### 4.1.4 Aerial photographs

Historical aerial photographs for the following years have been reviewed:

- 1951 (B&W)
- 1961 (B&W)
- 1975 (B&W)
- 1984 (Colour)
- 1994 (Colour)
- 2002 (Colour)
- 2008 (Colour)
- 2013 (Colour)
- 2016 (Colour)
- 2017 (Colour)

For the purposes of the aerial photography review the site has been divided into six areas as shown in Figure F below.

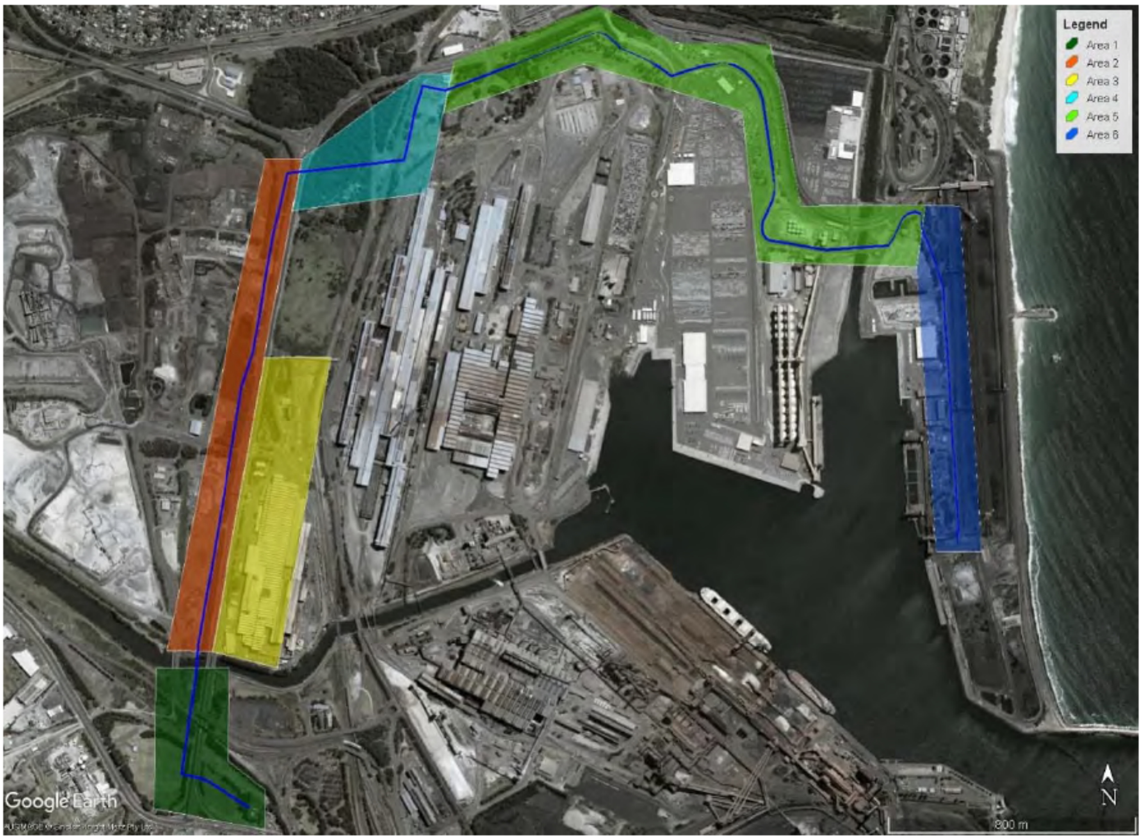


**Figure F - Aerial photography review areas**

#### Area 1 – South of Allans Creek

Springhill Road and Five Islands Road are visible along their current alignment through the aerial photograph history, although they only appear as dual carriageway on the current alignment from 1961. Railways in this part of the site also appear along the current alignment including the construction of overpasses over Springhill Road from 1961.

What appears to be a workers camp is visible and undergoes some expansion on the north-western corner of the Springhill Road – Five Island Road intersection until the 1975 aerial photograph. By 1984 the structures have been removed; however, the building footprints are still visible, while from 1994 the current site use as parkland has commenced. Areas to the north-east of the intersection are parkland or reserve throughout the aerial photo history while the Cringila meter station appears from 2002.

The area remains generally unchanged from 2002 onwards.

### Area 2 – West of Springhill Road

The area is predominately cleared but undeveloped in 1951 with some residual vegetation visible in the south of the area. By 1961 development is commencing or has been undertaken along the full extent of the alignment within this area. An unnamed road enters to this side of Springhill Road approximately halfway along the area. Masters Road does not appear at the northern end of this area until 1961.

South of the unnamed road appears to be used primarily as a hardstand laydown area from before 1961 to after 1994. In 2002 much of this area appeared to be grassed however from 2008 a number of hardstand pads appear to be constructed.

North of the unnamed road contains a sports oval and workers camp in 1961, these are removed by 1975 and the area becomes a hardstand laydown area until 1994. In 2002 some areas appear overgrown with grass and by 2008 some replanting and redevelopment is visible.

### Area 3 – East of Springhill Road, north of Allans Creek

This area is occupied by a factory in the 1951 aerial photograph which undergoes expansion activities until the 1975 aerial photograph. From this time onwards the area and factory remain generally unchanged.

### Area 4 – North-western pipeline extent

The area is generally undeveloped in the 1951 aerial photograph and by 1961 the industrial infrastructure through the site, including railways and roads appear to be generally in their current locations and the area remains unchanged to the present day.

### Area 5 – Northern pipeline extent

Outside a small area in the western end of this area in 1951 Area 5 is covered by the waters of Tom Thumbs Lagoon. Efforts at land reclamation are visible south west of the area on the western side of the lagoon. By 1961 the north of the lagoon including all of Area 5 are under some stage of reclamation. In 1975 reclamation is still ongoing in central parts of this area however it has been completed at the western and eastern extents with roads and other development generally present in the current footprint.

Within the central and eastern areas the reclamation appears completed by 1994 with the area in generally the current layout by 2008.

### Area 6 – Port Kembla Coal Terminal

In 1951 the area is generally underlain by beach and fore dune however by 1964 reclamation efforts are clearly visible and by 1975 these have concluded. Internal roads, structures and coal stockpile areas are all visible and in their current footprint by 1984 with the site remaining generally unchanged from this point onwards.

### 4.1.5 Previous Reports

GHD has been supplied with the following previous reports in relation to the PKCT area of the site:

- GHD (2011) Port Kembla Coal Terminal, Targeted Contamination Assessment of Refuelling Area and Waste Oil Tank, Dated January 2011
- GHD (2011) Port Kembla Coal Terminal, Groundwater Monitoring Event November 2011
- Douglas Partners (2012) Phase 1 (Desktop) Contamination Assessment, Proposed Car Park and Office Building, Port Kembla Coal Terminal, Port Kembla, Dated June 2012
- GHD (2012) Port Kembla Coal Terminal – Underground Petroleum Storage System, Six Monthly Groundwater Testing – July 2012
- Douglas Partners (2012) Phase 1 Contamination Assessment, Port Kembla Coal Terminal, Port Kembla, Dated August 2012
- GHD (2012) Port Kembla Coal Terminal – Underground Petroleum Storage System, Six Monthly Groundwater Testing – December 2012
- GHD (2013) Port Kembla Coal Terminal – Underground Petroleum Storage System, Two Monthly Groundwater Testing – February 2013
- GHD (2013) Port Kembla Coal Terminal – Underground Petroleum Storage System, Two Monthly Groundwater Testing – May 2013
- GHD (2013) Port Kembla Coal Terminal – Underground Petroleum Storage System, Groundwater Testing – August 2013
- Douglas Partners (2014) Contaminated Land Comment, Proposed Temporary Contractor Village, Port Kembla Coal Terminal, Port Kembla

Investigations by GHD were focussed primarily around underground petroleum storage system (UPSS) infrastructure located within the PKCT site (see Figure 2). The UPSS infrastructure, consisting of two 40,000 L tanks and associated pumps and lines, was assessed to be in good condition with no evidence of hydrocarbon contamination identified as being associated with the tanks. Soil contamination was identified during the initial investigation with total petroleum hydrocarbon (TPH) ($C_{10}$-$C_{36}$), benzo(a)pyrene and total polycyclic aromatic hydrocarbons (PAHs) identified above NEPM (1999), HIL F screening levels. Groundwater contamination was also identified for metals (arsenic, copper, zinc and manganese) above ANZECC (2000) marine 95% protection screening levels and total PAHs above ANZECC (2000) drinking water guidelines.

The Douglas Partners 2012 report assessed a small area north of the central workshop structures while the Douglas Partners 2014 report focused on the northern half of the PKCT (See Appendix C for report figures). From these two reports, the following potentially contaminating activities were identified by Douglas Partners within the vicinity of the proposed pipeline alignment.

Use of the site as a coal loader since the 1960s with no or limited information of prior environmental measures.

- Site filling with dredged and other unknown material.
- Potential leaks and migration of contaminants from refuelling area.
- Spills and leaks from workshop and storage areas and associated oil arrestor pits and waste oil storage.

Based on these potentially contaminating activities the following potential contaminants were identified by Douglas Partners:

- Heavy metals
- Total petroleum hydrocarbons
- Benzene, toluene, ethylbenzene an"d xylenes
- Phenols
- Polycyclic aromatic hydrocarbons
- Polychlorinated biphenyls
- Tributyl tin
- Asbestos

Douglas Partners recommended additional investigation in the form of a targeted Phase 2 Contamination Assessment to be undertaken "in work areas" and "in and around areas found to have an elevated risk of contamination and across the site to confirm the background contamination status".

## 4.2 Summary of site history

Based on site history information, the chronological historical land use is summarised below:

- Prior to between 1951 and 1961: The site is generally unoccupied cleared land or covered by Tom Thumbs lagoon
- 1951 to 1961: Transport infrastructure is developed in generally the current layout, some nearby factories are present and reclamation commences on Tom Thumbs Lagoon.
- 1961 to 2002: Site development and redevelopment takes place including reclamation of Tom Thumbs Lagoon. By 2002 all areas along the alignment are generally in the current layout.
- 2008 to present: The site remains generally unchanged.

## 4.3 Gaps in the site history

The following gaps in the site history were identified:

- Limited information is available on areas located outside the PKCT.
- Limited to nil information is available on site activities prior to 1951.

# 5. Site observations

## 5.1 Site walkover

A limited site walkover of the accessible sections of the pipeline route was conducted between 19/8/18 and 16/10/18. These areas can be broadly separated into three sections as summarised below. It should be noted that much of the pipeline route follows or runs adjacent to existing roads with the exception of the locations where horizontal directional drilling is taking place.

### PKCT Boundary

The walkover was conducted along the main access road within PKCT site boundary and immediately north of the boom gates along Port Kembla Rd The pipeline route exits the Berth 101 area (Photograph 3) and heads north running adjacent to the main road of PKCT (Photograph 1). Buildings, including administration and project buildings are located to the west of the pipeline route, while coal stockpiles and loaders are present to the east. The route follows Port Kembla Rd, heading north past the boom gates until the intersection of Tom Thumb Rd and Port Kembla Rd (Photograph 2). Drainage in these areas is likely to get captured by internal drainage systems or existing road drainage as most of the landscapes are paved surfaces.

### Bluescope visitor carpark area

The walkover was conducted in the area around the Bluescope visitor car park which was in the general vicinity of WorleyParsons geotechnical borehole BH-19. The area immediate area around BH-19 was mainly lightly vegetated with grasses and light tree cover, the vegetation did not appear to be distressed (Photograph 4). The area to the south-west of BH-19 was a visitor carpark for BlueScope, south south-east are the boom gates and entrance into BlueScope. There was a building west of BH-19 and paved car parking area located behind it. Drainage in this area is likely to infiltrate into the soil in unpaved areas, with runoff expected to get captured in existing stormwater drains.

### Cnr Five Islands Rd & Springhill Rd

The walkover was conducted on the grassed reserve on the corner of Five Islands Rd and Springhill Rd The immediate area south, east and north of BH-26 was a grassed reserve (Photograph 5); existing gas infrastructure was present in this area and the location where the proposed pipeline is expected to cross Springhill Road (Photograph 6). Drainage in this area is likely to infiltrate into the soil in unpaved areas, with runoff expected to get captured in existing stormwater drains located on Springhill Rd.

There was no direct evidence of stockpiling or surface contamination (e.g. asbestos) in the areas directly observed. It is likely that fill does exist in in all areas given the location is a built environment and the proximity to roads and major services is seen in all areas.

**Photograph 1 Looking south along the main access road in PKCT, note coal loader and stockpiles to the left of photograph.**

**Photograph 2 Looking north towards the intersection of Tom Thumb Rd and Port Kembla Rd, where the proposed pipeline route changes direction from a north-south alignment to approximately east-west.**

**Photograph 3 Looking east towards the northern end of berth and southern end of the coal stockpiles and loaders.**

**Photograph 4 Looking north in the grassed area near BlueScope site entry gate, note backfilled WorleyParsons BH-19 as disturbed ground in the centre left of the photograph**

**Photograph 5 Looking south-west over the grassed reserve on the corner of Five Islands Rd and Springhill Rd**

**Photograph 6 Looking west towards Springhill Road**

# 6. Data quality objectives

## 6.1 Overview

Data Quality Objectives (DQOs) have been established for this assessment to assist the design and implementation of data collection activities, to ensure the type, quantity and quality of data obtained are appropriate and address the project objectives. The DQO process described in the Guidelines for the NSW Site Auditor Scheme, 3rd edition (EPA, 2017) was adopted for this project. The DQO process involves seven steps:

- Step 1: State the problem
- Step 2: Identify the decision
- Step 3: Identify inputs to the decision
- Step 4: Define the study boundaries
- Step 5: Develop a decision rule
- Step 6: Specify limits on decision errors
- Step 7: Optimise the design

Description of each DQO step developed for this project is provided below.

## 6.2 Step 1: State the problem

AIE intend to redevelop Berth 101 of Port Kembla Coal Terminal with the construction of facilities to allow the importation and management of LNG, in order to connect this facility to the existing gas pipeline network a new pipeline is to be constructed between Berth 101 and Port Kembla gas transmission networks located Cringila. GHD has performed a review of the previous investigations and a desktop review of information available for the proposed pipeline alignment and identified the following potential contamination issues:

- Moderate to high potential for contamination to be present in soil and groundwater onsite.
- Moderate to high potential for acid sulphate soils to be present onsite
- Site soils and fill materials require assessment against NSW EPA Waste Classification guidelines for potential off-site disposal.
- The potential presence of as yet unidentified on-site or off-site contaminating sources.

The problem as it stands is that the degree to which contamination may pose a risk to human health and/or the environment within the proposed pipeline alignment as a result of the change in site condition is unknown.

## 6.3 Step 2: Identify the decisions

The decisions to be made at the end of this assessment are:

- Does soil and groundwater contamination at the site present a potential risk to identified human health and ecological receptors associated with the proposed pipeline alignment?
- Is there a need for further assessment, remediation and/or management of contamination (if identified)?
- What is the likely waste classification of material to be managed as part of the pipeline construction?

- Are acid sulphate soils present on site and is there need for further management?

## 6.4 Step 3: Identify inputs to the decision

The information considered in the decision making process comprised:

- Review of historical land uses and potential sources of contamination identified at the site and on surrounding properties.
- The proposed pipeline alignment extent and installation method.
- Published environmental information for the site, including geological and hydrogeological maps.
- The conceptual site model (CSM) developed for the site.
- Information obtained from previous investigations, listed in Section 4.1.5.
- Soil and groundwater analytical data obtained during the investigation, and comparison to applicable criteria for the proposed land use.
- Applicable guidelines, made or approved by NSW EPA under Section 60 of the *Contaminated Land Management Act 1997* (CLM Act).

## 6.5 Step 4: Define the study boundaries

The lateral investigation extent is the investigation area illustrated in Figure 2.

The maximum vertical extent of the soil investigation was 30.00 m bgl. Groundwater was not assessed as part of the geotechnical investigation.

The temporal extent of the investigation was between 29 August 2018 and 12 October 2018 for soil sampling.

## 6.6 Step 5: Develop a decision rule

The decision rules adopted in this detailed site investigation were:

- The concentrations of contaminants of potential concern are to be assessed against adopted site investigation levels, which are sourced from NSW EPA made or approved guidelines with reference to site-specific exposure scenarios for permissible and proposed land use.
  - If concentrations of contaminants in soils and groundwater are below the adopted investigation levels, then contamination at the site will be considered unlikely to pose an unacceptable risk to identified receptors. In such case, no further investigation, remediation or management will be considered warranted.
  - Conversely, when concentration(s) of contaminants of potential concern exceed the adopted site investigation levels, further assessment may be required to evaluate the need for additional investigation and / or remediation / management activities.

## 6.7 Step 6: Specify limits on decision errors

Two primary decision error-types may occur due to uncertainties or limitations in the project data set:

- A sample/area may be deemed to pass the nominated criteria, when in fact it does not. This may occur if contamination is 'missed' due to limitations in the sampling plan, or if the project analytical data set is unreliable.

- A sample/area may be deemed to fail the nominated criteria, when in fact it does not. This may occur if the project analytical data set is unreliable, due to inappropriate sampling, sample handling, or analytical procedures.

The following aspects were considered when establishing the acceptable limits on decision errors:

- The null hypothesis for the project is: the sample / investigation area is deemed to be contaminated. Sufficient weight of evidence, via the uses of statistical analysis (e.g. 95% upper confidence limit of the mean (UCL)) and/or gathering of multiple lines of evidence (e.g. desktop review and laboratory analytical data), would be required to reject / disapprove the null hypothesis.
- A quality assurance / quality control (QA/QC) assessment evaluating the reliability and useability of data, which are expressed as five data quality indicators (DQI) discussed in Section 6.7.1.

### 6.7.1 Data quality indicators (DQIs)

The DQIs for sampling techniques and laboratory analysis of collected samples identifies the acceptable level of error for this investigation. The DQIs adopted in this investigation comprise five components, being precision, accuracy, representativeness, comparability and completeness. Detailed discussion of each component is provided below:

- Precision – measures the reproducibility of measurements under a given set of conditions. The precision of the data is assessed by calculating the Relative Percent Difference (RPD) between duplicate sample pairs.

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where Co = Analyte concentration of the primary sample
Cd = Analyte concentration of the duplicate sample

- GHD adopts a nominal acceptance criterion of < 50% RPD for field duplicates and splits for organics and an acceptance criterion of < 30% RPD for inorganics. However, it is noted that this will not always be achieved, particularly at low analyte concentrations and in heterogeneous media.
- Accuracy – measures the bias in a measurement system. Accuracy can be undermined by such factors as field contamination of samples, poor preservation of samples, poor sample preparation techniques and poor selection of analytical techniques by the analysing laboratory. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes, laboratory blanks and analyses against reference standards. The nominal “acceptance limits” on laboratory control samples are defined as follows:

  – Laboratory spikes – 50-150% recovery for metals / inorganics and 60-140% for organics.

  – Laboratory duplicates – Nominal RPD values of 30% or lower. Higher RPD values are generally considered acceptable when the result is close to the PQL.

  – Laboratory Surrogates (Organics only) – 50% - 150% recovery.

  – Laboratory blanks - <PQL.

- Representativeness – expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples in appropriate locations across the investigation area, and by using an adequate number of sample locations to characterise soil and groundwater at the investigation area. Consistent and repeatable sampling techniques and methods are utilised throughout the sampling.
- Completeness – defined as the percentage of measurements made which are judged valid measurements. The completeness goal is set at there being sufficient valid data generated during the study. If there is insufficient valid data, then additional data are required to be collected.
- Comparability – is a qualitative parameter expressing the confidence whether one data set can be compared with others. This is achieved through maintaining a level of consistency in techniques used to collect samples and ensuring analysing laboratories use consistent analysis techniques and reporting methods.

## 6.8 Step 7: Optimise the design for obtaining data

With due consideration given to the DQO steps described above, and scope limitations, a sampling and analytical quality plan was developed to address the questions identified in Section 6.3 within the constraints of collecting data from the concurrent geotechnical investigation program.

# 7. Sampling and analysis plan

## 7.1 Incidental Sampling Program

WorleyParsons (WP) undertook a site geotechnical assessment of the pipeline route concurrently with the preparation of this Preliminary Site Invesitgation (PSI). To assist with understanding the potential contamination status of the site GHD provided direction and guidance on the opportunistic collection of samples for analysis for the following contaminants of potential concern (COPC)

- Metals (including chromium by toxicity characteristic leaching procedure (TCLP))
- Total recoverable hydrocarbons (TRHs)
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- Polycyclic aromatic hydrocarbons (PAHs)
- Asbestos

A total of 13 primary samples were collected from the following boreholes:

- BH12
- BH16
- BH17
- BH21
- BH22
- BH23
- BH24
- BH25
- BH26

Samples were collected via drill rig utilising push tube or standard penetration test (SPT) tubes, as contamination sample collection was a secondary objective for the fieldwork program sample collection was limited to circumstances where there was enough residual material after geotechnical sample collection.

Samples for acid sulphate soil (ASS) analysis were also collected where possible, utilising field screening. Samples typically targeted fill (possible dredged sediments) and natural soils. Based on field screening results, selected samples were analysed for a chromium reducible sulphur suite.

## 7.2 Quality assurance / quality control plan

A QA/QC plan was designed to achieve predetermined data quality indicators (DQIs) that will demonstrate accuracy, precision, comparability, representativeness and completeness of the data generated. The QA/QC plan was prepared to be implemented across both the pipeline sampling program and the Berth 101 land side sampling program as both sampling programs were implemented in a single round of fieldwork. Results from duplicates, trip spikes and trip blanks have been reported across both programs as required.

### 7.2.1 Quality assurance

Fieldwork will be undertaken by experienced and appropriately qualified scientists/engineers following written field procedures.

Sample collection will be conducted in general accordance with relevant GHD's Standard Operating Procedures (SOPs) which are based on general industry standards, the National Environment Protection (Assessment of Contamination) Measure 1999 as amended 2013 (NEPC, 1999), and Australian Standards AS4482.1 and AS4482.2, Guide To Investigation and Sampling of Sites with Potentially Contaminated Soil (Part 1 Non-volatile and semi-volatile compounds; and Part 2 Volatile Substances).

### 7.2.2 Field quality control samples

The following quality control samples will be collected and analysed for QA/QC purposes based on the:

- Intra-laboratory duplicate samples will be collected at the rate of 5% of the total number of samples collected (proposed for chemical analysis, excludes samples for asbestos analysis). This equates to one duplicate sample per two batches of processed material assessed.
- Inter-laboratory duplicate samples will be collected at the rate of 5% of the total number of samples collected (proposed for chemical analysis, excludes samples for asbestos analysis). This equates to one triplicate sample per four batches of processed material assessed.
- Trip blanks and trip spikes will be transported with samples at a rate of one per sample batch per day.

Rinsates blanks were not considered to be required, as sampling equipment will not be reused.

### 7.2.3 Laboratory quality control samples

Laboratory quality control will include the following:

- The laboratory analysis of samples will be undertaken by NATA accredited testing laboratories.
- Samples will be transported to the following laboratories under chain of custody for analysis:
  - Eurofins|MGT laboratory, Lane Cove, NSW – Primary soil samples.
  - ALS Environmental Services Pty Ltd, Sydney, NSW – Inter-laboratory duplicates.
- The NATA accredited environmental testing laboratories will implement a quality control plan conforming to Schedule B(3) 'Guideline on Laboratory Analysis of Potentially Contaminated Soils' of the National Environment Protection (Assessment of Site Contamination Measure 1999 as amended in 2013 (ASC NEPC, 2013); and
- The laboratory will perform reagent blanks, spike samples, duplicate spikes, matrix spikes, surrogate spikes and duplicates to assess laboratory quality control.

# 8. Assessment criteria

## 8.1 Contamination

The assessment criteria proposed for this project were sourced from the following references:

- NEPC (1999) National Environment Protection (Assessment of Site Contamination) Amendment Measure (No. 1) 2013 (NEPM)
- Friebel and Nadebaum (2011) CRC Care Technical Report No. 10 – Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater

The NEPM (2013) presents health based investigation levels for different land uses (e.g. industrial / commercial, residential, recreational, etc.) as well as ecological investigation levels.

The proposed pipeline alignment passes through multiple heavy industrial areas of Port Kembla as well as a small section of public parkland. The site land use across these areas is not anticipated to change under the proposed development.

The potential receptors include commercial / industrial workers, recreational / public open space site users / visitors and intrusive maintenance workers. It is expected during construction workers may be in direct contact with soil for short periods.

In addition to human health risks, ecological risks also need consideration for the above land uses. The ecological risks consider contaminant impacts to vegetation and transitory wildlife. The risk to those receptors is dependent on the exposure pathway and site activities, which may degrade ecological values (e.g. a railway corridor). The site and surrounding areas have been used for heavy industrial activities for over 50 years with significant sections of the alignment running over reclaimed land. The site is crosses multiple railway and road corridors as well lands used for a number of heavy industrial purposes significantly reducing the amenity for ecological receptors. Therefore, ecological values are considered to be significantly degraded and are not considered to require further assessment.

The following assessment criteria will be adopted for soil assessment purposes:

- Health investigation level (HIL) for non petroleum contaminants of potential concern (Table 1A(1) of NEPM HIL  C and D)
- Direct contact and intrusive maintenance worker screening values for petroleum hydrocarbons listed in Tables B3 and B4 (CRC Care, 2011)
- Management Limits for TRH fractions in soil (Table 1B(7) of the NEPM)

The assessment criteria selected are listed in Table LR1.

## 8.2 Waste classification

Samples were assessed against contaminant concentrations for classifying waste as detailed in the Waste Classification Guidelines - Part 1: Classifying Waste and Part 4: Acid Sulfate Soils (NSW EPA (2014)). This process is intended to provide an indicative waste classification for the samples collected only and is not indicative of the waste classification for all materials which might be encountered along the pipeline alignment.

Waste classification criteria adopted for this assessment are listed in Table LR2.

## 8.3 Acid sulphate soils

The assessment and management of coastal acid sulphate soils has been based on the following:

- Acid Sulfate Soil Manual (1998) prepared by the Acid Sulfate Soil Management Advisory Committee (ASSMAC 1998).
- Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M., 2014. Queensland Acid Sulfate Soil Technical Manual (QASSTM): Soil Management Guidelines. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government (Dear et al 2014).

It is generally accepted that the 1998 ASSMAC Guidelines, whilst still useful as a reference document, have been superseded in terms of up to date scientific research and management practices. For this reason the Queensland guidance has been adopted for management of coastal acid sulphate soils (CASS) on the east coast of Australia.

ASS action criteria adopted for this assessment are listed in Table 8-1.

### Table 8-1 - QASSTM (2014) acid sulphate soil action criteria

| Soil Texture Category | Approximate Clay Content (%) | Action Criteria (>1000 tonnes) | |
|---|---|---|---|
| | | Sulphur Trail Net Acidity | Acid Trail Net Acidity |
| | | (SPOS or SCR) (%) | TAA, TPA or TSA (mol $H^+$/tonne) |
| Coarse | <5% | 0.03 | 18 |
| Medium | 5% to 40% | 0.03 | 18 |
| Fine | >40% | 0.03 | 18 |

Notes:

Net Acidity calculated using acid base accounting

SPOS Peroxide oxidisable sulphur

SCR Chromium reducible sulphur

TAA Total Actual Acidity

TPA Total Potential Acidity

TSA Total Sulfidic Acidity

# 9. Field investigations

The subsurface investigation for the pipeline alignment was carried out between 29 August 2018 and 12 October 2018 by WorleyParsons field staff who were conducting a geotechnical investigation for the same project at the time of GHD's investigations. WorleyParsons field staff were briefed by GHD on the procedure to collect and adequately preserve samples, they were also supplied with all the necessary decontamination equipment and containers necessary to perform the task.

## 9.1 Fieldwork

The sampling locations were initially cleared used a suitably qualified service locator prior to excavation. Locations and elevation were then recorded by a surveyor, sampling locations are shown on Figure 2. Current investigation test pit and borehole logs are included in Appendix I.

Fourteen boreholes, designated BH12 and BH14 to BH26, were drilled using a truck mounted Scout rig. Drilling was advanced using 100 mm solid flight augers to penetrate pavement or gravel hardstand, continuous push tube sampling was used to sample until approximately 4 m to 5 m, wash boring and push tube were used to obtain samples from that point onward. Casing was advanced in all holes due to sub-surface conditions being largely saturated sand, which resulted in partial collapse of the boreholes at all locations.

Pac L Ultra product (drilling mud) was used to wash bore at an approximate ratio of 0.5/1000 L product to water, testing was carried out on this product to assess its chemical properties.

## 9.2 Soil sampling

Samples for contamination analysis were collected opportunistically from the geotechnical boreholes as practicable, noting that if geotechnical samples were required these took priority. During drilling, each sample was collected with a new pair of nitrile gloves, directly from the push tube sleeve or by direct sample grab.

Where possible soil samples were collected at major changes in stratigraphy or where evidence of odours or staining was noted (if observed). Clean 250 mL glass jars were filled with soil to the brim and immediately sealed with Teflon lined caps to lower the potential for loss of volatile contaminants. Samples were then labelled and placed directly into ice filled cooler boxes. A minimum of 50 g of soil was placed in zip lock bags for asbestos testing. A minimum sample of 100 g of soil was placed in zip lock bags for acid sulphate soil testing.

Quality control samples across the pipeline sampling programs included:

- Collection and analysis of two duplicate (intra-laboratory) and one triplicate (inter-laboratory) soil samples.
- One pair of laboratory prepared soil trip spikes and trip blanks were transported with the samples, results indicated no isues with volatile cross-contamination or recover.
- The available water on-site was from recycled and hydrant sources. GHD was advised that the water being used for drilling was from the hydrant water supply and not the recycled water. To assess the quality of water being used during drilling and assess the potential for cross contamination, a sample from the source water was collected and designated BWS01. This sample was analysed for a broad suite of COPC including total recoverable hydrocarbons (TRH), benzene, toluene, ethyl-benzne and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides (OCP), organophosphate pesticides (OPP), polychlorinated biphenyls (PCB), volatile organic compounds (VOCs), metals and pH. Bromodichloromethane, dibromochloromethane and chloroform as well as

some metals were detected above laboratory LOR in the background water. Results are considered to reflect typical tap water and are considered to be at an insufficient level to significantly impact soil sampling results. Analysis results are reported in Appendix F.

- Drilling mud was introduced into the borehole to stabilise the hole and facilitate sampling. The use of drilling muds was unavoidable, as sampling was required below the water table in largely non-cohesive soils. The safety data sheet (SDS) had limited detail on the specific ingredients in the drilling muds composition, therefore, samples of drilling mud, in solution (DW01) and concentrate (DS01) were collected and analysed for TRH, BTEX, PAH and metals. Detections of some TRH fractions and metals were identified in both samples however are considered to be at an insufficient level within the wet sample (DW01) to significantly impact soil sampling results. Drilling mud analysis results are reported in Appendix F.
- A single rinsate sample was collected during sampling, no contaminants of concern were detected above laboratory limits of report. Analysis results are reported in Appendix F.

The laboratory reports, chain-of-custody (COC), and Sample Receipts are provided in Appendix E.

# 10. Results

## 10.1 Subsurface conditions

GHD's investigation was concurrent with a geotechnical investigation of the berth and pipeline route being conducted by WorleyParsons. To assist with the preparation of this report GHD has been supplied with field logs from the geotechnical investigation which have been summarised below and in Table 10-1 with locations shown in Figure 2.

Fill materials were encountered up to more than 10 m thick, and generally contained coal, coal wash and slag with trace fragments of potential asbestos containing materials and other anthropogenic materials. Probable natural alluvial soils were encountered in all locations tended towards sand in the east with increasing clay content in the western extents of the alignment. Bedrock was not encountered above the depth of investigation (up to 30.0 m at BH 15) in the east but consisted of predominately siltstone or mudstone in the west

**Table 10-1 - Subsurface conditions summary**

| Location | Fill Depth | Fill Material | Natural Depth | Natural Material | Bedrock | Water level |
|---|---|---|---|---|---|---|
| BH12 | 1.75 | Gravelly Sand | > 15.00 | Sand to Sandy Clay | N/E | N/R |
| BH14 | 4.65 | Gravelly Sand to Gravelly Clay | > 25.62 | Sand to Sandy Clay | N/E | N/R |
| BH15 | 4.00 | Silty Sand | > 30.00 | Sand to Sandy Clay | N/E | N/R |
| BH16 | 10.50 | Silty Sand to Silty Gravel | 17.11 | Clayey Silt | Mudstone | N/R |
| BH17 | 5.70 | Gravelly Sand | 18.20 | Clay to Clayey Sand | Mudstone | N/R |
| BH18 | 1.90 | Sandy Gravel | 17.00 | Clay to Sandy Clay | Siltstone | 6.00 |
| BH19 | 1.00 | Sandy Gravel | 9.80 | Clay to Sandy Clay | Siltstone | N/R |
| BH20 | 4.50 | Gravelly Sand to Sandy Gravel | 12.60 | Clay to Sandy Clay | Siltstone | N/R |
| BH21 | 0.60 | Silty Sand | 9.75 | Clay to Clayey Sand | Siltstone | N/R |
| BH22 | 5.20 | Gravelly Sand to Sandy Gravel | 15.00 | Clay | Siltstone | 5.2 |
| BH23 | 2.50 | Gravelly Clay | 16.60 | Clay to Sandy Clay | Siltstone | 4.5 |
| BH24 | 1.75 | Gravel | 13.30 | Clay to Gravelly Clay | Sandstone | N/R |
| BH25 | 3.10 | Sandy Gravel to Gravelly Clay | 5.30 | Sandy Clay | Siltstone | N/R |
| BH26 | 1.00 | Sandy Gravel | 6.25 | Clay | Siltstone | N/R |

Note – N/E Not Encountered, N/R Not Recorded

## 10.2 Laboratory testing

### 10.2.1 Data validation

*Laboratory analysis*

Soil samples were transported in ice-cooled chests to the contract laboratory Eurofins|MGT laboratory, Lane Cove, NSW. A copy of the chain of custody for all batches is attached. The laboratory selected to carry out analysis is NATA accredited for the analysis performed. Test methods are listed on the attached laboratory reports.

Samples were selected for analysis based on geological origin type of the material, sample location, visual and olfactory evidence of potential contamination.

*Field and laboratory quality control assessment*

In order to validate the representativeness of soil sampling results, a range of field and laboratory quality control (QC) samples were collected and assessed during the investigation.

Based on our assessment, the following comments can be made:

- No laboratory non-conformances that pertained to GHD samples were reported.
- Field duplicates: Higher RPDs between 36% and 90% were recorded for some metals, which exceeded the adopted control limit (i.e. < 30% or no limit if result is less than ten times the limit of reporting). This result may indicate some variability in contaminant concentrations, particularly metals, which can be expected in fill. This is not considered to affect the conclusions of the report as all concentrations are well below the adopted assessment criteria.
- A single rinsate samples was collected, all analytes were below the laboratory LOR.
- Trip spike and blank results were within adopted control limits.

GHD considers that the laboratory QC results are representative of the soil conditions encountered at the locations sampled and therefore acceptable for the purposes of interpreting and verifying the analytical results in this assessment.

### 10.2.2 Analytical results – human health and management limits

The laboratory analytical results for soil are summarised in Table LR1 (Appendix F). Original laboratory reports are included in Appendix E. No exceedances of adopted human health assessment criteria were reported in soil samples.

Laboratory results were consistent with field observations.

### 10.2.3 Analytical results – preliminary waste classification

The laboratory results for this assessment are summarised in Table LR2 (Appendix F) and laboratory reports are included in Appendix E. Results were compared against contaminant concentrations supplied within NSW EPA (2014) Waste Classification Guidelines.

All contaminant concentrations were below the CT1 criteria, with the exception of chromium at BH16_1.0 which was below the SCC1 criterion. Further assessment using the toxicity characteristic leachability procedure (TCLP) confirmed that leachable concentrations for chromium in BH16_1.0 were below the TCLP1 criteria.

Based upon the results of the chemical assessment the material represented by the analysed samples is consistent with a General Solid Waste classification.

### 10.2.4 ASS laboratory testing

#### *Field Screening*

The ASS field screening results are included in Appendix E. The 15 samples were submitted for field screening and the results are summarised below:

- No samples reported $pH_{water}$ less than 4.5.
- $pH_{FOX}$ of less than 3.5 was reported for samples BH12_12.25-12.45, BH12_13.5-13.95 and BH17_7.5.

The field screening results indicate that there is a potential for actual ASS to be present at the locations and depths tested.

#### *Acid sulphate soils – chromium reducible sulphur method*

In order to supplement the ASS field screening results, five samples were submitted to the NATA accredited laboratory, for laboratory analysis using the chromium reducible method (Scr). The results were compared to the action criteria provided in the QLD (2014) Acid Sulfate Soils Technical Manual – Soil management Guidelines V4.0 based on greater than 1,000 tonnes of coarse texture soils to be disturbed.

The laboratory report is included in Appendix E. The results have been summarised in Table 10-2. Samples that exceeded screening criteria are located at depth beneath the PKCT at the eastern end of the pipeline alignment or at depth in the northern extent of the alignment on reclaimed land. Samples are taken from natural sediments.

**Table 10-2 - ASS chromium reducible sulphur analysis results**

| Sample ID | $pH_{KCl}$ | TAA (%) | Scr (%) | Net Acidity (%) | Liming Rate (kg $CaCO_3$ per tonne) |
|---|---|---|---|---|---|
| BH12 9.0-9.45 | 7.6 | <0.02 | 0.027 | <0.02 | <1 |
| BH12 12.25-12.45 | 5.3 | <0.02 | 0.15 | 0.14 | 7.1 |
| BH12 13.5-13.95 | 4.6 | 0.09 | 4.6 | 4.7 | 220 |
| BH17 7.5 | 6.5 | <0.02 | 0.73 | 0.6 | 28 |
| BH21 9.0-9.12 | 5.3 | <0.02 | 0.005 | <0.02 | <1 |

# 11. Preliminary conceptual site model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM is developed using information obtained from previous investigations, site history, site observations, proposed land use and expected ground conditions. Once the contamination status is understood through the sampling and analysis process, the CSM then allows the assessor to evaluate the risk posed by the contamination to the identified receptor, and whether remediation is required to manage that risk.

## 11.1 Potential contamination sources and associated contaminants of potential concern

Site history information and site observations indicate four potentially contaminating activities have occurred on and adjacent to the pipeline alignment. These activities and potential sources of contamination include:

- Fill materials including dredged materials, coal and coal by-product, steel production by-product (slag) and possible building demolition materials. Historical information indicates that significant sections of the proposed alignment are on land that has been historically reclaimed from Tom Thumbs Lagoon. In addition to this all locations assessed by WorleyParsons as part of their geotechnical investigation program had identified fill materials of varying depths, up to more than 10 metres in places.

  There is limited evidence available from aerial photographs that a number of structures were constructed and demolished, particularly along the western extent of the alignment, prior to 1984. The potential for use of hazardous building materials such as asbestos and lead based paints in these buildings is high and the potential impacts from poor demolition practices should be considered when assessing or excavating fill in these areas.

- Spills and surface application of fuels, oils and other chemicals associated with current and former industrial land uses. Since at least 1961 much of the pipeline alignment has been used for heavy industrial applications, including steel and steel product manufacture and bulk shipping. Surface spills and application of chemicals used for a range of activities such as steel production, transport and waste management may have potentially had top down impacts on underlying materials.

- Historical impacts associated with former nightsoil depot. Land titles records indicate that a small portion of the site within PKCT was utilised as a night soil depot between 1905 and 1955. From 1956 the sewage treatment plant north of PKCT was constructed and replaced the depot. While impacts at this location are anticipated to have attenuated over time more persistent components of activity may still be present.

- Current and historical impacts associated with use of land adjacent to the alignment as workshops and fuel depots. A number of workshops, store houses and refuelling points have been identified on land immediately adjacent to the proposed alignment within the PKCT. Recent historical groundwater monitoring around the UPSS infrastructure (GHD, 2011 to 2013) did not identify any contamination or evidence of spills or leaks. Potential for more recent spills or leaks from the UPSS as well as oil traps and separator pits associated with the workshops and identified by Douglas Partners (2012) cannot be precluded based on the available information.

Associated contaminants of potential concern (COPC) for these sources were assessed to be:

- Fill material along the alignment: TRH, BTEX, PAH, TBT, cyanide, ammonia, metals (including lead) and asbestos.
- Surface spills associated with current and former land uses: TRH, BTEX, PAHs, metals, phenols, volatile organic compounds (VOCs), volatile halogenated compounds (VHCs)
- Historical night soil depot: metals.
- Adjacent workshops and fuel depots: TRH, BTEX, PAHs, metals, phenols, oil and grease, volatile organic compounds (VOCs), volatile halogenated compounds (VHCs)

## 11.2 Potential exposure pathways

The primary pathways by which potential receptors could be exposed to the COPC outlined above are considered to be:

- Direct contact (including incidental ingestion) with contaminated soil or groundwater
- Inhalation of dust from contaminated soils
- Inhalation of vapours/gases generated by soil / groundwater contaminated by volatiles and semi-volatiles

## 11.3 Potential receptors

This assessment focuses on the proposed land use of the site. Accordingly, the key receptors of interest include:

- Future construction workers: individuals involved in potential future construction and maintenance of the site. It is assumed that the presence of buildings above the pipeline route is unlikely for maintenance purposes
- Future site users: including industrial workers and site visitors..
- Intrusive maintenance workers: carrying out repairs on the pipeline. It is expected that minor excavation activity could occur in the future (e.g. for installation of additional services).
- Ecological receptors: the site and surrounding areas have been used for heavy industrial purposes for 50 to 100 years. Some of these industries include the Port Kembla Steelworks and chemical plants, which have discharged waste waters into the Inner Harbour for many years. It is considered that the ecological amenity has been significantly degraded. It is not expected that the proposed development will encourage or improve ecological amenity.
- Recreational users: where the pipeline crosses areas of parkland and public open space.

## 11.4 Source-pathway-receptor linkages

Based on the above and as identified in the CSM, Table 11-1 lists the potential Source-Pathway-Receptor (SPR) contaminant linkages and Areas of Environmental Concern (AEC) that have been identified for the site.

### Table 11-1 - Source-Pathway-Receptor Linkages

<table>
<tr><th>AEC</th><th>Source</th><th>Pathway</th><th>Receptor</th></tr>
<tr><td>1</td><td>Fill material along alignment</td><td rowspan="3">Dermal contact with contaminated soil or groundwater.<br>Inhalation of dust from contaminated soils.<br>Inhalation of vapours/gases generated by soil and groundwater contaminated by volatiles and semi-volatiles (if present)</td><td rowspan="3">Future workers<br>Future site users<br>Intrusive maintenance workers</td></tr>
<tr><td>2</td><td>Surface spills associated with current and former land use</td></tr>
<tr><td>4</td><td>Adjacent workshops and refuelling depot</td></tr>
<tr><td>3</td><td>Historical night soil depot</td><td>Dermal contact with contaminated soils<br>Inhalation of dust from contaminated soils</td><td>Future workers<br>Future site users<br>Intrusive maintenance workers</td></tr>
</table>

While no potentially complete linkages have been identified through the sampling undertaken in this assessment, it should be noted that the sampling has been limited in nature, and the pipeline crosses over six kilometres of filled industrial land. Therefore, contamination has the potential to be encountered and should be anticipated when developing construction environmental management plans for the proposal.

# 12. Conclusions and recommendations

Based on the scope of work undertaken, and subject to the limitations in Section 1.3, the following is concluded.

- Available site history information indicates development along the pipeline alignment commenced between 1951 and 1961 and included the upgrade of transport infrastructure to the current standard, the reclamation of land within Tom Thumbs Lagoon and the construction of the steelworks and port facilities. The site usage has remained heavy industrial since this period and site activities appear to have been relatively unchanged since 1994.
- Based upon the findings of this investigation four potential areas of environmental concern (AEC) have been identified:
  – AEC 1 - Fill materials along the entire pipeline alignment including dredged materials, coal and coal by-product, steel production by-product (slag) and possible building demolition materials
  – AEC 2 - Spills and surface application of fuels along the entire pipeline alignment, oils and other chemicals associated with current and former industrial land uses
  – AEC 3 - Historical impacts associated with former nightsoil depot within PKCT
  – AEC 4 - Current and historical impacts associated with use of land adjacent to the alignment as workshops and fuel depots.
- AEC 1 and 2 are considered to have a moderate likelihood of contamination, fill material has been identified along the alignment whilst potentially contaminating activities have been occurring in the area since the 1950s. Limited soil sampling and analysis conducted opportunistically as part of the concurrent WorleyParsons geotechnical investigation did not identify any widespread, gross contamination; however it is insufficient to provide a detailed understanding of the contamination status of soils along the alignment.
- AEC 3 is located within a poorly defined area within PKCT. Due to the age of the depot and the time since active use the likelihood of residual contamination from this source is considered low. Later site activities including reclamation and land filling are likely to have further reduced the contamination potential.
- AEC 4 is considered to have a moderate likelihood of contamination. Previous investigations by GHD (2011 to 2013) did not identify any contamination likely to be associated with the UPSS infrastructure at the PKCT refuelling depot. Impacts from current or historical sources along the alignment have not been identified by this investigation but are considered likely. Contamination from this source if likely to be localised in the context of the alignment.
- Under the proposed site usage scenario a number of potentially complete source-pathway-receptor linkages were identified within the CSM for future site workers and users andintrusive maintenance workers. These include:
  – Dermal contact with contaminated soil or groundwater.
  – Inhalation of dust from contaminated soils.
  – Inhalation of vapours/gases generated by soil and groundwater contaminated by volatiles and semi-volatiles (if present).
- Preliminary waste classification of collected samples indicates that the soils sampled as part of this investigation would be classified as General Solid Waste should off-site disposal be required. This does not constitute a full waste classification of material within the

pipeline alignment and additional sampling and assessment will be required in order to confirm classification of specific materials should off-site disposal be required.

- Preliminary assessment of site soils for acid sulphate soils identified actual acid sulphate soils at BH12 and BH17. In both cases ASS was identified at depth (>12.25 m and 7.5 m) and are from buried lagoon sediments. This is consistent with the findings of the investigation within the Berth 101 investigation area.

Based upon the findings of the investigation, GHD recommends the following:

- Preparation and implementation of a construction environmental management plan (CEMP) to include an unexpected finds protocol (UFP) to effectively manage the identified potential contamination issues identified from both a human health and environmental perspective. This would include the assessment of materials to be disturbed across the site to inform appropriate management strategies.
- Assessment and classification of all material to be disposed of offsite as per NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* and *Part 4: Acid Sulfate Soils* prior to off-site disposal.
- Preparation of an Acid Sulphate Soils Management Plan (ASSMP) to include measures to manage actual and potential ASS should it be encountered during pipeline construction. Where possible any disturbance (either excavation and or dewatering) of theses natural sediments will need to be carefully managed.
- If the proposed pipeline alignment is likely to intersect groundwater, assessment of groundwater quality in those sections should also be carried out to inform construction management of potential contamination issues.

# 13. References


Dept. of Land and Water Conservation (1997) Wollongong 1:25,000 Acid Sulfate Soil Risk Map

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SIX Viewer https://maps.six.nsw.gov.au/

# Figures