antimony, cadmium, chromium, copper, cobalt, lead, mercury (inorganic), nickel, silver, selenium, vanadium, zinc, arsenic, aluminium), PAHs and tributyltin (TBT).

Results demonstrated that exceedences of the adopted guideline criteria were observed for copper and zinc. Other analytes were either below the detection limit or near the limit. The lack of cadmium exceedences observed

during the sampling events by SLR further supports the conclusion that the cadmium results measured in the 2009 sampling events by AECOM were erroneous.

14.2 Methodology

To assess the change in impacts to hydrology and water quality as a result of the modification, the previous Environmental Assessment and more recent documents *Preliminary Environmental Site Investigation* (ERM, 2013) and *Baseline Sampling Summary – Tug Berth Facility Construction* (SLR, 2011) were reviewed with consideration to the modified design and the extent to which this would result in additional hydrological and water quality impacts.

Design plans for the central portion of the multi-purpose terminal were also reviewed to understand the water quality management measures to be installed for the protection of surrounding waters during the operation of the terminal.

The impact assessment also considered the DGRs relating to hydrology, water quality and groundwater and including contamination. The DGRs are as follows:

- Stormwater management, including demonstration of how the modified project will be designed, constructed and operated to protect the water quality of watercourses and of Port Kembla harbour taking into account the document *Managing Urban Stormwater: Soils and Construction* (Landcom, 2006).
- An assessment of the potential for increased sediment dispersion and resuspension during increased dredging and any additional impacts associated with the dewatering, handling, temporary storage and reuse and/or disposal of increased dredge spoil volumes.
- An assessment of the potential for contaminated sediments that will be used as part of the modified development.
- An assessment of the increased potential for disturbance of dinoflagellate cysts and potential toxic blooms.

14.3 Impact Assessment

The modified activities have been assessed with respect to potential changes to hydrology and water quality impacts include:

- Increase in dredging footprint and dredging volumes, and slightly lengthened dredging campaigns.
- Altered alignment of Salty Creek culvert through the reclamation area.
- Altered drainage design for interim stormwater management on unpaved reclaimed surfaces.
- Increase in the volume of stockpiled imported fill.
- Excavation works associated with the construction of bulk unloading facilities, additional rail infrastructure construction and extension of the multi-purpose terminal access roads.
- Operation of the extended footprint of the multi-purpose terminal during Stage 1.
- Change in storage facilities for bulk materials on the multi-purpose terminal to include a covered bulk unloader facility, enclosed conveyors to and from enclosed storage sheds to transport bulk materials onto ships.

14.3.1 Construction

Potential impacts relating to the hydrology and water quality of the Outer Harbour and Salty Creek would not be significantly impacted by modified construction activities. For the most part, the existing conditions of consent would adequately mitigate the impacts related to the modification. Some minor amendments have been made to existing conditions to minimise those impacts which fall outside the scope of the commitments designed for the approved Outer Harbour Development.

Dredging

As identified in the previous Environmental Assessment, potential impacts resulting from dredging may still include:

- Generation of turbid plumes through mobilisation of sediment in the water column, which may impact on sensitive aquatic ecology.
- Exposure of ASS and disturbance of dinoflagellate cysts that may be within estuarine bottom sediments of the harbour, leading to a reduction in water quality and/or potential for toxic blooms. Potential changes in impact to aquatic ecology are detailed in **Chapter 17.0**.
- Mobilisation of contaminated sediments within the Outer Harbour, which is further explained in **Chapter 15.0**.

Modified dredging activities would be managed through measures outlined in the previous Environmental Assessment. As such, the increased dredging footprint and volume proposed as part of the modification would not result in additional impacts to hydrology and water quality in the Outer Harbour. Specific mitigation measures are outlined in **Section 14.4**.

Salty Creek and Darcy Road Drain

The altered alignment of Salty Creek is not likely to produce impacts additional to those outlined in the previous Environmental Assessment, being:

- Salty Creek to change from its current classification as an ICOLL to become permanently open to the sea and to tidal flushing, providing potential water quality benefits to the creek and Outer Harbour by reducing the build-up of pollutants that occurs when the mouth is closed for a period.
- Reduction of localised upstream flooding that occurs during rainfall events when the creek mouth is closed.
- Reduction in the variations of salinity and water levels with Salty Creek, with potential impacts on diversity and abundance of aquatic flora and fauna.

The previous Environmental Assessment outlined that the redirection of Salty Creek through the reclamation area would result in constraints to the existing fish passage between Salty Creek and the Outer Harbour. As fish are habitually deterred by long, dark tunnels, the use of the passage by fish may become limited between the two water bodies. Under this modification, Salty Creek would be redirected through the reclamation area in a more direct and shorter route (at a length of 312 metres compared to the approved 375 metres). However, this is unlikely to change the potential to adversely impact on the use of Salty Creek for the passage of fish. Further details relating to the impacts to aquatic ecology are outlined in **Chapter 17.0**. However, as outlined in Condition B25 of the Project Approval, the box culverts for conveying Salty Creek flows would incorporate a V-shaped recess to facilitate the movement of fish and other mobile aquatic species during periods of low flow and would be designed so as not to preclude light access as part of future project applications.

No changes would occur to the extension of the Darcy Road drain outlined in the previous Environmental Assessment. As a result no change to hydrology or water quality impacts outlined in the Environmental Assessment is expected.

Changes in the vicinity of the Darcy Road drain would include the increase in the volume of material stockpiled to the immediate west and east of the drain, to a combined total of 360,000 cubic metres, total footprint of approximately 3.9 hectares and overall height of 11 metres. The larger stockpile area and volume would increase the risk of sediment-laden runoff during periods of rainfall, which could adversely impact the Darcy Road drain, and the receiving waters of the Outer Harbour. Prior to the commencement of stockpiling, a stability analysis would be undertaken during detailed design to address all structural and settlement issues to prevent slumping of the stockpiles.

As per Conditions C18, C19 and C20 of the Project Approval, soil and sediment will be managed with consideration of the design and construction criteria for sediment retention basins described in the *Managing Urban Stormwater: Soils and Construction Volume 2B Waste Landfills* and *2E Mines and Quarries* (DECC, 2008). Specifically, all materials stockpiled shall be adequately managed to prevent erosion or dispersal of the materials. This would include the installation of erosion, sediment and pollution controls prior to the commencement of construction and the maintenance of these for the duration of construction and until such time as all ground disturbed by the works has been stabilised and rehabilitated so that it no longer acts as a source of sediment. The

technical specifications of the erosion, sediment and pollution control measures would be subject to input from construction contractors in the development of the CEMP.

General Construction

Potential impacts relating to general construction works outlined in the previous Environmental Assessment included:

- erosion of stockpiles and work areas resulting in sediment-laden runoff impacting on water quality
- fuel and oil leaks on the construction site
- generation and mobilisation of litter, heavy metals and organic contaminants during construction activities resulting in the degradation of the water quality in surrounding environment.

The proposed modification would not generate additional impacts but may increase the extent to which these impacts could occur. The most significant change would be associated with the increase in the sizes and volumes of the stockpiles for imported fill which would increase the risk of larger volumes of sediment-laden runoff. Additionally, further rail infrastructure construction to be undertaken as part of the modification as well as increasing the construction area for the multi-purpose terminal during Stage 1, would result in additional vehicles, plant and equipment on site.

The potential for impacts such as contamination of surface water runoff and groundwater, potential spills and leaks of hazardous materials and erosion and sedimentation during construction would increase as a result of increased construction activities. However, these impacts would be managed within the remit of the management measures outlined in **Section 14.4**. Control measures to minimise spills and contaminants or sediment entering surrounding watercourses would be included in the Soil and Water Management Plan, and include covering truck loads, enforcing vehicle speed limits to minimise the risk of spills, utilising truck washes and shaker grids at site exits and ceasing construction works during high wind events. Stockpiles would be covered when necessary, and watering of dusty areas would occur to prevent surface water quality impacts during construction.

14.3.2 Operation

Operational impacts identified in the previous Environmental Assessment would not change significantly as a result of the proposed modification.

The previous Environmental Assessment identified the following potential impacts during operation:

- impacts on water quality from potential fuels and oil spills and leaks, ballast water discharge and cargo losses
- mobilisation of sediments and contaminants through surface water runoff from impervious surfaces and unpaved reclamation areas within the proposed development site.

Whilst an increase in the number and size of ships would occur as a result of the modification, the extent of risk to water quality from spills and discharges would not significantly increase, as vessels would be operated to the same standards as those previously proposed to berth at the Outer Harbour Development. Ballast water discharge would be the responsibility of shipping operators to manage in accordance with international and domestic legislation.

Potential impacts to surface water quality resulting from cargo losses would be minimised by utilising covered storage facilities and conveyors as proposed in the modification. The previous Environmental Assessment allowed for open stockpiling of bulk materials handled through the multi-purpose terminal. The proposed modification includes storage sheds for the majority of the materials stored on the multi-purpose terminal, with the exception of one open stockpiling area for break bulk in the southern portion of the terminal, which remains from the previous Environmental Assessment. Break bulk contained in open stockpiles would likely comprise products such as saw logs, construction materials, project cargoes and steel products. As such, the open stockpiles would not result in sediment-laden runoff when impacted by wind or rain, posing no risk to the quality of surrounding waterways.

Materials would be transferred between the bulk unloader facilities, storage sheds and ships through an enclosed conveyor system, minimising the potential for cargo losses during material transportation. The benefits of a covered system and enclosed storage sheds include protection of bulk materials from wind and rain, minimising the risk of materials and sediment-laden runoff entering surrounding waterways thereby lowering the overall potential of impacts to surface water quality, despite the increase in the volume of materials to be transported through the multi-purpose terminal. In addition, the increase in the volume of material transferred through the

terminal necessitates a more efficient system, including more frequent train and ship movements, and a larger terminal area.

The conveyor system would compensate for the higher number of vehicles and plant, previously required to transport material from the bulk stockpiles onto vessels at berth. Fewer numbers of mobile plant on the multi-purpose terminal has the potential to lower the risk of fuel and hazardous chemical spillages on the terminal surface.

A clear set of management measures, outlined in **Section 14.4,** are included to manage these risks. Stormwater pollution control devices would be installed to manage surface water runoff across the hardstand terminal areas. For example, design of the central portion of the multi-purpose terminal will include the installation of a HumeCeptor® hydrodynamic separator, or equivalent, which would be used to prevent pollution from stormwater entering the Outer Harbour via capturing and treating all stormwater on site. The HumeCeptor® system is designed to meet designated water quality targets by removing:

- 85 percent of total suspended solids (TSS)
- 98 percent of free oils and grease
- 90 percent of gross pollutants.

Another example, for minimising impacts to surrounding water quality is the operation of a spill containment pit on the multi-purpose terminal. The spill containment pit would be designed to hold approximately 20 cubic metres of hazardous material in the event of a major spill. Liquids would then be pumped off-site, from the spill containment pit to a waste transfer vehicle which would dispose of the waste at an appropriately licensed facility.

Similar measures to decrease the risk of impacts to surface water quality would be implemented in the design of future portions of the multi-purpose terminal.

The extent of potential impacts arising from surface water runoff of unpaved reclamation areas would be reduced due to less of the reclamation area being left unpaved after the completion of Stage 1 construction. This modification also presents an improved drainage design for unpaved surfaces, which is shown in **Figure 4-3**. This would effectively minimise sediment-laden runoff by directing flows to several drainage lines on the reclamation surface, reducing central ponding of water that may have occurred as a result of the drainage design presented in the previous Environmental Assessment.

Additionally, Condition D6 of the Project Approval outlines the requirement for PKOPL to prepare and implement an Operational Environmental Management Plan (OEMP) that will detail how the environmental performance of the development will be monitored and managed to meet appropriate standards. Specifically, environmental performance issues would include stormwater and water quality management including the incorporation of the management measures outlined in an Integrated Water Cycle Plan, developed for construction of the project.

14.4 Mitigation and Management Measures

Mitigation measures outlined in the previous Environmental Assessment remain relevant for the proposed modification.

A summary of the key mitigation measures that will assist minimising potential hydrological and water quality issues include:

- Preparation and implementation of an Integrated Water Cycle Management Plan for the project to facilitate WSUD measures to ensure that stormwater systems are designed and built to minimise pollutant discharges into receiving waterways (Conditions B13 and B14 of Project Approval).
- Preparation and implementation of a Soil and Water Management Plan as part of the CEMP, to document mitigation measures to manage hydrology and water quality impacts associated with construction of Stage 1, as per Condition 37c of the Project Approval. The SWMP would include details on how land based soil erosion, discharge of sediment or water pollutants from the site would be managed in the short and long term. It would also cover details of contaminated soil and appropriate management methods, as well as a contingency plan for the discovery of contaminated material, major fuel or other chemical spill.
- A Dredging and Reclamation Environmental Management Plan (DREMP) would be prepared based on Project Approval Condition C35, and would include environmental management practices and procedures to be followed during dredging, reclamation and emplacement works.

- The DREMP would include a Water Quality Monitoring Program as required by Conditions C29 and C30 and including procedures outlined in Conditions C25 to C29. Water quality monitoring would be undertaken for turbidity, dissolved oxygen, temperature, pH, metals and metalloids and PAHs.
- Turbidity control measures (such as silt curtains, selection of appropriate work methods and preventing the overflow of barges or bunds) would be designed, installed and maintained outside and surrounding all dredging, reclamation and emplacement works in accordance with Conditions C22 to C24 of the Project Approval and the Water Quality Monitoring Program.
- The handling of oils and fuels, washing of all equipment, (including all concreting equipment) will be undertaken within bunded areas. Containers and pollutants trapped in bunded areas will be disposed of in accordance with the waste management section of the CEMP and the *NSW Waste Classification Guidelines 2008*. Any fuel spillage will be reported, documented and immediately remediated.
- PKOPL would undertake an ecological monitoring program (as per Condition C29f) to assess the ecological health of the Port Kembla Outer Harbour. This program would identify monitoring parameters, testing procedures and the framework for reporting monitoring results.
- The box culverts for conveying Salty Creek flows would be designed to the satisfaction of NSW Fisheries and shall incorporate a V-shaped recess to facilitate the movement of fish and other mobile aquatic species during periods of low flow and be designed so as not to preclude light access as part of future project applications (as per Condition B25 of the Project Approval).
- All materials stockpiled shall be adequately managed to prevent erosion or dispersal of the materials. Dredged sediments shall not be stockpiled on site, unless as otherwise agreed by the Director-General after assessment of relevant environmental impacts (as per Condition C20 of the Project Approval).
- Bulk materials on the multi-purpose terminal would be handled and stored in a covered bulk unloader facility, enclosed conveyors and enclosed storage sheds to minimise the potential for bulk materials to enter surrounding surface waters.
- PKOPL would design, construct, maintain and operate surface and storm water management infrastructure on the site to accommodate a 1 in 100 ARI rainfall event (as per Condition B14 of the Project Approval). On the central portion of the multi-purpose terminal this would include a HumeCeptor® system, or equivalent, to prevent polluted waters entering the Outer Harbour. The HumeCeptor® would treat water to meet water quality targets before discharging treated water into the Outer Harbour.
- Water quality controls during the operation of the central portion of the multi-purpose terminal would include operation of a spill containment pit to prevent hazardous liquid spills entering the Outer Harbour, Salty Creek or surrounding water bodies.

14.5 Conclusion

The majority of potential impacts related to hydrology and water quality would remain unchanged by the modification. Whilst there would be the risk of additional potential impacts to water quality from surface water runoff during the additional Stage 1 construction activities and increases in the dredging footprint and volumes, these would be adequately mitigated through existing measures including a Soil and Water Management Plan within the CEMP and a Dredging and Reclamation Environmental Management Plan. The alterations to the alignment of Salty Creek would also not alter the potential impacts identified in the previous Environmental Assessment. The Water Quality Monitoring Plan required by the Project Approval during dredging and reclamation, would assist in identifying triggers at which point contingency measures and actions would be taken in the event that construction is adversely impacting on water quality.

During operation there would be increased volumes of bulk materials being transferred from rail to terminal and from terminal to ship. However the materials would be handled in a contained manner using enclosed conveyors and storage sheds to minimise potential for materials to enter surrounding surface waters and the Outer Harbour. Appropriate storm water management infrastructure for the terminal areas would also treat stormwater before discharge to the Outer Harbour.

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15.0 Harbour Sediment Quality

This chapter provides an assessment of the potential impacts of the proposed modification on sediment quality within the Outer Harbour.

15.1 Existing Environment

The sediments of the Outer Harbour have undergone extensive disturbance since the first industrial use of the Port in the 1800s (PKPC, 2007). Development of Port Kembla into a deep water port has included dredging and reclamation activities to form the foreshore area of the Outer Harbour which exists today, and dredging for the creation of the tug harbour in recent years. In addition, the Outer Harbour has been impacted by industrial shipping traffic which has accessed the Port for over a century and the surrounding land uses. These ongoing activities have shaped the environment of the Outer Harbour.

The sediment quality assessment for the previous Environmental Assessment was based on a Sediment Investigation conducted by AECOM in 2009 (refer to Chapter 10.0 and Appendix B of the original Environmental Assessment, respectively). This investigation comprised a literature review of all sediment and contamination investigations conducted in the Outer Harbour prior to 2009, as well as results and conclusions drawn from AECOM field investigations, to characterise the nature of potentially contaminated sediments in the Outer Harbour. It included sampling of an existing spoil emplacement area in the Outer Harbour (indicated on **Figure 15-1**) as outlined in the previous Environmental Assessment. This area is bounded in part by underwater bunds constructed from slag material and contains dredged spoil from the Inner Harbour development during 2007 to 2008, some of which is contaminated.

AECOM's Sediment Investigation comprised sampling across the dredging footprint from the oxidic layer (surface of the harbour bed) and anoxic layer (between 0.5 metres and 4.8 metres below the harbour bed). Sampling methods included piston core (PC) samples, sediment grab (SG) samples and vibro core (VC) samples. The distribution of the original sampling locations is shown on **Figure 15-1**. **Figure 15-1** also indicates those sampling locations which have undergone review as part of this modification (further detailed in **Section 15.3**). Laboratory analysis of selected samples was undertaken for CoPCs based on historic site activities and previous investigation results.

Low and high tide harbour water samples were also collected, though these are not considered relevant to this analysis and are referred to further in the surface water quality and hydrology assessment (refer to **Chapter 14.0**) of this Environmental Assessment.

It should be noted that the areas investigated as part of the Sediment Investigation relate specifically to Stage 1 (Major Project) dredging area as Stage 1 comprises the majority of dredging works. The proposed dredging area for Stage 3, including the area north of the Port Kembla Gateway Jetty (currently leased until 2022) and the swing basin area south of the northern breakwater were not sampled. These areas would be subject to further assessment at a later stage, as per Concept Plan Condition 2.5 i), which requests an updated Harbour Sediment Assessment prior to any project applications or activities for Stage 2 and Stage 3. No dredging is proposed in Stage 2. In addition, the changes to dredging associated with the modification relate to Stage 1 only. Consequently, the sections below pertain to Stage 1 only, and as such there is no description of the environment or impacts relating to the broader Concept Plan provided in this section.

Sample results were compared against the ANZECC/ARMCANZ (2000) *Interim Sediment Quality Guidelines* (ISQGs) Low and High Trigger Values and the National Environment Protection Council *National Environment Protection (Assessment of Site Contamination) Measure Guidelines* (1999) (NEPM) for commercial and industrial land use, to assess suitability for use in reclamation of the land that would comprise the future berths.

The NEPM guidelines are currently under review by the NSW EPA. At the time of undertaking this assessment, the revised guidelines had not been released and as such, the assessment has been considered against the 1999 NEPM guidelines used in the previous Sediment Investigation.

The extent and nature of contamination identified within the sediments of the Outer Harbour in the Sediment Investigation is summarised below:

- Heavy metals contamination (concentrations exceeding their respective ANZECC ISQG trigger values) was identified across the majority of the dredge footprint within the shallow sediments (approximately 0 to 0.3 metres bgs).

- The highest concentrations of heavy metals (with concentrations greater than their respective ANZECC ISQG-High) were identified predominantly within the top 1.0 metre of the existing underwater emplacement area (western side of basin between multi-purpose and container terminals).
- Copper and lead concentrations (and to a lesser degree arsenic) exceeded the NEPC (1999) National Environment Protection (Assessment of Site Contamination) Measure Health-Based Soil Investigation Levels (SILs) for a commercial/industrial land use in localised areas at the southern end of the eastern container basin (current location of No.4 Jetty) and also in the vicinity of the Darcy Road Drain.
- PAH contamination was identified across the majority of the dredge footprint within the shallow sediments (approximately 0 to 0.3 metres bgs). The highest PAH concentrations (greater than their respective ANZECC ISQG-High) were identified within the spoil emplacement area.
- TBT contamination (exceeding the ANZECC ISQG-High) appeared to be confined to the southern end of the eastern container basin adjacent to the eastern breakwater (in the vicinity of No.4 Jetty).
- Elutriate testing is designed to simulate the release of contaminants from sediment during dredged material disposal, such as would occur during typical dredging campaigns for this development, when contaminated sediment is mixed with seawater during transfer to the encapsulated reclamation bunds. Allowing for a 1:4 dilution ratio, to simulate likely dilution and dispersion of CoPCs, it is considered that contaminant concentrations meet the relevant ANZECC criteria. It is therefore considered that the dredging and reclamation works are unlikely to have a significant impact on the receiving environment.
- Acid sulfate material was present between 0 and 3.3 metres (oxidic and anoxic layers) at the sample locations tested.

15.2 Methodology

This impact assessment has comprised a review of the original Sediment Investigation carried out as part of the previous Environmental Assessment and a desktop analysis of the potential for changes to impacts relating to contaminated sediments, as a result of this modification. Additional sampling was not deemed necessary due to the relatively minor change to the extent of dredging, which is outlined in more detail in **Section 15.3** and the coverage provided by the original sampling program. Instead, original sampling results were reviewed in light of the proposed alterations to dredging and reclamation footprint to determine likely results to be expected through the modification. Review of mitigation and management measures was undertaken to determine whether existing management measures would be suitable for the modification works.

15.3 Impact Assessment

15.3.1 Construction

Modifications to dredging are limited to a slight increase in the extent of the dredging footprint and volume of dredged material, to accommodate an overall reduction in the reclamation area. The progression of detailed berth and terminal design has determined the need for the widening of the basin between the multi-purpose and container terminals. This has resulted in a slightly larger dredging extent than originally approved.

To enable Cape and Super Post-Panamax vessels to berth at the multi-purpose and container terminals, the modified Stage 1 dredging footprint would extend approximately 20 metres east along the length of the western container terminal berth boxes. Additional dredging would also occur along the southern edge of the basin between the multi-purpose and container terminals. Subsequently, the total volume to be dredged in Stage 1 has increased by approximately 400,000 cubic metres or 25 percent of the total dredged volume. However, dredging would still occur to a depth between -15 metres and -16.5 metres, which is consistent with the assumptions contained in the original Sediment Investigation. Some of the previously deposited Inner Harbour dredge spoil contained within the existing emplacement would require extraction during dredging for the Outer Harbour Development, due to overlapping of this area with the proposed western basin and berth boxes.

No change to dredging methods would occur as a result of the modification, and drilling and blasting would still be required as pre-treatment for the dredging of rock where necessary. Approved dredging methods include a small cutter suction dredger, a backhoe dredger or a grab dredger. Dredging in the first portion of Stage 1 would be undertaken using mechanical dredging methods (backhoe or grab dredger). The cutter-suction method may still be required in later stages. As such, there would be no change to dredging plant and equipment.

The emplacement methods for all spoil that is to be dredged as part of the Outer Harbour Development, would remain largely unchanged as a result of the modification. Spoil would be relocated to bunds within the reclamation footprint. There would be no change to the construction method regarding this relocation or to the methods for construction of the containment bunds for the emplacement of all dredged spoil during construction of this development.

The original assessment outlined the following potential impacts that could arise from dredging:

- The potential release of contaminants from sediment during the dredging and/or placement of materials within the reclaimed areas due to physical processes or chemical changes.
- Mobilisation of bioavailable contaminants within sediments into the water column (through elutriation) and subsequent incidental ingestion and/or dermal absorption into the food chain.
- Disturbance of PASS and the risk of them becoming actual ASS when brought to the surface as part of the dredging and reclamation activities.

The potential for changes to these impacts as a result of the modification is outlined below.

Contamination

Based on our understanding of the existing contamination in the Outer Harbour, contaminant type and concentrations in the modified dredging area are likely to be consistent with those found within the approved dredging area. As indicated on **Figure 15-1**, the nearest existing sediment sampling locations to the areas where additional dredging would occur include:

- Piston Core (PC)55 and Sediment Grab (SG)16 in the south of the basin between the multi-purpose and container terminals.
- SG9 and SG10 in the south east of the basin between the multi-purpose and container terminals.
- PC34 to PC43 in the berth boxes of the western container terminal.

These sampling locations are between 10 to 30 metres from the new dredging areas. Due to this close proximity, it is considered likely that the reported sediment contaminant concentrations at these locations would be similar to, and representative of, sediment quality in the proposed extended dredging area.

Specific results of the previous Sediment Investigation at these sampling locations are presented in **Table 15-1**. The results indicate that heavy metals contamination is present at all locations (including combinations of antimony, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, vanadium and zinc), with random occurrences of PAH and TBT contamination at some locations.

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AECOM

SEDIMENT INVESTIGATION LOCATIONS

Port Kembla Outer Harbour Development
Environmental Assessment

Note: No dredging will be undertaken in Stage 2

FIGURE 15-1

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Table 15-1 Contamination results at previous sampling locations nearest to the modified dredging area

Contaminant	Exceedance Details	Relevant Sampling Locations*
Heavy metals	Concentrations exceeded respective ISQG-high trigger values, generally within shallow sediments (approximately 0 to 0.3 metres bgs)[1].	14 sampling locations (PC55, SG16, SG9, SG10, PC34, PC35, PC36, PC37, PC38, PC39, PC40, PC41, PC42, PC43)
PAH	Concentrations exceeded respective ISQG-high trigger values.	2 sampling locations (PC37 and PC43)
	Concentrations exceeded respective ISQG-low trigger values.	7 sampling locations (SG16, PC35, PC36, PC37, PC29, PC40, PC41)
TBT	Concentrations exceeded the ISQG-High trigger values.	3 sampling locations (PC34, PC38, PC39)

Source: Sediment Investigation (AECOM, 2009).

1 All sampling locations identified exeedances of high and low trigger values depending on the metal analysed.

It is expected that the additional material dredged as part of the proposed modification would contain similar contaminants and concentrations of contaminants. For this reason, it is expected that the existing mitigation measures and Project Approval conditions are sufficient to manage the risks of additional dredging. These include construction of secure spoil containment bunds, and auditing of these bunds and the emplacement method, which would be carried out in accordance with a Dredging and Reclamation Environmental Management Plan. In addition, utilisation of silt curtains to create a water column within which all dredging would be confined, ongoing turbidity and turbid plume monitoring and the use of mechanical dredging during Stage 1 to minimise turbidity, would seek to ensure minimal impacts beyond the water column.

As such, it is considered feasible that additional dredged material could be appropriately managed by adopting suitable dredging methodologies and environmental safeguards (refer to **Section 15.4**), as per the conclusions of the previous Sediment Investigation.

Elutriation

Applying the logic discussed above, it could be expected that elutriation testing results for the modified dredging area would also be representative of those identified in the original Sediment Investigation. For this reason, dredging in the modified dredging area may release copper, arsenic, vanadium and zinc into the water column at concentrations which exceed their respected ANZECC 2000 95 percent marine trigger values. However, a dilution ratio of at least 1:4 should be applied, consistent with the original assessment and the *National Assessment Guidelines for Dredging* (NADG) (2009) which provides for consideration of dilution and dispersion of CoPCs when considering elutriate test results. Accounting for this, dredging and reclamation of sediments within the modified area would be unlikely to have a significant impact on the receiving environment, if managed appropriately under the Dredging and Reclamation Environmental Management Plan as recommended in the original Sediment Investigation.

Potential Acid Sulfate Soils (PASS)

It is likely that PASS are present in the modified dredging area. This is based on the *Acid Sulfate Soil Risk Map (Edition 2) for Wollongong*, published by the Department of Natural Resources (DNR, 2002). The plan indicates that there is a 'High Probability' for ASS within the 'estuarine bottom sediments' of the Inner Harbour and that there is potential for severe environmental risk if bottom sediments are disturbed by activities such as dredging. This conclusion can be reasonably extrapolated to the Outer Harbour, which is categorised by the plan as 'open ocean' and therefore not categorised. The indications for ASS in the Outer Harbour are supported by the presence of acid sulfate material in the oxidic and anoxic layers at locations sampled during the previous Sediment Investigation. It is therefore likely that the modified dredging area would contain PASS.

The risk of disturbance to PASS would not increase as a result of modifications to the extent of dredging, as the magnitude of PASS is not likely to dramatically alter in the new dredging area. Dredged material that may contain PASS would be managed as per the commitments of the previous Environmental Assessment and Project

Approval conditions of consent (outlined in **Section 15.4**). This would minimise the risk of PASS coming into contact with oxygen and becoming actual ASS during dredging.

15.3.2 Operation

There would be no additional contamination impacts as a result of the proposed modification during operation, due to the completion of all dredging activities during construction. As per Concept Plan Condition 2.15, ongoing operational dredging requirements including maintenance dredging do not form part of the Concept Plan and are subject to assessment requirements of the EP&A Act, separate to the Outer Harbour Development.

15.4 Mitigation and Management Measures

The existing consent conditions for the Concept Plan and Major Project, and commitments outlined in the previous Environmental Assessment are considered appropriate for the management of potential impacts relating to both approved and modified dredging activities in the Outer Harbour. A summary of the mitigation and management measures to be implemented is provided below.

15.4.1 Construction Environmental Management Plan

PKOPL would, prior to the commencement of construction, prepare and implement a CEMP which would address soil and water quality and spoil management including ASS management under a Construction Soil and Water Quality Management Plan (further detailed in Major Project Approval Conditions C36 and C37).

15.4.2 Management of PASS/ASS

An Acid Sulfate Soils Management Plan would be prepared prior to the dredging and reclamation works. Measures for the appropriate management of Acid Sulfate Soils would be carried out in line with the *Acid Sulfate Soil Manual* (ASSMAC). These measures would either ensure that future works avoid exposing PASS to air or provide for appropriate management of the PASS. This would be consistent with Major Project Approval Condition C21 which determines that any construction activities in identified areas of ASS risk would be undertaken in accordance with the ASSMAC.

The DREMP would refer to the ASSMP and would include appropriate management measures for:

- Handling and transportation of PASS in a manner that minimises the exposure of PASS to air, where possible.
- Any PASS dredged material would be encapsulated and confined within an engineered containment structure (bunded area) at a lower depth within the reclamation.
- The removal of PASS from dredged material to land (if encapsulating and confining the material underwater is not possible).
- Any mobilisation of disturbed soils that are confirmed to be ASS.

15.4.3 Dredging and Reclamation

A DREMP would be prepared based on the measures recommended by the AECOM Sediment Investigation, 2009 and Project Approval Condition C35, and would include:

- Procedures for sediments to be dredged and transported directly to the emplacement area (to avoid the need for land storage and wastewater management, and avoid the exposure of PASS).
- Dredged sediments deposited as part of the proposed reclamation would be contained and effectively encapsulated and confined in an engineered containment structure which would be constructed of clean fill or clean residual soil and rock that is won as part of the dredging process.
- Dredged sediments would initially be placed at depth, below the depth of wave action at the base of the reclamation fill. As the reclamation level increases, protection would be provided by the perimeter bunds progressively constructed in ‘lifts’ which would prevent wave action from entering the emplacement area.
- Dredging and reclamation would be undertaken within the protection of parallel silt curtains (one silt curtain surrounded by another parallel silt curtain to act as a secondary buffer), encompassing the dredging and placement areas.
- Dredging technologies would be selected in consideration of their ability to minimise the generation of turbidity.

- Contingency measures would be implemented immediately in the event visible turbidity and harbour water quality impacts are identified during routine monitoring.
- Monthly flyovers would be undertaken to assess the presence of potential sediment plumes and algal blooms from the dredging or emplacement areas.

15.4.4 Water Quality Management

PKOPL would prepare and implement a Water Quality Monitoring Program to be incorporated into the DREMP, in accordance with Major Project Approval Conditions C25 to C29. Water quality monitoring would be undertaken for turbidity, dissolved oxygen, temperature, pH, metals and metalloids and PAHs. A Dredging Water Quality Monitoring Program would also be established.

Twice-daily manual measurements of turbidity would be carried out in conjunction with observations by personnel undertaking the dredging and reclamation activities to assist in early identification of problems and proactive implementation of mitigation measures. Turbidity control and inspection would be carried out in accordance with Major Project Approval Conditions C22 to C24 and the Water Quality Monitoring Program.

A Reclamation Water Quality Monitoring Program would be prepared and implemented under the CEMP. The program would monitor turbidity and other physico-chemical parameters surrounding the reclamation works and changes to those parameters as a result of the project.

15.4.5 Containment Structures and Emplacement Methods

- Prior to the commencement of dredging, reclamation and emplacement activities PKOPL would prepare and submit a Containment Structures and Emplacement Report. This would detail the design and methodology for the proposed emplacement cells and emplacement cell capping, to ensure that works prevent the dispersal of, or contain contaminated sediment during construction and operation of the project and to ensure that environmental and health risks would be appropriately mitigated and managed (Major Project Approval Condition B23).
- The Proponent shall engage an appropriately qualified person to audit the construction of the emplacement cells and the emplacement of dredged sediments at the practical completion of cell construction stages. The auditor would provide the Director General with a report within one month of each audit confirming that the construction and sediment emplacement are in accordance with the approval and the Containment Structures and Emplacement Report (refer to Project Approval Condition C31).

15.5 Conclusion

The proposed modifications to the extent of dredging and volume of dredged material are not likely to increase the risk associated with disturbance to contaminated sediments or PASS that would arise through dredging. It is likely that the modified dredging area would contain similar types and concentrations of contaminants to the previously approved dredging area, and the modification to the dredging extent would not create significant additional impacts. For this reason, it is considered that implementation of the approved mitigation measures and relevant conditions of consent would be suitable for minimising adverse effects to the receiving environment during the proposed dredging and reclamation works.

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16.0 Qualitative Human Health and Ecological Risk Assessment

This chapter provides an assessment of any change in risk to sensitive human health and environmental receptors in the Outer Harbour and surrounds, that may result from impacts relating to potential contact with contaminated sediments, soil and groundwater, during construction of the proposed modification.

16.1 Existing Environment

A *Qualitative Human Health and Ecological Risk Assessment: InSitu Sediment and Groundwater Contamination* (QHHERA) (AECOM, 2010), was undertaken for the approved development to consider risk associated with the contamination of in-situ sediments and groundwater. The QHHERA and a summary of the specialist report are located in Appendix D and Chapter 12.0 of the original Environmental Assessment, respectively.

The overall aquatic ecological environment within the Outer Harbour is highly modified due to:

- Physical modifications of the harbour (e.g. construction of breakwaters and jetties and dredging and reclamation activities) associated with the development of the port. These include:
    - Maintenance and construction dredging (most recently undertaken in 2011 for the development of the tug berth in the Outer Harbour).
    - Spoil disposal in the Outer Harbour resulting from Inner Harbour dredging campaigns and construction dredging.
    - Initial reclamation activities for Stage 1 of the Outer Harbour Development.
- The industrial nature of the surrounding area.
- Reported presence of pest species due to ballast discharge within the Outer Harbour.
- The high level of boating/shipping activity within the Outer Harbour.

The ecological value of the Outer Harbour area was therefore considered to be generally low at the time of the previous Environmental Assessment, and this remains consistent with conditions in which the modification would be undertaken. Previous investigations found that the bed sediments of the Outer Harbour contain elevated concentrations of CoPC including heavy metals and Total PAHs that were reported to exceed the relevant guidelines. These contaminant levels are further detailed in **Chapter 15.0**.

Since the previous Environmental Assessment, harbour water sampling by SLR identified no exceedences of cadmium in the Outer Harbour, supporting the conclusion drawn in the previous assessment that cadmium exceedences identified in 2009 sampling were erroneous. The SLR report also identified exceedences of the *ANZECC Guidelines for Fresh and Marine Water Quality 2000* for copper and zinc in the harbour water. However, these levels do not exceed *Guidelines for Managing Risks in Recreational Water* (National Health and Medical Research Council, 2008) for drinking water or aesthetic values for copper and zinc, respectively, and are therefore not considered relevant to human health.

With regard to recreational activities in the Outer Harbour, and potential risks to human health, it should be noted that fishing is permissible within certain sections of the Outer Harbour. Fishing is prohibited in the Inner Harbour.

16.2 Methodology

A review of the qualitative human health and ecological risks associated with the development has been undertaken with consideration to the proposed modification, in accordance with the methods employed for the previous assessment, being:

- Qualitative assessment of the potential for adverse human health or environmental risks associated with identified *in-situ* chemical contamination within PKOH sediments likely to be disturbed as part of the modification.
- Qualitative assessment of the potential for adverse human health or environmental risks associated with identified chemical contaminants in groundwater in the PKOH lands that are likely to be disturbed as part of the modification.
- Qualitative assessment of the potential risks associated with redistribution or dispersal of contaminants during modified dredging or reclamation activities.

Documents reviewed as part of this assessment included:

- *Qualitative Human Health and Ecological Risk Assessment: InSitu Sediment and Groundwater Contamination* (AECOM, 2010).
- *Preliminary Environmental Site Assessment: Port Kembla Port Corporation Outer Harbour Rail Network* (ERM, 2013).
- *Baseline Sampling Summary – Tug Berth Facility Construction* (SLR, 2011).

16.3 Impact Assessment

The modified elements of the development that may affect human health and ecological risk include:

- Amended dredging and reclamation footprint to slightly increase the basin area between the multi-purpose terminal to accommodate larger ships.
- Amended dredging volumes due to the changed footprint described above and the refinement of detailed design for Stage 1 dredging and reclamation. The Stage 1 dredging volume has increased from 1.22 million cubic metres (approved) to 1.62 million (proposed).
- Potential interception of groundwater that may contain contaminants, due to excavation required for modified rail infrastructure including the bulk unloading facilities, bulk loops and sidings.

Potential human health and ecological risks apply only to the construction phase of the project, and as such, the assessment below pertains to construction activities only.

16.3.1 Potential Human Health Risks

Sensitive Human Receptors

Risks to human health receptors would primarily occur during dredging works to be undertaken as part of the Major Project (Stage 1) or during intrusive construction works for road and rail infrastructure. Dredging and construction works associated with Stages 2 and 3 of the Outer Harbour Development would be addressed as part of future project applications. The previous environmental assessment assessed the potential risks to human receptors for the majority of receptor/exposure pathway combinations as low or moderate. Human receptors considered in the previous assessment are unchanged, being:

- Commercial or industrial workers at properties within the Outer Harbour lands.
- Recreational users of PKOH.
- Dredging workers.
- Intrusive construction or maintenance workers.

Potential Exposure Pathways

Contaminant migration and exposure pathways by which the above receptors may be exposed to identified contaminants in sediment and groundwater have not changed as a result of the modification. These pathways include:

- Ingestion of edible fish which have bioaccumulated contaminants present in Outer Harbour sediments or surface water.
- Incidental ingestion and/or dermal absorption of contaminants in sediment or surface water by recreational users of the PKOH (based on the industrial nature of the Outer Harbour area such that recreational use and exposures are not expected to be significant).
- Incidental ingestion and/or dermal absorption of CoPC in sediment or surface water by dredging workers (based on expectation that dredging activities will be managed such that direct contact with sediment or surface water by workers will be minimal).
- Incidental ingestion and/or dermal absorption of CoPC in groundwater following accumulation by workers in a maintenance trench or construction pit (based on expectation that contact will be incidental, of low frequency and short duration, and that appropriate PPE and hygiene procedures would be used to mitigate potential risks).

Other exposure pathways identified in the original assessment by which human receptors may be exposed to CoPC in sediment or groundwater, are considered to be incomplete or not applicable.

It is considered that potential risks associated with the effect of potential ingestion of CoPC in edible fish warrants further qualitative assessment prior to the commencement of dredging works. This further assessment would be based on detailed design of the dredging works and specific environmental management techniques which aim to minimise and control the dispersal of contaminated sediment.

Assessment of Potential Human Health Risks

The previous Environmental Assessment concluded the potential risk to human receptors from the approved development as low or moderate for most receptor/exposure pathway combinations.

A summary of the impact of the proposed modification on the risks identified in the previous Environmental Assessment is outlined in **Table 16-1** below.

It should be noted that the original risk ratings taken from the previous Environmental Assessment, are preliminary and assume the most conservative risk rating pre-mitigation. In addition, it should be considered that all risks relate to the short-term impacts of dredging and construction.

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Table 16-1 Impact of the proposed modification on approved human health risks

Risk/Exposure Pathway	Original Risk Rating	Justification	Modified Risk Rating	Justification	Mitigation Measures
Direct contact with harbour surface water by recreational users or dredging workers	Moderate	Significantly elevated cadmium concentrations reported in a couple of isolated harbour surface water samples, though these results may be erroneous based on other harbour surface water, sediment and elutriate analytical results as part of this investigation and historical water quality data in the Outer Harbour.	Low	Sediment exposed during additional dredging would likely contain similar contaminants (heavy metals, PAH and TBT) and concentrations to nearby sampling locations. Cadmium results were considered erroneous, however levels found were not in close vicinity to the modified dredging area but in harbour water samples HS02 and HS03 (approximately 1.04 kilometres and 650 metres from the reclamation area respectively) and these levels are therefore not expected to pose an issue during dredging activities. Additional harbour water sampling undertaken in 2011 by SLR at four different locations over five sampling events did not indicate the presence of cadmium in the harbour water. This further supports the conclusion that the cadmium exceedences previously identified in 2009 were erroneous.	DREMP would outline ways in which dredging, reclamation and emplacement works would be managed to minimise human health and ecological risks. Recreational fishers would be isolated from dredging areas. Boats would not be permitted to anchor in shipping channels and would be kept clear of dredging activities. Dredging management measures would seek to minimise direct contact with harbour water at all times to minimise risk to workers.
Direct contact with groundwater by intrusive workers	Moderate	Extent of exposure likely to be very low for any individual receptor, and potential risks can be managed with the use of appropriate personal protective equipment/clothing and hygiene procedures.	Moderate - High	The increased risk rating relates to: - More recent information becoming available regarding the depth of groundwater which appears to be shallower (1.15 metres to 2.29 metres) in the area of the rail loop (ERM, 2013).	Condition B22 of the Project Major Project approval requires Phase 2 investigation at excavation locations to determine presence of contaminated groundwater and associated mitigation measures if necessary.

Risk/Exposure Pathway	Original Risk Rating	Justification	Modified Risk Rating	Justification	Mitigation Measures
				- More recent information indicating the presence of trichloroethene (TCE) in one isolated sample on the western side of the balloon loop. TCE levels exceeded the human health criteria (ERM, 2013) adopted for this investigation, being the *Drinking Water Quality Guidelines* of the WHO (2011). - Extent of excavation required for the bulk unloader facility and likelihood that this would intercept groundwater, which may be contaminated. Whilst TCE does exceed criteria outlined in the WHO guidelines, the concentration measured in this well is considered unlikely to present a significant risk to human health based on the current site use and configuration, assuming groundwater is not abstracted for use (ERM, 2013). A Phase 2 soil and groundwater investigation would be undertaken for all areas to undergo excavation, and subsequent measures would be implemented to minimise impacts to human health. If TCE is present and concentrations pose a risk to health (based on criteria relevant to the likely exposure pathways for intrusive workers, being potential dermal contact or accidental ingestion), appropriate measures would be included in an Occupational Health and Safety Plan and the CEMP for workers. Measures would likely include appropriate PPE and hygiene procedures to minimise contact.	If required, measures to manage contaminated groundwater would be incorporated into the CEMP, including how the environmental and human health risks would be managed during the disturbance, remediation and/or removal of contaminated soil or groundwater. Mitigation specific to contaminants present would be included in an Occupational Health and Safety Plan and CEMP.

Risk/Exposure Pathway	Original Risk Rating	Justification	Modified Risk Rating	Justification	Mitigation Measures
Ingestion of edible fish tissue with elevated contaminant concentrations	High	Foraging/exposure in the PKOH, based on significantly elevated concentrations of CoPC reported in sediments. It is noted that the actual levels of receptor exposure (i.e. quantity of potentially impacted fish which could be ingested) and levels of CoPC concentrations in fish tissue are not known. It is considered that potential risks associated with this exposure pathway warrants further qualitative consideration.	High	Sediment exposed during additional dredging would likely contain similar contaminants (heavy metals, PAH and TBT) and concentrations to nearby sampling locations. Additional dredging areas and volumes would not directly increase the risk of ingestion of edible fish tissue, however more contaminants may be exposed, increasing the risk of bioaccumulation in fish inhabiting the Outer Harbour. Approved dredging management techniques that seek to minimise direct contact with water would be employed in modified dredging areas. In addition, recreational fishers would be isolated from dredging activities. Public access to the Outer Harbour foreshore is limited to the breakwaters and Christy Drive foreshore, north of the tug boat facility. Boats would not be permitted to anchor in shipping channels and would be kept clear of dredging activities.	Turbidity control measures would be designed, installed and maintained outside and surrounding all dredging, reclamation and emplacement works until turbidity in the water column has fallen below relevant turbidity limits. An inspection program would be implemented to ensure all turbidity control measures are maintained. All dredging, reclamation and emplacement works would ensure turbidity levels stay within relevant criteria in the WQMP (Major Project Approval Conditions C22 to C24). Further qualitative assessment is recommended based on detailed design of the dredging works and specific sediment dispersal management techniques.

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16.3.2 Potential Ecological Risks

Sensitive Ecological Receptors

Risks to ecological receptors would primarily occur during dredging works to be undertaken as part of the Major Project (Stage 1) or during intrusive construction works for road and rail infrastructure. Dredging and reclamation works associated with Stages 2 and 3 of the Outer Harbour Development would be addressed as part of future project applications.

The previous environmental assessment assessed the potential risks to ecological receptors for the majority of receptor/exposure pathway combinations as low or moderate. Additionally, the overall ecological value of the Outer Harbour is considered to be low due to the high levels of disturbance and historic physical changes to the harbour.

Ecological receptors considered in the previous assessment are unchanged, being:

- Benthic invertebrates (worms, bivalves etc.), deposit feeders (benthic fish, crabs, etc.) and micro-flora (diatoms, other microscopic algae species) which may be present in soft sediments.
- Hard substratum marcoalgae (seaweed) which may be present on existing revetment/breakwater walls, and hard substratum mobile (starfish) and sessile (sponge, anemone, dyrozoans, bryozoans, polychaetes, etc.) invertebrates.
- Pelagic organisms (primarily fish) which may reside in surface waters.

Potential Exposure Pathways

Contaminant migration could occur during dredging and spoil emplacement activities, whereby potentially contaminated sediment is moved from *in situ* harbour sediment to new locations within engineered containment bunds for the purposes of land reclamation. Exposure pathways by which the above receptors may be exposed to identified contaminants in sediment and groundwater have not changed as a result of the modification. These pathways include:

- Direct contact exposure (i.e. incidental ingestion and dermal contact) to contaminants:
- In sediments by benthic invertebrates, microalgae and fish.
    - In sediment pore waters (water filling the spaces between grains of sediment) by benthic invertebrates, microalgae and fish.
    - In surface water by benthic invertebrates, microalgae and fish, pelagic fish and hard substratum species.
    - Ingestion of bioaccumulated contaminants within algae, invertebrates and/or other fish by benthic invertebrates, microalgae and fish, pelagic fish and hard substratum species.
- Direct contact exposure to contaminants:
    - In sediments by pelagic fish/organisms.
    - In sediment pore waters by pelagic fish/organisms.

Other exposure pathways identified in the original assessment by which ecological receptors may be exposed to CoPC deriving sediment or groundwater are considered to be incomplete or not applicable.

Further qualitative assessment of potential ecological risks should be based on detailed design of the dredging works and specific environmental management techniques which aim to minimise and control the dispersal of contaminated sediment.

Assessment of Potential Ecological Risk

The previous Environmental Assessment concluded the potential risk to ecological receptors from the approved development as moderate or high for most receptor/exposure pathway combinations.

A summary of the impact of the proposed modification on the risks identified in the previous Environmental Assessment is outlined in **Table 16-2** below. The proposed modification would not alter the original risk ratings.

The high risk ratings outlined in **Table 16-2** reflect the risk posed to particular individual receptors within the harbour as a result of the proposed development and modification. However, the development overall would not significantly degrade the ecological value of the Outer Harbour which is low.

It should be noted that the original risk ratings taken from the previous Environmental Assessment, are preliminary and assume the most conservative risk rating pre-mitigation. In addition, it should be considered that all risks relate to the short-term impacts of dredging and construction.

Table 16-2 Impact of the proposed modification on approved ecological risks

Risk/Exposure Pathway	Original Risk Rating	Justification	Modified Risk Rating	Justification	Mitigation Measures
Direct contact with harbour surface water by all aquatic receptors	High	Elevated arsenic, cadmium (anomaly) and TBT concentrations and other chemicals reported in low concentrations.	High	Additional dredging extent and volume may disturb more contaminants present *in situ* in sediments. However, the overall risk would not increase due to the likelihood that contaminants would be of similar type and in similar concentrations to those indicated in nearby sampling locations (outlined in **Chapter 15.0**). Therefore, the level of risk to ecological receptors remains similar to that identified in the previous Environmental Assessment. Zinc and copper exceedences recorded by SLR may impact ecotoxicological risk, however further qualitative assessment for potential ecological risk is recommended, as per the findings of the original QHHERA. Application of approved mitigation measures such as controlling turbidity through appropriate dredging methods, installation of silt curtains and adequately containing emplaced spoil would minimise risks to ecological receptors posed by additional contaminants becoming mobilised in the Outer Harbour.	The DREMP would include utilisation of silt curtains and turbidity controls to create a water column within which all dredging would be confined, ongoing turbidity and turbid plume monitoring, secured spoil containment bunds, and auditing of these bunds and the emplacement method. In addition, the use of mechanical dredging during Stage 1 to minimise turbidity, would seek to ensure minimal impacts beyond the water column until turbidity in the water column has fallen below relevant turbidity limits. Water quality and ecological monitoring requirements would be contained within the DREMP (Major Project Approval Conditions C25 to 29 and C35). An ecological monitoring program would be undertaken to assess the ecological health of the Port Kembla Outer Harbour (Major Project Approval Condition C29 (f)).
Direct contact with sediment and/or pore waters by benthic organisms	High	Pore water concentrations not known. Overall risk present due to possibility of exposure to contaminants during dredging.	High		
Direct contact with sediment and/or pore waters by pelagic organisms	Moderate	Pelagic organisms expected to only intermittently contact sediments or pore water.	Moderate		
Ingestion of edible flora, invertebrates or fish by aquatic fauna	High	Bioaccumulative potential of contaminants varies. Overall risk present due to possibility of exposure to contaminants during dredging.	High		

16.4 Mitigation and Management Measures

Potential risks identified to human receptors would be managed by consideration of the nominated exposure pathways and through suitable design of construction methodologies. The potential risk associated with the direct contact with groundwater by intrusive workers, has been increased since the last assessment from moderate to high due to the further information available regarding groundwater depths and contaminants present. However, management of potential contact with groundwater, and associated risks, is catered for in the current Project Approval.

Risks to ecological receptors, notwithstanding the low ecological value of the harbour, remain unchanged and would be managed through careful consideration of the nominated pathways and suitable design of construction methodologies and environmental mitigation measures.

The majority of the existing consent conditions for the Concept Plan and Major Project, and commitments outlined in the previous Environmental Assessment are considered appropriate for the management of potential impacts relating to both approved and modified dredging activities in the Outer Harbour. A summary of the mitigation and management measures to be implemented is provided below:

- A DREMP would be prepared as per Project Approval Condition C35. The DREMP would outline environmental management practices and procedures to be followed during dredging, reclamation and emplacement works, to minimise human health and ecological risks. The DREMP would include the following actions:
    - Procedures would be developed for sediments to be dredged and emplaced in the reclamation area at essentially the same time (to avoid the need for land storage and wastewater management, and avoid the exposure of PASS).
    - Dredged sediments deposited as part of the proposed reclamation would be contained and effectively encapsulated and confined in an engineered containment structure which would be constructed of clean imported fill.
    - Dredged sediments would be placed at depth, below the depth of wave action at the base of the reclamation fill.
    - Dredging and reclamation would be undertaken within the protection of parallel silt curtains encompassing the dredging and placement areas.
    - Dredging technologies would be selected in consideration of their ability to minimise the generation of turbidity.
    - Turbidity control measures and monitoring requirements to prevent the release of visible sediment plumes or contaminants beyond installed measures as per Project Approval Conditions C22 to C24.
    - Regular monthly flyovers would be undertaken to assess the presence of potential sediment plumes and algal blooms from the dredging or placement areas.
    - Contingency measures would be implemented immediately in the event visible turbidity and harbour water quality impacts are identified during routine monitoring.
- A Water Quality Management Plan (to form part of the DREMP) would be developed, specifically including implementation of an ongoing ecological monitoring program to assess the ecological health of the Port Kembla Outer Harbour as per Condition C29 of the Project Approval.
- A further qualitative risk assessment would be undertaken once dredging methodology has been confirmed, prior to the commencement of dredging tasks in Stage 1 and Stage 3, as part of a future project application, and would include:
    - Qualitative risk assessment of contaminated sediment dispersal to assess potential risks to ecological receptors.
    - Recommendations and mitigation measures that arise from these additional assessments to be incorporated into the DREMP.
- Appropriate PPE and hygiene practices for construction workers.

- As per Condition B22 of the Project Approval, prior to the commencement of land based excavation activities, PKOPL shall prepare a Soil Contamination Report detailing the outcomes of Phase 2 contamination investigations at excavation locations, to detail whether or not the soil is suitable for the intended land use, or can be made suitable for reuse through remediation (where reasonably practicable), the likely remediation strategy for addressing any contamination that has been encountered (if required), and how the environmental and health risks would be appropriately mitigated and managed during the disturbance, remediation (if applicable) and/or removal of contaminated soil. If contaminants are present that exceed the relevant human health criteria, and are deemed to be a human health risk, the environmental and health risks would be appropriately mitigated and managed during the disturbance and would be addressed in the Occupational Health and Safety (OHS) Plan and CEMP, specific to works in this area.
- PKOPL would prepare a Site Management Plan (SMP) prior to the commencement of construction to manage excavation works. The SMP would include a groundwater monitoring program to be conducted at the site prior to the commencement of the works and as frequently as required thereafter. This program would be designed and undertaken so as not to impede construction or operation of the development. In developing the groundwater monitoring program PKOPL would review and utilise the results for the existing groundwater monitoring program being undertaken for the Outer Harbour.
- If contaminated groundwater is found, measures would be encompassed in the CEMP to appropriately manage the water, including potential treatment or disposal off-site at an appropriately licensed waste management facility.

16.5 Conclusion

The proposed modifications to the extent of dredging and volume of dredged material are not likely to significantly increase the overall level of risk to sensitive human or environmental receptors.

The potential risk associated with one exposure pathway, being direct contact with groundwater by intrusive workers has increased to a high level as a result of the modification. This is associated with further information becoming available since the previous Environmental Assessment regarding depth to groundwater and presence of TCE at one isolated sampling location in the Outer Harbour rail loop. Additionally, the bulk unloader facilities are expected to warrant excavation to a depth that would be likely to intercept groundwater.

Prior to the commencement of land excavation works, the Phase 2 investigation at excavation locations would determine potential human health and ecological risks, the manner in which these would be mitigated and managed during the disturbance, and if remediation or removal of soil and groundwater is necessary. Suitable mitigation measures including appropriate construction methods, personal protective equipment and permissible exposure criteria for workers would be determined and included in an OHS Plan or SMP, and the CEMP prior to the commencement of construction.

Risk levels of potential activities associated with the modification would remain unchanged for ecological receptors. Whilst the potential risk remains high for most ecological receptors as a result of the modification, it should be noted that the overall ecological value of the Outer Harbour is considered to be low, owing to the highly developed and disturbed nature of the harbour. Therefore, the modification is not likely to reduce any inherent value of the Outer Harbour environment.

It is considered that implementation of the approved mitigation measures and relevant conditions of consent would be suitable for minimising adverse effects to the receiving environment during the proposed dredging and reclamation works. However, further investigation and qualitative risk assessment is required prior to the commencement of dredging to adequately determine risks, and appropriate mitigation measures.

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17.0 Aquatic Ecology

This chapter provides an assessment of the potential impacts of the proposed modification on aquatic ecology. A summary of the previous aquatic ecology assessment is located in Chapter **16.0** of the previous Environmental Assessment, with the complete assessment *Survey of Marine Faunal Communities in the Area of the Proposed Port Kembla Outer Harbour Development* (UNSW, 2009) contained in **Appendix G** of the same document.

17.1 Existing Environment

17.1.1 Soft Substrate Habitat

Flora

The conditions in Port Kembla Harbour have not favoured the establishment of seagrass or mangrove communities, as identified in the *Port Kembla Outer Harbour Master Plan Environmental Considerations*, undertaken by Maunsell AECOM in 2008. Previous surveys in the harbour have found no significant macroalgal flora (marine vegetation) was associated with the soft substrate habitat.

Presence of dinoflagellate cysts has been recorded in Port Kembla Harbour. A sediment survey was undertaken by UNSW in 2009 as part of the previous Environmental Assessment, to assess the presence of dinoflagellate cysts in the area to be dredged and reclaimed as part of the Outer Harbour Development. A total of 14 sites were sampled within the Outer Harbour and Salty Creek. Potentially toxic dinoflagellate cysts (*Alexandrium sp.*) were identified at two sites from location L2 (which is located outside the development footprint but close to the swing basin) and one site at Salty Creek. Abundances of *Alexandrium sp*. were low (< 5/ml) and the toxic dinoflagellate *Gymnodinium catenatum* was not identified in any of the samples.

The presence of *Alexandrium sp.* cysts in the sediments raises the possibility of occurrence of potentially toxic algal blooms. During dredging, cysts can be disturbed and their dispersal through the photic layer of the water column is thus enhanced, leading to potential occurrence of toxic blooms. Blooms of *A. catenella* in southern Australian waters usually occur for about two to four weeks in the warmer months between December and April (Pollard and Pethebridge, 2002). However, to date there is no evidence of any toxic blooms occurring in Port Kembla (Pollard and Pethebridge, 2002), despite dredging and spoil movement taking place recently in the harbour and bed levelling with a sweep bar undertaken annually. This has included dredging for the creation of the tug harbour and historical dredging activities for the formation of the Port.

Fauna

Fish sampling using seine and gill nets was undertaken on the soft substrate habitat in the Outer Harbour as part of early environmental investigations for port expansion planning (AWT, 1999). In this study, seine nets were hauled by hand though the shallow sandy beach habit off Red Beach. Gill net sampling was undertaken in the deeper subtidal soft substrate habitat off Red Beach. A total of 221 specimens belonging to 13 taxa were recorded, with more than 60 percent being juveniles. The most abundant taxa were juvenile Yellowfin Bream (*Acanthopagrus australis*) and adult Sandy Sprats (*Hyperlophus vittatus*) (AWT, 1999). The Red Morwong (*Cheilodactylus fuscus*) was the only species collected in the gill nets surveys of the deeper soft substrate habitat. These results suggest that the soft substrate beach habitat off Red Beach potentially provides a nursery area for juvenile fish.

The sediment survey undertaken by UNSW in 2009 as part of the previous Environmental Assessment, also sampled for sediment infauna at four locations in the Outer Harbour and one location in Salty Creek. Thirty-two sediment infauna taxa were identified from the Outer Harbour sediment samples while 11 taxa occurred in the Salty Creek samples. The Outer Harbour taxa were dominated by Polychaete families Cirratulidae, Spionidae and Sabellidae, particularly at locations L2 (Cirratulidae and Sabellidae), L3 (Cirratulidae and Spionidae) and L4 (Cirratulidae). The Salty Creek sites were characterized by the presence of Bivalves, Polychaete family Nereididae and Oligochaetes. Assessment of the Outer Harbour ecological environment undertaken for the previous Environmental Assessment found that the harbour contained low ecological value overall due to the level of previous disturbance, as well as the low level of species diversity.

17.1.2 Hard Substrate Habitat

Flora

A survey of subtidal epibiota was undertaken by UNSW in 2009 as part of the previous Environmental Assessment. Surveys were undertaken along transects in the Outer Harbour consisting of the eastern breakwater, the wooden wharf piles of No. 6 Jetty (also known as Port Kembla Gateway), and No. 4 Jetty (Berth 206). The survey found Red and Brown algae were the predominant macroalgae with turfing taxa occurring on the jetties and crustose algae occurring on the breakwater.

Fauna

Fish fauna associated with the hard substrate habitat in the Outer Harbour was sampled using visual diver surveys by AWT (1999) and UNSW (2009). The UNSW (2009) study recorded a total of 19 species associated with the eastern breakwater locations with Mado (*Atypichthys strigatus),* Yellowtail (*Trachurus novaezelandiae)* and Moon wrasse (*Thalassoma lunare*) being the most abundant at these locations. Twelve species were associated with the No. 6 Jetty and No. 4 Jetty locations with Yellowtail, Mado, Silver Sweep (*Scorpis lineolatus*), Eastern Hulafish (*Trachinops taeniatus*) and Yellowfin Bream (*Acanthropagrus australis*) being the most abundant. Similarly AWT (1999) recorded high abundance of Yellowtail, Mado and Silver Sweep at the eastern breakwater locations. Only Yellowtail and Red Morwong (*Cheilodactylus fuscus*) were recorded at all the surveyed locations (UNSW, 2009).

Hard substrate sub-tidal epifaunal cover was also sampled and the results showed that barnacles were the predominant faunal cover on the eastern breakwater, while No. 4 Jetty and No. 6 Jetty locations supported a more diverse cover comprised of bivalves, porifera and ascidians.

17.1.3 Threatened Species, Populations and Communities

The NSW *Fisheries Management Act 1994* establishes provisions for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. The previous Environmental Assessment determined that the hard substrate of the existing Outer Harbour breakwaters may provide potential habitat for juveniles of one threatened fish species, the black cod (*Epinephelus daemelii).* However, the species has not been previously recorded in the Harbour (Maunsell AECOM, 2008), and was not recorded in the surveys undertaken by UNSW in 2009.

17.2 Methodology

Information contained in the previous Environmental Assessment, including the results of the report *Survey of Marine Faunal Communities in the Area of the Proposed Port Kembla Outer Harbour Development* (UNSW, 2009), were reviewed in order to assess the potential impact of the proposed modification on aquatic ecology during construction and operation. This section addresses the relevant DGRs, including:

- Assessment of the increased potential for disturbance of dinoflagellate cysts and potential toxic blooms.
- Assessment of the impact of increased dredging on marine flora and fauna, including threatened aquatic species, populations, and ecological communities and/or critical habitat consistent with the *Draft Guidelines for Threatened Species Assessment* (DEC/DP&I, 2005).

17.3 Impact Assessment

17.3.1 Construction

Key construction activities of the modification that may potentially impact on aquatic ecology include:

- Small increase in dredging footprint and volumes, and slightly lengthened dredging campaigns.
- Small reduction in the reclamation area.
- Altered alignment of Salty Creek through the reclamation area.
- Increase in the number of ship movements.
- Operation of larger Cape and Super Post-Panamax vessels.

Potential impacts to aquatic ecology as a result of dredging and reclamation activities outlined in the previous Environmental Assessment included the following:

- Water quality changes due to the generation of turbid plumes, related to:
    - Physical changes due to excessive sediment deposition leading to smothering of sediment infauna in the dredged and spoil emplacement (reclamation) areas.
    - Mobilisation of contaminants into the water column.
- Disturbance and suspension of dinoflagellate cysts and increased likelihood of toxic algal bloom occurrence.
- Blasting which creates a generation of shockwaves.
- Loss of approximately 30 percent of existing soft substrate habitat, including loss of sandy beach habitat (Red Beach). Some of this area has already been reclaimed during the initial Stage 1 works.
- Creation of approximately 1.77 kilometres of hard substrate habitat.

It should be noted that whilst dredging volumes have increased as a result of the modification, the assumed dredging depth has not changed, and remains between -15 metres and -16.5 metres.

The sensitive ecological receptors in the areas that would be directly and indirectly impacted include:

- Hard substrate macroalgae, epifauna and mobile fauna on the eastern and northern breakwaters may be sensitive to changes in water quality.
- Soft substrate infauna in Outer Harbour areas outside the development footprint may be sensitive to physical changes due to excessive sediment deposition.

Potential changes to the extent or magnitude of these impacts, and any additional impacts that would impact these sensitive ecological receptors, as a result of the modification are discussed below.

Water Quality Changes

Generation of Turbid Plumes

Dredging and reclamation would result in suspension of sediments in the water column generating sediment plumes (turbidity) which, unless controlled, could be dispersed some distances away from the disturbed area, potentially affecting water quality in the Outer Harbour.

Generation of turbid plumes can impact on sensitive receptors through reduced water quality. Prolonged reduction in light availability could lead to a shift in the predominant macroalgal taxa occupying the shallower habitats, thus affecting the community structure. However these changes in community structure are reversible and are not likely to alter the long-term values provided by this habitat. Turbidity would pose an issue for the period of dredging, approximately 18 months, after which conditions would return to normal in the Outer Harbour.

The hard substrate floral community structure in the Outer Harbour has been shown to be dominated by macroalgal taxa tolerant to low light conditions suggesting that the ambient water quality conditions provide relatively prolonged periods of high turbidity. Therefore any reduction in light availability due to increased turbidity levels is likely to not have significant impacts on the macroalgal community over the long term. Furthermore, dispersion of turbid plumes outside the footprint of the proposed development would be contained by controls including silt curtains, and sediment in the reclamation area would be contained by an engineered structure.

Mobile aquatic fauna, such as fish, within the area of the proposed development can avoid turbid areas by moving to more favourable locations, and there is sufficient area to enable this. This occurs under natural conditions as turbidity and other physico-chemical water quality parameters vary naturally and many aquatic organisms have wide tolerance and adaptive capacities (ANZECC, 2000). Therefore specific mitigation for impacts of turbidity on mobile fauna is not required.

Ambient conditions in the Outer Harbour indicate that increased turbidity levels are common as a result of both port operations and climatic events, and as such the harbour ecosystem is likely to have evolved greater tolerance to turbidity-enhancing activities. The proposed reclamation and operations associated with the Outer Harbour are therefore not considered to result in a significant increase in the turbidity already experienced in the harbour, especially if the proposed mitigation measures are implemented.

It is likely that the impacts described above are representative of what would occur as a result of the increased dredging footprint and volume proposed as part of the modification. The dredging would result in these impacts extending over a slightly larger area but would be mitigated through measures outlined in **Section 15.4** and **Section 17.4**, to adequately minimise the development of turbid plumes.

Turbidity associated with dredging activities, unless controlled, may temporarily affect hard substrate communities through water quality changes. Controlling dispersion of turbid plumes by installing silt curtains around the dredging and dredge emplacement areas would reduce the risk of water quality impacts on rocky reef dwelling biota. As soft substrate habitat is not favoured by this species it is considered unlikely that the modified dredging activities would have an adverse effect on the life cycle of black cod.

Dredging for the first stage of the Outer Harbour Development would use mechanical dredging methods, which, unlike hydraulic dredging, generate lower levels of turbidity as they do not create high disturbance through the creation of slurry. Additionally, dredged material will be permanently encapsulated in underwater containment bunds that are engineered to contain the volumes of material required for land reclamation for the Outer Harbour Development. PKPC is confident that these measures, and the permanency of the reclamation design, reduce the level of risk associated with dredging techniques such as those employed in the tug harbour dredging undertaken in recent years. It is considered unlikely that a breach of the permanent reclamation bunds would occur during construction of the Outer Harbour Development.

Smothering of Sediment Infauna

Sediment infauna are the benthic organisms that live within the substrate of a body of water, in this case in the sediment of the Outer Harbour. The previous Environmental Assessment outlined that smothering of sediment infauna in the Outer Harbour would occur in the process of dredging and reclamation, resulting in permanent and temporary loss of infauna in the reclamation and dredged areas respectively.

Previous studies of the impact of dredging activities in similar port environments demonstrated that dredging did not have long term effects on sediment infauna, as recolonisation of dredged areas occurred within a period of months. Benthic fauna can tolerate some sediment deposition as it is part of the natural structuring process. As the process is likely to be gradual, infaunal communities adapt by migrating through the sediment layer. The effect of high sediment loads, on benthic animals, near areas of sediment deposition has been found to be generally small (EPA Victoria, 2001).

It is therefore expected that, following the completion of reclamation, there would be sufficient sediment habitat remaining in the Outer Harbour to provide species for recruitment to the dredged areas, and these areas would sufficiently recover. However, it may take some time to recover the pre-dredging community structure of benthic organisms (such as Capitellids and Spionids) that create communities in highly disturbed environments, such as the Outer Harbour.

The reduction in the reclamation footprint, proposed as part of the modification, would see a decrease in the smothering of sediment infauna and a lower loss of permanent infauna habitat, which would be beneficial for sediment infauna overall. Temporary loss would occur across a slightly larger area with the increased extent of dredging. However, it is likely that this would recover within a period of months, as per the outcomes on sediment infauna found in previous studies undertaken in similar highly disturbed environments that have undergone dredging.

A Dredging and Reclamation Environmental Management Plan and Water Quality Monitoring Program would be prepared, and turbidity control measures would be installed to control sediment deposition during construction and operation, to ensure that all additional dredging would be undertaken in accordance with approved methods and conditions.

Mobilisation of Contaminants

The mobilisation of contaminants into the water column during dredging could have the greatest impact on sensitive ecological receptors. Previous sediment sampling in Port Kembla Harbour indicated contamination of the sediments within the areas to be dredged by a range of heavy metals, PAHs and other contaminants.

The bioavailability of heavy metals is considered to be limited due to low solubility in seawater. For metals to become detached from the sediments and transported away from the dredge area there would need to be a marked change in the pH, which is unlikely given the buffering capacity of the seawater. Hence bioavailability of metals would be limited primarily to ingestion pathways. Any fauna likely to ingest contaminated sediment would already be occasionally subject to such processes due to the ambient conditions harbour-wide. Therefore

additional dredging to be undertaken as part of the modification are not creating new pathways of exposure or exposing new ecological receptors to potential heavy metal contamination. However, it was determined in the previous Environmental Assessment that activities associated with Stage 1 may increase the duration of such exposure.

The mobilisation of contaminants into the water column could have the greatest impact on the hard substrate community structure through disruption of recruitment and settlement processes. Studies in Port Kembla Harbour (Knott *et al*., 2009) found that dredging activities resulted in large-scale suspension of contaminated sediments. During these dredging activities the recruitment of the dominant filter-feeders (e.g. barnacles and polychaete worms) was disrupted for up to four months, before recovery began (Knott *et al.*, 2009).

Mobilisation of contaminants in the water column following additional dredging in the vicinity of the western container berths as part of the modification would likely result in disruption to the substrate community structure at a level similar to that identified in the previous Environmental Assessment. However this would be over a longer period, due to the potential for slightly lengthened dredging campaigns.

Management measures would include turbidity control measures such as silt curtains, selection of appropriate work methods and preventing the overflow of barges or bunds (Conditions C22 to C24 of the Project Approval and the Water Quality Monitoring Program). These measures would assist in minimising the dispersion of sediment plumes towards sensitive ecological receptors found on the hard substrate within the Outer Harbour. Potential impacts on sensitive ecological receptors are discussed further in **Chapter 16.0**.

Disturbance and Suspension of Dinoflagellate Cysts

The previous Environmental Assessment identified the presence of *Alexandrium "catenella type"* cysts in the sediments of the Port, though numbers reported were relatively low. However, this raised the possibility of future potentially toxic blooms. During dredging, cysts can be disturbed and their dispersal through the photic layer of the water column is thus enhanced, leading to potential occurrence of toxic blooms. Blooms of *A. catenella* in southern Australian waters usually occur for about two to four weeks in the warmer months between December and April (Pollard and Pethebridge, 2002). However, to date there is no evidence of any toxic blooms occurring in Port Kembla (Pollard and Pethebridge, 2002), despite dredging and spoil movement taking place in recent works in Port Kembla Harbour. However, if cysts happen to be present in the additional dredged sediment, the proposed modification would increase the potential for cyst disturbance through the extension of the dredging area 20 metres to the east along the edge of the western container facility berths.

The dispersion of any suspended material would be managed by installing silt curtains to trap any suspended material within the area of disturbance. Water quality and ecological monitoring requirements would be contained within the Dredging and Reclamation Environmental Management Plan, as specified in Conditions C25 to C29 and C35 of the Major Project Approval. Avoiding dredging during conditions known to be associated with bloom formation in other similar environments would form part of monitoring, inspections and contingency actions for risk factors such as algal blooms, as identified in Condition C35 (ix) of the Major Project Approval.

Blasting

Underwater blasting can impact on aquatic biota due to the generation of underwater shockwaves. An underwater explosion produces a pressure wave form, with rapid oscillations from positive pressure to negative pressure which results in rapid volume changes in gas-containing organs leading to internal damage and mortality (Keevin and Hamden, 1997).

The extent of the underwater shock wave generation depends on whether the explosion occurs in open water or is confined. Confined explosions, such as that proposed as part of Stage 1, generate much less potential environmental impact as some of the pressure waves would be radiated into the surrounding stiff medium such as rock (US FWS, 2006). The potential for impacts is largely confined to fish and mammals for whom injury and mortality resulting from underwater blasts has been well documented (Keevin and Hamden, 1997).

The proposed modification may potentially increase the extent of drilling and blasting required for the removal of bedrock, due to the amended design of the reclamation footprint on the southern foreshore of the basin between the multi-purpose and container terminals. For this reason, the potential for an increase in impacts to marine species as a result of additional blasting would slightly increase.

However, this increase can be appropriately managed in accordance with the relevant conditions of the Project Approval. All marine blasting would be subject to Conditions C32 and C35 which state that pressure thresholds and appropriate distances would be identified to prevent physical trauma to fish and marine mammals during blasting, and would be included in the Dredging and Reclamation Environmental Management Plan. The development of these blasting specifications would be based on research of similar international guidelines.

Removal of Soft Substrate Habitat

Soft substrate in the Outer Harbour has been found to provide habitat for infaunal communities dominated by Polychaetes and limited fish fauna or nurseries.

The approved development would result in the loss of approximately 40 hectares of deeper soft substrate habitat in the Outer Harbour, which would be replaced by 2.74 kilometres of new hard substrate habitat following the completion of the reclamation. Although this loss was deemed a significant reduction in area, it was considered that there would be sufficient remaining deeper soft substrate in the Outer Harbour to provide the habitat values. Therefore compensatory measures for the loss of the deeper soft substrate were considered unnecessary.

The proposed modification would provide an overall beneficial impact to the soft substrate in the Outer Harbour, with the reduction of the reclamation footprint by approximately 1.1 hectares. This area would have previously undergone permanent loss due to smothering by reclaimed materials, and though temporary disturbance would occur due to dredging, there remains no need for additional compensatory measures for the removal of soft substrate habitat in the Outer Harbour.

Creation and Removal of Hard Substrate Habitat

Differences in hard substrate community structure showed that the rocky embankment of the eastern breakwater provides a low diversity habitat dominated by barnacles and crustose algae, while the jetty locations supported a more diverse cover comprised of tufting algae, bivalves, porifera and ascidians, with a relatively diverse fish fauna utilising the habitats provided by these structures.

In Port Kembla, it is possible that the Outer Harbour rock breakwaters, particularly at the entrance to the harbour, provide suitable habitat for black cod. However, no endangered populations of the black cod species have been recorded in Port Kembla Harbour.

The modification would not result in the removal or changes to the existing rocky reef that is formed by the harbour breakwaters, or result in changes to coastal rock pools. However, as per the original approval, jetty structures are to be demolished. The modification would not however affect plans for the creation of additional hard substrate along the revetments of the new reclamation area, as outlined in the previous Environmental Assessment and the length of hard substrate to be created would remain the same as that approved. As per Condition B24 of the Major Project Approval, hard substrate surfaces of the project will incorporate marine habitat friendly structures and aquatic habitat improvement features.

Moreover, the modification would not impact on any endangered or critically endangered ecological communities, which may be characterised by the presence of the black cod.

Draft Guidelines for Threatened Species Assessment (DECC and DPI 2005)

The assessment of impact of the proposed modification on the desired environmental outcomes for protection of threatened species are outlined in the *Draft Guidelines for Threatened Species Assessment* (DECC and DPI 2005), summarised in **Table 17-1**. This assessment refers only to black cod (*Epinephelus daemelii)*, as it is the only threatened species for which suitable habitat may be present within the harbour.

Table 17-1 Draft Guidelines for Threatened Species Assessment

TSA Guideline	Assessment	Net Impact
Maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation).	The modification would have no net impact on the black cod as there would be no direct impact on its potential key habitat and any indirect impacts through water quality changes can be mitigated through the installation of appropriate controls (such as silt curtains around the work areas).	No net impact

TSA Guideline	Assessment	Net Impact
Conserve biological diversity and promote ecologically sustainable development.	The modification would have no net impact on the biological diversity of Port Kembla Outer Harbour as characterised by threatened species. The temporary impacts associated with water quality changes would be controlled though the use of measures such as silt curtains around the work areas. Therefore principles of ecologically sustainable development as applied to threatened species would not be compromised by modifications to Stage 1 of the Outer Harbour Development.	No net impact
Protect areas of high conservation value (including areas of critical habitat).	The rocky reef habitat associated with the harbour breakwaters would not be changed under the modification. Port Kembla Outer Harbour is not likely to provide habitat of conservation value for black cod.	No net impact
Prevent the extinction of threatened species.	Reduction in numbers of this species along the NSW coastline has been associated with over-harvesting by line and spear fishing. The modification would not affect this existing threat to the species. As there is no direct impact on the black cod habitat and any indirect impact can be readily controlled, the modification is considered highly unlikely to lead to a local extinction of the black cod.	No net impact
Protect the long term viability of local populations of a species, population or ecological community.	As the existing rocky reef habitat formed by the harbour breakwaters is not altered by the modification, it is considered unlikely that the life cycle of the black cod would be affected such that a viable local population is likely to be placed at risk of extinction	No net impact
Protect aspects of the environment that are matters of national environmental significance.	Investigations undertaken indicate that the proposed modification would not have an impact on the matters of national environmental significance.	No net impact

Based on the results of the Threatened Species Assessment, the proposed modification is considered unlikely to have an adverse impact on the long term survival of the threatened species.

17.3.2 Operation

The previous Environmental Assessment assessed the change to Salty Creek from an ICOLL to a channel that would be permanently open to the sea and, hence, to tidal flushing. The resulting reduction in variations to salinity and water levels within Salty Creek would have the potential to change the species composition of fauna and flora from a smaller assemblage of species adapted to greater water quality and water level fluctuation, to a larger assemblage of species typically found in the surrounding marine environment.

The modification proposes a different alignment of Salty Creek through the reclamation area, via a shorter and more direct route (from the approved 375 metres to a modified 312 metres in length). This would still result in the transition of Salty Creek from an ICOLL to a permanently open channel and would not alter the expected impact to aquatic ecology in the creek.

The previous Environmental Assessment also noted the impact of the enclosure of Salty Creek on the potential use of the creek as a fish passage between the sea and the estuary, due to fish being deterred by long dark tunnels. The change to the Salty Creek alignment is not likely to change this expected impact. The modification proposes to alter the alignment to create a shorter and more direct route for Salty Creek through the reclamation area. This realignment would be better suited for the configuration of sheds and roads on the multi-purpose terminal, and will allow for best design of the Salty Creek culvert. In addition, Project Approval conditions have specified that the box culverts for conveying Salty Creek flows would be designed to incorporate a V-shaped

recess to facilitate the movement of fish and other mobile aquatic species during periods of low flow. It would also be designed so as not to preclude light access as part of future project applications. The design would require approval by the Department of Primary Industries (Fishing and Aquaculture).

The modification would result in an increase in, and larger, vessels visiting the Outer Harbour during operation. Approximately 170 more vessels would berth at the first multi-purpose terminal per year, than originally estimated. Larger Cape and Super Post-Panamax ships would berth at the first multi-purpose terminal and the western container facility. This change to expected shipping traffic may adversely impact on aquatic fauna in the Outer Harbour due to increased disturbance. However, as the Outer Harbour currently receives consistent vessel visits, as well as passing traffic bound for the Inner Harbour, this change is not likely to significantly increase the impact to aquatic fauna that currently inhabit an operational port environment.

17.4 Mitigation and Management Measures

As the majority of reclamation and dredging for the modification would be undertaken as part of the Major Project, the mitigation measures developed for construction of Stage 1 would also be relevant for Stages 2 and 3, though these stages would be subject to separate project applications. As such, mitigation measures for all stages of the Concept Plan are presented below. The previously approved mitigation measures and conditions of consent outlined in the Concept Plan and Project Approvals would adequately mitigate additional impacts resulting from the modification.

A summary of the mitigation measures that would minimise aquatic ecology impacts, resulting from the modification, is provided below:

- A Dredging and Reclamation Environmental Management Plan will be prepared and implemented during construction of the development, as per Condition C35 of the Major Project Approval, and would include a Dredging Water Quality Monitoring Program.
- A Dredging Water Quality Monitoring Plan in accordance with Conditions C25 to C29 of the Major Project approval. Water quality monitoring would be undertaken for turbidity, dissolved oxygen, temperature, pH, metals and metalloids and PAHs. Specifically the Water Quality Monitoring Plan would encompass an:
    - Ecological monitoring program (as per Condition C29 (f) of the Major Project Approval) to assess the ecological health of the Port Kembla Outer Harbour. This program would identify monitoring parameters, testing procedures and framework for reporting monitoring results.
    - Environmental performance criteria for dredging, reclamation and emplacement works including marine blasting thresholds and safe blasting distances to protect fish and marine mammals (also covered by Condition C32 of the Major Project Approval).
- Turbidity control measures (such as silt curtains, selection of appropriate work methods and preventing the overflow of barges or bunds) would be designed, installed and maintained outside and surrounding all dredging, reclamation and emplacement works in accordance with Conditions C22 to C24 of the Project Approval and the Dredging Water Quality Monitoring Program.
- An Acid Sulfate Management Plan will be prepared prior to the dredging and reclamation works. Measures for the appropriate management of Acid Sulfate Soils, in line with the *Acid Sulfate Soil Manual* (ASSMAC). These measures will either ensure that future works avoid exposing PASS to air or provide for appropriate management of the PASS. This would be consistent with Condition C21 of the Major Project Approval which determines that any construction activities in identified areas of ASS risk would be undertaken in accordance with the ASSMAC.
- In accordance with Condition B24 of the Major Project Approval, PKOPL shall ensure that hard substrate surfaces of the project incorporate marine habitat friendly structures and aquatic habitat improvement features taking into consideration *Environmentally Friendly Seawalls: A Guide to Improving the Environmental Values of Seawalls and Seawall-lined Foreshores in Estuaries* (Sydney Metro CMA and DECC, 2009).
- The box culverts for conveying Salty Creek flows will be designed to the satisfaction of Industry & Investment NSW and shall incorporate a V-shaped recess to facilitate the movement of fish and other mobile aquatic species during periods of low flow and be designed so as not to preclude light access as part of future project applications (as per Condition B25 of the Major Project Approval).

17.5 Conclusion

The proposed modifications to the dredging and reclamation activities are not likely to pose significant additional risk to aquatic ecology in the Outer Harbour. As such, construction and operation of the Concept Plan is not likely to result in significant impacts on the aquatic ecology of the Outer Harbour.

The loss of the deeper soft substrate habitat associated with additional dredging, is not considered likely to have a significant increase in impact, due to a reduction of the infauna to be permanently impacted by smothering during reclamation. The surveys of deeper soft substrate habitat showed that it is a low diversity faunal habitat and sufficient area of deeper soft substrate would remain in the Outer Harbour. In addition, the proposed modification would have no impact on the creation of new hard substrate habitat, to provide expanded aquatic habitat values to those that already exist in the Outer Harbour.

Changes to the dynamics of Salty Creek, associated with the approved Outer Harbour Development, are likely to impact on the species composition of this system, and the proposed alteration to the alignment of the creek is not likely to change this potential impact. For this reason, it is considered reasonable that measures outlined in the Project Approval remain in place to best service the movement of fish and other mobile aquatic species through the Salty Creek culvert.

A range of control measures will be implemented to manage and monitor potential impacts under the Dredging and Reclamation Environmental Management Plan, including minimisation of risks through effective turbidity controls such as the use of silt curtains and prevention of bund overflow. In addition, a Water Quality Monitoring Program would be implemented to monitor turbidity, dissolved oxygen, temperature and pH to inform reactive management responses if thresholds are breached during dredging or reclamation. Impacts resulting from marine blasting would be minimised through identification of appropriate blasting thresholds and distance to prevent harm to fish and other mobile aquatic species. With the implementation of mitigation measures, it is expected that potential impacts resulting from the modification would be adequately minimised.

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18.0 Terrestrial Ecology

This chapter provides an assessment of the potential impacts of the proposed modification on terrestrial ecology.

18.1 Existing Environment

18.1.1 Vegetation Communities

The vegetation on the landside area to be developed is limited as extensive historical development has resulted in high levels of vegetation clearance. There are few native trees present. Some isolated established tree plantings (*Melaleuca, Acacia, Eucalyptus* species as well as introduced species) are located between the Salty Creek channel and BlueScope Steel car park (refer to **Figure 18-1**). However, this fragmented stand is located outside of the Outer Harbour Development area and contains minimal to no native understorey or native ground cover species. Several small stands of trees (*Melaleuca, Acacia, Eucalyptus* species as well as introduced species) are located further upstream adjacent to the South Yard and at the top (southern end) of Darcy Road Drain. Vegetation in the vicinity of the North Yard includes sporadic and infrequent *Acacia* amongst *Lantana*, *Ricinus communis* (castor oil plant), *Pennisetum clandestinum* (kikuyu grass) and assorted herbaceous weeds. Adjacent to the bridge over Old Port Road is a *Lagunaria* (Norfolk Island hibiscus), further *Lantana* and *Pennisetum clandestinum* (kikuyu grass).

The previous Environmental Assessment found that two small wetland areas dominated by Typha spp. exist at the top (south western end) of Salty Creek (refer to Chapter 17 of the previous Environmental Assessment). There are narrow strips of grass and shrubs, including areas containing species characteristic of coastal saltmarsh communities, lining Salty Creek, Darcy Road Drain and the shoreline between Salty Creek and the Outer Harbour. The vegetation along Salty Creek is dominated by exotic vegetation such as *Lantana camara* (Lantana), *Chrysanthemoides monilifera* (Bitou Bush) and exotic grasses such as *Pennisetum clandestinum* (Kikuyu) and *Cynodon dactylon* (Couch Grass). A mixture of native and exotic sedges line the edges of Salty Creek and the dominant native shrub species, *Acacia longifolia var. sophorae*, occurs along the edges. Darcy Road Drain is dominated by *Acacia longifolia var. sophorae* with an understorey consisting of exotic grasses such as Couch Grass and Kikuyu.

The previous Environmental Assessment found that there are no threatened ecological communities listed under the EPBC Act occurring in the Outer Harbour area. There are small fragmented patches of vegetation containing Coastal Saltmarsh species along Salty Creek between Old Port Road and the foreshore railway line adjacent to the shoreline (refer to **Figure 18-1)**. This community is listed as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1997* (TSC Act). The Saltmarsh is present on both sides of the creek and varies in patch size and condition, with the majority of patches exhibiting a high level of weed encroachment. The dominant native species include *Sarcocornia quinqueflora* (Beaded Glasswort), *Paspalum vaginatum* (Saltwater Couch), *Juncus kraussii* (Sea Rush), *Suaeda australis* (Austral Seablite) and *Cyperus laevigatus* (Smooth Flatsedge). There are a number of exotic species that are encroaching into the Saltmarsh Community including Couch Grass and *Acacia longifolia var.sophorae*. Lantana and Bitou Bush, both noxious weeds, are scattered along the edge of the Coastal Saltmarsh. The overall extent of the fragmented Coastal Saltmarsh is estimated to be approximately 30 square metres.

18.1.2 Threatened Flora

A search of the *EPBC Act Protected Matters Tool* which was conducted as part of the previous Environmental Assessment revealed five threatened flora species of national significance with potential to occur in the Port Kembla locality. This includes two vulnerable and three endangered species. A search of the *DECC Wildlife Atlas* which was conducted as part of the previous Environmental Assessment revealed nine flora species listed as threatened under the TSC Act which have potential to occur in the locality. This includes three vulnerable and six endangered species.

The original Environmental Assessment reported that the likelihood of occurrence of the threatened flora species listed under the TSC Act and EPBC Act is low due to a lack of suitable habitat present within the Outer Harbour Development area.

18.1.3 Threatened Fauna

A search of the *EPBC Act Protected Matters Tool* which was conducted as part of the previous Environmental Assessment revealed 33 threatened fauna species of national significance which have potential to occur in the Port Kembla area. This includes 21 vulnerable, 11 endangered and one critically endangered species. A search of the *DECCW Wildlife Atlas* as part of the previous Environmental Assessment revealed 77 fauna species listed as threatened under the *TSC Act 1995* which have potential to occur in the Port Kembla area. This includes 65 vulnerable, 11 endangered and one critically endangered species. The original Environmental Assessment determined that of the species identified as having potential to occur in the area, only *Litoria aurea* (Green and Golden Bell Frog (GGBF)), *Pteropus poliocephalus* (Grey-headed Flying-fox) and *Sterna albifrons* (Little Tern) have a moderate to high likelihood of occurrence in the area.

A submission received on the previous Environmental Assessment noted that the *Dasyurus viverrinus* (Eastern Quoll,) which is listed as Endangered under the TSC Act, and the *Haematopus fuliginosus* (Sooty Oystercatcher), which is listed as Vulnerable under the TSC Act, have been recorded within the area of the proposed development. The Submissions Report on the Environmental Assessment reported that based on site investigations of the area, it is not believed that appropriate foraging habitat exists for the Eastern Quoll (AECOM, 2010). The report did note that there is potential foraging habitat for the Sooty Oystercatcher at the site but also concluded that there would be no significant impact to the Sooty Oystercatcher as a result of the development.

Green and Golden Bell Frog

The GGBF is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. The GGBF inhabits unshaded permanent, open-water swamps or ponds that have a variable water level and dense vegetation, marshes, dams and stream sides with a grassy area and rocks and/or vegetation nearby for sheltering (NPWS 1999). Adults are usually found close to, or in water or very wet areas in forests, woodlands, shrublands and open or disturbed areas.

The GGBF is known to occur in the Port Kembla area and to breed in areas near the site of the proposed development. In 2008, Gaia Research assessed potential and existing GGBF habitat in the vicinity of the proposed modification. Six locations (identified as Sites 6, 7, 8, 15, 17 and 18) proximate to the proposed modification were identified as known or potential habitat for GGBF. In 2008, PKPC constructed a breeding pond for GGBF at the Heritage Park site, near to and to the east of Site 18 (refer to **Figure 18-1**).

In 2011, Kevin Mills and Associates (KMA) conducted a targeted survey for the GGBF in the area of the initial stage of reclamation for the central portion of the multi-purpose terminal. Based on the survey results, it was concluded that neither the reclamation area, the adjoining land nor the lower reaches of Salty Creek is of importance for the GGBF. However, the report did state that the GGBF could move across these areas from time to time as they do through other areas in Port Kembla (KMA, 2011).

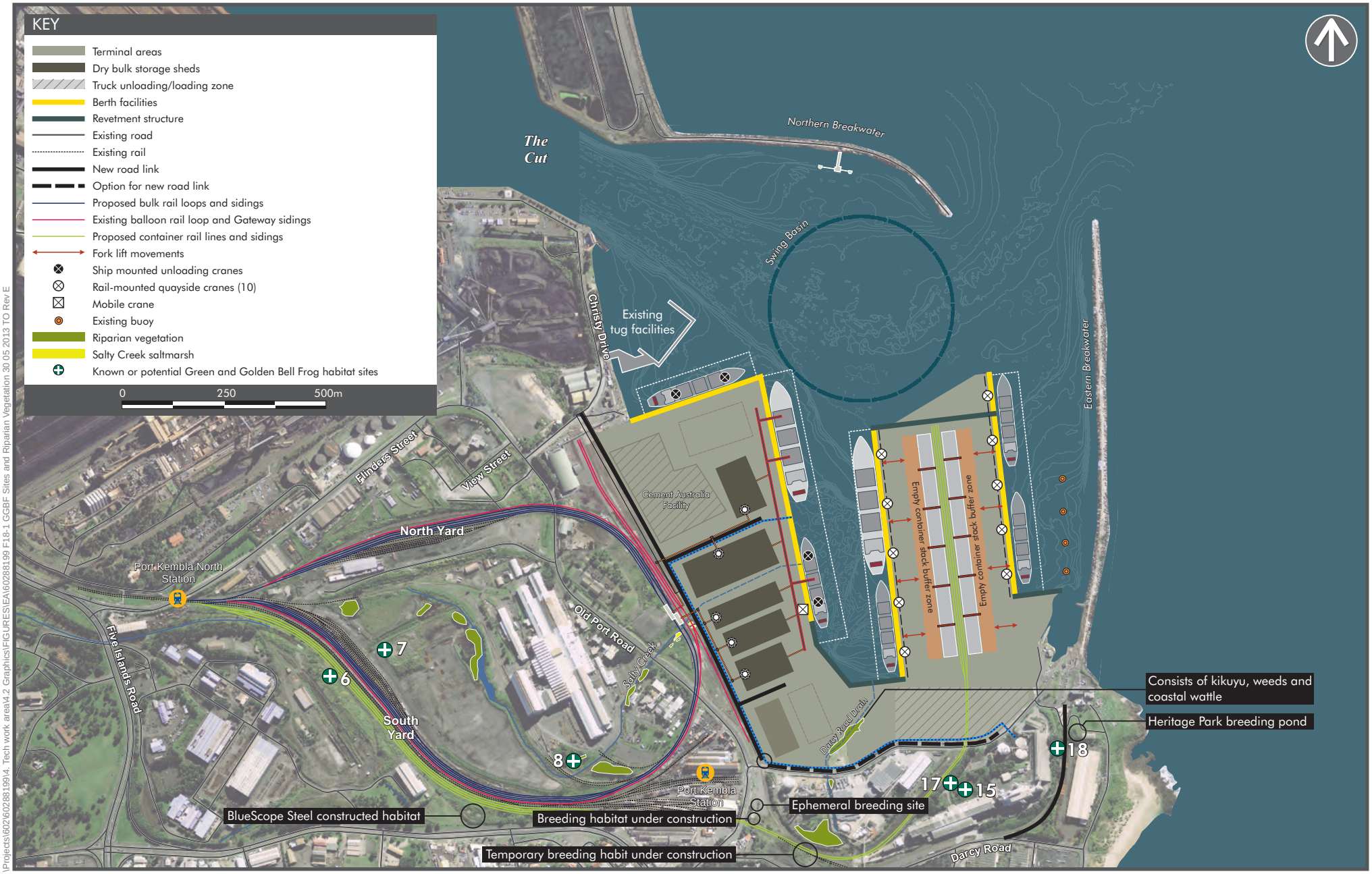
Grey-headed Flying-fox

Grey-headed Flying-fox is listed as Vulnerable under the EPBC and TSC Act. The Grey-headed Flying-fox is likely to forage in the urban areas surrounding the proposed Outer Harbour Development in flowering and fruiting specimens of both native and introduced tree species. Roost sites are typically located near water, such as lakes, rivers or the coast and vegetation often consists of patches of paperbark forest, mangroves and riparian vegetation though colonies also use highly modified vegetation in urban areas (DEWHA, 2009).

No roosting or foraging habitat for this species is found in the Outer Harbour Development area and no recent sightings of the Grey-headed Flying-fox have been recorded in the development area.

Little Tern

The Little Tern is listed as Endangered under the TSC Act. Shoreline habitats, including the rocky coast, the eastern breakwater and Red Beach at the mouth of Salty Creek, represent potential habitat for Little Tern, though no recent sightings of the species have occurred in the development area. Port Kembla was used regularly by Little Terns during the 1950s, however nesting sites were destroyed in the early 1960's during the development of Port Kembla Inner Harbour complex (NPWS, 2003). Red Beach and the small amount of associated sand dune vegetation broadly fits the habitat type used for nesting by the Little Tern and other seabird and shorebird species. However, because these areas were highly modified during the original development of the foreshore, Red Beach and the Outer Harbour are now considered unsuitable habitat for the Little Tern, as a result of exotic vegetation encroachment and industrial use.



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GREEN AND GOLDEN BELL FROG HABITAT SITES AND RIPARIAN VEGETATION

Port Kembla Outer Harbour Development
Environmental Assessment

FIGURE 18-1

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18.2 Methodology

Information contained in the previous Environmental Assessment, including the results of searches of the NPWS Atlas of NSW Wildlife and the EPBC Act Protected Matters Search Tool, the results of ecological surveys for the GGBF, and the impact assessment and submissions report for the previously approved Outer Harbour Development, were reviewed in order to assess the potential impact of the proposed modification on terrestrial ecology. Additional information that has become available since preparation of the Environmental Assessment, including the results of a targeted survey for the GGBF which was carried out prior to reclamation of the central portion of the multi-purpose terminal, was reviewed and used to inform the impact assessment for the proposed modification.

18.3 Impact Assessment

18.3.1 Construction

Construction activities associated with the proposed modification are not expected to introduce different impacts to those assessed in the previous Environmental Assessment. As identified in the previous Environmental Assessment, the construction activities for the Major Project would result in removal of the small patch of vegetation along Salty Creek (north of Old Port Road) which contains Coastal Saltmarsh species. This small area of Saltmarsh has low species diversity, is weed infested, fragmented and isolated from other areas of Coastal Saltmarsh. Therefore, impacts associated with the reclamation of this area are not significant due to the limited conservation value of the Coastal Saltmarsh occurrence within the area.

Construction activities would also result in vegetation removal around Darcy Road Drain and Red Beach. The previous Environmental Assessment concluded that these areas are considered to provide marginal potential habitat for threatened fauna species and seabird and shorebird species and concluded that mitigation would not be necessary for the removal of this vegetation.

The previous Environmental Assessment concluded that the proposed rail infrastructure upgrade of the South Yard during Stage 1 would require the removal of potential GGBF foraging habitat surrounding an artificial concrete-lined drain (identified as Site 8 in the Gaia Research report) to allow for the extension of a rail siding. The vast majority of the area where the siding would be extended is currently covered by gravel with minimal vegetation. Only the eastern end of the siding would directly affect potential GGBF habitat. The proposed modification would necessitate more extensive rail infrastructure upgrade works in this area of the South Yard which has the potential to affect a larger area of potential GGBF habitat identified as Site 8. The proposed modification would also necessitate rail infrastructure upgrade works in the South Yard in the vicinity of potential GGBF habitat identified as Sites 6 and 7 in the Gaia Research report. There is potential for indirect impacts to these sites including impacts from sedimentation and runoff, and disturbance from the movement of construction machinery, which would need to be managed. These areas of potential GGBF habitat were unaffected by the Major Project as originally proposed.

Rail infrastructure upgrades in the North Yard would not result in a significant impact to overall terrestrial ecology within the Outer Harbour. The majority of species in the vicinity of the North Yard are exotic species or weeds. Some vegetation removal may be necessary to allow for the construction and widening of the bridge over Old Port Road, however this would primarily impact kikuyu grass and *Lantana* resulting in minimal impact to native species.

The previous Environmental Assessment determined that construction of an access road to provide a direct public link from Darcy Road to the boat harbour as part of Stage 2 of the Concept Plan would occur in the vicinity of a prime breeding site for the GGBF (Site 15) but would not remove any significant breeding habitat. The Environmental Assessment also determined that construction of the access road and rail line to the container terminals would have the potential to result in potential impacts to the GGBF from collisions with construction vehicles but that frog exclusion fencing would minimise these potential impacts. The proposed modification does not change these conclusions. The previous Environmental Assessment concluded that Stages 2 and 3 of the Concept Plan would not have any impact on other threatened fauna species or on seabird and shorebird species.

18.3.2 Operation

The previous Environmental Assessment determined that excessive light spill and noise and vibration impacts from the Outer Harbour Development would have the potential to deter fauna species from foraging and roosting in the area. However, the Environmental Assessment concluded that with implementation of suitable mitigation measures, it would be unlikely that operation of the Outer Harbour Development would have any adverse impact on flora and fauna. The conclusion made in the previous Environmental Assessment remains applicable to the proposed modification.

18.4 Mitigation and Management Measures

The existing consent conditions for the Concept Plan and Major Project approvals for the Outer Harbour Development relating to the GGBF are considered appropriate to ameliorate the potential impacts associated with the proposed modification, given that the proposed activities are not expected to introduce different impacts to those assessed in the previous Environmental Assessment. Consistent with the existing consent conditions, a Green and Golden Bell Frog Master Plan would be prepared to provide a strategic framework on how GGBFs and their habitat would be managed within the harbour area, and to inform the development of individual GGBF management plans for each project associated with the Concept Plan approval (Concept Plan approval Condition 2.13). PKOPL is currently constructing new GGBF habitats adjacent to the Outer Harbour rail corridor (refer to **Figure 18-1**).

A CEMP would be prepared for the proposed modification which would include a Green and Golden Bell Frog Management Plan consistent with the *Green and Golden Bell Frog Master Plan* (when completed), the *Draft Recovery Plan: Green and Golden Bell Frog (Lesson 1829) Recovery Plan* (DECCW, 2005) and the *Best Practice Guidelines: Green and Golden Bell Frog Habitat* (DECCW, 2008) (Major Project Approval Condition C36). Prior to any works which involve the clearing of vegetation and debris within the Major Project (Stage 1) area, a suitable and targeted survey would be undertaken by an ecologist in order to allow for the detection of any GGBF. If GGBFs are detected, no clearing works would commence until GGBF response provisions have been implemented.

18.5 Conclusion

Under the proposed modification, the Major Project would still result in removal of an area of Coastal Saltmarsh in Salty Creek north of Old Port Road. This area of Saltmarsh is of relatively low quality and conservation significance due to its small size, weed invasion and low species diversity. The small size, linear shape and low species diversity of this patch would limit its potential habitat value for fauna such as wading birds.

The proposed modification would necessitate more extensive rail infrastructure upgrade works in the South Yard which has the potential to affect a larger area of potential GGBF habitat compared to the area of impact identified in the previous Environmental Assessment. Mitigation of potential impacts on the GGBF would be proposed in a dedicated Green and Golden Bell Frog Management Plan and targeted surveys for the GGBF would be conducted prior to any vegetation clearance. If GGBFs are detected, no clearing works would commence until GGBF response provisions have been implemented.

The proposed modification is unlikely to have a significant impact on other flora and fauna species, populations or ecological communities listed under the TSC Act or EPBC Act.

19.0 Coastal Hydrodynamics

This chapter provides an assessment of the potential impacts of the proposed modification on the coastal hydrodynamics within Port Kembla.

19.1 Existing Environment

The Port of Port Kembla consists of the Inner Harbour and the Outer Harbour. The Outer Harbour comprises a body of water enclosed to the south and west by the natural foreshore (Red Beach), and on the north and east by man-made breakwaters. The seaward opening between the two breakwaters provides the port entrance through which all ships access the Port. Once within the Outer Harbour, ships can access the Inner Harbour through The Cut at the western side of the Outer Harbour. There is a well-defined channel through the Outer Harbour for this purpose.

Within the Outer Harbour, there are six operational berths, a recreational boat harbour adjacent to the eastern breakwater and a purpose built facility for tugs immediately to the north of the Port Kembla Gateway. Reclamation for Stage 1 has been partially completed, which has modified the western foreshore. Prior to these works, Red Beach was the only section of foreshore that was not protected by a rubble revetment.

As part of the previous Environmental Assessment, the coastal hydrodynamic processes relevant to the development of the Outer Harbour were considered. This included studies for both infragravity (long) wave and gravity (ocean swell) wave transformation into the Harbour, tidal discharge and sea level fluctuations. This is discussed separately below.

As the majority of the reclamation and dredging would occur as part of Stage 1 of the Outer Harbour Development, the greatest resulting change in coastal hydrodynamics would occur at the completion of Stage 1. However, for the purposes of the original assessment, the impacts primarily focused on the Outer Harbour Development at completion.

19.1.1 Infragravity (Long) Waves

Major hydrodynamic processes affecting operations in the Outer Harbour include the entry of infragravity (long) waves past the breakwaters. Long waves have very low wave height (the amplitude can be in order of decimetres) and lengths that cycle over periods of minutes in contrast to short waves, which cycle in seconds. These waves can resonate within the harbour (seiching) and cause ships to range dangerously at their berths. The studies conducted for the previous Environment Assessment reported that there is an amplification of long wave heights around the western and southern shorelines, as well as the southern section of the eastern breakwater. Higher current speeds were observed in the shallower depths of the Outer Harbour.

The Outer Harbour (prior to the Outer Harbour Development) experiences seiching some 12 times each year, on average, which limits operations within the Outer Harbour and had led to dangerous ship movements while at berth. The Inner Harbour shows little response to the long wave energy with only minor wave height amplification at the northern extent of the berthing areas, where wave reflection occurs.

The approved reclamation footprint was designed to ameliorate the adverse impacts of harbour seiching. Infragravity (long) wave modelling conducted as part of the previous Environmental Assessment considered the impacts of the Outer Harbour Development for all stages of development, at the berths within the Inner Harbour (Berth 102, 109 and 112), the then proposed tug harbour, and berths within the Outer Harbour (the Port Kembla Gateway berths and the proposed multi-purpose and terminal berths).

The modelling demonstrated that the Outer Harbour Development would ameliorate infragravity (long) wave activity within the Port and conditions at all berths would be satisfactory for port operations. Specifically, moored ship modelling under seiching conditions for tugs, cargo and container ships at their respective berths confirmed that the Outer Harbour Development would be suited to the intended shipping operations. The predicted ship movements in the Outer Harbour were found, generally, to be well within acceptable guidelines.

However, fine tuning of the shape of the seaward (northern) end of the proposed container terminals would be required to eliminate the formation of a infragravity (long) wave in that location. The seaward edge of the container terminals would be a platform located on piles and is programmed under Stage 3 of the Concept Plan. Further assessment of the impacts associated with the narrow strip of reclamation around the existing No.6 Jetty (the Port Kembla Gateway) would also be undertaken as part of the future project application for Stage 2.

19.1.2 Gravity (Ocean Swell) Waves

The previous Environmental Assessment identified that, prior to the Outer Harbour Development, gravity (ocean swell) waves enter the Outer Harbour and dissipate along the western and southern foreshore between the Port Kembla Gateway and the No.3 Jetty. During severe storms, ocean swell waves some two metres high can shoal onto this spending (or dissipative) beach. Some ocean well wave energy enters the Outer Harbour also by overtopping the eastern breakwater during severe storms although the amount of wave energy entering the harbour this way is relatively low.

For pre-development conditions in the Outer Harbour, around 10 percent of the offshore significant wave height reaches the southern shore, with 30 to 40 percent of the offshore significant wave present within the Outer Harbour. There would be little penetration of the wave energy into the Outer Harbour when fully developed, with around 10 percent of wave energy reaching the outer perimeter of the tug harbour, the multi-purpose berths and the northern embankment of the container terminal. Less than 10 percent of the incident wave energy would impact the Outer Harbour Development berths.

The reclamation would remove ocean swell wave dissipation onto the existing beach on the western foreshore of the Outer Harbour. This would have the effect of eliminating one of the long wave generating processes within the Outer Harbour. The computed ocean swell wave height coefficients at the berths of the Concept Plan are small and swell wave heights would be within those allowable under the Permanent International Association Navigation Congress (PIANC) Guidelines for the shipping that is proposed.

There would be no ocean swell wave impact on erosion of unconsolidated foreshores of the Outer Harbour as finalisation of the Concept Plan would result in all foreshores being either vertical edge structures for berths or sloping rock revetments. Foreshore erosion is not considered an issue as no natural unconsolidated foreshore would remain in the Outer Harbour.

19.1.3 Tidal Hydraulics

Modelling of tidal flushing within the Inner and Outer Harbour showed the Inner Harbour experiences longer flushing periods compared to those of the Outer Harbour. The previous Environmental Assessment concluded that the Outer Harbour Development would give rise to:

- No discernible difference in tidal levels within the Inner or Outer Harbour.
- No significant impact on tidal velocities.
- Little effect on the tidal flushing of the Inner Harbour, with a small improvement in the most critical upper reaches of the Inner Harbour, and a slight reduction in The Cut.
- A slight reduction in tidal flushing between the multi-purpose terminal and container terminals, but these would remain within the same assessed flushing periods prior to the Outer Harbour Development. Modelling also found the impact of the reclamation on tidal exchange would not affect the saltwater cooling water system for BlueScope Steel's operations.

19.1.4 Water Level

The previous Environmental Assessment noted that water level fluctuations within the Outer Harbour result from the regular rise and fall of the tide, which at its extreme has a range of 2.0 metres at Port Kembla. However, at times elevated water levels are experienced during storms.

Reclamation and finished terminal levels have been designed to ensure future sea level rise can be accommodated for the economic lifetime of the development with a sufficient margin to ensure sustainability beyond that time into the future. The proposed reclamation level has been set to 4.0 metres PKHD and the finished pavement level of the terminal at 5.2 metres PKHD. These levels comfortably meet sea level rise predictions contained in the then NSW DECC *Draft Sea Level Rise Policy* for both the years 2050 and 2100. For example, in 2100, the finished pavement level would allow for a freeboard of 1.3 metres when assuming a sea level rise of 0.9 metres and during an extreme storm event.

19.2 Methodology

The DGRs require an assessment of the impact of increased dredging on hydrodynamics of the Port Kembla harbour, including Inner Harbour flushing, tidal flow, wave dynamics and bank erosion. Information contained in the previous Environmental Assessment was reviewed in order to assess the potential impact of the proposed modification on the conclusions of the coastal hydrodynamics assessment in terms of infragravity (long) wave activity, gravity (ocean swell) wave activity, and tidal hydraulics. This is documented in *Port Kembla Outer Harbour Development Environmental Assessment Coastal Hydrodynamics* (AECOM, 2010). Subsequent studies into coastal hydrodynamics, which were prepared for the design of the first multi-purpose berth under the Major Project (Stage 1) and address the changes required to cater for larger vessels, was also considered. As the proposed modification does not propose changes to the finished levels for the reclamation or finished pavement at the terminals, this aspect has not been further assessed.

19.3 Impact Assessment

Modifications to dredging are limited to a slight increase in the extent of the dredging footprint and volume of dredged material and a slight reduction in the reclamation area. The progression of detailed berth and terminal design has determined the need for minor widening of the basin between the multi-purpose and container terminals, and an increase in the assumed dredging depth used to calculate dredging volumes so as to accommodate larger Cape size vessels and Super-Panamax vessels. This has resulted in a slightly larger dredging extent that originally approved. Dredging would also occur to a depth between -15 metres and -16.5 metres, where the original hydrodynamics assessment assumed that terminal berths would be at a depth of -15 metres.

The proposed modification would also introduce larger vessels at the Outer Harbour Development. During the phased construction of Stage 1, the larger vessels would be more susceptible to infragravity (long) waves when moored at the terminal during the progressive construction of Stage 1, due to the dimensions of the vessel and incomplete construction of the container terminal.

19.3.1 Infragravity (Long) Waves

The changes to reclamation footprint under the approved Concept Plan would have negligible impact on the findings of the previous Environmental Assessment with respect to the infragravity (long) wave activity. The Concept Plan, as modified, would continue to improve conditions within the Outer Harbour when compared to the pre-development conditions of the harbour. Inner and Outer Harbour berths, at the completion of the project, would be suited for the intended port operations. The alterations to the dredging depth and extent (as originally assessed) are not a major influencing factor to changes to infragravity (long) wave activity. This is because the impacts of these activities are dictated by the presence of the northern and eastern breakwaters, and the disruption by the reclaimed footprint extending into the Outer Harbour.

Additional assessments of mooring conditions were conducted as part of design work for the first multi-purpose berth under Stage 1. This included the consideration of additional storm data collected in 2011, which was more severe than the 2008 storm data used in the previous Environmental Assessment. The assessment found that the progressive construction of Stage 1 would require use of different mooring configurations during certain infragravity (long) wave events when ships are moored at the multi-purpose terminal (that is, the method by which a vessel is tied at the berth, with requirements for operations to cease under certain conditions). Engineering design requirements were also identified for inclusion in the berth design. For larger infragravity (long) wave events where the allowable mooring line loads are exceeded, the vessels would need to be sent offshore until the storm conditions have abated. However, once fully developed, this constraint would not exist.

19.3.2 Gravity (Ocean Swell) Waves

The changes to reclamation footprint under the approved Concept Plan would have a negligible impact on the findings of the previous Environmental Assessment with respect to ocean swell wave activity within the Inner and Outer Harbour. The Concept Plan, as modified, would continue to improve conditions within the Outer Harbour when compared to the pre-development conditions of the harbour. As the changes to the dredging depth and extent would be so minor they would not significantly influence any additional ocean swell wave activity when considered in the context of the impacts as originally assessed. This is because the impacts of these activities are dictated by the presence of the northern and eastern breakwaters, and the disruption by the reclaimed footprint extending into the Outer Harbour.

As part of the additional assessments on mooring conditions following modification, the Cape sized vessel (which would occupy the first multi-purpose terminal) would be within allowable limits. Smaller vessels may be impacted by gravity (ocean swell) waves, however, would be within relevant guidelines.

For foreshore erosion, the proposed modification does not alter the findings of the previous Environmental Assessment, as no natural unconsolidated foreshore would remain in the Outer Harbour following the completion of Stage 1 of the Outer Harbour Development.

19.3.3 Tidal Hydraulics

The modification to the Concept Plan and the Major Project (Stage 1) would involve an increase in dredging volume and would result in a negligible increase in the tidal prism, being the total volume of water that flows into and out of the Port Kembla harbour with the tide. The previous Environmental Assessment identified that the average difference in the tidal elevation from before and after the Outer Harbour Development would be -0.01 millimetres in the Outer Harbour, and 0.01 millimetres in the Inner Harbour. The maximum calculated water level difference at any one time would be +/- four millimetres in the Outer Harbour and +/- seven millimetres in the Inner Harbour. These differences were considered insignificant, and were considered to most likely be a factor of the resolution of the assessment model. The modification to the Outer Harbour Development is not anticipated to significantly alter these conclusions due to the negligible increase in the tidal prism.

Changes in tidal flushing performance in the Outer Harbour with and without the Outer Harbour Development, as approved, were not anticipated to change significantly. The largest increase was identified as occurring between the multi-purpose and container terminals. The increased dredging required for the terminal berths may further change the flushing conditions at this location, but the extent of change is unlikely to be significantly different from that originally assessed. As discussed earlier within this section, there were slight increases in the period of flushing in and around The Cut, with small improvements in the extreme reaches of the Inner Harbour. It is anticipated that there would be no discernible change from that originally predicted by the previous Environmental Assessment as a result of the proposed modification.

19.4 Mitigation and Management Measures

Condition 2.19 of the Concept Plan relating to coastal hydrodynamics requires each stage to be designed and constructed to minimise increases in infragravity (long) wave and gravity (ocean swell) wave parameters within the Inner and Outer Harbours, and not to have a detrimental effect on harbour tidal flushing. Relevant studies would be undertaken during each progressive stage to meet the requirements of this condition.

19.5 Conclusion

The proposed modification would result in changes to the reclamation and dredging footprint, and an increase in the volume of dredging to accommodate larger Cape sized vessels and Super-Panamax vessels. These modifications are not anticipated to result in any significant change to the outcomes of the previous Environmental Assessment in terms of infragravity (long) wave and gravity (ocean swell) wave impacts, or the flushing of the Inner and Outer Harbour. In particular, the Outer Harbour Development, as modified, would continue to improve the conditions of the harbour during seiching conditions, when compared to the pre-development conditions of the Outer Harbour. The existing consent conditions for the Concept Plan require PKOPL to minimise infragravity (long) wave and gravity (ocean swell) wave parameters within the Inner and Outer Harbours, and not to have a detrimental effect on harbour tidal flushing. Relevant studies would be undertaken during each project application and the detailed design of each stage to meet the requirements of this condition.

20.0 Landscape and Visual Amenity

This chapter provides an assessment of the potential impact of the proposed modification on the landscape and visual amenity of Port Kembla and its surrounds.

20.1 Existing Environment

20.1.1 The Current Landscape

Port Kembla is an established major industrial precinct within the Illawarra. The landscape character of the Port and its immediate surrounds is typical of an active port and industrial precinct. The built form varies in size, building style and features, and has around 18 operational berths that import and export a variety of commodities. The most prominent visual features at the Port and immediate surrounds are the BlueScope Steel steelworks (which dominates vistas of Port Kembla), the Grain Corp grain terminal (and associated silos) and the 198 metres tall smoke stack at the former copper smelter and refinery site (which is located on the top of a hill and can be seen from many regional viewpoints). The stack is anticipated to be demolished by mid-2013.

The Outer Harbour itself is characterised by a mix of both built environment and natural features, including:

- Three jetties to the south (No. 3 and 4 Jetties) and west (the Port Kembla Gateway, or the No.6 Jetty). A smaller jetty is located on the northern breakwater, which handles flammable liquids and oils.
- Six operational berths (Berth 201, 202, 203, 204, 205 and 206).
- A concrete lined stormwater drain, known as Darcy Road Drain.
- The eastern and northern breakwater.
- Salty Creek, which extends from a location west of Port Kembla railway station and flows via a culvert under Old Port Road and discharges to the Outer Harbour.
- Red Beach, a small remnant of sandy beach which extends south from the existing Salty Creek outlet.
- A recreational boat harbour and boat ramp located adjacent to the eastern breakwater.
- Rail infrastructure located near Darcy Road, Foreshore Road, Old Port Road and Five Islands Road, and including rail sidings servicing the Port Kembla Gateway
- A tug boat facility, located north of the Port Kembla Gateway.

The Outer Harbour is undergoing transformation with the partial reclamation of the Stage 1 footprint of the Outer Harbour Development underway. Stockpiling of imported fill for the reclamation has occurred adjacent to Foreshore Road and construction of the CGM on the western portion of the multi-purpose terminal has commenced.

Beyond the port and industrial precinct to the south west is the low density residential suburb of Port Kembla. The closest residential properties are located to the south west of the Outer Harbour along Wentworth Street, approximately 400 metres from the intersection of Old Port Road and Foreshore Road. These properties are slightly elevated above the surrounding industry and the Outer Harbour.

20.1.2 The Previous Environmental Assessment

A landscape and visual impact assessment for the Concept Plan and Major Project (Stage 1) was undertaken as part of the previous Environmental Assessment. This assessment considered the potential impacts of the Outer Harbour Development during the construction and operation phases from a number of viewpoints in the immediate, local and regional landscape.

Visual impacts during construction were considered to be temporary and associated with general construction activities (such as stockpiles and lighting), dredging machinery and activities, and construction works for the terminal, berths and rail infrastructure in the South Yard.

The main visual impacts during the operation of the Outer Harbour Development would result from:

- increased port infrastructure such as cranes, forklifts and trucks
- increased area of hardstand following reclamation
- increased shipping and rail movements into and out of the harbour

- increased terminal lighting.

The previous Environmental Assessment concluded that the activities of the Outer Harbour Development during construction and operation would occur within the context of the existing heavy industry, port infrastructure and port activities in the Outer Harbour. As such, the resulting impacts on the immediate, local and regional landscape during construction and operation were considered to be nil, low or moderate.

20.2 Methodology

Information contained in the visual and landscape assessment component of the previous Environmental Assessment was reviewed in order to assess the potential impact of the proposed modification. Impacts on landscape and visual amenity were considered for the Outer Harbour Development (as modified) and the Outer Harbour Development (as approved) from the same locations assessed in the previous Environmental Assessment. A site visit was also conducted on 22 February 2013, which was used to inform the impact assessment for the proposed modification.

20.3 Impact Assessment

20.3.1 Construction

As acknowledged within the previous Environmental Assessment, there would be temporary visual impacts associated with the introduction of plant and equipment, and activities associated with dredging, reclamation, construction of the terminals and rail infrastructure upgrades. However, these impacts were considered to have a low to moderate impact on the visual landscape given the partial obstruction of the Outer Harbour Development by existing commercial and industrial developments, and the industrial nature of the landscape.

The key changes to construction activities that may alter the potential visual amenity impacts as a result of the proposed modification include:

- Additional construction activities in the North and South Yard to construct the rail infrastructure upgrades required to support the increased throughput of the multi-purpose terminal. This includes additional bulk rail loops, sidings, a rail bridge upgrade over Old Port Road and bulk unloading facilities.
- An increase to the volume of material to be temporarily stockpiled at the Outer Harbour Development from 100,000 cubic metres to 360,000 cubic metres at any one time, with an additional stockpile site located to the east of Darcy Road drain, in addition to the stockpile west of Darcy Road drain. The height of the stockpiles would increase from approximately 10 metres to approximately 11 metres.
- Additional construction activities associated with the construction of the enclosed storage sheds and conveyors within the Stage 1 footprint.
- Additional construction activities associated with the increase in the operational footprint under the Major Project (Stage 1), which would increase from nine hectares to 22.6 hectares.
- Reduced construction activity associated with Stage 2 of the Outer Harbour Development, given the proposed changes to the Outer Harbour Development staging.
- Additional construction activities associated with the selected treatment option(s) for the Old Port Road railway level crossing, which could consist of a grade separation solution (road over rail).

These changes are not considered to be significantly different to that originally assessed in the previous Environmental Assessment. While the extent of activities for Stage 1 would increase, the activities would be similar in nature and, in some cases, would result in reduced activities required for subsequent stages. Adjacent commercial and industrial developments would partially screen construction activities and stockpiling areas from certain immediate and local viewpoints. The industrial nature of the Port Kembla landscape would also further minimise the visual intrusiveness of the additional construction activities. For example, large bulk stockpiles occur within Port Kembla with coal stockpiles of around 20 metres present at the Port Kembla Coal Terminal.

The potential impacts associated with visual impacts during construction would be mitigated or managed by adopting the measures detailed in **Section 20.4**.

20.3.2 Operation

The previous Environmental Assessment determined that while the Outer Harbour Development would introduce permanent elements into the landscape, these would occur within the context of the existing heavy industry, port infrastructure and port activities in the Outer Harbour. As such, the impacts on the immediate, local and regional landscape during operation were considered to be nil, low or moderate.

The key changes to the Outer Harbour Development as part of the modification that have the potential to alter the potential visual amenity impacts of the operational environment of the Outer Harbour Development (as approved) include:

- Increase in the operational area of Stage 1 of the Outer Harbour Development with minor adjustments to the footprint of the total operational area resulting in a decrease of approximately one hectare.
- Use of a mix of enclosed storage sheds, one external break bulk stockpile and enclosed conveyor systems rather than open bulk stockpiles and conveyor system. The storage sheds (dry and break bulk) would indicatively be around 25 metres in height. **Figure 4-2** provides an indicative layout of how the storage sheds could be configured.
- Additional rail infrastructure within the North and South Yard, including bulk loops and bulk sidings to accommodate trains of up to 850 metres in length and the widened rail bridge over Old Port Road.
- Increase in rail movements of around nine trains per day, increasing the total rail movements associated with the Concept Plan from 21 trains per day to 30 trains per day at ultimate capacity.
- Increase in the size of ships that can be catered for at the Outer Harbour Development, with one berth to accommodate Super Post-Panamax vessels (which have a beam (or width) of approximately 42 metres and a length of approximately 330 metres), and one berth to cater for Cape size vessels (which have a beam of approximately 50 metres and a length of approximately 300 metres). Under the Concept Plan approval, all ships accessing the Outer Harbour Development would be Panamax size (being a vessel with a beam of approximately 32 metres and a length of approximately 230 metres).
- An increase in shipping traffic with an additional 170 vessels per year at ultimate capacity, being an increase from 1,500 vessel visits per year in the Outer Harbour to 1,670 vessels per year.
- A road bridge over the railway level crossing at Old Port Road, should grade separation be the preferred treatment option.
- Potential for an acoustic barrier up to eight metres high along the southern boundary of the South Yard at Five Islands Road, subject to further reasonable and feasible considerations.

Figure 20-1 provides an artist's impression on how the Outer Harbour Development (as modified) could appear, noting that two break bulk storage sheds are depicted. The configuration of the break bulk storage sheds would be considered during detailed design as per the recommendations of **Chapter 9.0** as part of the noise mitigation strategy for the Major Project (Stage 1).

Figure 20-1 Artists impression of the Outer Harbour as modified

The increase in shipping traffic and size of vessels at the Outer Harbour Development would be noticeable but consistent with the active port operations at Port Kembla.

The introduction of storage sheds, as opposed to stockpiling, would internalise operational activities and would partially screen other terminal operations, which would provide a potential improvement in the visual appearance of the Outer Harbour Development (as modified). The final configuration of these sheds would be subject to the requirements of future customers; however, large sheds would not be inconsistent with the existing built form of Port Kembla. Further, multiple sheds are envisioned which would minimise the visual bulk of the structures when viewed from the immediate, local and regional vantage points. It is also noted that the height of the proposed storage sheds would be similar to the clinker storage shed approved at the CGM, and would be lower than the approved silo and mill at the CGM, which will have a height of 60 metres and 50 metres, respectively.

Additional rail infrastructure and rail movements would be within an existing rail corridor. Therefore, the visual impacts would be consistent with the existing operations along this corridor. Likewise, should grade separation occur at Old Port Road, the presence of a bridge would not be inconsistent with existing transport-related infrastructure in the Port.

With consideration of these proposed changes, the potential impacts on the immediate, local and regional landscape were concluded to remain as low to moderate for the reasons as set out below:

- **Immediate Landscape** (refer to **Figure 20-2**): Views from areas in immediate vicinity to the Outer Harbour Development would continue to experience the greatest impact due to proximity. However, the modifications would be seen within the context of the industrial landscape, and are therefore not considered to significantly differ from that originally assessed. Other views to operational areas, vessels and berths during the operation of the Outer Harbour Development (as modified) would be partially obstructed by existing industrial premises and structures in the foreground.

  These would be additional rail infrastructure constructed in the South Yard, with increased rail movements, as a result of the proposed modification. However, this would not substantially change the views in this landscape given it is an existing rail corridor. As part of the noise mitigation strategy, an acoustic barrier has been recommended for further investigation. This may block views for receivers closest to the acoustic barrier. The wall itself has the potential to result in additional visual impacts, for example, should it be subject to graffiti. The inclusion of the acoustic barrier within the noise mitigation strategy, and its final design, location and height of the acoustic barrier would be confirmed during detailed design. PKOPL would consult with the closest residential landowners during detailed design once the extent, location and height has been confirmed.

If grade separation is selected as the preferred treatment option at Old Port Road, the presence of a bridge would be consistent with existing transport-related infrastructure at the Port. Further, the most impacted views would be from properties immediately adjoining the crossing which are considered to be of low sensitivity (given the industrial nature of those properties). The design of this bridge would influence the extent of visual impact on these properties. Consultation with these landowners would be undertaken by PKOPL during the determination of the preferred treatment option.

- **Local Landscape** (refer to **Figure 20-3, Figure 20-4** and **Figure 20-5**): The increase in vessel size, shipping frequency and the large storage sheds would be the key changes to the Outer Harbour Development that would be visible, depending on the viewing location. However, again, the impacts of the proposed modification would be seen in the context of the existing port and industrial development in the foreground and/or background, and would be entirely consistent with this visual context.
- **Regional Landscape** (refer **Figure 20-6**): The previous Environmental Assessment concluded that the distance of the Outer Harbour from the viewing locations, and the screening of the Outer Harbour by natural features or existing development would make the Outer Harbour Development indiscernible. The additional shipping traffic, and potentially, larger vessels, would be viewed from certain elevated vantage points and would reinforce the existing context. The storage sheds may also be visible. However, the modifications would be seen within the context of the port related infrastructure and therefore would not significantly increase the impacts of the Outer Harbour Development.

Figure 20-2 An immediate landscape view – view from the Outer Harbour lookout, Port Kembla (AECOM, 2010)

Figure 20-3 A local landscape view – view from Hill 60 Park, Port Kembla located approximately two kilometres from the Outer Harbour (AECOM, 2010)

Figure 20-4 A local landscape view – view from the intersection of Blaxland Avenue and Flagstaff Road, Port Kembla located approximately two kilometres from the Outer Harbour (AECOM, 2010)

Figure 20-5 A local landscape view – view from the Panorama Estate, Lake Heights, located approximately three kilometres from the Outer Harbour (AECOM, 2010)

Figure 20-6 A regional landscape view – view from Mt Keira (AECOM, 2010)

20.4 Mitigation and Management Measures

The existing Statement of Commitments and consent conditions for the Concept Plan and Major Project relating to visual impacts are considered appropriate to ameliorate the potential impacts associated with the proposed modification, given that the proposed activities are not expected to introduce significantly different impacts to those assessed in the previous Environmental Assessment. Consistent with the existing Statement of Commitments and consent conditions the following mitigation and management measures would be implemented:

- Construction activities and lighting during night works would be managed to minimise the period of disturbance and light spill respectively.
- Lighting for terminals, storage areas and plant/machinery would be carefully selected to minimise light spill during operations.
- All practicable measures to mitigate off-site lighting from the Major Project (Stage 1) would be taken, and PKOPL would ensure that all external lighting associated with the project would comply with Australian Standard 4282-1997 *Control of the obtrusive effects of outdoor lighting.*
- The use of reflective building elements would be minimised, and the use of building materials and treatments that visually complement the surrounding development would be used.
- A Design and Landscape Management Plan would be prepared to outline measures to minimise the visual impacts of the project and to consider the visual compatibility of the project with the surrounding broader land uses. The plan would identify design principles and standards, consider relevant design standards and policies (such as Australian Standard 4282-1997 *Control of the obtrusive effects of outdoor lighting* and relevant Council design standards), provide design details for the built elements of the project and include a landscaping strategy as well as details of landscape maintenance. This Plan is scheduled to be prepared prior to the commencement of constructing the final finished levels of the multi-purpose terminal.

20.5 Conclusion

The proposed modification would result in the construction and operation of additional structures and buildings, an increase in the size and number of vessels at the Port, and an increase in the number of rail movements. These modifications to the Outer Harbour Development would fit well within the context of the existing heavy industry, port infrastructure and port activities in the Inner and Outer Harbour. Existing developments would also screen views from certain vantage points.

The proposed modification is not anticipated to significantly alter the visual impacts of the Outer Harbour Development during construction or operation. The inclusion of the new elements into the Design and Landscape Management Plan for the Major Project (Stage 1) would ameliorate the impacts on the visual landscape.

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21.0 Other Issues

This chapter provides an assessment of the potential impacts of the proposed modification on hazard and risk, socio-economics, heritage, sustainability, climate change, waste management, recreational fishing and navigation.

21.1 Hazard and Risk

A Preliminary Hazard Analysis (PHA) was prepared as part of the previous Environmental Assessment (refer to Chapter 13 of the previous Environmental Assessment). The PHA was prepared to assess the potential hazards and risks associated with handling general cargo which could include Dangerous Goods (DGs) that enter the port in containers or bulk products transported in portable tanks or Intermediate Bulk Containers (IBCs).

Given that the type of DGs likely to be stored and handled at the container terminals were not known at the time the PHA was prepared, it was assumed that the DGs would be representative of those typically found at similar terminal facilities across a range of ports in NSW and Australia. Dry bulk and general cargo transferred between ships and the multi-purpose terminals area in Stage 1 would not comprise DGs and therefore the focus of the PHA was on operations for Stage 2 and 3 of the Concept Plan. The PHA did however assess the potential hazards and risks associated with handling sulphuric acid. Existing No.4 jetty (Berth 206) is currently used to import sulphuric acid and would be demolished as part of Stage 1 of the Major Project and facilities for the sulphuric acid imports, including a new pipeline, would be relocated to the first multi-purpose berth.

State Environmental Planning Policy No.33, Hazardous and Offensive Developments (SEPP 33) requires the hazards associated with the storage of DGs to be assessed and for the assessment to determine whether these hazards have the potential to impact off-site land uses. The policy is supported by a number of Hazardous Industry Planning Advisory Papers (HIPAPs) that provide guidance on the assessment of hazards and risks and provide acceptable hazard and risk criteria. The methodology used for the PHA was based on *HIPAP No.6, Hazard Analysis Guidelines*.

The PHA concluded that the Concept Plan would not exceed the requirements of SEPP 33. The Concept Plan would be classified as 'potentially hazardous' only and therefore would be permissible in the proposed location with implementation of appropriate mitigation measures. Further assessment of Stage 2 and 3 would be required when project applications are being sought to develop and operate the terminals.

The PHA also concluded that operation of the sulphuric acid pipeline and transfer facilities at the multi-purpose terminals as part of Stage 1 would not pose significant risks, as appropriate safeguards and mitigation measures would be put in place to minimise the risks and impacts arising from potential leaks and spills.

The proposed modification does not change the assumptions made regarding the type of DGs likely to be stored and handled at the container terminals, nor does it change the planned relocation of the sulphuric acid pipeline to the multi-purpose terminals.

The modification proposes to increase bulk throughput capacity at the first multi-purpose terminal berth from 4.25 Mtpa (as approved) to 16 Mtpa. Indicatively, the three main bulk commodities would likely be coal, iron ore and bauxite. The approved development proposed to export smaller quantities of coal and did not include export of iron ore or bauxite. Neither coal, iron ore or bauxite are considered hazardous under SEPP 33. Bauxite and iron ore are non-flammable, non-combustible and non-toxic. Coal is a combustible solid. Therefore, the only potential hazard associated with handling and storing these commodities relates to the potential for coal dust explosion and spontaneous heating of coal stockpiles. Mitigation and management measures as detailed below would be implemented to minimise these risks.

The previous Environmental Assessment assessed the potential for ship collisions in the Outer Harbour during day to day shipping operations. A review of potential impacts as a result of collisions indicated that the consequences of a release of DGs would be negligible, due to the safeguards used at the Port. This conclusion was supported by an incident report for the Port which showed no collisions between ships between 2000 and 2010. The most recent incident report for the Port shows there have been no collisions between ships in the past 3 years. While the proposed modification would increase the number and size of ships in the Outer Harbour from 1,500 to 1,670 per annum, the safeguards currently used at the Port would still be appropriate for managing shipping within the Outer Harbour.

The proposed modification does not alter the conclusion in the PHA and previous Environmental Assessment that operation of the Concept Plan and Major Project does not pose a significant risk to people and the environment. The existing approval conditions for the Concept Plan and Major Project are considered appropriate to ameliorate the potential impacts associated with the proposed modification. Consistent with the existing approval conditions, the following mitigation and management measures would be implemented:

- Implement the mitigation measures recommended in the previous Environmental Assessment and PHA, such as maintaining separation distances between flammable liquids and solids storage areas, and storing containers holding flammable, corrosive, toxic or environmentally active materials within a spill containment area, for the projects associated with the Concept Plan (Concept Plan approval Condition 2.27).
- Conduct Hazard Audits of each project associated with the Concept Plan consistent with *HIPAP No.5, Hazard Audit Guidelines*. Hazard Audits would be conducted 12 months after the commencement of operations and every three years thereafter, or as otherwise agreed by the Director General (Concept Plan approval Condition 2.28).
- Store and handle all DGs in accordance with all relevant Australian Standards, including bunds for liquid DGs that are capable of storing 110 percent of the volume of the largest single stored volume within the bund, and in accordance with the *Environment Protection Manual Technical Bulletin Bunding and Spill Management* (OEH, 2007) (Major Project Approval Condition B30).
- Prepare a Fire Safety Study consistent with *HIAPAP No. 2, Fire Safety Study Guidelines* and the NSW Government's *Best Practice Guidelines for Contaminated Water Retention and Treatment Systems* at least one month prior to commencement of construction of the Major Project, or within such further period as the Director General may agree (Major Project Approval Condition B31).
- Prepare a Final Hazard Analysis in accordance with HIPAP No. 6 a least one month prior to commencement of construction of the Major Project, or within such further period as the Director General may agree. The analysis would review the risks associated with the sulphuric acid pipeline (Major Project Approval Condition B31).
- Prepare a Construction Safety Study in accordance with *HIPAP No. 7 Construction Safety Study Guidelines* at least one month prior to commencement of construction of the Major Project, or within such further period as the Director General may agree. The study would identify construction hazards associated with construction of the multi-purpose terminals and relocation of the sulphuric acid pipeline (Major Project Approval Condition B31).

Given that the proposed modification would result in handling and storage of greater quantities of coal, it is recommended that mitigation and management measures be implemented to minimise the risk of coal dust explosions or spontaneous heating of coal stockpiles. Mitigation and management measures such as designing the conveyor and handling systems to prevent the accumulation of coal dust, regularly cleaning the conveyor and handling systems to remove any coal dust, and working coal stockpiles to prevent any dead pockets of coal would be implemented to minimise these risks.

21.2 Socio Economic

The previous Environmental Assessment determined that the overall impact of the Concept Plan on the social and economic characteristics of the area would be positive, and that the Concept Plan would also have a long term positive impact on the competitive environment for NSW ports (refer to Chapter 20 of the previous Environmental Assessment). The proposed modification does not change this conclusion.

The estimated $700 million dollar Concept Plan development would support economic growth in the Illawarra region and NSW as a whole through both long term and short term benefits. Construction of the Concept Plan would take place progressively through to 2037 and would generate significant direct and indirect employment opportunities for the Illawarra Region, as well as in NSW as a whole. The previous Environmental Assessment determined that in the period up to 2018, the construction activities to be undertaken as part of the Major Project would generate over 180 direct and indirect employment opportunities per year in the Illawarra Region and over 297 in NSW as a whole. The previous Environmental Assessment also concluded that the Major Project would increase regional and State income through construction. It estimated that the net contribution from the proposed development would add $19.5 million to the Illawarra's gross regional product (GRP) and $32.8 million to the gross state product (GSP) per year during construction. The proposed modification would extend the scope,

duration and the associated economic benefits of the construction activities to be undertaken as part of the Major Project by two years, with construction being completed in 2020.

The previous Environmental Assessment concluded that operation of the Concept Plan would have a significant beneficial economic impact on the Illawarra region and NSW. It was estimated that the Concept Plan would generate 1,252 and 1,470 direct and indirect employment opportunities in the Illawarra Region and NSW, respectively. It also estimated that the net contribution from the Concept Plan would add $134 million to the Illawarra's GRP and $160 million to the GSP per year. In the order of 384 and 451 direct and indirect employment opportunities would be generated by the Major Project in the Illawarra Region and NSW, respectively. The previous Environmental Assessment estimated that the net contribution from operation of the Major Project would add $41 million to the Illawarra's GRP and $49 million to the GSP per year.

The proposed modification would increase the bulk throughput capacity at the first multi-purpose terminal berth from 4.25 million tonnes per annum (as approved) to 16 million tonnes per annum. This would require increased investment to build additional infrastructure such as the storage sheds and conveyors, and the additional rail infrastructure. It is anticipated by PKOPL that an additional 75 direct jobs would be created as a result of the proposed modification, with flow on increased economic benefits associated with direct and indirect employment opportunities. During operations the proposed modification may also increase the contribution to the Illawarra's GRP and GSP.

By creating additional employment opportunities and flow on increased economic benefits associated with the additional employment opportunities, the proposed modification would likely improve local social issues. For example, the additional employees would likely increase retail activity in the local area.

The amenity of an area can be affected by air pollution (particularly from emissions of particulates), noise and traffic generation. Reductions in amenity from increased air pollution, noise and traffic can potentially lead to negative social impacts in the absence of mitigation and management measures. The operational noise assessment for the Major Project and Concept Plan identified exceedances at nearby sensitive receivers. However, identified mitigation options for the Major Project would enable compliance with the criteria at all receivers, except for a 2 dB exceedance at one receiver. The final suite of mitigation measures would be confirmed through an Operational Noise and Vibration Management Plan. Consideration of additional mitigation measures to reduce exceedances of the Concept Plan would be considered in future assessments for Stage 2 and Stage 3. The design of the proposed modification includes a number of improvements from an air quality perspective, the most important of which is the use of enclosed storage sheds and conveyors for handling bulk materials. The air quality modelling results predict that operation of the Major Project and Concept Plan, and when considered in a cumulative context, would result in some exceedances of the EPA assessment criterion for particulate matter which could impact the amenity of the local area. An Operation Air Quality Management Plan would be prepared to outline measures to minimise and manage air quality impacts. Road traffic associated with the proposed modification would not have an adverse impact on the amenity of the area. The proposed modification would slightly increase the number of construction-related trucks from 27 trucks per hour to 35 trucks per hour. This is comparable to the number of vehicles generated by the approved operational phase of the Stage 1 development (including the CGM) and well within the approved traffic volume generated at the ultimate completion of the Concept Plan. For both the Stage 1 and Concept Plan operational scenarios, it is anticipated that there would be an additional eight car movements, with no change in truck traffic, as a result of the proposed modification.

21.3 Heritage

A search of the Australian Heritage Information Management System (AHIMS) database which was undertaken as part of the previous Environmental Assessment uncovered no evidence that recorded or unrecorded Aboriginal sites would be impacted by the Concept Plan or Major Project (refer to Chapter 24 of the previous Environmental Assessment). All previously recorded Aboriginal sites are located well outside the impact area, and there is considered to be little or no likelihood that any intact or undisturbed subsurface Aboriginal heritage material remains in situ within the study area.

The Historic Heritage Assessment prepared as part of the previous Environmental Assessment determined that there would likely be some minimal impacts on listed heritage items in the Historical Military Museum during construction of the access road from Darcy Road to the boat harbour car park at the end of Foreshore Road. The assessment concluded that the setting of the heritage items would be impacted. The proposed modification would not result in any change in impact to the heritage items in the Historical Military Museum. Consistent with the

recommendations in the previous Environmental Assessment and existing approval conditions, the road would be designed and constructed to minimise impacts on the heritage items (Concept Plan Approval Condition 2.18).

The Historic Heritage Assessment determined that the State significant Mobile Block Setting Steam Crane would need to be relocated in order to ensure it is not affected by the proposed road construction as part of the Concept Plan which would link Darcy Road with the boat harbour car park. The proposed modification would not result in any change in impact to the Mobile Block Setting Steam Crane. Consistent with the recommendations in the previous Environmental Assessment and existing approval conditions, a Conservation Management Plan would be created for this item (Concept Plan Approval Condition 2.16).

The Historic Heritage Assessment determined that the No. 3, 4 and 6 Jetties have limited to low local historical significance due to intrusive modifications and their relatively poor condition. The No. 3 and 4 Jetties are programmed to be demolished as part of the dredging and reclamation works which are currently being undertaken. The proposed modification does not change the need to demolish the No. 6 Jetty (Port Kembla Gateway) in order to accommodate the Concept Plan (Stage 3) dredging and reclamation works. The Historic Heritage Assessment concluded that retention of the No.6 Jetty in its present condition would not be of great benefit to the Outer Harbour area. Archival recording of the No. 3, 4 and 6 Jetties was recommended prior to demolition (Major Project Approval Condition C21). The archival recording for Jetty No.3 was completed and has been submitted to OEH, the State Library and Wollongong City Council.

The shipwrecks *Adele* and *Clio* both ran aground off the northern breakwater of the Outer Harbour. The exact locations of the wrecks are not known but the Historic Heritage Assessment considered it unlikely that the shipwrecks would be located within the Outer Harbour basin. The proposed modification would marginally increase the extent of dredging in the areas between the multi-purpose terminal and the west side of the container terminal. However, since the shipwrecks are unlikely to be located in the Outer Harbour, the proposed modification is not anticipated to have any impact on shipwrecks. Consistent with the existing approval conditions, the dredging works would be subject to a shipwreck mitigation strategy to manage any unexpected discovery of shipwrecks (Concept Plan Approval Condition 2.16).

The rail infrastructure upgrades required as part of the proposed modification would not have any impact on items of heritage significance.

21.4 Sustainability

The proposed modification would require construction of several large storage sheds at the multi-purpose terminal. There is potential to capture water runoff from the roofs of the storage sheds. The captured water could be treated and stored in water tanks on site and reused for uses such as toilet flushing within amenities, cleaning of equipment and fire fighting. These and other water sensitive urban design measures would be investigated and confirmed during the detailed design for Stage 1 of the Major Project.

21.5 Climate Change

The proposed modification would not change the conclusion in the previous Environmental Assessment that the Concept Plan would likely be affected by changed climatic conditions during its design life (refer to Chapter 26 of the previous Environmental Assessment). The most significant impact would be from sea level rise and storm surges during extreme events. However, the proposed reclamation levels (4 metres PKHD) and finished terminal surface levels (5.2 metres PKHD) have taken these impacts into account and allow for sea level rise beyond the 50 year design horizon and could accommodate extreme sea level rise predictions to beyond 2100.

Increased rainfall, winds, storm activity, solar radiation and temperatures would result in accelerated degradation of materials and structures. Management of these impacts would occur through maintenance regimes that would be developed after the commencement of operations.

Impacts from extreme events such as intense rainfall and storms would be managed through PKOPL risk management and emergency regimes. Drainage capacity would be designed for projected intense rainfall events and consideration would be given to standards for overhead structures used for rail. Alternative power sources would also be considered to ensure power supply during extreme events is maintained.

21.6 Waste Management

The previous Environmental Assessment determined that the Concept Plan and Major Project would generate various waste types including dredged material, excess fill, scraps of construction materials such as wood and metals, domestic waste, sewage, as well as waste from operational equipment including oils (refer to Chapter 27 of the previous Environmental Assessment).

The proposed modification would not change the waste types generated during construction but would increase the volume of dredged material. This material would be deposited in the reclamation areas, reducing the need for the use of imported fill for reclamation. The proposed modification would also produce greater quantities of excess fill associated with construction of the rail unloaders and off cuts of construction materials associated with extension of the rail bridge over Old Port Road and construction of the storage sheds and conveyor systems at the multi-purpose terminal. If the material is of suitable quality, it would be used in the reclamation area. With the exception of generating waste water from wash down of the conveyors at the multi-purpose terminal, the proposed modification would not change the waste types to be generated during operation. PKOPL would investigate the potential for the treatment and recycling of this water to enable re-use of this resource.

As recommended in the previous Environmental Assessment all waste would be collected and disposed of by a licensed contractor to an appropriate facility for recycling or disposal. Waste Management Plans would be prepared prior to commencement of construction and operation activities and would emphasise potential for waste minimisation, recovery and reuse of waste including specific requirements for each of the waste types identified. Consistent with the existing approval conditions, the Waste Management Plans would form part of the CEMP and OEMP for the Major Project (Major Project Approval Conditions C36 and D6).

21.7 Recreational Fishing and Boat Harbour Access

The proposed modification would not result in changes to the area or layout of the recreational boat harbour. Access to recreational fishing via the boat harbour on the eastern side of the Outer Harbour would not be affected by the proposed modification. The modified reclamation footprint of the Outer Harbour Development would extend to the western edge of the boat harbour, as identified **in Figure 4-1**, though the footprint would not block access in or out of the boat harbour. Recreational fishers would exit and enter the boat harbour on the eastern side of the line of existing buoys (refer **Figure 4-1**).

Changes to the number and size of commercial shipping vessels would not impact upon the movements of recreational boats accessing the Outer Harbour. This arrangement is similar to many other ports in Australia where commercial and recreational vessels operate in close proximity to each other.

Additionally, the boat harbour would remain accessible by land during construction or operation of the proposed modification. The Proponent will include appropriate measures in a Safety Management Plan to ensure that safe access is provided for recreational boaters entering and exiting the small boat harbour.

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22.0 Cumulative Impacts

This chapter assesses the potential cumulative impacts of the proposed modification.

22.1 Existing Environment

22.1.1 Existing Development

Port Kembla is one of the three major ports in NSW and the Port area includes both the Inner Harbour and the Outer Harbour. Port Kembla is recognised as a major industrial precinct within the Illawarra region and the area surrounding the Port comprises a range of significant industrial premises including BlueScope Steel, Port Kembla Steelworks, Port Kembla Coal Terminal, Incitec, Graincorp, Orica, Morgan Cement, Port Kembla Gateway and Brick and Block.

Major arterial roads service the Port Kembla area including Five Islands Road and Masters Road which connect to the Southern Freeway and Princes Highway. Established freight rail lines service both the Inner and Outer Harbours and connect to the broader NSW freight rail network.

The industrial character of Port Kembla is a significant influence on the background noise and air quality conditions and on existing road and rail traffic conditions.

22.1.2 Proposed Development

The previous Environmental Assessment identified a range of projects in the vicinity of the Outer Harbour with the potential to cumulatively contribute, to varying degrees, to the environmental impacts from the Outer Harbour Development. This original list of projects has been updated in **Table 22-1** below to reflect projects lodged and/or approved through to the current period.

Table 22-1 Proposed significant development projects - Port Kembla area

Name and Location	Project Summary	Status	Potential Key Issues
Port Kembla Coal Terminal	Increased road receival to 24 hours per day	Approved in 2009	Road traffic, noise and dust
Port Kembla Coal Terminal	Increase bulk capacity throughput	Application for modification lodged in 2011	Rail
National Biodiesel	Establish soybean processing and biodiesel production facility	Approved in 2009 and under construction	Road traffic (road, rail and ship) and air quality
BlueScope Steel	Injection Station	Approved in 2008	Road traffic and air quality
Port Kembla Copper	Demolition project	Approved in 2010	Noise, air quality, heritage and safety
Graincorp Grain Terminal	Increase in annual capacity and operating hours and modify road traffic cap	Approved in 2011	Road traffic, rail, noise and air quality
Vesuvius Australia Gloucester Ave Port Kembla	Industrial ceramics refractory operation	Approved in 2011	Air quality and noise
Cement Australia	CGM	Approved in 2011 and under construction	Air quality, noise and road traffic

The most significant project from a cumulative impact perspective is the CGM which is to be located within the footprint for Stage 1 of the Outer Harbour Development. This project has been approved and is currently under construction. It is expected to commence operation in early 2014.

The CGM is located on a 4.2-hectare-site located on part of the initial Stage 1 reclamation area. The CGM is accessed from Christy Drive and will produce approximately 1.1 mtpa of finished product, being (cement and ground granulated blast-furnace slag (an alternative cement product). In addition slag, gypsum, limestone and clinker will be received at the site for processing. It will operate 24 hours a day.

The delivery and dispatch of product would primarily occur by road, with some raw materials and products including clinker and ground granulated blast furnace slag, received or dispatched by ship.

The assessment of the CGM project concluded that the key environmental issues related to noise, air quality and traffic. Key conditions of approval include:

- Limits on road traffic generation during operations and management through a traffic management plan.
- A rail feasibility report to assess the economical, logistical and operational feasibility of the CGM using the rail network to receive raw materials and to transport product.
- Noise and air quality conditions during construction and operation.

22.2 Methodology

The DGRs for the proposed modification require an assessment of the potential impacts of the modification for both construction and operation stages, in accordance with relevant policies and guidelines. Direct, indirect and cumulative impacts must be considered (including regard to other existing and proposed developments and activities on the site and in the locality).

In preparing the cumulative assessment for the modification the following documents have been reviewed:

- The previous *Environmental Assessment for the Port Kembla Outer Harbour Development* (AECOM March 2010) and the Major Project and Concept Plan approvals for this development
- The *Environmental Assessment for the Cement Grinding Mill* (Site Plus, October 2010) and the Major Project approval for this development.

22.3 Impact Assessment

22.3.1 Construction

The key project-related impacts during construction are likely to include road traffic associated with importation of fill and general construction activities, dust and air quality from the reclamation area and fill stockpiles, noise from various construction plant and equipment, and water quality impacts associated with dredging and spoil placement.

The specific elements of the modification which impact on construction-related activities during Stage 1 of the Outer Harbour Development include:

- additional area and volume of dredging
- additional area of construction for the expanded multi-purpose terminal
- increase in area and capacity of the imported fill stockpile
- additional activity associated with construction of storage sheds and conveyors for the multi-purpose terminal
- additional rail infrastructure works to support the proposed the bulk rail operations
- potential treatment of the at-grade rail crossing on Old Port Road.

The construction-related assessments that have been carried out for the Outer Harbour Development have included consideration of the potential impacts associated with these modified project elements. A series of management and mitigation measures are contained in the existing Major Project approval and additional measures have been recommended where appropriate.

The assessment of construction impacts has been based on conservative assumptions relating to the operation of construction plant and equipment. The assessments have focused on Stage 1 (Major Project) and have included an allowance for the potential overlap of some construction and operational activities.

The other key project under construction in the immediate context of the Outer Harbour is the CGM which is now well advanced and due for completion in late 2013. Construction-related environmental impacts associated with this project have been assessed, and appropriate environmental management requirements relating to noise, air quality, traffic and soils have been incorporated in the conditions of approval for this project.

The Concept Plan approval for the Outer Harbour Development includes a condition (Condition 2.29) requiring the preparation of a Cumulative Impact Protocol to detail measures to manage and monitor cumulative impacts associated with the concurrent construction and operation of project stages. This Protocol applies to the CGM project.

Detailed assessments of construction-related impacts associated with Stages 2 and 3 of the Concept Plan would be prepared in conjunction with project applications for each stage and would include an assessment of cumulative impacts as appropriate.

22.3.2 Operation

Rail

The proposed modification would result in an increase in rail traffic associated with the increased throughput capacity of the first multi-purpose berth in Stage 1. Rail traffic for Stage 1 would increase from four trains per day (approved) to 13 trains per day (proposed). The modification does not change the rail traffic movements associated with the general purpose and container operations in Stages 2 and 3.

From a cumulative perspective, the rail assessment includes a discussion of the impacts of these additional train movements on existing users of the balloon loop at the Outer Harbour including Gateway Jetty and BlueScope Steel. The proposed rail infrastructure associated with Stage 1 (rail loops, sidings and unloaders) is designed to accommodate the additional bulk train movements with no detrimental impact to the existing rail operations of these users.

The rail assessment also includes a discussion of the available capacity on the wider rail network with a focus on the Moss Vale to Unanderra line and the proposed Maldon-Dombarton Rail Link. This includes an assessment of existing and potential capacity assuming that identified upgrades are undertaken in the future. The assessment uses capacity analysis undertaken for both of these rail freight corridors as part of the *Maldon-Dombarton Rail Link Feasibility Study* (2011).

The assessment demonstrates that progressive upgrades of the Moss Vale to Unanderra line can deliver a bulk cargo capacity of up to 14 Mtpa which would meet the required rail capacity for the modified Stage 1. The assessment is based on a series of conservative assumptions and makes allowance for existing users of the rail network by calculating available capacity based on spare train paths only (i.e. all existing contracted services are excluded from the calculation).

Ultimately, rail operators such as ARTC will allocate available train paths on a competitive, commercial basis and according to market demand. All potential rail users including customers of the Outer Harbour Development will need to compete to secure access to the available train paths.

If additional capacity is required ARTC will, subject to reaching satisfactory commercial arrangements with potential customers, undertake the investment necessary to ensure capacity is made available. ARTC will also be responsible for obtaining approvals for these potential capacity upgrades including an assessment of the relevant environmental impacts in each case.

It is difficult to forecast demand created by any new potential users of the rail network over the timeframe of the Concept Plan. This is influenced by a number of factors including seasonal influences and macro-economic conditions. However, it is reasonable to assume that virtually all freight train paths (existing and proposed) will be focused on the Port Kembla Outer or Inner Harbours either as origin or destination.

Further project approval is required for Stages 2 and 3 of the Concept Plan and detailed rail assessments would be required to support these applications in the future. In addition, the Concept Plan approval requires the preparation of a Rail Master Plan which would address issues relating to network capacity and infrastructure upgrades before the Outer Harbour Development progresses to Stages 2 and 3. This provides an appropriate framework to assess available rail capacity for the general purpose and container rail operations in the future, including consideration of cumulative rail impacts.

Road Traffic

The proposed modification would not generate significant additional operational traffic as the increase in bulk throughput capacity at the multi-purpose terminal is to be handled by rail. There is only a small increase in traffic movements associated with extra employee numbers for the multi-purpose terminal during Stage 1. The assessment indicates that that these additional traffic movements would have no discernible impact on the local or regional road network.

The previous Environmental Assessment included an assessment of the cumulative traffic impacts associated with all three stages of the Outer Harbour Development over an extended timeframe (20 to 25 plus years). The assessment included background traffic on the road network assuming average annual growth rates over future years. The assessment considered that there was adequate capacity on the road network to accommodate the traffic associated with ultimate development of the Concept Plan.

The CGM is currently being developed on land within the multi-purpose terminal area for Stage 1 and will commence operation in early 2014. The existing Concept Plan approval for the Outer Harbour Development acknowledges the cumulative traffic impacts associated with both developments and creates average daily and peak hour traffic limits for Stage 1 and the Concept Plan. The modification proposes that these limits would be modified slightly to accommodate the additional employee traffic.

As part of the modification, a range of potential options for treatment of the at-grade rail crossing on Old Port Road have been assessed. The options involve temporary or permanent closure of the rail crossing and redirection of traffic to Five Islands Road or the new internal port access road as well as the option of grade separation of the crossing.

The impacts of redirecting this traffic have been subject of a preliminary assessment and it appears that there is adequate capacity on the road network to accommodate this diverted traffic, albeit there may be some travel time delays for some road users. However, it is recommended that further assessment work is undertaken and consultation with relevant government agencies and affected local businesses is carried out, before a preferred option is formally presented for consideration by RMS.

Air Quality

The air quality assessment undertaken for the modification has assessed cumulative impacts associated with both the Major Project (Stage 1) and Concept Plan. This has included an assessment of background contributions from industry in the surrounding area using recent monitoring data and the air quality modelling undertaken for the CGM. The assessment included both worst case and normal operating conditions for the Concept Plan.

For the Concept Plan, the assessment showed potential cumulative exceedances of criteria for some pollutants of concern such as PM_{10}, $PM_{2.5}$, TSP and dust. The exceedances were more pronounced in the worst case operational scenario and primarily related to dust emissions associated with truck movements on internal roads within the site. It is noted that these emissions were calculated using relatively conservative silt loading factors for the roads. A sensitivity analysis was conducted using lower silt loading factors and this revealed that the cumulative exceedances were significantly reduced. The assessment also showed potential cumulative exceedances of NO_2 during the worst case operational scenario for the Concept Plan. The key contribution to this exceedance is the presence of seven vessels at berth, which is considered to have a low probability of occurring.

A range of management measures have been recommended to mitigate these impacts including regular cleaning of the roads and monitoring of silt loadings to confirm if they match those used in the air quality modelling. Based on the results of the monitoring, proposed management measures can be adjusted as required. The feasibility of providing shore side power to the berths would also be investigated along with other options or technologies to reduce combustion emissions from ships, trains and trucks.

Noise and Vibration

The noise and vibration assessment undertaken for the modification has assessed cumulative impacts associated with both the Major Project (Stage 1) and Concept Plan. This has included an assessment of background noise contributions from industry in the surrounding area using noise logging data undertaken in association with the previous Environmental Assessment and also having regard to the results of on-going noise monitoring.

The assessment of the Major Project (Stage 1) identified potential exceedances of noise limits at the closest residential receivers on the opposite (south) side of Five Islands Road. Primarily these exceedances were associated with rail operations in the South Yard, noise from operational plant on the multi-purpose terminal and

operation of the bulk rail unloaders. The assessment of the Concept Plan also identified potential exceedances at these receivers, albeit there were more receivers impacted and the exceedances were more pronounced.

A range of potential mitigation options were identified including acoustic barriers, selection of quieter plant and/or enclosure/treatment of noisier plant equipment. The noise monitoring program would also provide an opportunity to progressively ground truth the modelling results as the development proceeds and to adapt noise management and mitigation measures as appropriate.

The CGM facility was approved in September 2011, and the approval includes noise limits for the operations at the site. In the case that the CGM does produce these predicted noise levels at receiver locations, then it can be expected that the cumulative industrial noise contribution would likely increase by 2 to 3 dB(A) from the predicted noise levels in the noise assessment for the Outer Harbour Development modification.

It is anticipated that there will be a period of time between the CGM commencing its operation to when Stage 1 operations begin at the multi-purpose terminal. This lead time will provide an opportunity to monitor the noise levels from the CGM and investigate any potential exceedances of noise limits in a cumulative context.

PKOPL would be responsible for noise emissions from the Major Project and the Concept Plan, and PKOPL has identified a suite of mitigation measures that would reduce noise contributions. Cement Australia would be responsible for noise emissions from the CGM.

Existing approval conditions for the Outer Harbour Development require noise monitoring and management which would include the progressive assessment of noise emissions as the cargo capacity of the development increases over time. This provides an opportunity for PKOPL to consider and implement any additional noise mitigation measures that may be required at each stage of development to address any cumulative noise impacts. There will also be a greater appreciation of the operational requirements for the future stages, which may alter the conservative assumptions applied in this assessment.

22.4 Mitigation and Management Measures

The existing approval framework for the Outer Harbour Development includes a number of mechanisms for managing cumulative impacts over the extended timeframe of the development. These include:

- Condition 2.29 of the Concept Plan approval requires the approval of a Cumulative Impact Protocol prior to commencing construction. The protocol details the measures to be implemented to manage and monitor the cumulative impacts associated with the concurrent construction and operation of project stages (including the CGM) particularly in relation to road and rail traffic, air quality and noise control.
- Further road, rail, noise, air quality and other assessments will be required as part of the project applications for Stages 2 and 3 of the Concept Plan. This will enable cumulative impact assessments to be undertaken based on an actual understanding of Stage 1 impacts and also based on known projects or proposals at that time.
- Condition 2.6 of the Concept Plan approval requires the preparation of a Rail Master Plan to address issues relating to rail regional rail network capacity and rail infrastructure upgrades required to service Stages 2 and 3 of the Outer Harbour Development. The Rail Master Plan will need to consider the available network capacity (spare paths) having regard to demand from other rail users in addition to demand from the Outer Harbour at that point of time.
- The Outer Harbour Development would be implemented progressively over an extended timeframe and the Concept Plan approval includes conditions requiring on-going monitoring of environmental impacts such as road traffic (Condition 2.8), air quality (Condition 2.22) and noise (Condition 2.25). As a result there is an opportunity for these on-going environmental monitoring programs to inform the environmental management and mitigation measures that are prepared for each progressive stage of development. It also provides an opportunity to respond to any cumulative impacts that may occur as a result of future developments.

22.5 Conclusion

Cumulative impacts associated with the modified Outer Harbour Development have been considered. The main potential cumulative impact issues relate to rail traffic, road traffic, noise and air quality. The CGM is the most relevant project in a cumulative impact context given its location within part of the Stage 1 footprint of the Outer Harbour Development.

Rail traffic impacts have been assessed in the context of existing users of the local rail network and provided the proposed rail infrastructure upgrades are carried out there would be no adverse impacts on existing rail users. On the basis that identified upgrades to the regional rail network are carried out, there is adequate rail capacity to service the proposed bulk rail operations in Stage 1 and to also service existing rail users. Further rail assessments will be required for Stages 2 and 3 and a Rail Master Plan will also need to be prepared.

Operational road traffic impacts associated with the modification relate solely to additional employees and are considered to be relatively minor. Traffic limits for the Outer Harbour Development have been established under the Concept Plan approval and include an allowance for traffic generated from the CGM. These limits will need to be adjusted to reflect the minor changes associated with the modification.

The air quality and noise assessments for the modification have included an assessment of background contributions from surrounding industry as well as emissions from the modified Outer Harbour Development. Both assessments have included analysis of a worst case operational scenario for the Major Project (Stage 1) and Concept Plan.

In both cases the assessments have noted some exceedances of relevant cumulative air quality criteria and noise limits at the closest residential receivers and have suggested a range of management and mitigation measures to address them.

The existing approvals for the Major Project and Concept Plan include an established framework of environmental monitoring and management requirements during construction and operation which includes the development of a Cumulative Impact Protocol. In addition, further environmental assessments will need to be prepared as part of the project applications for Stages 2 and 3 and this provides a further opportunity for assessment of cumulative impacts at a later time.