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Preliminary Site Investigation
Collie Roundhouse Redevelopment Area

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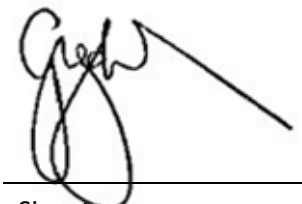
Reviewed by:	Greg Milner Manager – Contaminated Land & Waste (Director)		11 September 2020
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EXECUTIVE SUMMARY

Aurora Environmental (Aurora) was commissioned by The National Trust of Western Australia (NTWA) to undertake a Preliminary Site Investigation (PSI) for the Collie Roundhouse Redevelopment Area (the Site). The redevelopment area comprises Lot 561, Lot 2680 and portions of Lot 2856 and Lot 560.

Historical investigations undertaken by previous landowners (i.e. Public Transport Authority - PTA) have included a limited examination of the buildings for hazardous materials and the soils and groundwater to assess the potential for contamination. The results have shown that the Roundhouse contains asbestos containing materials (ACM) in bonded form in varying states of repair which, due to ongoing vandalism, includes asbestos cement fragments on the soil surface. A recent building assessment for hazardous materials also revealed the limited presence of friable asbestos materials.

Historical investigations identified the Site was used as a railway yard/depot and also had a wastewater treatment facility (although through the PSI this was identified to be offsite) and are land uses with the potential to cause contamination, as specified in the guideline 'Assessment and Management of Contaminated Sites' (Department of Environment Regulation - DER, 2014). Intrusive works assessing the potential for soil and groundwater impacts revealed the presence of buried ash deposits (containing elevated metal concentrations) as well as minor groundwater impacts. In general, data derived from the investigations did not reveal evidence for gross impacts to soil and groundwater at the Site, although it was recognised that there were some uncertainties that required additional assessment.

On the basis of these previous studies the Collie Roundhouse as Lot 561 was reported under the Contaminated Sites Act 2003 (CS Act 2003) and subsequently classified by the Department of Water and Environmental Regulation (DWER) as 'Contaminated – Restricted Use' (CRU) with the use restricted to industrial/commercial type activities.

To guide the adaptive reuse of the Roundhouse, NTWA is developing a concept plan which is understood to potentially include activities such as new stores, a brewery, hospitality tavern-dining use, a children's playground, and a carpark. A key part of achieving this vision is the requirement for the Collie Roundhouse lot to be reclassified to "Remediated for Restricted Use" (RRU) such that it is suitable for commercial use including sensitive land uses such as a children's playground and food preparation and cooking (hospitality tavern dining). To facilitate the reclassification more detailed information is required to better characterise the contamination status of the development area (the Site), the buildings onsite and to understand that potential contamination of the additional land (Lot 2680 and portions of Lot 2856 and 560, which NTWA are in the process of acquiring) included as part of the concept plan and redevelopment area.

It is understood that the Site will at some point in the redevelopment process likely be rezoned which will likely trigger a formal requirement under the CS Act 2003 for a Mandatory Auditors Report (MAR). As such, NTWA have appointed Warren Dodge of Welarm Pty Ltd (Welarm) to prepare a Voluntary Auditors Report (VAR) with a view to support re-classification of the Site to enable its rezoning and redevelopment.

OBJECTIVE

The objective of the PSI is to characterise the contamination status of the Site to understand the potential risk associated with the proposed redevelopment and assess if further works are required.

The technical objectives of the PSI are as follows.

- Identify the areas of potential environmental concern (APEC);
- Identify the probable contaminants of potential concern (COPCs);
- Assess the potential existence of Source-Pathway-Receptor (SPR) linkages; and
- Identify any potential data gaps.

SCOPE OF WORKS

The following scope of work was undertaken in order to achieve the PSI objectives:

- Collation of Site identification details and general information, including current layout and surrounding land uses, and a description of the existing environmental setting (i.e. climate, geology and hydrogeology etc.).
- Procure and review available background information such as dangerous goods licensing, historical ownership, historical aerial photographs, state and federal heritage registers, heritage articles and documents, council records and DWER Basic Summary of Records (BSR) to assist with assessing Site usage history and condition.
- Review of available previous reports pertaining to the activities conducted at the Site, to assist with understanding potentially contaminating industries, activities and land uses.
- Review of historical site assessment data in context of current regulatory requirements.
- Completion of a site inspection.
- Development of a Conceptual Site Model (CSM) including the identification and analysis of SPR linkages and rating the likelihood of potential sources impacting receptors; and
- Identification of data gaps and recommendations.

CONCLUSIONS

The desktop review identified the Site had been extensively used as part of railway operations, primarily related to the transport of coal and to a lesser extent for passenger transport. It is understood that the original Collie railway depot used to service and maintain the steam locomotive fleet was to the east of the Site, however due to increased demands and the ageing structure a new depot was proposed. This resulted in the establishment of the new depot in the late 1950's which included the Roundhouse and Turntable structures amongst others, that extended across the Site and its surrounds. However, operation use of the new depot was relatively short-lived when oil replaced coal as a preferred fuel for locomotive power. Steam locomotives last used the depot operationally in 1971 with the associated buildings going out of use and becoming derelict after that time. By the 1980s, the declining use of rail for transporting coal and other goods saw the buildings progressively removed by the 1990s, most of the sidings in the rail reserve were removed and many structures demolished. No other potentially contaminating activities were identified onsite other than those related to the rail operations.

Review of historical plans/maps identified various structures that may have existed onsite and review of aerial photography confirmed the presence of several structures onsite, which included the Roundhouse, Turntable, Workshop, Compressor Shed, Shunting Crew Buildings and Accommodation

Building. Based upon the plans and potential building footprints identified in previous investigation inspections several other structures may have been present onsite such as the Boiler Shed, Cool and Hot Water Storage Tanks. However other structures such as the Coal Testing Shed and Single Men's Quarters may not have existed based on the locations indicated in the plans reviewed and the lack of confirmatory evidence from the site inspection.

Several environmental investigations were accessed and reviewed as part of the desktop review which had completed extensive intrusive investigations to characterise the contamination status of the Site. Review of the historical reports and the associated soil and groundwater quality data collected showed that the historical data was suitable for use in characterising the Site (albeit often with different investigation boundaries) and assessing potential risks via comparison to current relevant guideline criteria. The Tier 1A risk assessment did not identify any gross contamination onsite that would present an unacceptable risk. However, several data gaps were identified as not all COPCs had been considered or assessed and some of the identified APEC, noted as part of the desktop assessment had not been investigated.

A site inspection was undertaken to assess for APEC and verify the presence of other APEC identified during the desktop assessment. A total of 18 onsite APECs were identified through the PSI with an additional 16 offsite APEC identified. The CSM identified seven potentially complete SPR linkages and two unlikely SPR linkages. As a result, the following data gaps were identified:

- Data Gap 1 – What are the groundwater conditions entering into the Site?
- Data Gap 2 – Do the ash deposits contain asbestos fines (AF)/friable asbestos (FA) and does that require future management/remediation?
- Data Gap 3 – Do the identified stockpiles or areas of Construction and Demolition (C&D) waste present an unacceptable risk?
- Data Gap 4 – Are there any unacceptable risks present associated with current and or former infrastructure onsite and offsite?
- Data Gap 5 – Are there existing soil impacts onsite that present an unacceptable risk?

Further works are considered warranted to assess these data gaps, such that the potential risks associated with the Site as identified though the CSM can be clarified and whether they subsequently require management in the context of the planned future use(s).

RECCOMENDATIONS

On the basis of the findings and conclusions made above the following recommendations are made for consideration:

- Provide this report to the appointed CS Auditor for endorsement;
- To target and address the data gaps identified by the PSI undertake preparation of a Sampling and Analysis Quality Plan (SAQP) to guide a Detailed Site Investigation (DSI) aimed at more closely assessing potential risks associated with the proposed Site redevelopment; and
- Establishment of a legal land parcel which the DWER can reclassify based upon the findings of future investigations. This may be in the form of Interest Only Deposited Plan(s) that corresponds to the Collie Redevelopment Area. The current Site area fully encompasses two

lots (lots 561 and 2680) and includes portions of other lots (lots 560 and 2856) and future works within the Site may not achieve reclassification of the subject lots (i.e. classifications are normally applied to entire lots and there may be other contamination issues on Lot 561 and 2865, which have not been assessed/resolved and are not within the Site boundary).

1 INTRODUCTION

Aurora Environmental (Aurora) was commissioned by The National Trust of Western Australia (NTWA) to undertake a Preliminary Site Investigation (PSI) for the Collie Roundhouse Redevelopment Area (the Site). The redevelopment area comprises Lot 561, Lot 2680 and portions of Lot 2856 and 560, as depicted in Figure 1.

1.1 BACKGROUND

The former Collie Roundhouse (located on Lot 561) was formerly a key part of rail operations in Collie, however, has remained derelict since becoming redundant in the early 1970s. The Collie Roundhouse is one of few relatively complete roundhouses remaining in Australia with many having been demolished after similarly going out of use.

It is understood that the NTWA, Heritage Western Australia (WA) and Shire of Collie have recognised the significance of the Collie Roundhouse and have placed it on their heritage registers and inventories. Additionally, due to its prominent position at the entrance to the Collie township the Roundhouse, through its potential for conservation and adaptive reuse, has been recognised as an important opportunity to assist the economic diversification of Collie, particularly in the context of the changing local economy which has a reduced emphasis on coal mining.

Historical investigations undertaken by previous landowners (i.e. Public Transport Authority - PTA) have included a limited examination of the buildings for hazardous materials and the soils and groundwater to assess the potential for contamination. The results have shown that the Roundhouse contains asbestos containing materials (ACM) in varying states of repair with ACM fragments also present in surface soil, due to ongoing vandalism of the Roundhouse structure. In addition, ash deposits in soil have also been identified which require to be characterised.

On the basis of these previous studies the Collie Roundhouse as Lot 561 was reported under the Contaminated Sites Act 2003 (CS Act 2003) and subsequently classified by the Department of Water and Environmental Regulation (DWER) as 'Contaminated – Restricted Use' (CRU) with the use restricted to industrial/commercial type activities.

To guide the adaptive reuse of the Roundhouse, NTWA is developing a concept plan which is understood to potentially include activities such as new stores, a brewery, hospitality tavern-dining use, a children's playground, and a carpark. Additionally, the State Government has recently allocated approximately $1M from the Collie Futures Industry Development Fund, to assist with turning the concept plan for the Collie Roundhouse into reality.

A key part of achieving this vision is the requirement for the Collie Roundhouse lot to be reclassified to "Remediated for Restricted Use" (RRU) such that it is suitable for commercial use including the sensitive land uses including a children's playground and food preparation and cooking (hospitality tavern dining). To facilitate the reclassification more detailed information is required to better characterise the contamination status of the development area (the Site), the buildings onsite and to understand that potential contamination of the additional land (Lot 2680 and portions of Lot 2856 and 560, which NTWA are in the process of acquiring) required as part of the concept plan and redevelopment area.

It is understood that as the Site will likely be rezoned which will likely trigger a requirement for a Mandatory Auditors Report (MAR). As such, NTWA have appointed Warren Dodge of Welarm Pty Ltd (Welarm) to prepare a Voluntary Auditors Report (VAR) with a view to support re-classification of the Site to enable its redevelopment.

In assessing the contamination status of the Site, a PSI was required to be undertaken. It is anticipated that this PSI will be used as the basis for the preparation of a Sampling and Analysis Quality Plan (SAQP) and a subsequent Detailed Site Investigation (DSI).

1.2 OBJECTIVES

1.2.1 Project Objective

The overarching objective project is to enable re-classification of the Site for its redevelopment, in line with the following guidelines:

- Assessment and Management of Contaminated Sites (Department of Environmental Regulation – DER, 2014);
- National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (NEPC, 1999 as amended 2003); and
- Department of Health (DoH) Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia (2009).

1.2.2 Preliminary Site Investigation Objective

The objective of the PSI is to characterise the contamination status of the Site to understand the potential risk associated with the Site and assess if further works are required.

The technical objectives of the PSI are as follows.

- Identify the areas of potential environmental concern (APEC);
- Identify the probable contaminants of potential concern (COPCs);
- Assess the potential existence of Source-Pathway-Receptor (SPR) linkages; and
- Identify any potential data gaps.

1.3 SCOPE OF WORKS

The following scope of work was undertaken in order to achieve the PSI objectives:

- Collation of Site identification details and general information, including current layout and surrounding land uses, and a description of the existing environmental setting (i.e. climate, geology and hydrogeology etc.).
- Procure and review available background information such as dangerous goods licensing, historical ownership, historical aerial photographs, state and federal heritage registers, heritage articles and documents, council records and DWER Basic Summary of Records (BSR) to assist with assessing Site usage history and condition.
- Review of available previous reports pertaining to the activities conducted at the Site, to assist with understanding potentially contaminating industries, activities and land uses.

- Review of historical site assessment data in context of current regulatory requirements.
- Completion of a site inspection.
- Development of a Conceptual Site Model (CSM) including the identification and analysis of SPR linkages and rating the likelihood of potential sources impacting receptors; and
- Identification of data gaps and recommendations.

2 SITE IDENTIFICATION

The Site that makes up the study area of the PSI is depicted in Figure 2. Site identification details are provided in Table A below. The certificate of title's (CoT) are presented in Appendix 1.

TABLE A: SITE IDENTIFICATION DETAILS

IDENTIFICATION FEATURES	DETAILS
Site Name:	Collie Roundhouse
Site Address:	Throssell St/Coalfields Highway, Collie, WA, 6225
Title Identification Details:	The Site extends over the following Lots: • Lot 561 on Plan 68077 (entirety). • Lot 2860 on Plan 36230 (entirety). • Lot 560 on Plan 68077 (select portion only). • Lot 2856 on Plan 36230 (select portion only).
Coordinates of Site Boundaries	Depicted in Figure 2.
Approximate Site Area	7.62 hectares • Lot 561 – 6.17ha. • Lot 2860 – 0.35ha. • Lot 560 – 0.48ha. • Lot 2856 – 0.62ha.
Local Government Authority:	The Shire of Collie
Current Zoning:	Railway (Shire of Collie Town Planning Scheme No. 5), applies to all Lots. Zoning presented in Figure 3.
Current Site Use:	• Lot 561 is vacant. • Lot 2860 is vacant. • Select portion of Lot 560 as part of the Site is vacant with the remaining used by PTA and leased by Aurizon. • Select portion of Lot 2856 as part of the Site is used as access corridor by Arc Infrastructure and the remaining by both PTA and Aurizon.
Current *CS Act 2003* Classification	• Lot 561 has been classified as CRU. • Lot 2860 has not been reported. • Lot 560 is yet to be classified. • Lot 2856 is yet to be classified.

TABLE A: SITE IDENTIFICATION DETAILS

IDENTIFICATION FEATURES	DETAILS
Previous Environmental Investigations/Reports:	• Greg Rowe and Associates (1998) Collie – Landuse Plan for Non-Operational Railway Reserve. • Golder Associates (2002) Phase I Environmental Site Investigation Former Collie Railyard, Collie WA, January 2002. • Halpern Glick Maunsell (2002a) Sampling and Analysis Programme - Detailed Site Investigation – Collie Railway Yard, Collie, WA, Western Australia Government Railways Commission, July 2002. • Halpern Glick Maunsell (2002b) Detailed Site Investigation – Collie Railway Yard, Collie, WA, Western Australia Government Railways Commission, October 2002. • Halpern Glick Maunsell (2003) Groundwater Monitoring – Collie Railway Yard, Collie, WA, Western Australia Government Railways Commission, May 2003. • Golder Associates (2007) Preliminary Environmental Site Investigation Collie Roundhouse and Depot, Coalfields Road Collie WA, January 2007. • RiskCover (2011) Collie Round House Site Risk Review, National Trust of Australia (WA), September 2011. • Golder Associates (2013a) Data Gap Analysis and Work Plan Collie Roundhouse, Coalfields Road Collie Western Australia, February 2013. • Golder Associates (2013b) Groundwater Assessment Collie Roundhouse, Coalfields Road Collie Western Australia, November 2013. • Engtech Risk Consultants (2015) Remediation Closeout Report – Brake Pads (Stockpile) Collie Round House, April 2015. • Aurora Environmental (2020) Hazardous Material Management Plan Collie Roundhouse, 7 May 2020.

2.1 SITE LAYOUT AND SURROUNDING LANDUSE

The Site is approximately 200km south of Perth and 60km inland from Bunbury. Collie is well known for producing coal, being the only coalfields in Western Australia and also for power production through the Muja Power Station, east of the town centre.

The Site is within the Collie township with the Site and was unoccupied at the time of the site inspection, with the Roundhouse, Turntable, Compressor Shed and unknown building (west of the Compressor Shed, thought to be accommodation building) the notable above ground infrastructure still present. Five groundwater monitoring wells are also understood to have been installed onsite, however only four identified during the site inspection.

Surrounding land uses and zoning of the Site are presented in Figure 3, with the land use described below:

- North – current functioning railway line between Collie and Australind, followed by Collie State Forest to the north-west portion of the Site and mixed use/residential to the north east of the Site.
- East – vacant land zoned parks and recreation followed by the Collie Visitor Centre, commercial building operating as Collie Mowers, vacant land zoned parks and recreation and Prinsep Street.
- South – Coalfields Highway/Throssell Street, followed by the Collie Ridge Motel and Comfort Inn which is surrounded by residential properties.
- West – the area immediately west of the Site is zoned railways, which belongs to PTA. It is understood that PTA lease the office (west of the Roundhouse) building to Aurizon, with the area used as part of the railway line operations, predominantly as a laydown area with the majority of the former buildings and infrastructure removed.

3 SITE ENVIRONMENTAL SETTING

3.1 CLIMATE

The Collie area experiences a Mediterranean climate, characterised by hot dry summers and cool wet winters (Varma, 2002). Climate data has been sourced from the Bureau of Meteorology (BOM) Collie Weather Station (003032) (BOM, 2019a).

Mean monthly rainfall is highest in July at 175.9mm, with an average of 14.2 rain days. The lowest mean monthly rainfall is 14.3mm in February, with an average of 1.9 rain days. The average annual rainfall is 928.4mm, with an average of 88 rain days per year. Approximately 75–80% of the annual rainfall takes place during the months of May to September.

The mean annual maximum and minimum temperatures for the Collie Aero Weather Station are 22.5°C and 8.4°C, respectively. The highest temperatures are usually experienced in January, when the mean monthly maximum temperature is 30.5°C and the mean monthly minimum temperature is 13.2°C. Minimum temperatures occur in July, when the mean monthly maximum and minimum temperatures are 15.5°C and 4.2°C, respectively.

The annual prevailing wind direction during the morning (9am) is generally an easterly whilst the afternoon (3pm) annual wind direction is typically north-westerly.

3.2 TOPOGRAPHY

The Site is located in a valley with the topographical gradient from west to east towards the Collie River, there are hills to the north and south of the Site (HGM, 2003).

A review of topographic contours on Landgate's Map Viewer Plus (Landgate, 2020) indicated the Site is relatively flat, sitting at approximately 190m Australian Height Datum (AHD). A feature survey and contour plan provided by H & H Architects (Appendix 2), indicates the immediate area surrounding the Roundhouse and Roundtable is relatively flat sitting around 190m AHD grading to the north-east of the Site which is situated at approximately 189m AHD. The central portion of Lot 561 is slightly elevated at approximately 191m AHD with a slight slope to the north and south at approximately 190m AHD.

An open drain/trench was noted to be on the southern portion of the Site during the site inspection and Golder (2013a) noted that some low-lying areas were waterlogged during the winter months.

3.3 GEOLOGY AND SOILS

Review of the Geological Survey of WA 1:50,000 Environmental Geology Map (Collie Sheet 2131, Geological Society of Western Australia, 1986) indicated the surface geology of the Site predominately lies within geological unit S_{14} and a small portion to the east within unit L_{A3}, as depicted in Figure 4. The units are described below:

- Unit S_{14}: SAND – white to pale grey, fine to medium grained, occasionally coarse, angular to sub-angular quartz, little fines and poorly to moderately sorted.
- Unit L_{A3}: LATERITE – massive, indurate, nodular and vesicular, iron-cemented, much fine to medium angular quartz and occasionally some rounded quartz and quartzite pebbles.

The generalised stratigraphy of the Collie Basin (of which the Site is situated within) adapted from DoW (2007) is presented in Table B below.

TABLE B: COLLIE BASIN LITHOLOGY

GROUP	FORMATION	MAXIMUM THICKNESS (M)	LITHOLOGY
Ungrouped	Surficial Sediments	4	Alluvium, colluvium, laterite
	Nakina Formation	20	Sandstone, mudstone
Collie Group	Muja Coal Measures	450	Sandstone, minor shale and coal seams
	Premier Coal Measures	600	Sandstone, minor shale and coal seams
	Allanson Sandstone	400	Sandstone
	Ewington Coal Measures	75	Shale, sandstone and coal seams
	Westralia Sandstone	79	Sandstone
Stockton Group	Moorhead Formation	370	Mudstone and tillite
	Shotts Formation	-	Gravel conglomerate and basement clasts, sandstone

3.3.1 Site-Specific Geology

The geology encountered through the Detailed Site Investigation (DSI) works undertaken by HGM (2002), which involved test pits to 4m bgl and groundwater well installation to 12m bgl, was consistent with the geological mapping detailed earlier. The stratigraphy encountered by HGM (2002) is summarised below:

- 0.0-0.2m: Fill – Gravel, poorly graded, brown laterite.
- 0.0-0.4m: SAND – dark grey, medium to fine grained, organic rich quartz sand.
- 0.4-1m: SAND – pale grey, medium to coarse, rounded to sub rounded, quartz sand.
- Below 1m: Clayey SAND – pale grey, poorly sorted, angular to sub angular quartz grain, stiff moist.
- Below 5m: SILT – pale brown, clayey silt, stiff moist.

An embankment with rock approximately 300mm below the ground surface was noted at the eastern end of the Site (adjacent to the hill up to Throssell Street and near Atkinson Street) (HGM, 2002). Coal cinder waste deposits were also identified to be present onsite.

Golder (2013) also installed two groundwater monitoring wells, with the geology encountered similar to the described by HGM (2002). All groundwater monitoring well logs are provided in Appendix 3.

3.3.2 Acid Sulphate Soils

Acid Sulphate Soils (ASS) is the common name given to soils and sediments containing iron sulphides. When exposed to air due to drainage or disturbance, these soils produce sulfuric acid, often releasing toxic quantities of iron, aluminium and heavy metals.

A search of the Australian Soil Resource Information System (ASRIS) (ASRIS, 2019) was undertaken to determine the risk of ASS. There is no known risk of ASS beneath the Site based on ASS Risk Mapping being mapped as 'B' low probability with confidence unknown. The map also indicates no known occurrence of ASS within 2km of the Site.

3.4 HYDROGEOLOGY

Review of the DWER Water Register (DWER, 2020a) was not able to provide any information relating to the depth of groundwater or quality, however, identified three groundwater resources below the Site:

- Collie – Nakina;
- Collie – Lower Collie Group; and
- Collie – Stockton.

HGM (2003) noted that the regional groundwater flow direction in the Collie Basin had been significantly modified by dewatering activities associated with the coal mines such that the regional flow direction was to the south. However, HGM (2003) considered the unconfined aquifer onsite to be governed by factors in the immediate area such as the topographical gradient. As such the inferred groundwater flow direction indicated by HGM (2002b) was considered to flow to the east towards to the Collie River (approximately 700m from the Site).

3.4.1 Site-Specific Hydrogeology

It is understood that three groundwater monitoring events (GME) have been undertaken at the Site. Two were completed by HGM comprising one as part of the DSI (2002b) works and one as a standalone GME (2003), with the other completed by Golder (2013b). The groundwater levels recorded during each GME are detailed below:

- HGM (2002b) – July 2002: groundwater was recorded to vary between 0.99m below ground level (bgl) at MB2A to 3.43m bgl at MB3. HGM, (2002b) noted that groundwater wells MB1A and MB2A were installed on the first day of drilling and the groundwater levels changed significantly the following day, as such they were replaced and screened at appropriate intervals. Raw gauging data could not be reviewed and interpreted with confidence from what was presented in the reports due the poor quality scan of the report (scanned copy only).
- HGM (2003) – March 2003: groundwater was recorded to vary between 2.4m bgl at MB2 to 5.2m bgl at MB3. Again, raw gauging data could not be reviewed and interpreted due to the poor quality scan of the report.
- Golder (20013) – 29 August 2013: groundwater was recorded to vary between 1.17m below top of casing (btoc) at MB2 to 3.97m btoc at MB3.

Based on the calculated hydraulic head from the groundwater monitoring wells, Golder (2013b) determined that the inferred groundwater flow direction was to the south-southeast to southeast, consistent with that inferred by HGM (2002b, 2003).

Based on the conductivity measurements recorded by both HGM (2002b, 2003) and Golder (2013b) the groundwater conditions in the unconfined aquifer are considered to be representative of fresh water, based on a maximum calculated Total Dissolved Salt (TDS) value of 221mg/l.

As part of the site inspection, discussed in Section 6, Aurora gauged four of the wells (MB2 appeared to have been destroyed), MB04 appeared to be dry and MB5 blocked by tree roots. The standing water level at MB1 was recorded at 5.555m below top of casing (btoc) and MB3 was at 6.300m btoc.

3.4.2 Registered Groundwater Bores

A search of the DWER's Water Information Reporting (WIR) database (DWER, 2019b) indicates there are no registered bores onsite, however six registered bores were recorded within a 1km of the Site. Details of these bores are listed in Table C below. Figure 5 presents the locations of the registered bores identified in the WIR database search. Further detail for each bore is provided in Appendix 4.

TABLE C: SUMMARY OF REGISTERED BORE DETAILS

BORE WIR ID	SITE OWNER	APPROXIMATE LOCATION	DEPTH OF BORE	PURPOSE
61200027	Department of Water	Approximately 850m northeast of the Site	11.65m bgl	Hydrogeology Reports Data Capture.
61200030	Department of Water	Approximately 900m southwest of the Site	38.73m bgl	Hydrogeology Reports Data Capture.
61210961	Unknown	Approximately 85m north of the Site	153.14m bgl	No specific data available, however may have been associated with a mining tenement or mining exploration.
61210997	Collie Bowling Club	Approximately 750m northeast of the Site	60m bgl	No specific data available, however the location appears to correlate to a groundwater abstraction licence area, likely for irrigations purposes.
61270116	Collie Ridge Motel	Approximately 110m south of the Site	54m bgl	No specific data available, however the location appears to correlate to a groundwater abstraction licence area, likely for irrigations purposes.
61270145	Unknown	Approximately 110m south of the Site	54m bgl	Considered to be a duplicate of 61270116, noting almost identical co-ordinates and bore depths.

A review of the BOM Australian Groundwater Explorer Database (BOM, 2020b) also noted the six registered groundwater bores consistent with the DWER WIR database.

3.4.3 Surface and Groundwater Abstraction Licences

It is noted that the Collie township and Site lies within a Proclaimed Groundwater Area, as depicted in the DWER March 2020 Map (Appendix 5) as a result it is illegal to abstract water from a proclaimed watercourse or groundwater without a licence (*Rights in Water Irrigation Act 1914*).

A search of the DWER's Water Register (DWER, 2020) which details current licensed ground and surface water abstraction sites indicates there no groundwater abstraction license for the Site, with four identified groundwater abstraction licenses within a 1km radius of the Site, this has been depicted in Figure 5 and summarised below.

- Licence 165487 associated with 185-195 Throssell St, Collie (Lot 317 on Diagram 88000) is allocated to the Collie Ridge Motel, with an allocation of 3,000kL of water from the lower Collie Group aquifer, the licence expires on the 26 February 2028. The licence area is approximately 50m south of the Site. It is likely that the groundwater is abstracted for irrigation purposes, although this is not noted.
- Licence 182684 associated with 1 Porter St, Collie (Lot 2620 on Plan 214678) is allocated to the Collie River Valley Tourist Park, with an allocation of 2,000kL of water from the lower Collie Group aquifer, the licence expires on the 30 September 2026. The licence area is approximately 550m south of the Site. It is likely that the groundwater is abstracted for irrigation purposes, although this is not noted.
- Licence 95416 associated with mining tenement AM70/262 (Pit 1, Pit 1 Deeps, Pit 3, Pit 4 & Pit 5 Mine Sites) is allocated to the Premier Coal Limited, with an allocation of 18,000,000kL of water from the lower Collie Group aquifer, the licence expires on the 30 December 2024. The licence area is adjacent to the eastern portion of the Site. It is likely that the groundwater is abstracted for dewatering of the mines.
- Licence 54612 associated with Crown Reserve 35487 is allocated to the Department of Education, with an allocation of 20,000kL of water from the lower Collie Group aquifer, the licence expires on the 21 February 2023. The licence area is approximately 500m north of the Site. It is likely that the groundwater is abstracted for irrigation purposes.

Several surface water abstractions licences were noted to be within a 1km radius of the Site, however were all related to abstraction from the Collie River and was not deemed relevant to the investigation, as such they were not considered further as part of this investigation.

3.4.4 Public Drinking Water Source Areas

In order to protect the State's drinking water resources, the DWER has defined certain areas of the state as being 'Public Drinking Water Source Areas' (PDWSAs) using the following three priority rating categories.

- Priority 1 (P1) classification areas are managed to ensure that there is no degradation of the drinking water source by preventing the development of harmful activities in these areas. For P1 areas the guiding principal is risk avoidance.
- Priority 2 (P2) classification areas are managed to ensure that there is no increased risk of water source contamination/pollution. For P2 areas the guiding principal is risk minimisation.

- Priority 3 (P3) classification areas are defined to manage the risk of pollution to the water source from catchment activities.

The search of the PDSWA database (DWER, 2020c) indicated that there were no PDWSA areas within a 1km radius of either of the Site.

3.4.5 Groundwater Dependant Ecosystems

Groundwater Dependent Ecosystems (GDEs) are ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements and include all vegetation ecosystems.

Review of the BOM Groundwater Dependent Ecosystems Atlas (BOM, 2020c) notes the Site not being mapped as an aquatic or terrestrial ecosystem. However, the Collie State Forest to the North and South of the Site, have both been mapped as having a moderate potential for groundwater interaction.

3.5 SURFACE WATER

3.5.1 Hydrology

No surface water bodies are present onsite, or known to exist onsite, however it has been noted that some low-lying areas were waterlogged during the winter months (Golder, 2013). HGM (2002b) recorded the presence of an open drain on the southern portion of Lot 561. Aurora also noted the presence of the open drain/trench, during the site inspection discussed in more detail in Section 6, which is likely operates as an open drain to manage surface water.

HGM (2002b) noted the presence of a permanent stream 100m north of the railway line (both up and cross gradient of the Site), which in the inferred release location of the main subsurface drain water. It is understood the drain collects surface water from the preparation shed to the west, the Roundhouse and Turntable, however it's functioning capacity is unknown. During the site inspection the offsite stream was inspected however was not flowing at the time suggesting that it may be ephemeral.

Review of the DWER Waterways Conservation Act Management Areas, viewed through National Map (Australian Government, 2020), did not identify the Site to be within a *Waterways Conservation Act 1984* Management Area.

The Collie River, approximately 850m east of the Site, is the closest down hydraulic gradient surface water body to the Site.

3.5.2 Significant Wetlands

There are no registered or identified Ramsar sites, Important Wetlands or Geomorphic Wetlands within the Site boundary as viewed through National Map (Australian Government, 2020). The DWER Geomorphic database (unreviewed) does note the presence of a Forest Conservation area north of the Site and a Conservation Park to the south of the Site which is protected under the Conservation and Land Management (*CALM) Act 1984 Section 5(1)(a)*.

3.6 FLORA AND VEGETATION

3.6.1 Vegetation

The Site is located in the Southern Jarrah Forest (JF2) subregion, one of 403 subregions recognised under the Interim Biogeographical Regionalisation for Australia (IBRA) (Australian Government, 2005). JF2 is characterised by Jarrah-Marri forest on laterite gravels, and in the eastern part by Wandoo-Marri woodlands on clayey soils. Eluvial and alluvial deposits support *Agonis* shrublands and in areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands (Hearn *et al*., 2002).

At a finer scale the pre-European vegetation in the area is mapped as the Muja Vegetation Complex which is described as Open woodland of *Melaleuca preissiana-Banksia littoralis-Banksia ilicifolia* with some *Eucalyptus patens* on moister sites, *Banksia* spp. on drier sites of valley floors in the subhumid zone (DPaW, 2016).

Golder (2007) described the Site as being cleared of natural vegetation with the exception of sparse grasses including buffalo grass in areas of low vehicle movement and in depressions.

Along the northern boundary of the site was a strip of thicker grasses and vegetation which were distinct to the vegetation across the remainder of the site. Some remnant native vegetation occurred along the southern boundary of the site, notably grass trees (Golder, 2013a).

The Protected Matters Search Tool (PMST) report (DAWE, 2020) (Appendix 6) listed one conservation significant flora species, the Dwarf Bee-orchid (*Diuris micrantha,)* as species or species habitat known to occur in the area (including a 2km radius of the site). The Dwarf Bee-orchid is listed as 'Vulnerable' under the *Environment Protection and Biodiversity Act 1999* (EPBC Act).

The Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database (DBCA, 2020) search result (Appendix 7) did not include any flora species of conservation significance listed under the *Biodiversity Conservation Act 2016* (BC Act). The database search result revealed the following DBCA priority flora species may occur within a 2km radius of the site:

- Priority 1 - Caladenia validinervia
- Priority 3 - Adenanthos cygnorum subsp. Chamaephyton
- Priority 4 - Calothamnus graniticus subsp. Leptophyllus, Grevillea ripicola (Collie Grevillea), Hypolaena robusta, Pultenaea skinneri (Skinner's Pea)

Whilst the above vulnerable and priority flora has been identified to potentially occur in a 2km radius of the Site, it is considered unlikely to be present onsite given the extensive clearing and intensive rail operations that has been historically undertaken onsite.

3.6.2 Threatened and Priority Ecological Communities

The PMST report and the Threatened Ecological Communities (TEC) Database (Australian Government, 2020) did not indicate that any Federal or State listed TECs or Priority Ecological Communities occurred or would be likely to occur on the site or within a 2 km radius.

3.7 FAUNA

The PMST[1] report listed seven bird and three mammal species of conservation significance that may or are known to occur in the area (including a 2km radius of the site). The species and their conservation status under the EPBC Act are listed in Table D below.

The NatureMap database[2] listed three bird species and seven mammal species of conservation significance that are listed under the *Biodiversity Conservation Act 2016* (BC Act) or on the DBCA's priority fauna list. These species are included in Table D below.

Given the lack of suitable fauna habitat at the Site it is unlikely any of these species would rely on the Site.

TABLE D: CONSERVATION SIGNIFICANT FAUNA SPECIES THAT MAY OCCUR IN THE AREA

SPECIES	CONSERVATION STATUS	PMST COMMENT
BIRDS		
Botaurus poiciloptilus Australasian Bittern	Endangered (EPBC Act)	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper	Critically Endangered (EPBC Act)	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo	Vulnerable (EPBC Act) Threatened (BC Act)	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo	Endangered (EPBC Act) Threatened (BC Act)	Species or species habitat known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo	Endangered (EPBC Act) Threatened (BC Act)	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl	Vulnerable (EPBC Act)	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew	Critically Endangered (EPBC Act)	Species or species habitat may occur within area
Ixobrychus flavicollis subsp. Australis Black Bittern (southwest subpop.)	Priority 2 (DBCA)	-
Falsistrellus mackenziei Western False Pipistrelle	Priority 4 (DBCA)	-
MAMMALS		
Dasyurus geoffroii Chuditch	Vulnerable (EPBC Act) Threatened (BC Act)	Species or species habitat known to occur within area

[1] The PMST report included one fish species which has been excluded as there are no water bodies on/near the site.
[2] The NatureMap database search result listed one fish and one mussel species that have been excluded.

TABLE D: CONSERVATION SIGNIFICANT FAUNA SPECIES THAT MAY OCCUR IN THE AREA

SPECIES	CONSERVATION STATUS	PMST COMMENT
Pseudocheirus occidentalis Western Ringtail Possum	Critically Endangered (EPBC Act) Threatened (BC Act)	Species or species habitat may occur within area
Setonix brachyurus Quokka	Vulnerable (EPBC Act) Threatened (BC Act)	Species or species habitat may occur within area
Myrmecobius fasciatus Numbat	Threatened (BC Act)	-
Phascogale tapoatafa subsp. wambenger South-western Brush-tailed Phascogale	Specially protected (BC Act)	-
Hydromys chrysogaster Water-rat	Priority 4 (DBCA)	-
Isoodon fusciventer Quenda	Priority 4 (DBCA)	-

3.8 ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Areas (ESAs) are specified areas or a class of area declared by the Minister for the Environment under Section 51B of the *Environmental Protection Act 1986* (EP Act). ESAs are generally associated with areas of significant vegetation, conservation significant flora and high value wetlands.

There are no ESAs mapped at the Site, or within a 2km radius.

4 SITE HISTORY

4.1 SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS

As part of characterising the Site and to further understand potential risks associated with the Site, a review of historical environmental reports was undertaken, a summary of the reports reviewed, and their findings is presented in Table E below. It is understood that the CS Auditor has been provided the historical environmental reports and as such they have not been included as an Appendix to this report.

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
Greg Rowe and Associates (1998)	**Collie – Landuse Plan for Non-Operational Railway Reserve** Westrail (now PTA) appointed a consultant team to investigate and make recommendations to the potential of the surplus railway reserve land (Reserves 10519, 36584 and 5247 with an estimated area of 39 hectares). As part of these works a Preliminary Site Assessment (PSA) for potential contamination was undertaken, this involved reviewing historic operations to assess areas of concern. Several developments/structures were noted to be present across the railway reserve investigation area based upon data collected from consultation with knowledgeable past and present Westrail personnel, review of aerial photography, photos from Westrail personnel and review of Westrail historical records from the Library and Information Services of Western Australia (LISWA) Battye Library. Those relating to the Site, including approximate construction dates, include: • the railway line constructed in 1898; • the loop siding constructed in 1908; • the wagon repair shed constructed in 1938; and • the Roundhouse and associated Turntable constructed between 1954-1958. The following was also identified west of the Site (up-hydraulic gradient): • the diesel locomotive shed constructed between 1954-1958; • the fuel depot, chromate water tank and wastewater treatment tank constructed in the 1980s. Additionally, a mechanical coaling plant was constructed in 1938, however the exact location was unknown at the time of the report (located to the west of the Roundhouse as identified through this PSI). The report identified 23 areas of potential environmental contamination across the entire railway reserve investigation area, of which four related to the Site, which included: • the Roundhouse; • the Turntable; • the wagon repair shed; and • ash deposits east of the Turntable. Fourteen areas of potential environmental contamination were also identified west of the Site (up-hydraulic gradient) in close proximity to the diesel locomotive shed. In addition, to the 23

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
	areas of potential environmental contamination, herbicide application was applied to the rail reserve to control weeds. Further investigation in regards to the potential contamination status was considered required to assess potential health and environmental risks.
Golder Associates (2002)	**Phase I Environmental Site Investigation Former Collie Railyard** Western Australian Government Railways (WAGR) Commission engaged Golder to undertake the Phase I Environmental Site Assessment (ESA) on a portion of land between the Collie Roundhouse to the west and Atkinson Street to the east (approximately 4.8 hectares). As part of the report, interviews were undertaken associated with past activities. Mr. David Sloan, a former train driver who had been in Collie over 21 years recalled the Roundhouse being used to do engine repairs (day to day, with more complex going to the Midland Yards) and being used as the examiner's area. Mr. Sloan indicated that the ash from the coal-fired engines were commonly dropped into pits, shovelled onto the ground prior to loading into wagons and disposing onsite. The Collie Shire Council Environmental Health Officer (Mr, Colin Weedon) noted that fly ash near the study area generally extended 1.5m bgl. Mr Arthur Rudivini (former District Engineer of Bunbury) mentioned that the ash could be uniformly distributed over the Site. Five opportunistic samples were collected based upon field evidence for potential contamination (dark staining, rubble, etc.) and were analysed for metals (arsenic, cadmium, chromium, copper, lead, nickel, mercury and zinc), Total Petroleum Hydrocarbon (TPH) fractions, Polycyclic Aromatic Hydrocarbons (PAHs), Organochlorine Pesticides (OCP) and total phenolics. The analytical results did not suggest the presence of gross contamination given all samples were below the health investigation limits for that time. The report identified nine areas of potential environmental concern: • Areas of stressed vegetation. • Former Wagon Repair Shed. • Former Weighbridge (noted to be offsite in HGM (2002b)). • Ash deposits. • Former location of the AST and crane. • Black stained soil. • Historical activities east of the site (former service station, engine shed, barracks, washout plant and ash deposits). • Historical activities west of the site (diesel refuelling, oil interceptor and settling tank, chromate tank, workshops). • Storm drain network beneath the site. The report suggested that there was a significant potential for contamination to be present at the Site and further investigation was required.
Halpern Glick Maunsell (2002a)	**Sampling and Analysis Programme Detailed Site Investigation** HGM were engaged by WAGR to prepare a sampling and analysis programme (SAP) for implementation of a DSI, based upon the findings of the Golder (2002) investigation and following recommendations from the Department of Environmental Protection (DEP) for the area east of the Roundhouse in the railway yard (approximate study area of 4.8 hectares, did not include the Roundhouse or Turntable).

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
	Given that uniform soil impacts may be present onsite (based on herbicide application and ash) a combination of a systematic and judgemental sampling pattern was considered to be appropriate to assess soil conditions across the Site, with an allowance of 25 systematic samples for metals, TPH and OCPs and an allowance of 30 judgemental samples for metals, 20 judgemental samples for PAHS, benzene, toluene, ethylbenzene and xylenes (BTEX), phenols and 4 judgemental samples for Polychlorinated Biphenyl (PCB). The sampling density was considered to be more conservative than that required for a site of 4.8 hectares in accordance with former Department of Environmental Protection (DEP) Management Series guideline document titled 'Development of Sampling and Analysis Programs' for a 95% confidence of a hotspot with a diameter of 35m. Details for the installation of three groundwater wells and a groundwater monitoring event were also included with a QC program to be implemented for both soil and groundwater during the DSI works.
Halpern Glick Maunsell (2002b)	**Detailed Site Investigation – Collie Railway Yard** The report was prepared by HGM with input from Enviroskill International. Additional historical information was collected from relevant persons including: • President of the Collie Railway Society who had been a resident immediately opposite the site since the 1940s. • Taffy Trehern from the Collie Railway Society and Site drawings provided by Taffy Trehern. • Gary Miller, Driver Coordinator form the Australian Western Railway with 22 years' experience driving locomotives in Collie. • Jim Maloney, Vice President of the Collie Heritage Group. The report indicated that a single man's quarters was present between the Turntable and the wagon repair shed, which may have had a septic tank and leach drain, however this was not identified through this PSI. It was noted that the coal cinder waste disposal area at the eastern end of the site dated to the beginning in the 1900's prior to the 1920s. Previous reference to a weighbridge onsite was noted to be present to the north of the railway offsite. A total of five groundwater monitoring wells were installed, two wells (MB1A and MB2A) were installed on the first day of drilling and the static water level was noted to have changed significantly on the second day, as a result, new wells (MB1 and MB2) were installed with appropriate screen intervals. Wells MB1A and MB2A were left as PVC pipe, while the other three wells had steel lockable monuments protecting the PVC casing. All groundwater samples were noted to contain concentrations of TPH and PAHs below the laboratory limit of reporting (LOR) however some elevated metal concentrations (copper and nickel) were noted to exceed both the adopted aquatic ecosystem guidelines and drinking water guideline criteria. All soil samples were noted to contain concentrations of TPH, PAHs, PCB and pesticides below the laboratory limit of reporting (LOR) and below the adopted assessment criteria. Twenty-seven samples noted elevated concentrations of arsenic and/or chromium and/or copper and/or zinc that exceeded the exceeded the adopted ecological criteria, however all metal concentrations were below the adopted human health criteria. Leachability testing, using the Australian Standard Leaching Procedure (ASLP), was undertaken on 16 of the 27 metal samples that exceeded the ecological criteria to assess the risk to the underlying groundwater aquifer. In general, the metals demonstrated a low potential to leach,

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
	with only two samples for zinc noted to have concentrations that exceeded the aquatic ecosystems freshwater criteria. The soil investigation program implemented via the excavation of test pits also identified four coal ash waste deposits, although they were not fully delineated. The presence of a rubbish tip waste at the ground surface and a sulphur like odour was noted during the installation of MB2, however this was restricted to the immediate vicinity of the groundwater monitoring well. It was also noted that an extensive drain system runs from 100m south of the engine shed (referred to as the preparation shed within this PSI report, approximately 400m west of the Roundhouse) that traverses south of the Roundhouse, through the Site and discharges to a stream approximately 100m north of the current railway tracks. A strong hydrocarbon odour was noted at the start point and a minor hydrocarbon odour at the discharge point, however no visible sheen was noted. The report recommended that the site was suitable for use as a miniature railway theme park. The report also recommended that an additional GME be undertaken to confirm the suitability of groundwater to be used for landscape irrigation of the miniature railway theme park.
Halpern Glick Maunsell (2003)	**Groundwater Monitoring – Collie Railway Yard** HGM were engaged by WAGR to undertake a GME (March 2003) of the three groundwater monitoring wells onsite (MB1 to MB3, which excluded MB1A and MB2A as they were not deemed suitable for sampling), as recommend from the DSI. It was noted that the groundwater levels dropped (approximately 1.4m) from the previous events, which was likely a reflection of seasonal fluctuations. It was noted that MB2 did not decrease at the same proportion as MB1 and MB3 and was inferred to be included from mounding via a nearby topographical low point where storm water collects and infiltrates. Groundwater samples were analysed for metals, TPH, BTEX, PAHs, PCB and pesticides. Concentrations of BTEX, PAHs, PCB were below the laboratory LOR. Minor concentrations of TPH were detected. Concentrations of dieldrin were detected above the laboratory LOR but were below the adopted guideline criterion for drinking water. Copper was detected in all wells, however, was below the guideline criterion for drinking water. The report recommended that the groundwater was suitable for the purpose of landscape irrigation, with ongoing monitoring but not as a source of drinking water given the presence of TPH.
Golder Associates (2007)	**Preliminary Environmental Site Investigation Collie Roundhouse and Depot** The PTA engaged Golder to undertake a PSI of the Roundhouse, Turntable and area to the west (portion of Lot 2857 and 2856 for an approximate area of 15 hectares) to assess its environmental status. During the site inspection, several pieces of surface debris were visible including slag, railway dog spikes, sleepers, oil drums, 44 gallon drums, train brake pads and black ashy accretions. Additionally, an extensive drainage network was visible, it was noted to be infilled with sediment or caved in, Mr. Miller noted that the drainage system was probably in disrepair as the region became inundated during the winter months. The black ashy accretions were sampled and noted to contain elevated metals and hydrocarbons. Asbestos containing fibre cement cladding was observed to be on the surface soil, likely from the Roundhouse structure, with asbestos fibres also noted by Golders to be observed in the surface soil. However, Aurora consider this unlikely and was likely to be asbestos bundle fragments as asbestos fibres can be difficult to visually observe in soil. The soil was sampled in this area of observation with asbestos in soil identified.

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
	A large pile of train brake pads was observed north of the roundhouse and considered to represent a risk given their age and potential composition (asbestos). Two AST's located north of the Roundhouse, which were noted to contain chromate/nitrate water for use in the train radiators and the other sand for use on the train wheels. An oil sump (noted to be a triple interceptor trap in this PSI report) was also observed west of the Roundhouse, with a rusted drum sitting on the sump, with the drum observed to contain a tarry black material, which had spilled onto the surface. The smaller buildings west of the Roundhouse were inferred to be a length-runners hut, formerly used as temporary accommodation unit for workers, with a sleeping quarter and ablutions. In addition, one of the buildings was a boiler room (known as the Compressor Shed within this PSI report). The area north of the railway line was understood to have been historically used as a coal mine and a direct current power station that was formerly operated by the Shire of Collie. Several warning signs were also observed warning the dangers of hot ash deposits and potential for spot fires. The report recommended that a DSI be undertaken to assess both soil and groundwater media, additionally a management plan to be implemented for the removal of asbestos materials. Further investigation into the former DC power station and coal mine was also considered warranted.
RiskCover (2011)	**Collie Roundhouse Site Risk Review** – (report not in full, three pages missing) RiskCover prepared this report for NTWA, whilst not clear appears to have included a site inspection which has noted that the former Roundhouse cement wall cladding been damaged, with fragments observed on the surface along with potential fibrous dust. Additionally, the report noted the former Golder (2007) investigation. Four recommendations were made, as detailed below: • The Roundhouse remained locked and no-one should be allowed to enter without appropriate personal protective equipment (PPE). • An appropriate site management plan (SMP) should be developed to deal with controlling site access, removal of equipment stored within the Roundhouse. • Determine if other buildings or pile of brake pads are within the NTWA boundary. • Liaise with PTA and develop and plan for decontamination of the site.
Golder Associates (2013a)	**Data Gap Analysis and Work Plan Collie Roundhouse** The PTA engaged Golder prepare a data gap analysis and work plan for Lot 561, such that any data gaps from previous reports could be identified and develop recommendations to enable the contamination status of the site to be assessed. A site walkover and opportunistic soil sampling was undertaken, with seven samples collected. In general samples were below the adopted assessment criteria with the exception of two samples which contained either barium or copper above the ecological criteria, both collected from an ash like material. In assessing the contamination status of the Site and data gaps, the existing reports were reviewed with seven data gaps identified as summarised below. • There are differences in previous investigation boundaries and current investigation boundary. Are there areas that have not been previously investigated?

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
	• Aerial photography was only reviewed up to 2000, have there been significant changes to the land use onsite since that time? • There is an absence of data base searches, which may not have been available at the time of reporting which could aid the understanding of potential contamination sources and receptors in the investigation boundary. • Former FOI requests did not return any information which contradicted investigation observations in terms of AST's. • Have the investigation area site observations changed? • Are there any additional areas of potential environmental concern? • What is the quality of groundwater at the Site, given that lack of a comprehensive assessment? In assessing the data gaps, six of the data gaps were considered to be closed out though additional desktop assessment and the site walkover. However, the groundwater data gap was considered to remain open with the report recommending two alternatives being restrict groundwater access or additional groundwater assessment to be undertaken. The report concluded that the remaining areas of potential environmental concern identified to be present onsite could be suitably managed through a management plan, based on the ongoing commercial/industrial land use. The report also made additional recommendations, which have been summarised below. • Asbestos fragments located in and around the Roundhouse should be removed by a licensed asbestos removalist and disposed offsite to a licensed landfill facility. • As the site may be redeveloped, earthworks may be undertaken in the future, as such a suitable construction environmental management plan (CEMP) should be prepared to address unexpected finds and managing environmental construction risks. • Any excess soil that is considered to be aesthetically or geotechnically unsuitable should be tested and assessed against the landfill waste classification and waste definitions.
Golder Associates (2013b)	**Groundwater Assessment Collie Roundhouse** The PTA engaged Golder to undertake further groundwater assessment underneath Lot 561 as per the recommendation from Golder (2013a) and following correspondence from the Department of Environment and Conservation (DEC) to assess for the presence of gross impacts. As part of the assessment Golder undertook the following scope of works: • Installation of two groundwater monitoring wells. • Installation of passive vapour samplers in four of the groundwater wells (MB3, could not be accessed at the time of installation). • Collection of groundwater samples from five groundwater monitoring wells. • Laboratory analysis of both groundwater and vapour samples. Static groundwater levels were consistent with that observed by HGM (2002b and 2003), with the inferred groundwater flow direction to the south-southeast to southeast.

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
	Analytical results noted elevated concentrations of copper and zinc however, were considered to be representative of regional groundwater conditions rather than a result of historical activities. Concentrations of herbicides, pesticides, phenols, volatile organic compounds (VOCs), total recoverable hydrocarbons (TRH), and monocyclic aromatic hydrocarbons (MAHs) in groundwater were all below the laboratory LOR. The analytical results from the passive vapour sampling detected TRH, BTEX and hydrochlorofluorocarbon above the laboratory LOR. The detection of TRH and BTEX was inconsistent across the sample locations and Golders suggested it may have been a reflection of an external source (i.e. vehicle exhaust) rather than an onsite unidentified source. Additionally, the presence of hydrochlorofluorocarbon's were considered to be reflective of background water quality rather than historical activities. The report concluded based on an ongoing commercial/industrial land use, the site did not represent an unacceptable risk to the environment or human health.
Engtech Risk Consultants (2015)	**Remediation Closeout Report – Brake Pads (Stockpile) Collie Round House** The PTA engaged Engtech Risk Consultants (ERC) to provide asbestos removal and validation services on Lot 561 for a stockpile of asbestos containing train brake pads as noted in previous investigations undertaken by RiskCover (2011) and Golder (2013a). ERC and Action Asbestos Demolition (AAD) prepared an asbestos removal control plan, prior to the remediation works to document the required management measures to be implemented to protect both the environment and human health. A total of 23.34 tonnes of brake pads were removed from the site and sent to the Shire of Collie landfill. Following brake pad removal, the underlying soils appeared to be free of ACM, were validated through the progression of five test pits and sieving of the excavated material from the test pits. Samples were also collected from the sieved soil material and sent for laboratory analysis for asbestos fines (AF)/Fibrous asbestos (FA), which was not detected in any of the samples. In addition, an asbestos air fibre monitoring program was implemented with no detectable concentrations above the laboratory LOR. On the basis of the results, which indicated that all known and visible ACM has been removed from the area of the former brake pad stockpile, ERC considered the risk to human health (within the areas validated as part of this project) to be mitigated and insignificant, requiring no ongoing management.
Aurora (2020)	**Hazardous Materials Management Plan Collie Roundhouse** Aurora was engaged by NTWA to develop a hazardous materials management plan as part of the tender documentation for the management and removal of hazardous materials identified at the Collie Roundhouse. The removal of these materials formed part of a broader scope of works comprising urgent conservation works. Seven hazardous materials were identified which was deemed to require treatment and/or removal in preparation for the refurbishment project, as detailed below: 1. ACM including corrugated and flat sheeting to roof vents and walls; 2. Asbestos containing composites and bituminous materials such as joint mastic, window putty and fuse backing boards; 3. Asbestos textiles, 4. Asbestos insulation to electrical componentry such as millboard and fuse packing; 5. Debris & residues from weathered or damaged asbestos cement, 6. Asbestos friction and gasket materials; and

TABLE E: SUMMARY OF HISTORICAL ENVIRONMENTAL REPORTS IN CHRONOLOGICAL ORDER

REPORT	SUMMARY AND OUTCOMES
	7. Lead based paints. The ACM that was identified ranged from non-friable to friable and good to poor condition which present a range of risks of fibre release when handling or during removal work. Additionally, anecdotal information suggested that pesticides for termite infestation prevention may have been used on the timber flooring within the Roundhouse and may also be present in the underlying soils.

4.2 HISTORICAL PLANS, MAPS & FIGURES

A review of historical plans, maps and figures associated with historical Site activities was undertaken to assess the location of previous infrastructure and buried waste that may not have been observed through historical aerial photography (Section 4.4) to better understand APEC. A list of the historical plans, maps and figures which were used in assessing the presence of APEC with their associated structures are detailed below and have been included in Appendix 8.

Figure 6 displays the on and offsite infrastructure/features and areas of inferred buried waste associated with railway activities that may influence the contamination status at the Site based on the review detailed below. Refer to the feature numbers to examine the location of each item relative to the Site.

The location of railway lines has not been included as part of the historical infrastructure given the lines move periodically and are considered a low risk of potential contamination given the underlying ballast material which may have been subject to minor leaks or pesticide application were removed with the lines.

Western Australia Government Railways Commission (WAGRC) – Collie Loco Depot Engine Roundhouse Site Plan, Plan No. 43626/16, dated January 1955.

Notes

Given the Plan is dated January 1955 it may be possible that this was a plan for the proposed depot and not a as built plan, as such not all of the structures may have been built.

Some of the structures detailed below have not been observed in historical aerial photography or during the site inspection, however this may be a result in the lack of aerial photography during 1959 and 1966 period, although considered unlikely. Additionally, coal was replaced with oil/diesel in 1961 as the preferred fuel and the associated train infrastructure for coal was not required to the same extent and may have being phased out as a result during this time period, as a result not all of the infrastructure may have been required.

Onsite Infrastructure

- Roundhouse (Feature ID 12): noted to be present onsite through site inspection and review of aerial photography.
- Turntable (Feature ID 19): noted to be present onsite through site inspection and review of aerial photography.

- Boiler Shed (Feature ID 3): adjacent to the Roundhouse on the south-eastern corner, no structure observed in this location in historical aerial photography or during the site inspection, however Golder (2013a) did note the potential for a structure to be in the area based on a footprint observed during their site inspection.
- Coal Testing Shed (Feature ID 4): located approximately hallway between the Turntable and Wagon Repair Shed, no structure observed in this location in historical aerial photography or during the site inspection.
- Wagon Repair Shed (Feature ID 7): the plan shows it was located on the eastern portion of Lot 561. Whilst the Wagon Repair Shed was noted to be present in the February 1966, June 1975 historical aerial photography it was not located as per the plan. The Wagon Repair Shed was actually located offsite, with the other minor associated structures present onsite. The other structures are considered to be used by shunting crew, based on anecdotal evidence discussed in Section 4.6. The Wagon Repair Shed and Shunting Crew Buildings (Feature ID 26) were not present in March 1980 historical aerial photography. C& D waste was noted in the vicinity of the former Shunting Crew Building footprint area during the site inspection.
- Diesel Locomotive Workshop, referred to as the Workshop (Feature ID 5): adjacent to the Roundhouse on the western edge, noted to be present in the February 1966 historical aerial photography, understood to have been demolished sometime in the 1970's. No longer present in March 1980 historical aerial photography (discussed in Section 4.4).

Several rail lines were also noted to go through the Site including into to the Wagon Repair Shed (both east and west direction), south of the Roundhouse (both east and west direction) and from the Turntable going through the roundhouse and to the Workshop (west only) and to the western portion of the depot.

<u>Offsite Infrastructure</u>

- Offices (Feature ID 6): west of the Roundhouse understood to be present in the form of the Aurizon leased building, however, does not align perfectly with the plan. May have been built larger than the original plan.
- Oil Store (Feature ID 8): west of the Roundhouse and north of the offices, no structure observed in this location in historical aerial photography or during the site inspection.
- Breakdown Crane Shed (Feature ID 11): north of the Oil Store, no structure observed in this location in historical aerial photography or during the site inspection.
- Ash Rake Out Pit (Feature ID 24): north-west of the Offices, may have existed based on unknown structure in the February 1966 historical aerial photograph.
- Sanding Plant (Feature ID 9) and Mechanical Coaling Plant (Feature 10): north of the Ash Rake Out pit, may have existed based on two unknown structure in in the February 1966 historical aerial photograph, however layout is not exact with the plan. A hand drawn WAGR proposed plan (plan no. 67660, dated 1975 provided separately by Jeffery Austin from Rail Heritage WA), was prepared for redevelopment of the area but was not used, however it did note the presence of an existing coaling plant in this location. As such these structures are considered likely to have been present offsite.

- Preparation Shed and Engine Pits (Feature ID 20): approximately 400m west of the Roundhouse, shed still present offsite, however it appears only the frame remains. Understood to be heritage listed.
- Main Water Tank (included as part of Feature ID 20): adjacent to the Preparation Shed, likely to have existed based on the February 1966 historical aerial photograph.
- Tool Kit Building (included as part of Feature ID 20): south of the Preparation Shed, no structure observed in this location in historical aerial photography or noted in other reports or notes. Was likely attached to the Preparation Shed.

WAGRC – Collie Loco Depot Engine Roundhouse & Workshop Air & Water Services, Plan No. 48106/2, dated January 1955.

Notes

Given the Plan is dated January 1955 it may be possible that this was a plan for the proposed depot, prior to the construction and development of the depot and not all of the structures may have been built.

Onsite Infrastructure

- Hot and Cold Water Tank (Feature ID 14 and 15, respectively): located adjacent to the Roundhouse on the south eastern side, not observed in historical aerial photography, located in similar location to the boiler shed.
- Compressor Shed (Feature ID 13): on the western side of the Roundhouse and south of the Diesel Locomotive Workshop, still in current location.

WAGRC – Collie Loco Depot Engine Roundhouse Layout of Drainage for Roundhouse and Turntable, Plan No. 44032/5, dated August 1958.

Notes

The Plan is dated January August 1958 and is considered likely to be close to as constructed given the Roundhouse was built in 1956 (DPLH, 2018). The plan indicates the six bays in the northern portion of the Roundhouse were planned to be used for maintenance and the eight bays in the southern portion were to be used for cleaning and washdown.

Onsite Infrastructure

- Oil Interceptor Settling Tank and Drain Network (Included as part of Feature ID 12): the interceptor tank is located on the western side of the Roundhouse, which has been noted in during the site inspection. In addition, it appears of drainage from the Roundhouse and Turntable link to the Underground Stormwater Drain.

Greg and Rowe (1998) Collie – Landuse Plan for Non-Operational Railway Reserve Figure 4 – Historical Development.

Notes

The report notes that new infrastructure was built in 1980s (east of the current investigation Site), however does not provide a source of this information.

Onsite Infrastructure

- Loop siding: located in the central portion of the Site, based on the construction date was likely associated with the original depot (1898 to 1959) east of the Site.

Offsite Infrastructure

- Fuel Depot (Feature ID 21): located south of the Preparation Shed, can be partially observed in both March 1980 and December 1988 aerial photography.
- Wastewater Treatment Plant (Feature ID 23): located between the Roundhouse and the Preparation Shed, can be observed in the March 1980 (two ponds) through to the December 1991 (three ponds and two structures) aerial photography.
- Chromate Water Tank (Feature ID 16): located west of the Preparation Shed (assumed to be AST outside the bunded area), can be partially observed in March 1980 through to October 1966 aerial photography.
- Nightowl Service Station (Feature ID 17): located east of the Site, was first apparent in Aerial Photography in 1966 identified.

Golder Associates (2002) Phase I Environmental Site Investigation Former Collie Railyard Figure 2 – Site Plan.

Notes

Many of the Site features and locations appear to have been incorrectly interpreted such as the weighbridge (discussed below as an example), and incorrect interpretation of the ash deposits based on the Greg and Rowe (1998) report, as such no details were adopted from this report.

- Weighbridge: noted to be in the central portion of the Site, however HGM (2002b) suggest this was likely located offsite and the location was incorrectly interpreted in the report. Based on the lack of evidence in historical aerial photographs of a weighbridge onsite, it is considered likely to have been located offsite.

HGM (2002b) Detailed Site Investigation – Collie Railway Yard Figure 3 – Historical Site Activities.

Onsite Infrastructure

- Single Men's Quarters: located in the central portion of the Site. The single men's quarters is assumed to have been included based upon additional information, however the exact source is not specified in the report. Review of historical aerial photography cannot identify the presence of this structure and no other reports mention this being onsite in the location specified in the report. However, based on WAGR plan 23410, the original Collie station did have a single men's house (near Steere St) which was east of the Site. Aurora consider that the Single Men's Quarters was likely the metal clad building onsite (Feature ID 18), referred to as the Accommodation Building, based on the findings from the site inspection, which observed mattresses and an ablution room as detailed in Section 6. The accommodation building was first observed in the 1980 aerial photograph.
- Wagon Repair Shed (Feature ID 7): located on the eastern portion of the Site, the report states it was built prior to the 1920s, which is likely incorrect given there were no observable structures

other than the trainlines prior to 1944. As such it may have been associated with the original depot to the east of the Site, which was established in that time period, however the building was correctly located.

Other Site Features

- Cinder Waste Deposits (Feature ID 1): there are four areas of identified coal ash deposits likely identified during the test pitting intrusive works, with their inferred extent presented on the figure, which may need to be delineated.
- Underground Services (Feature ID 2): the drain network associated with the Roundhouse goes into an underground drain, which originates from the south of the Preparation Shed and goes through the Site and going offsite into an inferred permanent stream. There is no reference in the report to the source of the underground services however as underground service location was undertaken was likely identified during service location as part of the intrusive works. During the site inspection the offsite release location of the drain was identified, however no water was identified in the stream and as such was considered to be ephemeral.
- Aboveground Services: it is noted in previous reports that a power line runs through the Site, however based on Figure 3 only one transformer has been identified to be present. Other transformers may have been onsite, but there are no known plans or details of other transformer locations.

ERC (2015) Remediation Closeout Report – Brake Pads (Stockpile) Collie Round House Figure 1 – Site and Sample Locations.

Other Site Features

- Train Brake Pad Stockpile area: the figure indicates that the train brake pad stockpile was located approximately 10m north of the Roundhouse in close proximity to one of the trees currently onsite. The train brake pad stockpile has been removed and validated to be free of contamination.

No new information to the Site structures based on figures/ plans was presented in reports from HGM (2003), Golder (2007), Golder (2013a) or Golder (2013b), as such was not included in the detailed review as above. However, five additional features were observed during either the site inspection or through the historical aerial photograph review, as detailed below.

- Length Runner Buildings (Feature ID 27): two brick construction buildings located offsite east of the office and west of the accommodation building (Feature ID 18) were identified during the site inspection. Their original use was unknown, based on the lack of documentation of them in the historical reports. The buildings closest to the Aurizon office were first observed in aerial photography dating from 1966. Based on anecdotal information, detailed in Section 4.6, the two brick buildings were accommodation for length runners, which would temporarily use the buildings during rail line inspections.
- Sand and Nitrate/Chromate AST's and Shed (Feature ID 22): two AST's (one understood to contain sand and the other a combination of water, nitrate and chromate, based on information detailed in Section 4.3 and noted in Golder, 2007) and a shed, which is located approximately

70m north of the Roundhouse. The structures were observed during the site inspection and first noted in 2001 aerial photography.

- Diesel AST (Feature ID 25): one AST noted approximately 150m north-east of the Turntable (understood to store diesel based on information detailed in Section 4.3). The AST was first observed in 2017 aerial photography.
- Offsite Ash Deposit (Feature ID 28): as observed in the 1975 aerial photograph review, ground disturbance in inferred trenches can be observed west of the administration building in close proximity to the ash rake out pits. It is considered likely that the ground disturbance activities were trenches for the ash material.
- 1975 ASTs (Feature ID 30): two ASTs were noted in the 1975 aerial photography, both offsite. The AST approximately 100m north of the Turntable was likely used to fill vehicles for use along the railway, the other AST and side structure approximately 600m east of the turntable was likely used to fill diesel locomotives during the transitional period from the steam to diesel locomotives.

4.3 HISTORICAL PHOTOGRAPHS

To provide further confidence regarding the absence/presence of the historical structures onsite, as discussed above and as detailed in Section 4.6, Aurora reviewed photographs from the rail heritage website, relating to the Collie Roundhouse[3]. The search of "Collie" identified 469 related photos, it was noted that a large portion of the files did not relate to the Site, however there were several photos in which the Site can be clearly observed. Based on review of the historical photographs, the following structures/features were observed:

- Collie Roundhouse (Feature ID 12);
- Turntable (Feature ID 19);
- Workshop (Feature ID 5);
- Compressor Shed (Feature ID 13); and
- Open drain.

Other offsite buildings/structures that were observed related to the larger depot operations included:

- The two brick length runner buildings (Feature ID 27);
- The administration building (Feature ID 6);
- Preparation shed (Feature ID 20);
- Chromate tank (Feature ID 16); and
- Ash rake out pit (Feature ID 24).

Other features could also be observed in the images including that of the DC power station and a water tank, which appeared to be north-west of the Workshop (offsite). Based on this review and in

[3] http://www.railheritagewa.org.au/archive_scans/

combination with other data, no additional buildings/infrastructure are considered to be present onsite from that listed in Section 4.2 and 4.5.

4.4 LAND OWNERSHIP

A historical certificate of titles (CoT) summary search for the four Lots (560, 561, 2856 and 2860) that form the Site was sent to Landgate, however Landgate noted it was difficult to trace the Lots due to the significant changes in historical surveys associated with the Lots. As a result, Landgate limited the search to the current Crown Reserve's being 47127 (Lots 561 and 2860) and 36584 (Lots 560 and 2856). The search summary document is attached in Appendix 1.

Review of the search summary for Reserve 47217, which dated back to 2003, noted that the Reserve is owned by the State of Western Australia and is under management order, with NTWA representing the primary interest holder. Historically, the Department of Regional Development and Lands and the Collie Railway Station Group (CRSG), for the purpose of a miniature railway, which was not developed, have also been previous interest holders.

Review of the search summary for Reserve 36584, which dated back to 1980, is owned by the State of Western Australia and is under management order, with PTA representing the primary interest holder and has been used historically for railway purposes.

Landgate indicated that Reserves 36584 and 47217 were also historically part of Reserve 10519, which is owned by the State of Western Australia and is under management order, with PTA representing the primary interest holder. Review of the search summary for Reserve 10519, which dates back to 1919, indicates the Reserve was originally gazetted for railway purposes, with no known information prior to 1919.

Based on the information above it is considered likely that the potential contaminating activities associated with the Site is limited to railway activities.

4.5 HISTORICAL AERIAL PHOTOGRAPHS

Aerial photography for the Site was reviewed using Landgate's Map Viewer Plus (Landgate, 2020) online viewing tool which was accessed 22 April 2020. Aerial photography available on Landgate's Map Viewer included 19 aerial photographs from 1996 to 2019. A selection of these photographs (based on notable Site changes and quality) have been reviewed in Table F below, however, has not been purchased given they are easily accessible for review on Landgate.

An Air Photo Request was submitted to Landgate to find any other historical aerial photography that existed prior to 1996 that was not available on Landgate's Map Viewer Plus. The request identified an additional six aerial photographs, comprising of aerial photographs from 1966, 1971, 1975, 1980, 1985 and 1991. A review of available aerial photography on Geosciences Australia (2020) was also undertaken, on the basis that additional aerial photography may have been available due to the significance of the Collie Roundhouse. This search uncovered two additional aerial photographs dated 1944 and 1966, the 1944 aerial photograph was purchased and has been included in Appendix 9.

Review of previous environmental reports identified that 1966 and 1988 historical aerial photography had been reviewed and included within the Golder (2007) and Golder (2013a) reports, which covers the extent of the current Site boundary, and was therefore considered to be required to be purchased from either Landgate or Geosciences Australia.

A preview of five of Landgate's (1971, 1975, 1980, 1985 and 1991) historical aerial photographs was undertaken, three aerial photographs were purchased and included within the review below, based on observed changes in the photographs and quality. The purchased aerial photographs have been included in Appendix 9.

A summary of the aerial photography can be found in Table F below.

TABLE F: SUMMARY OF HISTORICAL AERIAL PHOTOGRAPHS

DATE/SOURCE	SITE	SURROUNDING AREA
9 January 1944 Geoscience Australia in Appendix 9 (Black and White)	A railway line is present going through the middle of the Site (east to west), with vegetation immediately cleared each side of the line. A dirt track can be observed to the north of the line which goes east to west. Another dirt track (presumed for vehicles) is present in the central portion of the Site going north to south. There are no buildings or other notable infrastructure onsite. Some remnant trees and vegetation can be observed.	General – The Collie township has been significantly developed. North – Mostly vacant land, with remnant vegetation and potential swamp, marsh area. A railway line from the former Co-Op Coy's Mine near the north eastern portion of the Site comes near the eastern portion of the Site and joins the main railway line. Large scale infrastructure can also be observed further north, understood to be a DC power station. East – Ongoing railway line, potential train workshop or service area. South Prinsep St does not connect to North Prinsep St. South – Mostly bushland, with some tracks present through the bush area, some residential buildings also noted south of the eastern portion of the Site. A railway line (understood to go to a timber mill) extends from the South also approaches and joins the railway line onsite. West – Ongoing railway line, vacant bush land with tracks, potential swamp area.
February 1966 Golder (2007, 2013a) (Black and White)	The Site has undergone substantial development, with the majority of the Site cleared. Several structures can be seen onsite which include the Roundhouse and Turntable, the Workshop, Compressor Shed and Wagon Repair Shed along with another unidentifiable structure near the Wagon Repair Shed. One railway line extends of the main track north of the Site, entering the eastern portion of the Site and goes south of the Roundhouse structure which eventually joins the main line. Another railway line from the west enters the Site and joins to the Turntable.	North – The main railway line is present, which has several different tracks, following cleared land and potential swamp/marsh area. The former northern railway line is no longer present. East – Ongoing railway line, potential train workshop/service area no longer present. Potential tennis courts/recreational grounds to the south east of the Site. South Prinsep St does not connect to North Prinsep St. The former nightowl service station is present. South – Some of the vacant bushland has been cleared. With some unknown structures observed. West – Substantial development and clearing has occurred. The current administration building leased by PTA to Aurizon is present, and two other unknown buildings and the Preparation Shed can also be observed.

TABLE F: SUMMARY OF HISTORICAL AERIAL PHOTOGRAPHS

DATE/SOURCE	SITE	SURROUNDING AREA
		Several other structures are present which are unknown however may potentially include the sanding plant, ash rake out pit, wastewater tank and/or mechanical coaling shed. Numerous rail tracks can be observed joining into the main track.
June 1975 Landgate in Appendix 9 (Black and White)	The former Workshop building that was adjacent to the Roundhouse is no longer present and the soils in that area appear to have been reworked. Another structure near the wagon repair shed is evident, with some darker soils along the railway line near the wagon repair shed. Some small objects can be observed in cleared areas, likely to be used as a laydown area for rail operations.	North – A large above ground storage tank (AST), considered to be used for diesel storage, with vehicles and another structure present observed north of the Roundhouse and railway lines. A separate AST and structure, likely used to refuel the locomotives, can be observed north of the railway line west of the wagon repair shed. Further to the North a power station can be observed. East – An additional structure is noted adjacent to the potential tennis courts/recreational grounds to the south east of the Site. South – No significant changes. West – One of the former structures north of the administration building is no longer present, three AST's (possibly containing either water or diesel) can be observed adjacent of the Preparation Shed. Ground disturbance can be observed west of the administration building, potentially trenches for the disposal of ash material.
March 1980 Landgate in Appendix 9 (Coloured)	The Wagon Repair Shed and associated structures are no longer present. Some of the former railway lines that passed through the Site are no longer present and a new line is present that passes near the Turntable.	North – the large AST and associated infrastructure is no longer present. The refuelling AST can no longer be observed. The DC power station appears to have been decommissioned. East – New structures are noted east of the recreational tennis courts, and several trains are observed which remain in their current location as part of the information centre. South Prinsep St and North Prinsep St are now connected. South – No significant changes. West – The AST's associated the Preparation Shed are no longer present a new AST is established south of the Preparation Shed.
December 1988 Golder (2007, 2013a) (Black and White)	A new structure appears to be present onsite, one between the Roundhouse and the administration building (one of the unknown buildings).	North – No significant changes. East – No significant changes. South – No significant changes.

TABLE F: SUMMARY OF HISTORICAL AERIAL PHOTOGRAPHS

DATE/SOURCE	SITE	SURROUNDING AREA
		West – It appears two structures are present southwest of the Preparation Shed, possibly associated with the fuel depot.
December 1991 Landgate in Appendix 9 (Coloured)	The majority of the Site appears unchanged, it appears the Site is being used as a laydown area to store railway line tracks and panels. Additionally, some of the ground appears to have been reworked along the southern boundary near the central portion of the Site.	North – No significant changes. East – Recreations tennis courts no longer present, as turned into car park. South – Additional residential development present. West – It appears two structures are present southwest of the Preparation Shed, possibly associated with the fuel depot. Structures and ponds appear to be present north-west of the administration building, likely to be the wastewater treatment tank system.
October 1996 Golder (2007, 2013a) (Coloured)	No notable changes.	North – No significant changes. East – No significant changes. South – Ongoing residential development present. West – No significant changes.
January 2001 Landgate Map Viewer (Coloured)	Site does not appear to be used as a laydown area, appears mostly vacant. An oval shape can be noted in the central portion of the Site which may be related to a potential ash deposit.	North – Two ASTs and a shed is to the north of the Roundhouse, as discussed later in the report likely to store sand and nitrate/chromate water. East – No significant changes. South – Ongoing residential development present. West – Fuel depot no longer present, the wastewater treatment tank system no longer present.
March 2008 Landgate Map Viewer (Coloured)	Significant stockpiling of soils can be observed in the central portion of the Site, likely to be imported from another location, source not obvious from historical aerials.	North – Appears the soils have recently been disturbed and may be the source of the stockpiles present onsite. The shed next to the AST's is no longer present. East – No significant changes. South – Ongoing residential development, Collie Ridge Motel present. West – No significant changes.
November 2010 Landgate Map Viewer (Coloured)	Stockpiles are no longer present onsite. The eastern portion of the Roundhouse appears to be used as a laydown area.	North – Another shed/structure is present next to the two AST's. No other significant changes. East – No significant changes. South – No significant changes. West – No significant changes.
November 2014	The area east of the Roundhouse is no longer used for laydown, no other notable changes.	North – North of the railway line, a large gravel stockpile/laydown area is present.

TABLE F: SUMMARY OF HISTORICAL AERIAL PHOTOGRAPHS

DATE/SOURCE	SITE	SURROUNDING AREA
Landgate Map Viewer (Coloured)		East – No significant changes. South – No significant changes. West – The cladding that formed the Preparation Shed is no longer present, with underlying steel frame present.
September 2019 Landgate Map Viewer (Coloured)	No notable changes, with the exception of green grass present along portions of the Site.	North – A large AST and other infrastructure is present near the gravel stockpile area. East – No significant changes. South – No significant changes. West – No significant changes.

4.6 CORRESPONDENCE

No formal interviews were proposed to be undertaken as part of the PSI, given the following:

- previous investigations had interviewed people with a working knowledge of the Site;
- that the Site was no longer in use and had been vacant for several years; and
- tracking down contactable and relevant people would have been extremely difficult, given the time that had passed since historical rail operations.

Notwithstanding, Aurora contacted Jeff Austin from Rail Heritage WA for information regarding the Site. Jeff had indicated that the Site had not been well documented in comparison to other rail operations which had occurred around similar time periods. Jeff was able to provide some articles from the Railway Gazette, which did not provide any additional information in context to the contamination status of the Site and some proposed plans (detailed in Section 4.2), which were never implemented.

Jeff was able to provide some information regarding the coal quality which was variable and generally (from the open cut mines (lower calorific value and variable ash content)) of a poor quality and that WAGR specifically designed its locomotive fireboxes to burn this lower quality coal and had few problems. On this basis the requirement for a Coal Testing Shed was possibly deemed to be surplus to needs and not established. As well as possibly due to the availability of a testing laboratory at Midland Junction.

Norm Hayward an aboriginal elder was invited to one of the future vision workshops and turned out that he was a former steam locomotive operator in and out of Collie between 1964 and 1974 before moving to other locations. Norm was questioned by Aurora on his time at Colle and was able to recall that ash material was not deposited or buried on Lot 561 and indicated that it was disposed offsite near the old depot to the east of the Site. Norm also noted that the two buildings/structures south of the wagon repair shed was associated with the shunting crew rather than the wagon repair operations. Norm was not able to recall the exact use of the shunting sheds, however it is considered likely to have been used for meals or similar. Norm also recalled the two offsite brick buildings (Feature ID 27) were utilised periodically for accommodation purposes for length runners (personnel used to inspect the

train lines for operational maintenance purposes). Norm was also able to recall the presence of the boiler shed, which was used as a steam source for the cleaning of the locomotives, which occurred in the Roundhouse, however he was not able to recall the presence of the Coal Testing Shed.

The Collie Railway Station Group (CRSG) were also contacted to assess the presence of the stockpiles identified in the historical aerial photograph review (Section 4.5), given they were responsible for Site ownership at that time, as identified in Section 4.4. Peter Hall, the current CRSG chairperson, indicated that the majority of the committee were not involved at that time and would not be able to provide advice in this matter. Peter was able to identify a document (provided in Appendix 10) written by the person responsible (Mrs J Macdonald) for the project (however was formerly managed by Mr Brynley Treherne the Secretary at the time) that was addressed to the Department of Planning Lands and heritage (DPLH) noting the land had been taken from the CRSG. The document also indicated that the Site had been used by Main Roads WA during part of the Coalfields Highway upgrade and in return received a fence compound. The CRSG were not able to release contact information from former members, however did confirm that Aurora's contact details had been passed on so additional information could be sought. Aurora has not however, received any further correspondence from former members involved with the project.

Main Roads WA were questioned in regards to the stockpiles, however many of the personal again that had been involved with the Coalfields Highway widening works had moved on. Neil McCarthy from Main Roads WA indicated that the Coalfields Highway project did not occur until 2010-2011 and was unlikely to be the source of the stockpiles. Neil pointed out that area immediately north of the rail line and Site, appeared to have been recently been disturbed (in that time period) and could be the source of the material.

Stuart Campbell from PTA was contacted in regards to the source of the stockpiles and indicated that PTA had no information on the stockpiled material. However, Stuart suggested that Aurizon be contacted as they lease a portion of property from PTA.

As such Aurizon was contacted, Paul Parkinson responded and indicated that Aurizon's lease was confined to the administration building area and recommended contacting Arc Infrastructure. An email was sent to Arc Infrastructure, however no correspondence was received at the time of preparing this report.

NTWA indicated that it has been in possession of the Site since 2011 and during that time the Site has remained vacant and unused. The only known operations to take place on Lot 561 by NTWA is ongoing vegetation management in the form of slashing once a year and that a weed killer was applied once in 2016 and outsourced to a contractor who applied the weed killer in accordance with current guidelines and manufacturers specifications.

4.7 DANGEROUS GOODS STORAGE RECORDS

A Freedom of Information (FOI) search was submitted on the Department of Mines, Industry, Regulation and Safety (DMIRS) Dangerous Goods Site Register system on the 5 March 2020, regarding applications and current/historical licences for storage of dangerous goods, inspection reports, plans and any non-conformances held for Lots 560, 561, 2856 and 2860.

A response was received from DMIRS dated 15 April 2020 presented in Appendix 11, which contained five documents. Review of the response and provided documentation demonstrates that Aurizon,

have a 110kL AST on Lot 2856 that stores diesel fuel (adjacent of the railway line, north-east of the Roundhouse), licensed from June 2016 to June 2021 under DGS022173. It is understood that the original application proposal was submitted in March 2013 which was supplied with a map, which also displays a nitrate water tank (understood not licensed).

The DMIRS online Dangerous Goods Site Register system (DMIRS, 2020) was viewed on 28 April 2020, to assess if there were any other properties upgradient of the Site which also stored dangerous goods, of which none where identified. Two properties were identified to have or have licenses to store dangerous goods both cross gradient of the Site as presented in Figure 7, however were not considered to present a potential contamination risk given their distance from the Site and not being up hydraulic gradient.

4.8 DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATION RECORDS

4.8.1 Contaminated Sites

The State Government, through the DWER has the overall responsibility for administering and enforcing the *CS Act 2003* and its associated regulations. Part of this responsibility includes maintenance of the Contaminated Sites Database. The Contaminated Sites Database holds information on known contaminated sites that have been classified by the DWER as:

- Contaminated – remediation required (CRR);
- CRU; and
- RRU.

Review of the DWER online database (DWER, 2020d) identified that Lot 561, which forms a part of the Site, was classified as CRU on 10 February 2015. Review of the BSR (Appendix 12), identified that ash deposits across the Lot from coal-fired train engines, contained elevated metals (arsenic, chromium, copper and zinc) and groundwater contained elevated copper and nickel concentrations. A risk assessment undertaken in 2013, considered to be the Golder (2013a) report, did not identify an unacceptable risk associated with the Site based on an ongoing commercial/industrial land use, however identified that contamination may be present at unacceptable risk to more sensitive land uses. On this basis DWER restricted Site use to commercial/industrial land uses, with further investigation to be undertaken prior to a change to a more sensitive land use.

Review of other surrounding properties within a 1km radius of the Site to be classified as per the above classifications, identified offsite property 57 Johnston Street (Lot 20 on Diagram 73853) as CRU, which is located approximately 400m east of the Site. Review of the BSR (Appendix 12), notes that this property was classified in April 2017 and operates as a service station with hydrocarbons identified in groundwater below the property. Investigations have identified that no unacceptable risk based on the current ongoing land use for commercial/industrial operations, however the Site is not to be developed for a more sensitive land use prior to further investigation or remediation. Additionally, bi-annual groundwater monitoring is required to demonstrate that the plume is not migrating offsite (inferred to be to the north west towards Collie River) and is naturally attenuating. On the basis of the BSR, the distance from the Site and general groundwater flow direction, the property is not considered likely to affect the Site.

It is understood DWER also has these additional four classifications not presented on the public database:

- Possibly contaminated – investigation required (PC-IR);
- Decontaminated;
- Not contaminated – unrestricted use; and
- Report not substantiated.

A BSR request was submitted to DWER for 2856 and 2860 given the other four classifications are not available on the database. DWER responded noting that Lot 2860 had not been reported to the department as a known contaminated site, however noted that they had information relating to Lot 2856 but were yet to make a classification of the Lot.

Given the historical activities undertaken on Lot 560, a detailed summary of records (DSR) request was submitted to DWER. Similar to that of Lot 2856, DWER indicated that is was yet to make a classification for Lot 560, but had four reports related to the lot including Golder (2002), HGM (2002), Golder (2013a) and Golder (2013b).

The classified properties are shown in Figure 8.

4.8.2 Freedom of Information

A FOI request was made to the DWER on 28 April 2020 for documents referencing the Site that may relate to any inspection notes, pollution incidents, leakage reports, correspondence, abatement notices, contamination/pollution issues, complaints and any other file notes.

Correspondence from DWER was received on 30 April, 5 May and 18 May 2020, regarding a specified date range of the search, the removal of surrounding lands from the search and further scope reduce given DWER assessed that the search would exhaust significant resources from the FOI Unit, respectively. DWER supplied a spreadsheet which identified 28 documents related to the request such that Aurora could further narrow the search.

Review of the 28 document descriptions did not indicate any inspection notes, pollution incidents, leakage reports or complaints. But rather the descriptions were noted to be general correspondence or file notes relating to the contaminated sites classification of the Site.

As such the FOI request was not pursued any further given no additional information relating to potential contamination issues were likely to be uncovered that has not already been obtained. The responses and document list are attached in Appendix 13.

4.9 LOCAL GOVERNMENT

An FOI application was submitted to the Shire of Collie seeking records relating to planning/building applications, complaints and contamination for the Site on the 5 March 2020. The response from the Shire of Collie, identified 38 documents relating to the Site, which is provided in Appendix 14.

Review of the document descriptions notes no complaints or contamination issues, however reference to a Conservation Plan and Landuse Plan is mentioned (the Greg Rowe and Associates (1998) report), and a FOI application likely related to the Golder (2013a) report. The documents were not requested given Aurora had already obtained a copy of both reports.

The other documents were noted to be generally related to the ownership of the Roundhouse, scheme amendments and future development.

4.10 HERITAGE

4.10.1 Aboriginal Heritage

The Aboriginal Heritage Act 1972 defines Aboriginal Heritage Sites and provides for the preservation of places and objects customarily used by or traditionally important to Aboriginals, and prohibits the concealment, destruction or alteration of any Aboriginal Heritage Sites. An Aboriginal site may:

- Exist in any area of Western Australia.
- Not have been recorded in the register of Aboriginal sites or elsewhere.
- Not have been identified in previous heritage surveys or reports on that area but remains fully protected under the Act.

A review of the Aboriginal Heritage Inquiry System (AHIS), maintained by the Department of Planning, Lands and Heritage (DPLH) (2020) accessed on the 28 March 2020, indicates that the Site is not located upon an Aboriginal Heritage listed Site. However, one Aboriginal Heritage Site (ID: 15329) was identified within a 1km radius of the Site, approximately 120m north of the Site. The site (Appendix 15) was registered due to its mythological significance.

Additionally, the search noted that the enquiry is on land within or adjacent to the Gnaala Karla Booja Indigenous Land Use Agreement, which is understood to cover an area of approximately 30,000km^2.

4.10.2 Cultural Heritage

The presence of heritage sites was investigated using the inherit database (Government of Western Australia, 2020) which contains detailed information about cultural heritage places entered in the State Register of Heritage Places, local government inventories and other lists, the Australian Government's heritage list, and other non-government lists and surveys.

The database identified that both the Collie Roundhouse and Turntable are heritage listed (Place Number 00541), with the assessment documentation for its heritage status provided in Appendix 16, no other heritage sites where identified onsite.

It was noted that several other heritage listed sites surrounded the Site boundary such as:

- the Locomotive Shed (approximately 400m west of the Roundhouse, referred as the Preparation Shed within this PSI) (Place Number 25329);
- residential properties (181 to 163) south of the Site and south of Throssell Street/Coalfields Highway including the Old Roads Board Office and Coal Machinery Memorial at 161 Throssell Street/Coalfields Highway; and
- Railway Memorial and Railway Museum east of the Site and west of the Collie Visitor Centre.

The offsite heritage sites were considered unlikely to be affected by future Site redevelopment works. It is understood that the Roundhouse and Roundtable are heritage listed and a Conservation Management Plan exists (Department of Planning, Lands and Heritage – DPLH, 2018) detailing the specifics of significance. Future redevelopment/restoration works are understood to be planned in

accordance with the Conservation Management Plan to maintain where practical the specifics of significance.

4.11 BRIEF SUMMARY OF SITE HISTORY AND SURROUNDS

The increasing need for power led the colonial government to offer a reward for the discovery of a major coal deposit, with an exploratory mine being established in Collie 1894 (DPLH, 2018). Once the quality of the coal and its extent was established the Collie coalfield was declared in 1896 and the government's coal mine offered for tender (DPLH, 2018). A railway line that went through the Site was established (completed 1898), with a depot and a Goods Shed (both completed in 1898) established east of the Site (DPLH, 2018).

Additional infrastructure at the original Collie railway depot (east of the Site) included a loop siding (1908), locomotive washout plant and engine drop pit (1910), machine shed (1916), a goods shed (1923), trainman's barracks (1929), a wagon repair shop and mechanical coaling plant (1938) (DLPH, 2018). The ash deposits onsite identified by HGM (2002b) were likely to have originated from the original railway depot east of the Site, prior to 1944. It is understood based on aerial photography the only infrastructure onsite was rail lines prior to 1944.

Given the large demand for energy post the second world war, the state government embarked on a program to transmit electrical energy across the settled south-west corner of the state and an interconnected system of power stations, transmission lines and distribution networks was built up, so that coal mined at Collie was converted to electrical energy in nearby power stations and used across the region (DPLH, 2018). The first power station in Collie was built by the Collie Power Co and officially opened in March 1931, understood to be built off Patstone Road, near to the Co-operative Colliery (which was understood to be approximately 700m north-west of the Roundhouse). It is understood that the power station closed in 1971 and was demolished in 1982 (Bird, 2010). Based on aerial photography, in which soil disturbance can be observed, some of the surrounding land associated with the power station may have been used to deposit fly ash waste. Based on review of the contaminated sites database, the power station property does not appear to have been classified.

The post war period also resulted in significant increases in the mining and transportation of coal from Collie, as a result a large yard was proposed and this was to be west of the Collie township, including a new locomotive depot and roundhouse. However, the depot never reached the size originally planned (pes comm: Jeff Austin, Rail Heritage WA).

The turntable was built in Germany and shipped to Australia, which arrived in Fremantle in June 1954 (DPLH, 2018). The Roundhouse was completed in 1956 and the Turntable was installed by June 1957 (DPLH, 2018). Review of the 1956 WAGRC annual report also noted that workshops, offices, amenities block, permanent way and coaling and watering facilities (three 5,600 gallon tanks) would be provided in the coming year. The locomotive depot was complete and in use by 1959. Other structures included as part of the depot at that time included a diesel locomotive shed and diesel locomotive workshop and wagon inspection pits, dated 1954-1958.

The working life of the steam depot was relatively short-lived when oil replaced coal as a preferred fuel over a broad spectrum of Government and private users (DPLH, 2018). On 24 December 1971, the last steam locomotive, the "S549", left Collie. It is understood that a proposed plan was developed to amalgamate the original depot (east of the Site) with the new depot (including the Site), however

this did not eventuate. Given the reliance of diesel locomotive power, additional infrastructure was needed to support the trains including a fuel depot (established west of the Site). In addition, a wastewater treatment plant was built to process wash water and spent chromate water.

During the 1980s, the declining use of the railway for transporting coal and goods saw the demise of the railway depot (DPLH, 2018). By the 1990s, most of the sidings in the rail reserve were removed and many structures demolished (DPLH, 2018). The Site remained vacant and unused until the CRSG was given the management order for Lot 560 in 2003, which was planned to be developed into a miniature railway line. However, this was never developed, the Site temporarily was used to store unknown sandy material for a brief period until it was removed and the remainder levelled onsite. The Lot was transferred to NTWA in 2011 and has since remained vacant.

Based on review of the Site history the contaminating activities to have occurred onsite are the burial of the ash material prior to the1940s, historic rail operations from 1950s to 1970s and the use of land for stockpiling unknown material in 2008. Other offsite activities such as rail operations and the former DC power station also have a potential to influence the contamination status at the Site.

5 REVIEW OF HISTORICAL DATA

A considerable amount of data has been amassed for the Site via a series of intrusive investigations and GMEs prepared to inform the assessment of potential soil and groundwater impacts in regards to the risk associated with the current Site use being for commercial/industrial activities. The results have been compared to historical assessment criteria, many of which have since been updated or become obsolete. However, for the purposes of this investigation it is considered appropriate that the historical data set be compared to assessment criteria that are relevant to the proposed site concept plan and from a regulatory perspective are the most current.

5.1 REVISED ASSESSMENT CRITERIA

Schedule B1 of the amended NEPM (as amended 2013) states that the most appropriate assessment criteria for use in a range of environmental settings and land use scenarios should be selected by considering factors including the protection of human health, ecosystems, groundwater resources and aesthetics. The revised assessment criteria have been sourced from the following guidelines:

- Department of Environment and Regulation (DER, 2014) Assessment and management of contaminated sites;
- The amended NEPM (NEPC, 1999) Schedule B1 – Guideline on Investigation Levels for Soil and Groundwater;
- CRC Care Technical Report No. 10 (Friebel and Nadebaum, 2011) Health Screening Levels (HSLs) for Petroleum Hydrocarbons in Soil and Groundwater (for direct contact criteria and intrusive maintenance worker criteria not presented in the amended NEPM (NEPC, 1999)).

The initial concept plan concept plan which is understood to potentially include activities such as new stores, a brewery, hospitality tavern-dining use, a children's playground, and a carpark. Many of these uses can be considered as commercial, however Residential and Public Open Space (POS) criteria have also been adopted as the most conservative land uses for the Site media.

5.1.1 Soil

5.1.1.1 Human Health

HSLs developed by CRC CARE for selected petroleum compounds and fractions published in the amended NEPM (NEPC, 1999) (except for direct contact and intrusive maintenance worker HSLs, extracted from Friebel and Nadebaum, (2011)) were adopted to assess human health risks to identified potentially sensitive receptors via the following exposure pathways:

- HSL-A Low Residential (chronic exposure via direct contact pathways including dermal contact and ingestion, and dust and vapour inhalation); and
- HSL Intrusive Maintenance Worker (chronic exposure of shallow trench worker via direct contact pathways, including dermal contact and ingestion, and dust and vapour inhalation).

"The soil and groundwater HSLs are based on three-phase equilibrium theory and soil vapour is limited by the maximum solubility limit of the chemical in the soil pore water phase or the groundwater. The soil saturation concentration of a particular contaminant is the condition where pore water is at its solubility limit and soil vapour is at the maximum vapour concentration. When a calculated HSL in soil

or groundwater exceeds this limit, the vapour in the soil or above groundwater cannot result in an unacceptable vapour risk and is denoted as non-limiting" (amended NEPM (NEPC, 1999)).

It is noted that for both soil and groundwater the HSL for recreational and open space are non-limiting and as such were not considered any further given the presence of values from HSL-A. Where no values are available for HSL-A, comparison was made to the soil saturation concentrations values.

HSL criteria applicable to sandy soils were adopted based on the reported lithology of shallow soils at the Site. Given the majority of historical samples collected at the Site were taken from shallow soils, the historical results were compared to HSLs for vapour intrusion corelating with 0m to <1m.

Health Investigation Levels (HILs) for residential (HIL-A) presented in Schedule B(1) of NEPM (1999 as amended 2013) were used as Tier 1 chronic health screening criteria for COPCs other than petroleum hydrocarbons. Consideration to HIL-B (residential with minimal soil access) and HIL-C (recreational) were considered however HIL-A's were considered the most conservative and as such were adopted.

5.1.1.2 Terrestrial Ecology

Site specific Ecological Investigation Levels (EIL) were not adopted for this assessment due to insufficient data for calculations to be undertaken. Consequently, the minimum concentrations for urban residential/public open space (URPOS) have been adopted for assessment purposes as a conservative measure, noting no identified sensitive ecological receptors onsite and that extensive clearing/industrial operations have been undertaken onsite. The criteria were adopted based upon potential future use where sensitive ecological receptors may return to Site, e.g. landscaping vegetation. Ecological Screening Levels (ESL) for URPOS have been adopted to assess risk to petroleum hydrocarbons compounds.

The depth of application for EILs and ESLs applies from the surface to 2.0 m bgl which corresponds to the root zone and habitation zone of many species (NEPC, 1999).

Management Limits

The amended NEPM (NEPC, 1999) 'management limits' are additional screening levels that are applicable to petroleum hydrocarbon compounds only. They are intended to be applied following evaluation of human health and ecological risks and risks to groundwater resources. The amended NEPM (NEPC, 1999) states that the management limits are intended as 'interim Tier 1' screening criteria aimed at avoiding or minimising the formation of observable LNAPL, fire and explosive hazards; and the effects on buried infrastructure (e.g. penetration of, or damage to, in-ground services by hydrocarbons). The amended NEPM (NEPC, 1999) qualifies that the management limits are relevant to operating sites, where 'significant' sub-surface leakage of petroleum compounds has occurred, or when decommissioning industrial and commercial sites. Given that the historical data set indicates that only minor concentrations of petroleum compounds have been detected in groundwater, gross sub-surface leakage of these compounds is considered to not have occurred at the Site and, as such, Management Limits were not applied as part of this assessment.

5.1.2 Groundwater

Considering the availability of scheme water in the area it is considered unlikely that groundwater is consumed for drinking water purposes. As such, the highest beneficial use of groundwater in the area is considered to be used for non-potable purposes.

5.1.2.1 Non-potable groundwater use

It has been assumed that any abstracted groundwater (bore water) would only be used for domestic non-potable purposes, including garden reticulation and vehicle washing, and not for drinking, bathing, filling swimming pools, food preparation or cooking unless it has been appropriately tested and treated. The following guidance will be used to assess risks associated with direct and indirect exposure routes along with risks associated irrigation:

- Non-Potable Groundwater Use (NPUG) in the DWER (2014) Assessment and management of contaminated sites, contaminated sites guidelines (Department of Health (DoH) (2014) Contaminated Sites Ground and Surface Water Chemical Screening Guidelines).
- Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) (2000) – Long-term irrigation (LTI) water values.
- ANZECC & ARMCANZ (2000) – Short-term irrigation (STI) water values.

5.1.2.2 Aquatic Ecosystems

Based on historical monitoring data the inferred groundwater flow direction at the Site is in a south-southeast to southeast direction towards to the Collie River, approximately 800m east of the Site.

DER (2014) stipulates that when assessing surface water bodies, or groundwater which discharges to surface water bodies, the ANZECC & ARMCANZ guidelines are to be adopted. It is understood that while this guidance has been updated by ANZG (2020), stress and physical default guideline values are yet to be released. As such, the ANZECC & ARMCANZ (2000) guidance has been referred to as a reference. The ANZECC & ARMCANZ (2000) guideline provides assessment criteria at three different protection levels, namely:

- High conservation/ecological value ecosystems, being those which are “effectively unmodified or other highly-valued ecosystems, typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations”;
- Slightly-moderately disturbed ecosystems, being ecosystems in which “aquatic biodiversity may have been adversely affected to a relatively small but measurable degree by human activity, such as rural streams receiving runoff from land disturbed by grazing or pastoralism, or marine ecosystems adjacent to metropolitan areas”; and
- Highly disturbed ecosystems, being those which are “measurably degraded ecosystems of lower ecological value, such as shipping ports and harbours serving coastal cities, urban streams receiving road and stormwater runoff, or rural streams receiving runoff from intensive agriculture/horticulture”.

The Collie River is considered to be a slightly to moderately disturbed system, given the impacts of dewatering from nearby mines, close proximity to agricultural land and close proximity to the Collie township. Therefore, a moderately disturbed ecosystems protection level, for protection of 95% freshwater receptors, has been adopted as follows:

- ANZECC & ARMCANZ (2000) – Physical and chemical stressors default trigger values for freshwater quality of upland rivers in south-west Western Australia for slightly disturbed ecosystems (Freshwater).

Where no guideline criteria were available for analytes the following was adopted as part of the freshwater criteria:

- ANZECC & ARMCANZ (2000) – Toxicant trigger values for freshwater for slightly-moderately disturbed ecosystems (Freshwater).

5.2 DATA COMPILATION PROCESS

A review of the historical environmental reports identified the following reports had collected samples for analytical assessment for characterisation purposes:

- Golder Associates (2002) Phase I Environmental Site Investigation Former Collie Railyard, Collie WA, January 2002.
- Halpern Glick Maunsell (2002b) Detailed Site Investigation – Collie Railway Yard, Collie, WA, Western Australia Government Railways Commission, October 2002.
- Halpern Glick Maunsell (2003) Groundwater Monitoring – Collie Railway Yard, Collie, WA, Western Australia Government Railways Commission, May 2003.
- Golder Associates (2013a) Data Gap Analysis and Work Plan Collie Roundhouse, Coalfields Road Collie Western Australia, February 2013.
- Golder Associates (2013b) Groundwater Assessment Collie Roundhouse, Coalfields Road Collie Western Australia, November 2013.

It was noted that ERC (2015) also collected samples for validation purposes following limited remediation works. This data was not considered to require re-assessment as current guidelines were applied and samples were not collected for assessing the overall environmental characteristics of the Site.

Additionally, PACM samples that were collected from near the Roundhouse building to confirm the presence of ACM was not considered further, as it has already been established that Roundhouse contained asbestos materials.

5.2.1 Sample Locations

The sample locations from previous reports were transposed onto one figure, as displayed on Figure 9. This was undertaken by overlaying the existing figures to the Site location with known features (such as the Roundhouse and surrounding roads), as this was deemed the most accurate way to reproduce the sample locations

It is noted that whilst some of the historical sample locations were outside of the Site boundaries, the associated data however has been retained for comparison purposes given the broadly similar land use across the former rail yards and therefore similar processes and waste materials produced (i.e. ash).

5.2.2 Data Handling

An attempt was made to obtain the relevant analytical reports in a excel or other electronic format, to minimise the potential for transcription errors. However, due to the age of the data several reports could not be sourced from Analytical Laboratory Services (ALS) Environmental, as the laboratory indicated they only keep data up to five years, this included reports:

- EP0603580 – dated 21 December 2006 from Golder (2007).
- EP1207050 – dated 12 September 2012 from Golder (2013a).
- EP1306650 – date unknown (laboratory report not attached to the report), Golder (2013b).

Also, given their age laboratory reports from ARL could only be provided in pdf format, which had already been attached in previous reports. Additionally, report 62036 – dated 3 January 2002 from Australian Environmental Laboratories in Golder (2002) could not been sourced as the business is no longer in operation.

Given that acquiring the raw data in electronic format was not possible, the analytical data in the laboratory reports was manually transcribed with care into a usable format. A 10% spot check of that data was completed after tabulation to ensure that no errors had occurred through the transcription process.

5.3 QUALITY REVIEW OF HISTORICAL DATA

Prior to the use of the analytical data for assessment of characterisation purposes, a review was considered to be required of both data quality and general compliance with DWER (2014) and NEPM (as amended, 2013) to ensure it was of sufficient quality for interpretation purposes.

The high-level criteria applied to assess data integrity are detailed in Table G below and the findings are presented in Table H below. Professional judgement was also applied, based on the overall CSM understanding and comparability with other data observations.

TABLE G: HISTORICAL DATA INTERGRITY ASSESSMENT FACTORS

CRITERIA	HISTORICAL DATA INTERGRITY ASSESSMENT FACTORS
Representativeness	Sampling locations, analytical suite, sampling methodology appropriate for matrix.
Comparability	Analysis undertaken by a National Association of Testing Authorities (NATA) accredited laboratory with appropriate LORs selected.
Completeness	Chain of custody (COC) documentation and laboratory reports available, decontamination procedures and records available and satisfactory results and frequency of QC samples. Rinsate blank samples, field blanks, trip blanks to be within acceptable limits.
Precision	Field duplicate and triplicate samples have appropriate Relative Percentage Difference (RPD) values.
Accuracy	Surrogate spike samples, matrix spike samples and laboratory control samples undertaken and within the required limits.

TABLE H: SUMMARY OF DATA INTEGRITY ASSESSMENT FINDINGS

REPORT	REPRESENTATIVENESS	COMPARABILITY	COMPLETENESS	PRECISION	ACCURACY	COMMENTS
Golder (2002)	• In context of the investigation scope of works (being a PSI with limited sampling) the sampling (analysis of five primary samples) approach was considered to be appropriate, to provide a general indication of the soil quality (i.e. the absence/presence of gross contamination). Sampling targeted stains, stressed vegetation or waste material. Samples were analysed for an appropriate selection of COPCs. • Procedures outlining handling and storage of samples is considered appropriate and in general accordance with guidelines. Surface samples are considered appropriate in the context of assessing spills which are likely to occur at the surface.	• The analysis of samples was undertaken by a NATA accredited laboratory. • All laboratory LORs were below investigation levels.	• COC and laboratory certificates was provided in the report, with samples being received by the laboratory in an appropriate timeframe to be analysed within the holding times. However, there was no date or extraction time on the laboratory report to determine if samples were analysed within the holding times. • The stainless steel sampling equipment was washed and rinsed between sample locations, however does not indicate if a detergent was used. • No rinsate, field or transport blanks were undertaken, to assess potential for cross contamination during sampling and sample transport.	• One duplicate sample was collected, with all relative percentage difference (RPD) values within the acceptable limits. • No triplicate samples were collected.	• All internal blank, duplicates, surrogates spike samples, matrix spikes were within acceptable ranges.	The quality control implementation is not in full compliance with the current regulatory requirements, however based on the quality control implemented in a worst case scenario would have resulted in cross contamination resulting in false positives and as a result in considered conservative. Review of the data is considered to be comparable to that of the existing dataset and as a result cross contamination is considered unlikely. Based on the above Aurora considered the data to be acceptable to be used within the larger data set to aid in characterisation of the Site.
HGM (2002b)	• A SAQP was established with an appropriate soil sampling strategy to ensure a sufficient sampling density and analytical suite (with reference to the COPCs). However, the actual methodology is somewhat unclear and samples appear to have been collected through test pitting. Sample collection/storage and management is suitable based upon the SAQP. • The groundwater wells were situated appropriately to assess the groundwater flow	• The analysis of samples was undertaken by a NATA accredited laboratory. • All laboratory LORs were below investigation levels (the original metal analysis however exceed the metal investigation levels). • Well construction logs are presented in the report, with MB1, MB2 and MB3 appearing to be appropriately constructed.	• COC and laboratory certificates was provided in the report. • Review of the holding times for groundwater samples noted that the repeat testing for metals (original analysis was within holding time, however LORs were not sufficient) exceeded the holding times and TPH given it only had a holding time of on day. • Review of the holding times for soil samples noted only base neutral pesticides exceeding the holding time requirements.	• One duplicate sample was collected as part of the GME, however the RPD values were not calculated. • Three duplicate samples were collected as part of the soil investigation, however the RPD values were not calculated. • No triplicate samples were collected. • The groundwater field blank sample contained elevated metals, indicating potential contamination.	• All internal blank, duplicates, surrogates spike samples, matrix spikes were within acceptable ranges.	A SAQP was developed for the investigation which has allowed a process to be undertaken to methodically characterise the investigation area. Overall, the soil investigation provides a robust dataset for site characterisation albeit all samples from the surface and no asbestos sampling was undertaken on the ash material. Given the exceedances in holding times for both metals and groundwater further investigation was considered required, however is considered to be comparable to the larger dataset (with the exception of copper and nickel) and is

TABLE H: SUMMARY OF DATA INTEGRITY ASSESSMENT FINDINGS

REPORT	REPRESENTATIVENESS	COMPARABILITY	COMPLETENESS	PRECISION	ACCURACY	COMMENTS
	direction, however the eastern portion of the Site has not been characterised. The sampling methodology does not appear to be appropriate for volatiles.		• No rinsate, field or transport blanks were undertaken for the soil investigation, to assess potential for cross contamination during sampling and sample transport. • One field blank was collected for the groundwater investigation.			deemed suitable for characterisation purposes.
HGM (2003)	• Sampling was undertaken as per the SAQP, with the addition of preservatives to extend the holding time of TPH and BTEX for analysis and the additional QC samples.	• The analysis of samples was undertaken by a NATA accredited laboratory. • All laboratory LORs were below investigation levels.	• COC and laboratory certificates was provided in the report, with samples being received by the laboratory in an appropriate timeframe to be analysed within the holding times. All samples were analysed within the appropriate holding times, with the exception of PAHs which were exceeded by one day and was not considered to affect the integrity of the results. • One rinsate and one field blanks was collected which contained concentrations below the laboratory LOR.	• One duplicate sample was collected, with all relative percentage difference (RPD) values within the acceptable limits, with the exception of one which was attributed to low analyte difference which has exaggerated the RPD value and Aurora do not consider it to affect the integrity of the results. • No triplicate samples were collected.	• All internal blank, duplicates, surrogates spike samples, matrix spikes were within acceptable ranges.	Additional QC was implemented and investigated in the report. The groundwater did detect elevated TPH concentrations which was not consistent as part of the larger dataset. Overall, the data and quality control was considered acceptable and the data suitable to be used within the larger data set to aid in characterisation of the Site.
Golder (2007)	• In context of the investigation scope of works (being a PSI with limited sampling) the sampling (collection of six samples) approach was considered to be appropriate, to provide an indication of the soil quality (note the absence/presence of gross contamination). Sampling targeted stains, stressed vegetation or waste material. Samples were analysed for an appropriate selection of COPCs.	• The analysis of samples was undertaken by a NATA accredited laboratory. • All laboratory LORs were below investigation levels with the exception of three samples for pesticides due to matrix interference, however all pesticide concentrations were below the laboratory LOR.	• COC and laboratory certificates was provided in the report, with samples being received by the laboratory in an appropriate timeframe to be analysed within the holding times. All samples were analysed within the appropriate holding times. • No rinsate, field or transport blanks were undertaken, to assess potential for cross contamination during sampling and sample transport.	• One duplicate sample was collected, with all relative percentage difference (RPD) values within the acceptable limits. • No triplicate samples were collected.	• Internal blank, duplicates, surrogates spike samples, matrix spikes were generally within acceptable ranges with a few exceptions. In the case of the exceedances Golder reviewed the exceedance in context of the other results and determined the exceedances did not affect the integrity of the analytical results, of which Aurora agree.	The quality control implementation is not in full compliance with the current regulatory requirements, however based on the quality control implemented in a worst case scenario the non-compliance would have resulted in cross contamination potential false positives and as a result is considered conservative. Review of the data is considered to be comparable to that of the existing broader dataset with no outliers and as a result cross

TABLE H: SUMMARY OF DATA INTEGRITY ASSESSMENT FINDINGS

REPORT	REPRESENTATIVENESS	COMPARABILITY	COMPLETENESS	PRECISION	ACCURACY	COMMENTS
	• Procedures outlining handling and storage of samples is considered appropriate and in general accordance with guidelines. Surface samples are considered appropriate in the context of assessing spills which are likely to occur at the surface.					contamination is considered unlikely. Based on the above Aurora considered the data to be acceptable to be used within the larger data set to aid in characterisation of the Site.
Golder (2013a)	• In context of the investigation scope of works (being a data gap assessment with limited sampling) the sampling (collection of 11 samples) approach was considered to be appropriate, to provide an indication of the soil quality (note the absence/presence of gross contamination). Sampling was undertaken on suspect areas of contamination concern. Samples were analysed for an appropriate selection of COPCs. • No details on sampling procedure or figure demonstrating the sample locations, other than sample descriptions.	• The analysis of samples was undertaken by a NATA accredited laboratory, however the asbestos analysis was undertaken in accordance with NEPM and was not NATA accredited. • All laboratory LORs were below investigation levels.	• COC and laboratory certificates was provided in the report, with samples being received by the laboratory in an appropriate timeframe to be analysed within the holding times. All samples were analysed within the appropriate holding times. • No rinsate, field or transport blanks were undertaken, to assess potential for cross contamination during sampling and sample transport	• No duplicate or triplicate samples were collected.	• Internal blank, duplicates, surrogates spike samples, matrix spikes were generally within acceptable ranges with a few exceptions being exceedances of surrogate compounds (5) and one matrix spike exceedance. No quality control review was undertaken by Golder to assess the relevance of the exceedances.	The quality control implementation is not in full compliance with the current regulatory requirements, however based on the quality control implemented in a worst case scenario the non-compliance would have resulted in cross contamination potential false positives and as a result is considered conservative. Review of the data is considered to be comparable to that of the existing dataset and as a result cross contamination is considered unlikely. Based on the above Aurora considered the data to be acceptable to be used within the larger data set to aid in characterisation of the Site.
Golder (2013b)	• Two new monitoring wells were installed which were located in the eastern portion of the Site was considered to be required, however the reasoning for the choice of well locations in not clear. The GME sampled both the new and existing wells which is considered appropriate.	• The analysis of samples was undertaken by NATA accredited laboratories. • All laboratory LORs were below investigation levels, with the exception being 15 analytes.	• No COC or laboratory certificates were provided in the report. • Three transport blanks were collected, with no elevated concentrations, indicating no cross contamination during transport. • No rinsate or field blanks were undertaken, to assess potential	• One duplicate/triplicate sample pair was collected, from the five groundwater samples at an appropriate rate. • There were 6 RPD values outside the acceptable limits. Review of the exceedances suggest it was likely an affect or low concentrations which has exaggerated the RPD	• The laboratory reports were not attached, as such Aurora could not review. However, Golder did have a QA/QC section which did discuss these aspects and concluded that the data was suitable.	Whilst the raw laboratory data was not provided in the report, it appears based on review of the tables that Golder has used a data program to extract the data, which has likely removed the potential for errors in the tabulated data set. The groundwater methodology employed and quality control is considered suitable, however Aurora must trust that the QA/QC section review of the

TABLE H: SUMMARY OF DATA INTEGRITY ASSESSMENT FINDINGS

REPORT	REPRESENTATIVENESS	COMPARABILITY	COMPLETENESS	PRECISION	ACCURACY	COMMENTS
	• Vapour sampling was undertaken however it is unclear why it was undertaken given there was no previous evidence of vapour or recommendations to undertake that scope. • A methodology for well installation, groundwater and vapour sampling is present.		for cross contamination during sampling.	value and Aurora do not consider it to affect the integrity of the results.		report for assessment of the laboratory quality given the laboratory certificates were not attached. Overall, Aurora considers the groundwater data suitable and is consistent with the overall dataset. However, the vapour data may have been compromised given the ambiguous results and has not been adopted for further assessment. Additionally, vapour sampling in monitoring wells is not acceptable by today's standards and should have been in dedicated vapour wells.

Whilst, in the context of the currently regulatory requirements for the assessment of potential site contamination, there are a number of QA/QC measures/procedures that appear not to have been undertaken, sample locations not clearly identified and some laboratory reports not available. The investigations results are generally comparable with each other, providing an overall level of confidence in understanding the contamination status of the Site and suitable characterisation of certain types of material (i.e. ash). In addition, available QA/QC results reported the majority of results within acceptable criteria and as such the precision and accuracy of the data is considered to acceptable. It is considered that if cross contamination had occurred (unlikely if decontamination protocols adhered to) this would have likely resulted in false positives as such the data is likely to be conservative in that context.

In summary, based on the findings of the review and the fact that the Site has not been used for any similar potentially contaminating activities (with the exception of a laydown area for soil stockpiles – which is not considered a contaminating activity) since the time of sample collection the historical data is considered to be suitable to aid in Site characterisation and inform the CSM for further investigations or management.

5.4 TIER 1A RISK ASSESSMENT & INTERPRETATION OF HISTORICAL DATA SET

The historical data set was tabulated against the adopted assessment criteria to enable a Tier 1A Risk Assessment. Additional commentary is also included below in each sub section in context of exceedances and the potential risk associated with the Site.

5.4.1 Soil Data

5.4.1.1 Metals

A total of 95 samples have been analysed for eight standard metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and lead), with seven of the 95 samples having also been analysed for an extended suite to include barium, beryllium, cobalt, manganese and vanadium.

The historical data set was tabulated against the adopted assessment criteria and has been presented in Table 1. In general, the metal concentrations were below the assessment criteria with the exceptions of chromium, copper, lead and zinc. A more detailed review of the exceedances is presented below.

Chromium (III)

Three samples were noted to exceed the chromium HIL-A criterion of 100mg/kg with one sample exceeding the EIL-URPOS criterion of 190mg/kg as detailed below:

- SA-6 (Golder, 2002) containing a concentration of 110mg/kg;
- C (Golder, 2007) containing a concentration of 190mg/kg; and
- D (Golder, 2007) containing a concentration of 221mg/kg.

Samples C and D were collected by Golder (2007) west of the Site in close proximity to the Preparation Shed (approximately 400m offsite, see Figure 9). Sample D was collected inside the Preparation Shed storage room and Sample C from black ash material with pink metallic lustre. Sample SA-6 was collected by Golder (2002) near the northern portion of the Site near inferred ash deposit area.

Whilst two of the three samples that contained elevated concentrations of chromium are in areas of inferred ash material, it is considered unlikely that the ash material generally contains elevated chromium on the basis of the wider data set and other known ash samples which have lower chromium concentrations. This is evident in samples collected during the same investigation period, sample B (Golder, 2007) and SA-2 (Golder, 2002) which both contained a significantly lower chromium concentration.

This is further supported by the wider data set which also sampled the ash material such as samples collected by Golder (2013) with Samples 1, 2, 3 and 4 described to have been collected from ash material. In addition, inferred ash samples that contained elevated metals concentrations collected by HGM (2002b; samples COL-C3-01, COL-C14-01, COL-C21-01, COL-C23-01, COL-JS01-01, COL-JS04-01, COL-JS04-02, COL-JS05-01, COL-JS05-02, COL-JS07-01, COL-JS08-02, COL-JS09-01, COL-JS10-01, COL-JS13-01 and COL-JS16-01), all contained chromium concentrations well below the HIL-A criterion.

The three elevated chromium concentrations described above are considered to be outliers and may be a result of minor chromate water spills, as speculated by Golder (2002), however is not considered to represent gross contamination across the Site. On this basis of the entire chromium concentration

data set, elevated chromium concentrations are not widespread and any potential interaction is considered to be limited it is not considered to represent an unacceptable risk to human health or ecological receptors.

Copper

All copper samples contained concentrations well below the HIL-A criterion of 6,000mg/kg by almost a factor of 10 and as a result does not pose an unacceptable risk to human health. It was noted that 17 samples contained elevated copper concentrations above the EIL-URPOS criterion of 60mg/kg, with the elevated samples containing concentrations ranging from 67mg/kg (COL-JS07_01 – HGM, 2002b) and 330mg/kg (COL-JS05_02 – HGM, 2002b).

In general, it appears that the samples that contained elevated copper concentrations have a strong correlation with the inferred ash material and does not appear to be associated with background soil conditions. The correlation of elevated copper in the ash material is not unexpected given the former locomotive boilers were likely constructed with a combination iron and copper. Another source of the elevated copper concentrations may be due to normally background concentrations in the coal concentrated in the ash by the burning process.

Given that the lack of current ecological receptors onsite, the elevated copper concentrations onsite are considered unlikely to represent an unacceptable risk. However, noting that the plan is to develop the Site which may include new gardens and vegetation, any new seedlings or associated bushes/shrubs may be required to be planted in new fertile soils.

Lead

All samples contained lead concentrations well below the HIL-A criterion of 300mg/kg and EIL-URPOS criterion of 1,100mg/kg with the exception of three samples which exceeded the HIL-A criterion as detailed below:

- B (Golder, 2007) containing a concentration of 354mg/kg;
- C (Golder, 2007) containing a concentration of 305mg/kg; and
- D (Golder, 2007) containing a concentration of 302mg/kg.

As previously discussed, samples C and D were collected offsite near the Preparation Shed and sample B was collected onsite near the Roundhouse and Turntable in an inferred area of ash material. The elevated lead concentrations are not considered to be associated with either the ash material or background conditions of the soil and appear to be isolated in nature. Given that only one sample onsite was noted to exceed the HIL-A criterion, no unacceptable risk to human health or the environment is considered to be represented by these samples.

Nickel

All samples contained nickel concentrations well below the HIL-A criterion of 400mg/kg indicating no unacceptable risk to human health. Two samples were noted to be equal or exceed the EIL-URPOS criterion of 30mg/kg as detailed below:

- COL-C12_01 (HGM, 2002b) containing a concentration of 30mg/kg; and
- COL-JS08_02 (HGM, 2002b) containing a concentration of 42mg/kg.

Given that the majority of samples were well below the EIL-URPOS criterion, the noted exceedances above are not considered to be associated with either the ash material or background conditions of the soil and are likely to be isolated in nature. Given the samples are isolated, it is likely that there are no unacceptable risks to ecological health.

Zinc

All zinc samples contained concentrations well below the HIL-A criterion of 7,400mg/kg and as a result does not pose an unacceptable risk to human health. It was noted that 10 samples contained elevated zinc concentrations above the EIL-URPOS criterion of 70mg/kg, with the elevated samples containing concentrations ranging from 84mg/kg (Sample 2 – Golder, 2013a) to 1,450mg/kg (D – Golder, 2007).

Of the 10 samples, three are located offsite near the Preparation Shed, two sample locations are unknown and the remaining five locations (on and offsite) are associated with ash material. The elevated zinc concentrations are not considered to be representative of background soil conditions and only have a minor apparent association with ash material, and as such zinc impacts are not considered to be widespread.

Given that the lack of current ecological receptors onsite, the elevated zinc concentrations onsite are considered unlikely to represent an unacceptable risk. However, noting that the plan is to develop the Site which may include new gardens and vegetation, any new seedlings or associated bushes/shrubs may be required to be planted in new fertile soils.

5.4.1.2 Metal Leachate Concentrations

To assess the potential for metals to leach into the environment, previous investigations (HGM, 2002b and Golder, 2013a) undertook leachate sampling on 21 selected primary samples, presented in Table 2. The samples that underwent the leachability testing (not specified, however assumed to be deionized water) were generally associated with the ash material and areas of contamination concern. A few samples however, also underwent leachate analysis and did not have associations with elevated metal total concentrations.

In general, the data indicate that the metals have a low ability to leach in comparison to their original soil concentrations. Review of the tabulated leachable concentrations against the groundwater assessment criteria showed that two samples exceeded the freshwater guideline criterion for nickel of 0.011mg/L. However, 17 samples exceeded the zinc freshwater guideline criterion of 0.008mg/L.

The relatively low leachability of metals and the minor leachability of nickel and zinc is not considered to pose an unacceptable risk given the following:

- the relatively low overall total soil concentrations for nickel and zinc and that elevated zinc concentrations are not reported in groundwater data (see Section 5.4.2);
- the lack of freshwater bodies onsite; and
- the closest being the Collie River approximately 800m down hydraulic gradient of the Site.

5.4.1.3 *Hydrocarbons*

Hydrocarbon analysis data has been tabulated against the adopted criteria and is presented in Tables 3 and 4.

Total Petroleum/Recoverable Hydrocarbons

Fourteen samples were analysed for the former TPH NEPM 1999 fractions which could not be compared to the adopted assessment criteria that been established for the NEPM (as amended 2013) TRH fractions. From the 14 samples, seven samples contained concentrations below the laboratory LOR for all fractions, five were slightly elevated (not considered to represent contamination), however two samples (C and D – Golder, 2007) were identified to contain elevated concentrations, which suggest a potential for unacceptable risk which needs further consideration. However, both samples C and D are located offsite, west of the Roundhouse) near the Preparation Shed.

Only one sample was analysed for the NEPM (as amended 2013) TRH fractions, which contained minor concentrations close to the laboratory LOR. Whilst TPH/TRH was not extensively tested across the Site (likely a data gap), evidence suggests that there are not gross hydrocarbon impacts and therefore an unacceptable risk.

BTEX

Four samples were analysed for BTEX, with all four samples containing concentrations of BTEX below the laboratory LOR and the adopted assessment criteria.

Polycyclic Aromatic Hydrocarbons

Forty-three samples were analysed for PAHs with all of the detected concentrations below the adopted assessment criteria. Thirty-four of the samples also contained concentrations of PAH analytes below the laboratory LOR. The nine samples that did contain detectable PAH concentrations above the laboratory LOR were generally minor and close to the laboratory LOR.

As such no unacceptable risk to human or ecological health is considered present and that historical Site activities has not resulted in PAH impacts or contamination.

5.4.1.4 Pesticides

Pesticide data has been tabulated against the adopted criteria and is presented in Table 5 and 6.

Fifty-eight samples were analysed for organophosphorus pesticides (OPPs) with 54 samples analysed for OCPs and 20 samples for base neutral pesticides. All samples contained pesticide concentrations below the laboratory LOR and the adopted assessment criteria, which indicates that pesticides are unlikely to represent an unacceptable risk to human or ecological health.

5.4.2 Groundwater Data

Groundwater monitoring wells MB1, MB2 and MB3 (installed by HGM, 2002b) has been sampled on three separate occasions (three groundwater monitoring events - GME) while MB4 and MB5 (installed by Golder) have been sampled once during the third GME by Golder (2013b). HGM (2002b) undertook the first GME (wells MB1, MB2 and MB3) on 19 July 2002, HGM (2003) undertook the second GME (wells MB1, MB2 and MB3) on 6 March 2003 with Golder (2013b) completing the third GME (wells MB1 to MB5) on 29 August 2013.

5.4.2.1 *Metals*

Metal data has been tabulated against the adopted criteria and is presented in Table 7.

Arsenic

Arsenic concentrations in all groundwater monitoring wells have remained below the laboratory LOR, with the exception of MB1 (and the duplicate sample), which slightly exceeded the laboratory LOR during the first GME by HGM (2002b). Arsenic concentrations have consistently remained below the adopted assessment criteria in all groundwater monitoring wells.

Cadmium

Cadmium concentrations in all groundwater monitoring wells have remained below the laboratory LOR during each GME, although the LOR was slightly elevated during the second GME by HGM (2003). All groundwater monitoring wells have generally remained below the adopted assessment criteria with the exception of MB1, MB2 and MB3 during the second GME, which exceed the freshwater guideline criterion due to the raised laboratory LOR.

Chromium

Chromium concentrations in all groundwater monitoring wells have remained below the laboratory LOR, with the exception of MB1 (the duplicate sample) and MB2, which slightly exceeded the laboratory LOR during the first GME by HGM (2002b). Chromium concentrations have consistently remained below the adopted assessment criteria in all groundwater monitoring wells.

Copper

Elevated copper concentrations were detected above the laboratory LOR in MB1, MB2 and MB3 during the first GME by HGM (2002b) and above the freshwater criterion of 0.0014mg/L. Elevated copper concentrations were detected again in MB1 during the second GME by HGM (2003), which also exceeded the freshwater criterion. Groundwater wells MB2 and MB3 also exceeded the freshwater criterion due to a high laboratory LOR.

During the third GME by Golder (2013b) copper concentrations were detected in MB2, MB3 and MB4 slightly exceeding the laboratory LOR, with MB2 and MB3 the only groundwater monitoring wells exceeding the freshwater criterion.

It is likely that the first GME by HGM (2002b) may not have been truly reflective of groundwater conditions given the wider metals dataset is generally elevated in comparison to the second and third GME data sets. In reference to the second (HGM, 2003) and third (Golder, 2013b) GME, copper concentrations are generally low and although some exceedances of the freshwater criterion are noted, it is considered likely to be reflective of regional groundwater conditions rather than a result of historical Site activities.

Lead

Lead concentrations in all groundwater monitoring wells have remained below the adopted criteria and generally been below laboratory LOR or detected only slightly exceeding the LOR.

Mercury

Mercury concentrations in all groundwater monitoring wells have remained below laboratory LOR. Although, all wells have exceeded the freshwater criterion of 0.00006mg/L due to a higher laboratory LOR. Whilst this is not considered to be ideal, given that no detections have been noted above the laboratory LOR gross impacts are not considered to be present.

Nickel

Nickel concentrations in groundwater monitoring wells MB1, MB2 and MB3 were detected above both the laboratory LOR and the freshwater criterion of 0.011mg/L during the first GME (HGM, 2002b). However, was subsequently below the freshwater criterion in all groundwater monitoring wells during the second (HGM, 2003) and the third (Golder, 2013b) GMEs.

Zinc

Elevated zinc concentrations have been detected in all groundwater monitoring wells above both the laboratory LOR and the freshwater criterion of 0.008mg/L. Given that zinc has been detected in all groundwater wells both up and down hydraulic gradient the concentrations may be a reflection of regional groundwater concentrations rather than a result of historical Site activities.

5.4.2.2 Hydrocarbons

Hydrocarbon data has been tabulated against the adopted criteria and is presented in Table 8.

Total Petroleum/Recoverable Hydrocarbons

All groundwater monitoring wells were sampled for TPH fractions during each GME, with all samples containing concentrations below the laboratory LOR with the exception being the second GME (HGM, 2003) were slightly elevated TPH fractions in MB1 were recorded. Given that no other elevated TPH concentrations were detected in any other groundwater monitoring wells and that the first and third GME did not detect any elevated TPH concentrations it is considered likely to be an anomaly and not representative of ongoing groundwater quality.

The third GME (Golder, 2013b) analysed the groundwater samples for the NEPM (as amended 2013) TRH fractions, which all contained concentrations below the laboratory LOR and assessment criteria.

BTEX/Monocyclic Aromatic Hydrocarbons

Groundwater samples were analysed for BTEX during the second (HGM, 2003) GME and both BTEX and MAHs during the third GME (Golder, 2013b) with all samples containing concentrations below the laboratory LOR and assessment criteria.

Polycyclic Aromatic Hydrocarbons

PAHs were analysed during each GME with all samples containing concentrations below the laboratory LOR and the adopted assessment criteria with the exception being benzo(a)pyrene (BaP). BaP concentrations in all groundwater monitoring wells were below the laboratory LOR during each GME, however the laboratory LOR was higher than the NPUG assessment criterion of 0.0001mg/L.

Whilst the exceedance of the NPUG assessment criterion is not ideal, given the absence of other detectable PAHs, the potential for gross impacts with PAHs is low.

Halogenated Benzenes

Groundwater samples were analysed for halogenated benzenes during the third (Golder, 2013b) GME with all samples containing concentrations below the laboratory LOR and assessment criteria. The exception being 1,2,3-Trichlorobenzene. 1,2,3-Trichlorobenzene where the concentrations detected in all groundwater monitoring wells were below the laboratory LOR, but the laboratory LOR was higher than the freshwater criterion of 0.003mg/L.

Whilst the exceedance of the freshwater criterion is not ideal, given the absence of other detectable benzene compounds, gross impacts to groundwater quality at the Site by halogenated benzenes is considered unlikely.

5.4.2.3 Herbicides & Pesticides

Herbicide and pesticide data have been tabulated against the adopted criteria and is presented in Table 9.

Herbicides

Groundwater samples were analysed for herbicides during the third GME only, with all samples containing concentrations of herbicides below the laboratory LOR and the adopted assessment criteria.

Organochlorine Pesticides

Groundwater samples were analysed for OCPs during the second (HGM, 2003) and third (Golder, 2013b) GME, with all samples containing concentrations of OCPs below the laboratory LOR and the adopted assessment criteria with the exception of Dichlorodiphenyltrichloroethane (DDT). DDT concentrations in all groundwater monitoring wells were below the laboratory LOR during each GME analysed, however the laboratory LOR was higher than the freshwater criterion of 0.00006mg/L.

Whilst the exceedance of the freshwater criterion is not ideal, given the absence of other detectable OCPs, gross impacts to groundwater quality at the Site by OCPs is considered unlikely.

Organophosphorus Pesticides

Groundwater samples were analysed for OPPs during the second (HGM, 2003) and third GME (Golder, 2013b), noting that the OPP suite during the second GME was limited, with all samples containing concentrations of OPPs below the laboratory LOR and the adopted assessment criteria with the exception of Chlorpyriphos, Diazinon, Malathion and Parathion. Chlorpyriphos, Diazinon, Malathion and Parathion concentrations in all groundwater monitoring wells were below the laboratory LOR during each GME analysed, however the laboratory LOR was higher than the freshwater criterion of 0.00006mg/L.

Whilst the exceedance of the freshwater criterion is not ideal, given the absence of other detectable OPPs, gross impacts to groundwater quality at the Site by OPPs is considered unlikely.

Carbamate Pesticides

All groundwater wells were sampled and analysed for carbamate pesticides during the third GME (Golder, 2013b), with all samples containing concentrations below the laboratory LOR and the adopted assessment criteria with the exception of Carbofuran. Carbofuran concentrations in all groundwater monitoring wells were below the laboratory LOR, however the laboratory LOR was higher than the freshwater criterion of 0.00006mg/L.

Whilst the exceedance of the freshwater criterion is not ideal, given the absence of other detectable pesticides and that carbamates are typically short-lived with half-life periods comprising an anaerobic half-life of 78 days, aerobic half-life of 4-17 days (sandy soil) and hydrolysis half-life between 12.1 days in neutral conditions to approximately 4 years in acidic (pH 5) water (Carpenter, 1990), gross impacts to groundwater quality at the Site by carbamate pesticides is considered unlikely.

5.4.2.4 Nutrients

Nutrient data has been tabulated against the adopted criteria and is presented in Table 10.

All groundwater wells were sampled and analysed for nutrients during the third GME (Golder, 2013b). Concentrations of nitrite, ammonia and oxidised nitrogen were below the assessment criteria in all groundwater wells with the exception of nitrate. Nitrate concentrations in monitoring wells MB1 to MB4 exceeded the nitrate freshwater criterion of 0.7mg/L.

Nitrate concentrations were highest at MB1 (4.44mg/L) which is not unexpected given that maintenance and cleaning that was historically undertaken near the Roundhouse/workshop and the up Aurizon WWTP/septic tanks (although the WWTP function is unknown). Nitrate concentrations were slightly lower at down hydraulic gradient wells MB2 (1.61mg/L) and MB3 (1.74mg/L) and then again elevated at MB04 (2.9mg/L) which may be due to a cross gradient source although unlikely. Nitrate was lowest at down gradient well MB5 (0.09mg/L) which contained concentrations below the freshwater criterion. Whilst relatively elevated nitrate concentrations have been detected onsite and may be potentially going offsite it is considered that the elevated concentrations would not reach the downgradient receptor being the Collie River given that attenuation processes would likely reduce concentrations to acceptable levels. Additionally, nitrate concentrations were below the NPUG, LTI and STI criteria such that no unacceptable risks are considered to be present to down hydraulic gradient groundwater users.

Reactive phosphorus concentrations in all groundwater wells exceeded the freshwater criterion of 0.005mg/L however, this was as a result of the laboratory LOR being higher than the assessment criterion. Given that all wells contained concentrations below the laboratory LOR and no identified onsite sources of phosphorus gross impacts to groundwater quality at the Site by reactive phosphorus is considered unlikely.

5.4.2.5 Other Analytes

VOC's, solvents, phenolics and PCB data has been tabulated against the adopted criteria and is presented in Table 11.

Volatile Organic Compounds & Solvents

All groundwater wells were sampled and analysed for VOCs and solvents during the third GME (Golder, 2013b) only, with all samples containing concentrations of VOCs and solvents below the laboratory LOR and the adopted assessment criteria.

Phenolics

All groundwater wells were sampled and analysed for phenolics during the third GME (Golder, 2013b) only, with all samples containing concentrations of phenolics below the laboratory LOR and the adopted assessment criteria with the exception of pentachlorophenol. Pentachlorophenol concentrations in all groundwater monitoring wells were below the laboratory LOR, however the laboratory LOR was higher than the freshwater criterion of 0.0036mg/L.

Whilst the exceedance of the freshwater criterion is not ideal, given the absence of other detectable phenolics, gross impacts to groundwater quality at the Site by pentachlorophenol is considered unlikely.

Polychlorinated Biphenyls

Groundwater wells were sampled and analysed for PCBs during the second GME (HGM, 2003) which was limited to Aroclor 1254 and a wider suite for the third GME (Golder, 2013b), with all samples containing concentrations of PCBs below the laboratory LOR and the adopted assessment criteria with the exception of Aroclor 1254. Aroclor 1254 concentrations in all groundwater monitoring wells were below the laboratory LOR, however the laboratory LOR was higher than the freshwater criterion of 0.0001mg/L.

Whilst the exceedance of the freshwater criterion is not ideal, given the absence of other detectable PCBs, Aroclor 1254 is not considered to pose an unacceptable risk to groundwater quality.

5.4.3 Summary

5.4.3.1 Soil

Based upon review of the historical dataset, gross soil contamination does not appear to be present onsite as part of historical Site activities associated with the operation of the railway yard. In general, the majority of the samples analysed appear to have been surface/shallow samples (79) which based on the risk profile of the Site associated with historical activities (i.e. spills and incorrect management of chemicals/wastes likely the largest contamination sources of risk, followed by uncontrol filling which could have been observed through visual assessment during sampling) the analysis of surface samples is deemed to be appropriate. It is noted that the sampling at a greater depth is also consistent with that of the surface samples in terms of both ash material and inferred “unimpacted” material. It is also noted that there is a general lack of sampling in and around the Roundhouse, north (in Lot 2856) and west of the Roundhouse (in Lot 560). Additionally, no known sampling has been undertaken east of the Roundhouse post 2008, when stockpiles of unknown source were observed in aerial photography.

Assessment of herbicides/pesticides associated with historical track maintenance indicates that these materials (if used) were applied appropriately and considered likely not to represent an unacceptable risk to soil or groundwater water quality. Additionally, the risk from hydrocarbon contamination appears to be low, however higher risk areas such as in and around the Roundhouse have not been sampled sufficiently.

The ash material identified onsite has undergone relatively more extensive characterisation for a wide range of COPCs and impacts appear to be limited to relatively minor elevation of metal concentrations, in particular copper and zinc which exceed the EIL URPOS criteria. Whilst the exceedances of copper and zinc are noted, given the historical heavy industrial use and that no sensitive ecological receptors have been identified onsite the risk to ecological receptors is considered to be low. Future management of ecological receptors (i.e. new gardens/vegetation) may be appropriately managed via the addition of new soil material or plantation of tolerant species. Other metals have also been detected in the ash material such as total chromium, lead and nickel however these appear to be isolated in nature and may be attributed to other events/activities such as concentrated in ash as a result of coal burning, spills or other historical activities and are not considered to represent gross contamination or an unacceptable risk.

Investigation into the leachability of the metals in the ash material also demonstrated the metals in general have a very low tendency to leach with the exception being zinc which demonstrated a higher capacity and exceed the freshwater criteria.

The relatively low leachability of metals and the minor leachability of nickel and zinc is not considered to pose an unacceptable risk given the following:

- the relatively low overall total soil concentrations for nickel and zinc and that elevated zinc concentrations are not reported in groundwater data (see Section 5.4.2);
- the lack of freshwater bodies onsite; and
- the closest being the Collie River approximately 800m down hydraulic gradient of the Site.

Additionally, metal leachate concentrations were below the NPUG, STI and LTI indicating no unacceptable risk to human health.

Whilst relatively extensive testing of the ash material has been undertaken, the ash material has yet to be analysed for the potential presence of asbestos and therefore the potential risk to human health cannot be assessed. It is known that the WAGR regularly used asbestos products (e.g. gaskets, gland packing, lagging) in the construction and operation of rolling stock and that steam locomotives used asbestos lagging (often comprising woven chrysotile blankets) to insulate boilers. Additionally, experience gained from contamination assessments undertaken at the former WAGR railway workshops in Midland as documented by ATA Environmental (2007) has shown that ash deposits at the workshops regularly contained asbestos in the form of asbestos fines (AF)/fibrous asbestos (FA) which required remediation works to mitigate potential health risks.

Additionally, it is understood that both locomotive and other rolling stock brake blocks contained asbestos materials. Based on information provided by the CS Auditor, suggested by previous experience of the DWER, it is possible that diffuse AF/FA may have been generated from the general movement of trains and other shunting based activities, with no investigation to date undertaken at the Site to assess the status.

5.4.3.2 Groundwater

Based upon review of the historical dataset, gross groundwater contamination does not appear to be present below the Site. It is noted that certain analytes for metals, pesticides and hydrocarbons as examples exceed the assessment criteria in a small number of samples. These exceedances are however, generally associated with laboratory LORs being greater than the current assessment criteria rather than evidence of contamination, particularly, given the general absence of detectable concentrations above the laboratory LOR. Consequently, it is considered that the data set generally indicates that groundwater quality at the site is not grossly impacted.

The presence of copper and zinc in groundwater are considered to be a result of background and/or regional conditions. The only identified onsite source which has potential to impact copper and zinc in groundwater is the ash deposits. Leachate testing (which is an aggressive leaching process relative to passive seepage of meteoric waters over time) of the ash material was undertaken which demonstrated low leachability of metals in the ash material. Additionally, no significant difference in metals concentrations was recorded down inferred hydraulic gradient of the identified ash deposits (MB4 and MB5) in comparison to MB02 (situated up hydraulic gradient of known ash deposits). As no

other significant onsite source of metals has been identified through the PSI process and noting the generally minor concentrations and fluctuations in groundwater, the slightly elevated metal concentrations is likely to be a result of background conditions (i.e. not affected by the Site). Other offsite sources were considered (such as from Lot 560 and the western portion of Lot 2856) however given the concentrations are comparable at all wells and that MB05 is unlikely to be influenced from sources located in Lot 560 and/or from the western portion of Lot 2856 (based on an inferred south-southeast to southeast groundwater flow direction and distance).

With reference to the elevated nitrate in groundwater, in the context that elevated concentrations detected near MB01 and MB02 which have potential nearby sources (Roundhouse, WWTP and nitrate AST for MB01 and nitrate AST for MB02), noting that MB05 is significantly less (more than a factor of 10) and no sources have been identified in its vicinity, the elevated nitrate concentrations are considered to be elevated with reference to the background conditions, represented through MB05.

Elevated concentrations of nitrate, copper and zinc have been detected above the laboratory LOR and the freshwater criteria however there are no identified freshwater receptors onsite. Whilst the elevated nitrate, copper and zinc concentrations have been detected onsite and may be potentially going offsite it is not considered to pose an unacceptable risk given the following:

- the closest freshwater being the Collie River approximately 800m down hydraulic gradient would not likely receive the same concentrations identified below the Site, as natural attenuation factors would likely reduce concentrations to acceptable level prior to reaching the Collie River; and
- nitrate, copper and zinc concentrations were below the NPUG, LTI and STI criteria such that no unacceptable risks are considered to be present to down hydraulic gradient groundwater users.

Noting the locations of the groundwater wells, there is a general lack of data on the western boundary of the Site (west of the Roundhouse) and only one GME has included nutrients.

6 SITE INSPECTION

A site inspection was undertaken by an experienced Aurora environmental scientist on the 19 and 20 May 2020. The inspection included a general inspection of the Site to identify APEC and verify the presence of other APEC identified during the desktop assessment of this PSI.

To ensure that other unknown APECs were not missed, the inspection was undertaken by walking in transects (not undertaken in a direct line, when obstructions present such as vegetation, buildings or fences) across the Site in a general west/east to east/west direction, in approximate 10m spacing between the transects. This provided confidence that no gross contamination was missed, with the only restriction being the presence of surface vegetation covering the ground surface.

The findings of the site inspection are discussed below, and features identified presented in Figure 10.

6.1 LOT 561

Lot 561 was observed to be vacant at the time of the inspection with the Roundhouse and Turntable (Appendix 17 - Plate 1) the only above ground infrastructure present. Approximately 70% of the Lot was observed to fenced with cyclone fencing and barbed wire (Appendix 17 - Plate 2) as indicated on Figure 10. Small gaps in the fencing were observed either side of the main access gate to the lot, which may allow access by unauthorised personal. Cyclone fencing was observed to be present internally within the lot surrounding the Roundhouse and Turntable. All fences were observed to be good condition with no evidence of large holes or damage observed at the time of the site inspection. A preliminary walkover undertaken on 13 March 2020, did note some sections of the fence were damaged, however were likely to have been fixed prior to the site inspection.

The Roundhouse appeared to be derelict and was observed to be in a degraded condition with moderate amounts of the ACM cladding fragments and glass observed to have fallen off the building and are present on the surface soils (Appendix 17 - Plate 3), a likely result of vandalism. ACM fragments were observed to present in the soil surface to the east and south surrounding the Roundhouse (Figure 10). All ACM fragments observed on the surface soils surrounding the Roundhouse were observed to be flat fibre cement sheeting (i.e. one source being the Roundhouse cladding). The ACM fragments on the surface soils were observed to be in good to moderate condition and ranging in size from 1cm x 1cm up to 1m x 0.5m, with sharp corners (Appendix 17 - Plate 4). A stockpile of ACM fragments was observed on the surface within the Roundhouse, (Appendix 17 - Plate 5) as indicted by Figure 10.

A total of 14 bays were observed within the Roundhouse, some of the service pits contained general rubbish such as plastic pipe, wiring, tyres, etc. and others were noted to have been backfilled with concrete/bitumen (Appendix 17 - Plates 6 to 7). On either side of the service pits the surface was either concrete or timber decking, with the northern six bays comprising decking sitting on top of bearers and sand with the southern eight bays being concrete. The concrete was noted to be in reasonable condition for its age while some of the decking timbers looked like they were partially rotted. It is understood that the layer of sand is approximately 75-100mm thick with underlying concrete present, this was not verified during the site inspection. Some minor stains were noted on the floor surface within the Roundhouse building (Appendix 17 - Plates 8) but nothing to suggest the presence of gross contamination. The building was subject to a HAZMAT survey (Aurora, 2020) with the findings detailed in the report noting several items identified to contain asbestos and lead paint. A workmen's carriage was also present in the Roundhouse (Appendix 17 - Plate 9).

A triple interceptor trap (TIT) was confirmed to be present to the south of the Roundhouse building. Two half metal rusted drums in poor condition were observed on top of the triple interceptor lid (Appendix 17 - Plate 10). One of the drums was observed to be empty and the other was noted to contain a black tar-like product with a mild chemical odour. There was no evidence that this material had spilled out of the drum into the surrounds or into the TIT, however previous reports such as Golder (2007) suggested it had. The lid of the TIT was lifted to inspect the contents, which could only be partially lifted, due to the condition of the handles on the lid, which had degraded and could not support the weight of the lid. The TIT was observed to contain water in all three sections, no staining, sheens or odours observed. Several stormwater drainage pits were noted in the vicinity of the TIT, with no evidence of contamination noted in the water in these drains.

The Turntable and small operators shed appeared to be in derelict state (Appendix 17 – Plates 11 to 12) with the electrical infrastructure for operation unlikely in a functioning capacity, however a manual pully operation is present and still may function. The associated operators shed (Appendix 13 - Plate 14) appeared to be a steel structure and contained a wooden floor, a chair, gearbox and associated running equipment. The building was subject to a HAZMAT survey (Aurora, 2020), with the findings detailed in the report noting several items identified to contain asbestos and lead paint. No evidence of contamination was present in the form of stains or odours was noted in the operators shed. The Turntable platform was made from a combination of steel, which was rusted and wooden decking, some of which were rotten and unlikely to be safe to stand on (Appendix 17 - Plate 15).

The underlying surface of the Turntable was covered in low grassy vegetation, with the northern section of the vegetation notably distressed in comparison to the surrounding vegetation (Appendix 17 - Plate 16). No obvious cause of the vegetation distress was noted during the site inspection, however, may be associated with drainage, rather than historical activities.

The majority of the lot surface was covered with low-lying grasses and weeds, particularly the eastern portion, which impeded observations of the general ground surface conditions in many areas (Appendix 17 - Plate 17). Several soil types were noted to be present at the surface of Lot 561 with two inferred natural soil units observed. described below:

- SAND: dark grey, fine to medium grained sand, poorly graded (Appendix 17 - Plate 18). This unit was inferred to be topsoil and estimated to cover approximately 40% of the Lot; and
- SAND: white, fine to medium grained, poorly graded (Appendix 17 - Plate 19). This unit was estimated to cover approximately 40% of the lot and also observed at the base of the open drain/trench which is located in the southern portion of the lot.

In addition to the inferred natural soils observed, several types of fill/reworked material were observed on the surface, these include:

- Roadways/paths within Lot 561 comprised mostly of an ironstone (laterite) road base (Appendix 17 - Plate 20) with some sections of the roadways having a sealed bitumen surface, which was noted to be in a degraded state with the ironstone road base beneath exposed.
- Sporadic blue metal gravels were observed on the ground surface at the Site gate entrance and in a potential former laydown area, approximately 10m east of the Roundhouse. The gravel is considered likely to be associated with that used for railway ballast given the size, however no stains were observed to suggest to was formerly used as railway ballast.

- SAND: white, fine to medium grained well sorted. This material was adjacent to the open drain/trench on the southern portion of the Lot and inferred to be reworked material excavated from the drain/trench. A small section of this material identified in Figure 10, was observed to contain C&D waste including potential ACM (PACM) fragments in the form of fibre cement asbestos cement sheeting base (Appendix 17 - Plate 21), different to that observed from the Roundhouse and buildings west of the Roundhouse. Multiple forms of PACM were observed in this area, described as either flat fibre cement sheeting or wide diameter cement fragments. The source of this PACM was unable to be discerned during the walkover, no significant evidence of fly tipping was observed. The PACM was observed to range in dimensions between 2cm x 3cm and 10cm x 12cm.
- Black ash material was observed on the Site surface (Appendix 17 - Plate 22), in locations consistent with the ash deposits previously identified in HGM (2002b). No additional ash material was observed during the walkover. The ash material appeared to mostly be buried with only small portions of the ash material visible at the surface.

The remaining vegetation observed across Lot 561 appeared to be in good condition (except for the vegetation in the Turntable base).

Minor quantities of waste material (in addition to that east of the Site entrance, near the open drain/trench) was observed throughout Lot 561. This included several steel rails observed at two locations (Appendix 17 - Plate 23 and Plate 24) within Lot 561 and some minor C&D waste observed to contain concrete, bricks and metal as depicted in Figure 10 which appeared to be associated with the former Wagon Repair Shed (Feature ID 7 on Figure 6) footprint. During the site inspection the footprints of other potential structures which may have existed (identified as part of the desktop review in Section 4.8) were inspected. No evidence of contamination or waste material was noted in these areas during the inspection.

An open stormwater drain/trench is present running along the southern boundary of the Site (Figure 10). This drain was noted to extent from Lot 560 to the east to the central portion of the southern boundary of Lot 561. There was no standing water at the time of the inspection. The walls and base of the drain were observed to consist white, fine to medium grained sand, with no evidence of stains.

The surface of Lot 561 was observed to be generally flat with small undulations across eastern portion of the Lot (Appendix 17 - Plate 25), which may have been a reflection of the former stockpiles observed to have been present in 2008 historical aerial photography. Several stockpiles were also observed during the inspection of Lot 561. For the purpose of this investigation, the stockpiles were assigned numerical values, with the locations of the identified stockpiles presented in Figure 10 and descriptions of the stockpile presented in Table I below. Photographs of the stockpile are presented in Appendix 17 Plates 26 to 32.

TABLE I: SUMMARY OF LOT 561 IDENTIFIED STOCKPILES

STOCKPILE IDS	SOIL TYPE	ESTIMATED VOLUME (M^3)	WASTE OBSERVED	COMMENTS
SP1	Sand: white, fine to medium grained, moderately graded.	5-10m^3	Construction and demolition (C&D) waste including concrete and bricks. No ACM or	Vegetation coverage including several large trees. Inferred to be

TABLE I: SUMMARY OF LOT 561 IDENTIFIED STOCKPILES

STOCKPILE IDS	SOIL TYPE	ESTIMATED VOLUME (M^3)	WASTE OBSERVED	COMMENTS
			staining observed in stockpile.	reworked soil from open drain/trench.
SP2	Coarse ironstone gravels/cobbles.	1-2m^3	No waste observed. No ACM or staining observed in stockpile.	No soil observed in the stockpile.
SP3	Sand: cream, fine to medium grained, moderately graded, dry with fine to medium limestone gravels (sand inferred to be crushed limestone).	5m^3	No waste observed. No ACM or staining observed in stockpile.	Partial vegetation coverage. Mostly low-lying grasses.
SP4	Coarse blue metal gravels.	5m^3	No waste observed. No ACM or staining observed in stockpile.	Stockpile of railroad ballast material.
SP5	Mixture of blue metal and ironstone gravels.	<1m^3	No waste observed. No ACM or staining observed in stockpile.	No soil observed in the stockpile.
SP6	Ironstone gravels	1m^3	No waste observed. No ACM or staining observed in stockpile.	No soil observed in the stockpile.
SP7	Sand: grey, fine to medium grained, moderately graded, dry with some fine gravels.	5m^3	C&D waste including concrete and brick observed on stockpile surface. Domestic waste including glass and plastic were observed. No ACM or staining observed in stockpile.	Stockpile was a low-lying mound.
SP8	Sand: brown, fine to medium grained sand with ironstone gravels and coarse blue metal gravels.	5m^3	Scrap metal waste from old storage drums observed in the soil surface of the stockpile. No ACM or staining observed in stockpile.	Stockpile was outside of the fenced compound to the north of the Roundhouse building.

A total of four groundwater monitoring wells were observed to be present during the site inspection, with MB2 unable to be located. A broken portion of concrete was noted in the vicinity of the MB2 documented location. This was considered to be associated with MB2 well monument cover (Appendix 17 - Plate 33), given the square shape observed in the broken concrete. It is possible that during grass slashing or other related activities, it may have been destroyed. In addition to the groundwater monitoring wells, two concrete soak wells were observed in the eastern portion of Lot 561. One of the soak wells was observed to be sitting on the surface of the ground with no evidence

it was in use. The second soak well was observed further to the east. This well was at the ground surface but also did not appear to be in use. Several concrete fragments were noted be present within the easternmost soak well. Photographs of the two soak wells are presented in Appendix 17 – Plate 34 and Plate 35.

The four remaining monitoring wells were gauged during the site inspection. Two of the wells, MB4 and MB5, were found to be blocked by what was inferred to be tree roots due to the proximity of the wells to established trees. The standing water level was recorded at MB1 and MB3 to be 5.555m below top of casing (btoc) and 6.300m btoc respectively.

6.2 LOT 2860

Lot 2860 is located at the eastern end of the Site (see Figure 2). It was observed to be vacant with no current or historical infrastructure present at the time of the inspection, with no identified evidence of waste or signs of potential contamination. This area appeared to be used as a public open space with vegetation covering the majority of the lot (Appendix 17 - Plate 36).

The topography of the lot was observed to be steeply sloping from the south to north, with a potential difference in height of 4m (noted through Google Earth). No evidence of the former land use was observed on the soil surface within Lot 2860.

6.3 LOT 560

A small section of the Site exists in the eastern portion Lot 560, which is west of the Roundhouse and belongs to PTA (see purple highlighted land on Figure 2). Two buildings were present within this portion of the Site but outside of the Aurizon lease (Appendix 17 - Plate 37).

One of the buildings (located closest to the Roundhouse) is likely the Compressor Shed (Appendix 17 - Plate 38), which was observed to be in a poor derelict condition with missing panels and a missing door and constructed of timber framing and ACM cladding with a concrete floor. A large steel structure was also noted adjacent to the building on the western side which was likely a compressed air reservoir. The ACM on the walls and the roof of the building have been damaged and resulted in quantities of ACM on the soil surface surrounding the building and the ground surface inside the building(Appendix 17 - Plate 39), again likely a result of vandalism. The ACM fragments on the soil surface surrounding the Compressor Shed were noted to be in predominantly good bonded condition ranging in size from approximately 1cm x 1cm up to 55cm x 45cm with sharp edges.

The Compressor Shed was separated into two rooms, one small room on the eastern side, likely used for general storage, although historically was likely used for ablutions. The other larger room to the west which was likely were the air compression infrastructure was present. The smaller room contained ACM fragments on the surface, no staining or other evidence of contamination was noted. In the larger room, there was a raised engine bed, ACM fragments and broken PVC pipe was noted on the floor. In addition, the room appears to have been subject to a fire with evidence of a burning noted on the concrete floor and on the walls (Appendix 17 - Plate 40). Potential evidence of hydrocarbon staining may have also been present on the concrete floor however was difficult to differentiate from the burn marks. Golder (2007) had identified staining on the concrete floor of the Compressor Shed.

The other building appeared to be made of pressed metal cladding (west of the Compressor Shed) (Appendix 17 - Plate 41), was locked, and could not be accessed. Looking into the structure it was

evident that there was three rooms and a potential ablution. The inside of the building had signs and mattresses and may have historically been used for accommodation purposes.

The majority of surface soils in Lot 560 consisted of ironstone (laterite) gravels except for the access road that consisted of fine to medium grained white gravels. A small dark area of soil was (Appendix 17 - Plate 42) inspected north of the two buildings, which upon closer observation it appeared to be in a slight topographic low where finer sediments gathered during rainfall events rather than staining. No staining was noted on the surface of the soils in the area. The former Workshop (Feature ID 5 on Figure 6) building footprint was inspected, however no evidence of C&D waste of other signs of contamination were observed.

6.4 LOT 2856

A section of the Site extends into a portion of Lot 2856 which is managed by ARC infrastructure used as an access corridor (see orange highlighted area on Figure 2). No infrastructure was observed in this area, however minor railway related waste was noted to be stored within the area which was in the form of several burned railway sleepers and steel rails and other related sleeper jewellery (Appendix 17 - Plate 43). It was considered unlikely that the railways sleepers had been burnt onsite given the underlying material did not have any evidence of burning.

A small stockpile (SP9) (Appendix 17 - Plate 44) was also observed in the vicinity of the railway waste which comprised a grey, fine to medium grained sand with an estimated volume of $2m^3$. Stockpile SP9 also contained railway related scrap metal with old rail pads and rail bolts were noted to be on the stockpile surface. Evidence of destroyed 55-gallon drums were noted to present within the stockpile.

The surface soil was consistent with that on Lot 560. No vegetation was observed to be present on the portion of the Site within Lot 2856 with the exception of a single large tree adjacent to the area where the waste was stored.

6.5 OFFSITE

6.5.1 North

North of the Site boundary near the Arc access corridor, adjacent to the railway line, two AST's and a small shed was observed (Appendix 17 - Plate 45). As noted in the DMIRS documents, the large AST to the west is likely for storage of sand, which is consistent with the field observations were sand appeared to have been spilt around the AST. The smaller AST between the large AST and the shed is understood to contain nitrate water based on the DMIRS documents. However, historical reports (Golder, 2007) suggest the AST may have been used for storage of nitrate/chromate water. The shed was closed and locked at the time of the inspection, such that its contents could not be assessed. No labels were on the AST's or the shed, the AST's were noted to be in good condition, although they were not contained in bunds. No evidence of staining below the AST's or surrounding the shed was noted.

An additional AST (Appendix 17 - Plate 46) was also observed on the northern side of the railway tracks, north of the inferred former Wagon Repair Shed. Based on the DMIRS documents, it is understood to be used for storage of diesel. Viewing from a distance indicated there was no bund for the AST, however no obvious signs of staining could be noted.

An underground stormwater drain was identified during the desktop to be present running east-west beneath the Site (Feature ID 2 on Figure 6), with the outlet point for the drain identified in a possible "creek" to the north in an area of vacant crown land. During the site inspection the outlet point (Appendix 17 - Plate 47), was noted, however the "creek" was dry. The area surrounding the outlet was covered in dense vegetation, with no evidence of staining, odours or distressed vegetation in the vicinity of the outlet point.

6.5.2 East

As part of the desktop review, the former locomotive washout plant/engine pit (1890s to 1940s) was identified to the east of the Site (Lot 2864). This area was inspected during the Site walkover and is currently being used a cark park for the Collie information centre. In addition, there is a caravan sewage disposal point (Appendix 17 - Plate 48) within the carpark, the disposal point appeared to be in good condition with no evidence of contamination noted during the inspection.

Further east of the Site, the former Nightowl Service Station was identified as a potentially contaminating land use. The property is currently being used for commercial purposes as a retail property (STIHL lawn mower retail shop) (Appendix 17 - Plate 49). There was no evidence of former service station equipment at the property (i.e. bowsers), with the exception to the building which had a canopy, a typical service station feature. The majority of the property was noted to be covered in bitumen, which was in good condition with no stains evident. The property is noted to be elevated with respect to the Site, view of the northern wall embankment (Appendix 17 - Plate 50) C&D waste was noted in the embankment.

6.5.3 South

No potential sources of contamination were noted to the south during the PSI desktop assessment and as such the site inspection did not undertake a detailed walk south of the Site.

6.5.4 West

The land immediately to the east of the Site is PTA land leased to Aurizon and includes the Aurizon Collie Depot (blue highlighted area on Figure 2). The Aurizon depot consisted of three brick buildings, one large building used as an office (Feature ID 6 on Figure 6) and two smaller brick buildings (Feature ID 27 on Figure 6).

The southern brick building was signed as part of the Aurizon Collie Depot Trade Waste Treatment Plant (Appendix 17 - Plate 51). There did not appear to be any infrastructure within the brick building associated with the WWTP other than an electrical board. Three concrete lids (Appendix 17 - Plate 52) were noted immediately to the west which may have been associated with the WWTP or septic tanks. No evidence of staining or odours was noted in the vicinity of the treatment plant.

The northern brick building was observed to be vacant with no current use.

The surface around the Aurizon depot consists of a sealed bitumen carpark and ironstone road base gravels.

7 AREAS & CONTAMINANTS OF POTENTIAL ENVIRONMENTAL CONCERN

7.1 CONTAMINANTS OF POTENTIAL CONCERN

Potential contaminating activities that have been undertaken at the Site are primarily related to rail activities, maintenance/servicing and uncontrolled fill activities. Based on guidance from DER (2014) the COPCs to be considered associated rail activities are include:

- Petroleum hydrocarbons.
- MAHs (e.g. BTEX).
- Phenolics (creosote).
- Metals (e.g. arsenic, cadmium, chromium, iron, lead, zinc).
- Nutrients (e.g. nitrates, ammonia).
- Carbamates.
- Organochlorine pesticides (e.g. pentachlorophenol).
- Organophosphates pesticides.
- Herbicides.
- Asbestos.
- Additional contaminants according to what has been transported by rail (coal is not considered to be a contaminant).
- Based on the main Site operations (Railway Yards) the majority of COPCs have been considered and assessed through previous investigations. Although some analysis such as nutrients and petroleum hydrocarbons have been somewhat limited and not sufficient for Site characterisation purposes. Additionally, asbestos in the ash deposits has not been investigated.
- Offsite up hydraulic gradient potential contaminating activities also include the former power station, railway yard (and associated infrastructure) and WWTP. The general COPCs associated with these activities, are presented in Table J below.

TABLE J: POTENTIAL OFFSITE COPCS

WWTP	POWER GENERATION	SERVICE STATION
• Nutrients (e.g. nitrogen, phosphorus) • Metals (aluminium, arsenic, cadmium, chromium, cobalt, lead, manganese, nickel, potassium, zinc) • Phenols	• Fly ash (can comprise of sulfates, metals, total dissolved solids, selenium). • Petroleum hydrocarbons. • PAHs (e.g. tars, benzo(a)pyrene). • Asbestos. • PCBs. • MAHs (e.g. BTEX).	• Petroleum hydrocarbons • MAHs • PAHs • Methyl tertiary-butyl ether and other oxygenates • Metals (e.g. barium, cadmium, copper, lead, nickel, zinc) • Oil and grease

TABLE J: POTENTIAL OFFSITE COPCS

WWTP	POWER GENERATION	SERVICE STATION
• Pathogens (e.g. E. coli, Enterococci)	• Metals (e.g. copper, lead).	• Solvents (e.g. trichloroethylene)

7.2 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

The onsite APEC considered to be present/identified as part of the desktop assessment and site inspection are detailed below in Table K and presented in Figure 11.

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
1. Roundhouse	The Roundhouse was noted to service and clean locomotives and as a result may have impacted the underlying soils and groundwater, albeit unlikely given the base of the floor is concrete in good condition, with the exception of a finite quantity of soil under the wooden decking floor in a limited portion of the building. Anecdotal evidence as noted in Aurora (2020) indicates the wooden decking (in bays 1 to 6) may have been preserved with pesticides, with the liquid applied directly to the timber which may have infiltrated to the underlying layer of sand (understood to be underlain by a concrete base). Given that the former rolling stock brake pads contained asbestos (ERC, 2015) it may also be possible the AF/FA is present in the timber sleepers and in the soil. Additionally, the Roundhouse has been subject to vandalism which has resulted in ACM fragments scattered around the structure on the surface soil.	Based on the historical Site activities the COPCs associated with these areas are considered to be petroleum hydrocarbons, PAHs, nutrients, metals, pesticides and asbestos. Other COPCs such as phenols, carbamates, herbicides have been discounted due to the following: • Phenols are considered to biodegrade rapidly (in soil and water), with the half-life degradation occurring in two to five days, but up to nine days in estuarine rivers (ATSDR 2008), "phenol is expected to leach to groundwater; however, the rate of phenol biodegradation in the soil may be so rapid, except in cases of large releases such as spills or continuous releases such as leaching from landfill sites, that the probability of groundwater contamination may be low (Ehrlich et al. 1982)". • Carbamates are typically short-lived with half-life periods with an anaerobic half-life of 78 days, aerobic half-life of 4-17 days (sandy soil) and hydrolysis half-life between 12.1 days in neutral conditions to approximately 4 years in acidic (pH 5) water (Carpenter 1990). • Based on the historical analytical data herbicides have not been overapplied and have not been detected above the laboratory LOR, as such does not warrant further investigation. Pesticides are considered to be a COPC for soils within the northern bays below the timber decking, based on the anecdotal evidence and given they will be reworked as part of restoration works. There is a potential for pesticides to also be present below the building pads. Whilst the application of pesticides cannot be discounted (given that many government agencies applied pesticides during this time period, 1950s) it is considered somewhat unlikely that pesticides were applied to structures such as the Roundhouse given the general construction materials used being a concrete pad, iron/steel beams supported with asbestos cladding (i.e. not subject to degradation from insects). On this basis, pesticides, if present in soils beneath building pads, are not considered to represent a risk given no direct contact is possible whilst the buildings remain. However if the Site or a building was redeveloped in the future, i.e. a new potential exposure pathway is created, as part of a change in land use then the potential presence of pesticides will need to be assessed in the context of the proposed new land use(s).	In general, limited sampling has been undertaken in and around the Roundhouse and further works are deemed required. It is understood that NTWA have released to tender a hazardous materials remediation work package to remove identified hazardous materials associated with the Roundhouse structure to make safe to a practical extent which includes an emu-bob to remove the visible ACM fragments on the surface soil. The building remedial works tender also includes the removal of the inferred impacted sand, below the wooden floor boards with both the floor boards and sand to be stockpiled onsite for assessment (including sampling and analysis) to determine management options.
2. Turntable	The Turntable was utilised to rotate steam locomotives into the correct position after coming in and out of the Roundhouse and Workshop. The locomotives would have spent only a limited time on the Turntable which minimises the potential for leaks into the underlying soil. Diesel locomotives are understood to not have been stabled in the Roundhouse.	Based on the historical Site activities the COPCs associated with these areas are considered to be petroleum hydrocarbons, nutrients, metals, pesticides and asbestos. PAH's have not been included as a COPC based on the historical data set, which demonstrates no gross contamination or evidence of unacceptable risks in regards to the adopted assessment criteria.	No sampling has been undertaken in the turntable, as such sampling is considered required for characterisation purposes.

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
	It was noted during the site inspection that a portion of the underlying vegetation was distressed, however this may have been a result of poor drainage rather than historical Site activities, as the vegetation was able to establish in the first instance.		
3. Workshop	The workshop was adjacent to the Roundhouse (northwest corner) and likely was used for maintenance activities which may have impacted the underlying soils and groundwater (the workshop internal construction conditions are unknown, i.e. the presence/ absence of a hardstand surface, although it is considered likely to have been present). The workshop has been demolished and if demolished incorrectly may have resulted in additional contaminants being present such as ACM fragments along with construction and demolition (C&D) waste. No evidence of contamination was present in the vicinity of the workshop footprint during the site inspection however it may be present in the underlying soils. No sampling has been undertaken in the building footprint.	Based on the historical Site activities the COPCs associated with these areas are considered to be petroleum hydrocarbons, nutrients, metals, pesticides and asbestos. As discussed above phenols, carbamates and herbicides have been discounted as potential COPCs. If gross contamination is identified than additional COPCs such as solvents may be required to be assessed. Whilst pesticides cannot be discounted, as discussed above, the presence of pesticides are considered unlikely based on the materials likely used for the workshop (concrete floor, iron/steel beams covered with rolled metal or asbestos cladding). Additionally, it is noted that the Workshop was established in the 1950s and subsequently demolished in the early 1970s (gone in 1975 aerial photography), if pesticides were applied prior to the establishment and noting that the maximum half-life of commonly used OCPs being 15 years, (Jayaraj et. al., 2020)), it is expected that pesticides would have undergone three half-life periods since the building has remained vacant (i.e. direct sunlight exposure, which likely decreases half-life rate) and four half-life periods since the building was established further reducing the concentrations of pesticides that may have been present. Further to the above, the large analytical dataset which has been obtained from previous investigations demonstrates that all samples analysed for pesticides have contained concentrations below the laboratory LOR. Whilst Aurora notes that pesticides generally have a low mobility, if gross impacts were present it would have been expected to be encountered in groundwater given the shallow nature of the groundwater below the Site. Given the absence of gross impacts based on the current groundwater analytical dataset, gross impacts in soil are unlikely.	No known sampling has been undertaken in the footprint of the workshop and further works are deemed required.
4. Shunting Crew Buildings	It is understood that the two buildings south of the Wagon Repair Shed was for the shunting crew likely as a rest/meals area. On this basis the potential for contaminating activities to occur is considered to be low. Previous work by HGM (2002b) included sampling (samples COL-JS07 and COL-JS08) in the vicinity of the buildings during the delineation of the ash deposits. Selected samples were analysed for metals, PAHs, which detected concentrations below the laboratory LOR and adopted assessment criteria, with the exception of some slightly elevated metals associated with the ash material. Down gradient groundwater well MB05 suggests that gross groundwater contamination is not present. The Shunting Buildings have been demolished and if demolished incorrectly may have resulted in additional contaminants being present such as ACM along with C&D waste. The construction of the buildings is not known, although likely to include ACM based on the date of the structures. The site inspection did observe potential C&D waste in the vicinity of the buildings.	Based on the historical analytical data collected COPCs associated with Shunting Buildings is considered to be asbestos and pesticides. As previously discussed, the potential for the presence of pesticides is considered to be low.	No known sampling has been undertaken in the footprint of the Shunting Buildings and further works are deemed required.

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
5. Ash Deposits	It is understood that the ash material generated from the operation of the steam locomotives was generated through burning of coal and to a lesser extent wood and other wastes. It is understood that as part of the "new" Collie Depot, ash rake out pits were present (offsite, west of the Site) for the removal of the ash material from the steam locomotives, however the location for burial was not documented. However, it is considered unlikely to have been buried onsite during the operation life of the "new" depot given the disturbance of the ash deposits could not be observed in the historical aerial photographs and due to onsite structures including rail lines. Additionally, anecdotal evidence provided by Norm Hayward indicated that no ash material was buried onsite during his time onsite between 1964 to 1974. HGM (2002b) indicated that ash deposits onsite was likely deposited during the original Collie depot (east of the Site) operation in the 1920's. Review of historical aerial photographs suggest that burial of the ash deposits from the "new" Collie west depot occurred offsite west of the administration building. Based on previous experience undertaken at the Midland railway yard and other sites, AF/FA has been encountered in ash material. Aurora has not been able to confirm the actual process of how the AF/FA enters into the ash material and given that the use of steam locomotives and asbestos products is essentially extinct any conclusions are necessarily based on observations and experience by Aurora personnel. Aurora has worked on a number of sites where wood/coal fired boilers were used to provide mechanical power and these sites include railway workshops (former WAGR Midland workshops), former water pump stations (Perth-Kalgoorlie water pipeline) and historical mine sites in the goldfields region. It has been Aurora's experience at each of these sites that asbestos in the forms of AF/FA are present in the waste ash produced from the combustion of coal/wood. The asbestos detected in the ash mostly comprises chrysotile and is generally seen in the following two forms: 1) visible woven asbestos products or fragments thereof such as for example gaskets, rope, tape, gland packing and lagging. These materials tend to be distributed irregularly through the ash and are often in a degraded form; and 2) asbestos fines. The asbestos fines are detected via the collection and analysis of soil samples and comprise free fibres, fibre bundles and small pieces of woven products. This form tends to be distributed more homogenously through the ash and it has been Aurora's experience that approximately one in three samples analysed detected the presence of asbestos fines. Using the knowledge collected at each of these sites over time (including anecdotal evidence), it is understood that waste materials, such as oily rags, cotton waste etc, were regularly discarded by disposal into the boilers to be burnt. It is inferred that this likely also included asbestos containing products (like those described earlier) produced by regular maintenance activities. These asbestos products were then subjected to extreme heat removing any organic bonding agents as well degrading the asbestos structure itself. These materials were then further progressively broken up and degraded by activities such as coal lumps landing on them in the firebox during firing activities, shaking/agitation of the coal bed during locomotive operation and subsequent handling of the ash such as raking out the ash pan, excavating out ash pits and final disposal in pits. The handling of the now degraded asbestos products to produce AF/FA then became distributed more widely through the ash body. On the basis of the above AF/FA is expected to be encountered within the ash material and may pose an unacceptable risk. Elevated metal concentrations have been detected but are not considered to pose an unacceptable risk to human health and/or groundwater through leaching. However, concentrations have been noted to exceed the EILs. Based on anecdotal information from previous investigations the ash material may have been buried and uniformly spread across the Site. However, based on the intrusive investigations undertaken by HGM (2002b) the ash material appears to have been	Based on the historical analytical data collected COPCs associated with ash material is considered to be metals and asbestos. Metals have been extensively tested and characterised within the ash material. Other COPCs such as phenols have been previously discounted as discussed above and TDS (through groundwater) demonstrating they do not represent a risk. Metals are considered to be a COPC for ash material, however metals has been extensively tested and is considered to be well understood/characterised and as such further assessment of metals is not considered to be required. Other COPCs as provided by DER (2014) such as landfill gases, petroleum hydrocarbons and nutrients have been discounted due to the following: • The ash material has been subject to burning at high temperatures (in excess of 1,000C° and therefore does not have an elevated amount of putrescible organic materials. As a consequence, the ash does not have the compositional organics to allow for gas generation. Additionally, the Agency for Toxic Substances & Disease Registry (2020) outlines that landfills usually start to "produce appreciable amounts of gas within 1 to 3 years. Peak gas production usually occurs 5 to 7 years after wastes are dumped. Almost all gas is produced within 20 years after waste is dumped; however, small quantities of gas may continue to be emitted from a landfill for 50 or more years. The ash material at Collie was likely deposited prior to the 1950s (1920s as indicated by HGM, 2002b), i.e. at least 70 years in age. This coupled with the fact that the deposits are shallow and not capped with an impermeable layer means that any gases that may have been produced would have been expelled to the atmosphere. • Petroleum hydrocarbon testing (via analysis of TPH, TRH, BTEX and PAHs) in soil onsite by others has not identified gross contamination and in general only isolated minor exceedance have been identified which do not represent an unacceptable risk. Samples collected within ash material and subjected to analysis for PAHs has have generally been detected concentrations below the laboratory LOR. This is considered to be reflective of the likely low PAH content in collie coal and the high temperatures at which the coal was burnt. Additionally, groundwater wells (MB04 and MB05) in close proximity to the ash deposits have not identified gross petroleum hydrocarbons in groundwater. Given that the ash material has resulted through burning of materials such as coal and wood, the absence of petroleum hydrocarbons is expected. • Elevated nutrient concentrations have been detected in groundwater monitoring well MB1, however nutrient concentrations are lower down hydraulic gradient of known ash deposits (groundwater monitoring well (MB04 and MB05) despite the potential for ash to have been buried at or near groundwater levels. As such elevated nutrients contained within the ash material is not considered to pose an unacceptable risk.	Whilst the testing of the ash material has been extensive further investigation of the material is considered to be warranted to assess for the potential presence of AF/FA. An additional aspect for consideration in terms of the future use of the Site, will be if the ash material poses an aesthetic risk to Site users, should AF/FA not be detected.

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
	distinctly buried in four major deposits across the eastern portion of the Site and potential for a minor deposit east of the Roundhouse. Again, based on the works done by HGM (2002b) the ash deposits may be up to 2m thick. The site inspection did not identify any new ash deposits or evidence of uniform ash spreading. The former ash deposits were identified during the site inspection; however, the surface distribution could not be assessed given the presence of surface vegetation which restricted this aspect of the inspection. Noting the works that have been done to date it is considered unlikely that ash material has been uniformly spread across the Site. The minor ash deposit located adjacent to the Roundhouse is likely to be associated with the use of the boiler shed, given its inferred proximity rather than that generated from the locomotives.	• Given the known process that produced the ash material other COPCs such as PCBs, sulphides, alkanes, organic acids are not required for future consideration.	
6. Compressor Shed	The Compressor Shed is still present onsite, as noted during the site inspection. The Compressor Shed was noted to be in a derelict state during the site inspection with asbestos cladding fragments observed on the surface soil surrounding the building, broken windows and a damaged door. Additionally, the shed appeared to be subject to a minor fire, as burn marks were evident and previous reports have also noted staining on the concrete floor (the concrete was noted to be in good condition). No staining was observed surrounding the building, which suggest the spills that caused the stains were likely minor and operational in nature. The Compressor Shed has been subjected to a HAZMAT survey which confirmed the presence of asbestos containing materials. The shed may be subject to hazardous materials works associated with the tendered building remedial works, to be confirmed	Based on the historical Site activities the COPCs associated with the Compressor Shed are petroleum hydrocarbons, metals, and asbestos.	No known testing has been undertaken in or around the Compressor Shed, with further investigation deemed warranted, to ensure spills have not escaped into the surrounding soils.
7. Boiler Shed	The Boiler Shed was east of the Roundhouse and likely was used to aid in maintenance operations of the locomotive boilers (likely power steam cleaners, with pipes going into the Roundhouse were works would have been carried out). The presence of the Boiler Shed onsite could not be confirmed as part of the site inspection or identified as part of the historical aerial photography review. The Boiler Shed may have been demolished or not ever established. If demolished incorrectly may have resulted in additional contaminants being present such as ACM along with C&D waste. One previous soil sample was collected in the vicinity of the Boiler Shed (COL-B2_01 – HGM, 2002b) and was assessed for metals which contained concentrations below the adopted assessment criteria. Additionally, there is no mention in the HGM (2002b) report of observed C+D waste in this location. No evidence of contamination was present in the vicinity of the workshop footprint during the site inspection. However previous reports may have identified a former building footprint in the vicinity of the inferred Boiler Shed location and the presence of elevated nitrate concentrations have been detected in groundwater the vicinity of the Boiler Shed position through groundwater sampling at monitoring well MB1.	Based on the historical Site activities the COPCs associated with the Boiler Shed are metals, nutrients, PAHs and asbestos.	Whilst the presence of the Boiler Shed could not be confirmed, though aerial photography or photos it is considered likely to have existed based on previous observations in historical reports potentially identifying a building footprint and based on anecdotal evidence. Additionally, the source of elevated nitrate concentrations is unknown. As such further investigation is deemed warranted.
8. Coal Testing Shed	The Coal Testing Shed was inferred to be east of the Roundhouse based on Plan No, 43626/16. These sheds are understood to have been used to assess the quality of the coal in terms of its calorific value and variable ash content for use in the locomotives. The presence of the Coal Testing Shed onsite could not be confirmed as part of the site inspection or review of historical aerial photography or by other reviewed documents/images or by anecdotal evidence.	Based on the historical Site activities the COPCs associated with the Coal Testing Shed may have been metals and asbestos.	Given the Testing Shed was unlikely to have been established and that no other signs of contamination were observed during the site inspection, no further investigation is deemed warranted.

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
	The Coal Testing Shed has been demolished or was never established. If demolished incorrectly may have resulted in additional contaminants being present such as ACM along construction and demolition (C&D) waste. During the site inspection, no evidence of the building footprint or C&D waste was encountered. It is understood in correspondence with Jeff Austin of Rail Heritage WA that the Collie coal quality was variable and generally poorer (from the open cut mines (lower calorific value and variable ash content)) was of a poor quality and that WAGR specifically designed its locomotive fireboxes to burn this lower quality coal and had few problems. Additionally, it is understood that the Midland Junction workshops did have a Coal Testing Shed and material may have been sent there when required. On this basis the requirement for a Coal Testing Shed was likely possibly deemed to be surplus to needs and not established.		
9. Hot and Cold Water Tanks	The tanks were located southeast of the Roundhouse and understood to have stored cold and hot water, which may have also contained concentrations of nitrate and chromate. The presence of the tanks onsite could not be confirmed as part of the site inspection or review of historical aerial photography review. During the site inspection, no evidence of the footprint or C&D waste was encountered in the area where its location is understood to be. Two samples were collected in the vicinity of the tanks (COL-CO1_01 and COL-JSO1_01 – HGM, 2002b) with one of the samples in the area containing elevated concentrations of Copper and Zinc. Additionally, groundwater monitoring well MB01 in the vicinity contains elevated concentrations of nitrate.	Based on the historical Site activities the COPCs associated with the Hot and Cold Tanks are metals and nutrients.	Although its presence could not be confirmed the correlation with the elevated nitrate in groundwater suggest that further investigation is deemed warranted.
10. Underground Stormwater Drain Network and TIT	The Underground Stormwater Drain Network is understood to originate offsite to the west, just south of the Preparation Shed. It links to the TIT and stormwater infrastructure associated with the Roundhouse/Turntable, south of the Roundhouse and goes through the centre of the Site in a north eastern alignment with an outlet at an ephemeral stream/drain to the north of the Site. The current condition of the drain network is not fully understood as previous reports have suggested that sections may have been backfilled or damaged. However, during the site inspection water was noted present in the TIT, which suggests there is still some functional capacity. The offsite release location was observed during the site inspection and no stains were noted or signs of vegetation stress. No sheens were noted in the TIT, however previous reports noted a drum containing a tar like material which was on top of the TIT with evidence of leaking into the TIT.	Based on the historical Site activities the COPCs associated with these areas are considered to be petroleum hydrocarbons, nutrients, metals and asbestos.	Whilst no stains were noted at the outlet location, AF/FA that has weathered from onsite and offsite infrastructure may be present within the drainage network which may have been released to the offsite location. As such further investigation is warranted to assess for potential offsite impacts.
11. Open Drain/Trench	The open drain/trench runs along the southern Site boundary for approximately half the length of the Site and is considered to reduce the potential from flooding, which has been documented to occur in historical reports. Previous sampling undertaken by HGM (2002b) collected five samples from within the drain (COL-A1_01, COL-A4_01, COL-A5_01, COL-A8_01 and COL-A9_01), with the samples analysed for metals and pesticides, all of which contained samples below the adopted assessment criteria. During the site inspection it was noted on the northern side of the open drain/trench, east of the Site gate entrance, that C&D waste was present in an elongate mound which also contained some PACM. However, this material did not lie within the open drain/trench.	Based on the historical Site activities the COPCs associated with this area is considered to be petroleum hydrocarbons, nutrients, metals and asbestos.	Previous sampling has not indicated the presence of contamination and the site inspection did not observe any evidence of contamination. As such no further investigation is deemed warranted.

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
12. C&D Waste	As previously mentioned, C&D waste has been observed near the open drain/trench with potential ACM fragments appearing to be present. The origins of the C&D waste are not understood given no historical building have been identified within close proximity and that historical stockpiles were located further north. Additionally, C&D waste was also observed during the site inspection near the centre of the Site (40m north-west of MB04) where no known infrastructure noted to exist, which also deemed to require investigation. C&D waste located near the former Shunting Crew buildings also requires investigation, to be addressed via APEC 4.	Based on the observations through the site inspection the COPCs associated with these areas are considered to be and asbestos, metals and OCPs.	Sampling is considered required to ascertain the extent of the C&D waste and to characterise the presence of COPCs to better understand the associated risk.
13. Historical Stockpiles	As identified in the historical aerial photography review, numerous stockpiles were temporarily stored in the central portion of the Site, east of the Roundhouse in 2008. Aurora sought advice from multiple former landowners and operators such as PTA, Main Roads WA, CRSG, Aurizon and Arc Infrastructure as to the potential origins of the stockpiles, however the source could not be confirmed. It is noted that the stockpiled material appears to have been derived from earthworks approximately 200 metres to the north of the Site (based on soil disturbance works which can be viewed in the historical aerial photographs) with the material "temporarily" stored onsite. Based on a conservative estimate of 300 stockpiles (individual truckloads) with an estimated volume of each stockpile of 18m^3, at least 4,500m^3 of material is estimated to have been stored onsite. Whilst the source of the material cannot be confirmed, it is considered unlikely to present an unacceptable contamination risk, considering the following: • Review of historical aerial photography in the area of the inferred earthworks did not indicate the presence of any potentially contaminating activities. • The estimated volume suggests the material may have been associated with a major development program, rather than coming from a contaminated site, or a result of illegal tipping. • Based on the aerial photographs, the stockpiles do not demonstrate any black or dark stained areas and was suitable for vegetation growth. • The site inspection did not observe any staining within the vicinity of the former stockpiles. • Noting the space and volume of material that was present onsite, permission was likely sought to store the material, which also suggests that it did not present an unacceptable risk to be stored. It is considered likely that the material was flattened out onsite (based on letter from CRSG to DPLH) and was observed during the site inspection with an undulation noted in the former area.	Whilst no unacceptable impacts are considered to be present, they cannot be categorically ruled out. Given that the material is inferred to have originated north of the Site, COPCs should be associated with the activities undertaken in this area. Review of historical operations from the area does not appear to have been subjected to rail activities and/or power station activities, although stockpiling was noted in the vicinity (likely due to source the sand, for rail operations) as such COPCs are considered to be limited to metals, pesticides and asbestos. Should future investigation works note other potential evidence of contamination/impact the COPCs may need to be revised.	Whilst noting that the stockpiles are considered unlikely to represent an unacceptable risk of contamination, further works are required to confirm the absence of unacceptable impacts, on the basis that the source of the material cannot be confirmed.
14. Site Inspection Identified Stockpiles	During the site inspection, nine minor stockpiles were identified onsite. Two of the stockpiles (SP1 and SP7) were identified to contain C&D type waste and two stockpiles (SP8 and SP9) were noted to contain scrap metal. No stains or odours were noted to originate from any of the stockpiles.	Based on the material observed within the stockpiles SP1 and SP7 asbestos should be considered as a COPC. Stockpiles SP8 and SP9 should considered metals as a COPC.	Further assessment with regards to SP1 and SP7 with regards to potential for ACM is considered warranted. Additionally, further assessment to metal concentrations in soil, within stockpiles SP8 and SP9) is considered required. The remaining four stockpiles (SP2 to SP6) do not warrant further investigation given no signs

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
			of contamination were observed during the site inspection.
15. Onsite Accommodation Building (Feature ID 18)	Based on the site inspection observations regarding the building west of the Compressor Shed, identifying mattresses and a potential ablution room, it is considered likely to have formerly been used for accommodation purposes. The site inspection did not identify any signs of contamination (stains, odours and/or ACM fragments) around the immediate surrounds of the building. It is understood that it was a common practice to spray the soil underlying the building pads of government agency building with OPCs to extend the life of buildings (i.e. preventative spraying for termites). Based on the wider soil and groundwater analytical data set it is considered unlikely that excessive spraying was undertaken (given the lack of detectable concentrations) which would pose an unacceptable risk. However, given that the soils directly underlying the building have a lower potential for attenuation concentrations may still be detectable below the building footprint.	OCPs may be a COPC, if soils were historically treated. As previously discussed as, there is no current direct pathway for direct contact with the underlying soils, contamination is not considered to exist whilst the buildings remains. However if the Site or a building was redeveloped in the future, i.e. a new potential exposure pathway is created, as part of a change in land use then the potential presence of pesticides will need to be assessed in the context of the proposed new landuse(s). A HAZMAT assessment identified some asbestos materials and lead based paints, however based on the current condition of the building does not pose a risk of contamination unless removed/demolished incorrectly and/or subject to vandalism.	No further investigation is deemed warranted.
16. Waste Material encountered during installation of MB2	During the installation of MB2 and MB2A, HGM (2002b) described encountering rubbish-tip material (the composition of this material was described as glass and pottery) with a sulphur odour. It was noted to extend approximately 0.5m bgl from the surface at both MB2 and MB2A. The text in the HGM (2002b) report suggest that the further exploration undertaken by HGM (2002b) within the "immediate vicinity" of MB02 did not find any additional buried waste material and it appeared to be isolated in nature. However, it is not clear what the additional exploration entailed. Review of the HGM (2002b) soil logs indicates that three trenches were dug around JS14 which may have been approximately 30m from the wells. Other samples also surrounding the wells (JS14, E2, E4 and JS15, approximately 25-40m from the wells) did not identify any rubbish tip material. On the basis of the surrounding soil locations which did not identify the rubbish material, the trenches not identifying the rubbish material it is likely confined to a limited area. Whilst groundwater data from MB2 did not demonstrate gross impacts from this rubbish material (such as hydrocarbons, nutrients, TDS), it is understood that no soil samples have been collected to adequately characterise the material.	COPCs associated with the waste material include sulfides, metals and asbestos.	Further assessment should occur in immediate vicinity of the former well locations. Should rubbish material not be encountered in the immediate vicinity (which would not be unexpected based on HGM (2002b) comments) then sampling may not be required.
17. Golder (2002) Oil Stained Area	Golder (2002) noted an area of oil stained soils associated with the presence of gaskets on top of the surface soil (as viewed via Golder, 2002 photo 3) on the eastern portion of Lot 560. The stained soils were not located during the Aurora site inspection (i.e. no evidence of the gaskets and/or black stained soils). Noting the localised/minor nature of the oil stained soils (not representative of gross impacts) and the time that has since passed (~18 years) any minor impacts would have the potential to be difficult to positively identify including from ground cover and thus not unexpected it could not be identified. Whilst this area appears to be localised the potential for contamination is noted and no samples have been collected in the area.	COPCs associated with the stained soils include petroleum hydrocarbons, metals, metals and asbestos.	Whilst the probability of identifying the area is low (noting it was not uncovered during the site inspection and the impacts appeared minor in nature), further investigation is deemed warranted to confirm that it is minor and if uncovered sampling is deemed required to characterise the material if identified.
18. Diffuse AF/FA Across the Site	Based on Auditor discussions with the DWER, it is understood that there may be a possibility of diffuse AF/FA being present across the former surface of the railway yard. This is on the basis that rolling stock brake blocks were understood to have contained asbestos materials and may have generated AF/FA during braking activities onsite. The former railway lines were discounted as an APEC given that the lines moved periodically and are considered a low risk of potential contamination given the underlying	COPCs associated with the former site surface would be AF/FA.	Additional works are required to assess the potential presence/absence of diffuse AF/FA across the former operational yard.

TABLE K: SUMMARY OF ONSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS	DISCUSSION
	ballast material which may have been subject to minor leaks, or diffuse AF/FA were removed with the lines.		

The offsite APEC considered to be present/identified as part of the desktop assessment and site inspection are detailed below in Table L.

TABLE L: SUMMARY OF OFFSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS /MEDIA	DISCUSSION
19. Wagon Repair Shed	Maintenance activities associated with the repair of rolling stock may have the potential to impact the underlying soils and groundwater. The Wagon Repair Shed, located offsite, has been demolished and if demolished incorrectly may have resulted in additional contaminants being present such as ACM along with C&D waste. The construction of the buildings is not known. The site inspection did observe potential C&D waste in the vicinity of the unknown associated structures.	Based on the historical Site activities the COPCs associated with these areas are considered to be petroleum hydrocarbons, metals and asbestos. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. Potential groundwater impacts, if present, may impact upon the Site, given it is located up hydraulic gradient.	Based on groundwater conditions down hydraulic gradient of the Wagon Repair Shed at MB5, gross groundwater impacts are considered unlikely. No further investigation deemed required.
20. Former DC Power Station	It is understood that a former power station was in operation to the north-west of the Site (approximately 250m). Review of the DWER online contaminated sites database, did not identify the former power station as being a classified site, as such it is unknown whether there is a potential contamination issue associated with the former power station. Review of historical aerial photographs indicate that a dam was present offsite likely associated with the power station activities and ground disturbance was also observed, which may indicate the potential burial of wastes possibly including fly ash material.	Based on the historical power station activities petroleum hydrocarbons and metals are considered to be the most likely COPCs. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. Potential groundwater impacts, if present from the power station, may impact upon the Site, given it is located up hydraulic gradient.	A BSR/DSR should be requested to ascertain the contamination status of the Site, should it have been previously investigated to understand if groundwater impacts exist and any risk it may present to the Site. Given that no obvious offsite impacts (elevated hydrocarbons or TDS) have been historically detected in groundwater well MB02, MB04 or MB05 groundwater impacts are considered unlikely to be present beneath the Site.
21. Diesel AST	As indicated by the DMIRS search, an offsite 110KL AST storing diesel is north of the Site. During the site inspection the AST was observed with no bund, however there was no evidence of spills. Additionally, there are no known incidents or reports of spills associated with the Diesel AST.	Based on the AST contents hydrocarbons are considered to be the most likely COPCs. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. Potential groundwater impacts, are considered unlikely to be present as there is no known spills or evidence of spills.	No further investigation is deemed required.
22. Nightowl Service Station	It is understood that the former Nightowl Service Station operated to the east of the Site and in considered to be down hydraulic gradient. Review of the DWER online contaminated sites database, did not identify the former service station as being a classified site, as such it is unknown whether the fuel infrastructure has been decommissioned and removed and if there is a potential contamination issue associated with the former service station.	Based on the historical service station activities petroleum hydrocarbons and metals are considered to be the most likely COPCs. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. If groundwater impacts existed it is considered unlikely to impact upon the Site given the distance from the Site boundary to the service station (approximately 100m to the east) and that is down hydraulic gradient.	No further investigation is deemed required.
23. Caravan Sewage Disposal Point	As noted during the site inspection, located in the car park area for the Collie Information Centre (in Lot 5858) a sewage disposal point was observed. No tanks were observed, and no stains or odours were noted within the area. It is noted that Lot 5858 is not registered or licensed as a Prescribed Premise under the Environmental Protection Act 1986 (EP Act) to operate as a sewage facility (category 54 or 85) or a liquid waste facility (category 65). As such the sewage disposal system either stores the waste material or may act as septic tank system.	Based on the storage of sewage material nutrients and pathogens are considered to be the most likely COPCs.	Domestic septic systems (treating less than 540L/day) are not considered to cause contamination to a site providing that operated in compliance with regulations 15 to 19 of the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974, (CS Regulations, 2006). Given that the Caravan Sewage Disposal Point acts either as a storage location or a domestic septic system no further investigation is deemed warranted.

TABLE L: SUMMARY OF OFFSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS /MEDIA	DISCUSSION
24. Historic WWTP	Based on historical aerial photography review and HGM (2002b) a WWTP associated with the former rail activities was identified offsite, approximately 100m east of the Preparation Shed. It is understood to have treated oily wastewater from the refuelling shed, prior to the WWTP it was though that the oily wastewater was discharged to the soak pits (HGM, 2002b). It is unknown whether the WWTP also processed any nitrate/chromate water.	Based on the WWTP activities petroleum hydrocarbons, nutrients and metals are considered to be the most likely COPCs. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. Potential groundwater impacts, if present from the WWTP, may impact upon the Site, given it is located up hydraulic gradient.	In general, groundwater monitoring wells have not detected evidence of gross hydrocarbon contamination, as such it is considered unlikely to have impacted upon the Site.
25. Aurizon WWTP/ Administrative Building and Septic Tanks	During the site inspection a sign was noted on what appeared to be an electrical box on one of the brick buildings referring to an Aurizon trade WWTP. The presence of a trade WWTP was not noted to be present during previous investigations. It is considered unlikely that Aurizon would have installed a trade WWTP and the sign is considered likely to be associated with electrical box for the septic tanks associated with the administrative building. No other infrastructure was observed during the site inspection indicative of a WWTP. It is noted that Lot 561 is not registered or licensed as a Prescribed Premise under the Environmental Protection Act 1986 (EP Act) to operate as a sewage facility (category 54 or 85) or a liquid waste facility (category 65). As such the reference to a WWTP is considered likely to be associated with the administrations septic tank system.	On the assumption that the WWTP is associated with for domestic purposes with the administration building nutrients and pathogens are considered to be the most likely COPCs.	Whilst septic tanks are not considered to enable contamination elevated nitrate concentrations have been detected in groundwater downgradient of the septic tanks in groundwater monitoring well MB1. Consideration for the installation of an additional groundwater monitoring well will aid in assessing the source of the elevated nitrate concentrations in groundwater monitoring well MB01.
26. Nitrate AST adjacent to the Sand AST	The Nitrate AST is located approximately 75m north of the Roundhouse adjacent to a shed and a Sand AST. The Nitrate AST may also contain chromate based on information contained within Golder (2007). During the site inspection it was noted that the AST was not contained within a bund, however no obvious spills were noted to have originated from the Nitrate AST. There are no known incidents or reports of spills associated with the Nitrate Tank which was noted to be onsite between 1996 and 2001 based on aerial photography.	Based on the AST contents nutrients and metals are considered to be the most likely COPCs. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. Potential groundwater impacts, if present from the AST, may impact upon the Site, given it is proximity and that it is located up hydraulic gradient.	Whilst elevated nitrate concentrations have been detected in former groundwater monitoring well MB2, they are not the highest detected onsite and as such may be reflective of background/upgradient conditions. Consideration for the installation of an additional groundwater monitoring well near the AST's will aid in providing further information as to whether the AST may be a contributing source.
27. Chromate AST	An additional chromate AST was noted to be present offsite by Golder (2002), approximately 40m east of the Preparation Shed, with the AST also observed in historical aerial photography.	Based on the AST contents and that of similar known to exist, nutrients and metals are considered to be the most likely COPCs. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. Potential groundwater impacts, if present below the AST, are considered unlikely to impact upon the Site even though it is located up hydraulic gradient on the basis of the distance from the Site (approximately 230m), unless gross contamination was present.	Whilst elevated nitrate concentrations have been detected in groundwater below the Site (MB1), it is considered unlikely to have originated from the former Chromate AST given the distance from the Site and that chromium has not been detected in groundwater wells at elevated concentrations. Consideration to additional groundwater wells are being considered for the high nitrate concentrations at MB1. Should they not delineate the source, further investigation may be warranted in regards to the former Chromate AST.
28. Fuel Bay/Depot	The former Fuel Bay was located south of the Preparation Shed and was likely used to store diesel for the use by diesel locomotives. Based on the historical aerial photographs the area appeared to be bunded. There are no known incidents or reports of spills associated with the Fuel Bay, additionally, no staining was noted during previous inspections undertaken by Golder (2007). No evidence of hydrocarbon contamination has been identified in groundwater below the Site, based on historical data.	Based on the AST contents hydrocarbons are considered to be the most likely COPCs. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors. Potential groundwater impacts, if present below the former Fuel Bay, are considered unlikely to impact upon the Site even though it is located up hydraulic gradient on the basis of the distance from the Site (approximately 260m), unless gross contamination was present.	No further investigation is deemed required.
29. Preparation Shed	The Preparation Shed is located approximately 250m west of the Roundhouse and was understood to have service pits and associated tank structures. Golder (2007) noted that the Preparation Shed contained an oil storeroom, which had stains on the surface, with additional staining also noted around the shed. This further supports that a standalone oil store was unlikely to have been established.	Based on the historical Site activities the COPCs associated with these areas are considered to be petroleum hydrocarbons, nutrients, metals and asbestos. Any onsite soil impacts are considered unlikely to impact upon the Site or Site receptors.	No further investigation is deemed required.

TABLE L: SUMMARY OF OFFSITE AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

APEC	UNDERSTANDING	COPCS /MEDIA	DISCUSSION
	Previous sampling (Sample C, Sample D and Sample E) undertaken in proximity to the Preparation Shed, Golder (2007), indicated elevated concentrations of metals and hydrocarbons were present in the surface soil.	Potential groundwater impacts, if present below the Preparation Shed, are considered unlikely to impact upon the Site even though it is located up hydraulic gradient on the basis of the distance from the Site (approximately 250m), and no evidence of gross hydrocarbon contamination being detected in groundwater monitoring well MB1.	
30. Mechanical Coaling Shed	The coaling shed was located approximately 150m north-west of the Roundhouse and was observed to be present in historical aerial photography. The Historic WWTP (APEC 19) was later developed in the location of the Mechanical Coaling Shed.	Based on the historical Site activities the COPCs associated with this area is considered to be petroleum hydrocarbons and metals. Any offsite soil impacts are considered unlikely to impact upon the Site or Site receptors, given it was later developed into the WWTP.	No further investigation is deemed required.
31. Other Infrastructure	Other infrastructure located west of the Site, included the Sanding Plant and the Breakdown Crane Shed. The presence of the Sanding Plant and Breakdown Crane Shed were not confirmed as part of the PSI.	Given the location could not be confirmed, they are considered unlikely to have been established. As no COPCs are considered to exist.	No further investigation is deemed required.
32. Ash Deposits	Based on aerial photography and on the understanding on how the ash material generated from the steam locomotives was managed (i.e. deposited from the trains into the ash rake out pits and then buried in trenches as required), ash material is considered likely to be present west of the administration building.	Based on Aurora's previous experience and the analytical dataset of the sampling done on the ash material on and offsite, COPCs are considered to be limited to metals and asbestos. Any offsite soil impacts (asbestos) are considered unlikely to impact upon the Site or Site receptors, additionally metals show a low tendency for leachability and are considered unlikely to cause contamination of the groundwater below the Site.	No further investigation is deemed required.
33. Length Runner Accommodation Buildings	The two brick buildings located outside of the Site, located east of the Aurizon Administrative Building are understood to have been used for length runners during inspection of the rail lines. There are no known contaminating activities associated with the use of accommodation. No evidence of contamination/contaminating activities were observed during the site inspection other than WWTP sign that was noted on one of the buildings. Soils underlying the building pads may have historically been sprayed for OCPs.	Soils beneath the building pads may have detectable concentrations of OCPs, however unlikely to impact on site conditions. The WWTP has previously been addressed in APEC 22.	No further investigation is deemed required. Buildings are heritage listed and will stay in place.
34. 1975 ASTs	Review of the 1975 aerial photograph identified two AST's, both offsite. One AST, located approximately 100m north of the Turntable, was likely used to fill vehicles for use railway operations. The other AST and side structure, located approximately 600m east of the turntable, was likely used to fill diesel locomotives during the transition period from the steam to diesel locomotives. It appears that the ASTs were operationally relatively short lived based on the aerial photography (the ASTs were not present in the 1980 photograph) review, which is not unexpected given the changes that were taking place generally at the Site. Should spills have occurred at these locations, there is a potential	Soils below the ASTs and groundwater may be impacted by hydrocarbons, metals and methyl tertiary butyl ether (MTBE).	No further investigation is deemed required as off Site and no evidence of significantly elevated hydrocarbons in groundwater samples taken at MB02 or MB04 that may indicate migration onsite of hydrocarbon impacted groundwater.

8 PRELIMINARY CONCEPTUAL SITE MODEL

The DWER risk-based approach to contaminated site management requires that investigations be completed and a CSM developed to determine the source, nature and extent of contamination and potential impacts to human health and the environment. Development of a CSM outlining the sources, pathways, receptors and the potential linkages between them is the standard preliminary step in the human health and ecological risk assessment process.

If one of these three elements are missing, then there can be no risk.

8.1 POTENTIAL SOURCES

A primary source (S) of contamination is the first point at which a chemical or hazardous agent (such as asbestos) has been introduced via a leak, spill or deliberate disposal released directly from the original source.

The primary sources considered to be present at the Site are:

- (S1) Roundhouse/Turntable and associated infrastructure;
- (S2) Compressor Shed; and
- (S3) Ash deposits.

Other potential secondary sources of contamination at the Site consist of the following:

- (S4) Historical infrastructure that has not been demolished correctly and potentially impacted the soil;
- (S5) Site Inspection Identified Stockpiles;
- (S6) C&D Waste;
- (S7) Impacted soil/water as a result historical leaks/activities;
- (S8) Elevated nitrate concentrations in groundwater;
- (S9) Potential OCP impacted soils below onsite building pads;
- (S10) Historical Stockpiles;
- (S11) Buried tip rubbish;
- (S12) Oil stained soil; and
- (S13) Diffuse AF/FA across the former levels of the operational rail yard.

In addition to the above, other offsite APEC which may act as a source of potential contamination (S13) and has the potential to impact groundwater up hydraulic gradient of the Site.

8.2 POTENTIAL EXPOSURE PATHWAYS

For the purpose of this assessment, possible exposure pathways (P) are identified as natural and/or man-made pathways for the preferential migration of COPCs in the liquid and/or gaseous state. Potential contaminant migration pathways for the COPCs include:

- (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres.

- (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater;
- (P3) Vertical migration of contaminants to groundwater;
- (P4) Horizontal groundwater flow;
- (P5) Abstraction of impacted groundwater;
- (P6) Uptake of COPCs by flora/fauna; and
- (P7) Atmospheric migration of odours/contaminants.

8.2.1 Discounted Pathways

Consideration was given to other pathways, e.g. vapour intrusion however, they were not included given within the SPR linkage assessment on the following basis:

- absence of unacceptable concentrations of petroleum hydrocarbons in both soil and groundwater;
- absence of onsite and nearby up gradient structures that could have caused gross quantities of impacts to soil and groundwater (i.e. ASTs);
- locations where petroleum hydrocarbons may have accumulated such as in the TIT, were observed to have no odours or surface sheens;
- areas where “hydrocarbon” related stains were noted in previous investigations, could not be identified and were likely minor in nature; and
- given the time passed (40+ years) in relation to historic train/rail operations, which would have used petroleum hydrocarbons (i.e. no other users based on the desktop assessment), concentrations are likely to have significantly degraded and more volatile compounds would have stopped releasing volatile vapours.

8.3 POTENTIAL RECEPTORS

For the purpose of this assessment receptors (R) include persons, structures, utilities, ecological receptors, shallow groundwater and water supply wells that are, or may be, adversely affected by the chemicals of concern.

Potential receptors on or in the vicinity of the Site, which have exposure pathways that may be complete are summarised below.

- (R1) Future Site workers and workers in excavations;
- (R2) General public, visitors and patrons of future establishments;
- (R3) Users of groundwater abstraction bores;
- (R4) Offsite residents and general public down gradient of the Site; and
- (R5) The ecology of the Collie River.

8.4 SPR LINKAGE ASSESSMENT

The refined CSM is presented in Table M, which describes the source-pathway-receptor (SPR) linkages at the site.

TABLE M: SPR LINKAGE ASSESSMENT

Source	Pathway and Transport Mechanism	Receptor	SPR Linkage?	Justification
• (S1) Roundhouse/Turntable	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow • (P7) Atmospheric migration of odours/contaminants.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R4) Offsite residents and general public down gradient of the Site.	Potentially Complete	It has been established that the Roundhouse structure contains ACM and ACM fragments have been identified within the structure and on the surrounding surface soil. It is understood that the cladding has been subject to vandalism which has aided in the creation of the ACM fragments on the surface soil. The act of breaking the cladding has the potential to release asbestos fibres into the atmosphere where inhalation may occur. The decking timbers and underlying sand has been identified to potentially contain elevated pesticide concentrations and AF/FA. It is understood that NTWA have put out to tender a building remediation work package which includes removal of identified hazardous materials associated with the Roundhouse and Turntable structures to make safe to a practicable extent which, also includes an emu-bob to remove the visible ACM fragments on the surface soil. The hazardous materials tender also includes the removal of the inferred impacted sand, below the wooden decking boards with both materials to be stockpiled onsite and assessment to determine management options. Appropriate safety precautions and the use of PPE should be undertaken during these works to minimise the potential exposure of workers and to that of the surrounding environment. Additional work is still deemed required to characterise the surrounding soil conditions to assess potential SPR linkages and to identify the potential source of nitrate in groundwater detected in close proximity to the Roundhouse. The soil conditions underlying the Turntable have not been characterised, as such the risk to receptors is unknown. However, given it is difficult to access the area below the Turntable and associated environmental risk is considered to be low.
• (S2) Compressor Shed	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P7) Atmospheric migration of odours/contaminants.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R4) Offsite residents and general public down gradient of the Site.	Potentially Complete	It has been established that the Compressor Shed structure contains ACM and ACM fragments within the structure and on the surrounding soil surface. It is understood that the cladding has been subject to vandalism which has created the ACM fragments on the soil surface. The act of breaking the cladding has the potential to release asbestos fibres into the atmosphere where inhalation may occur. Additionally, the site inspection noted evidence of a fire which has the potential to degrade the ACM and release asbestos fibres into the atmosphere for inhalation. It is understood that NTWA will include removal of hazardous materials from the Compressor Shed in the Roundhouse building remedial works package tender. Additional work is still deemed required to characterise the surrounding soil conditions considering the limited sampling undertaken in this area and due to observed stains within the Compressor Shed floor to assess potential SPR linkages.
• (S3) Ash Deposits	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P6) Uptake of COPCs by flora/fauna. • (P7) Atmospheric migration of odours/contaminants.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R4) Offsite residents and general public down gradient of the Site.	Potentially Complete	The ash deposits are considered to have been well characterised to date with no unacceptable human health risks identified as part of the characterisation works. However, no assessment is yet to be done regarding the potential presence/absence of AF/FA within the ash deposits. Previous contamination assessment works completed as part of the former WAGR railway workshops redevelopment in Midland as documented by ATA Environmental (2007) has shown that similar ash deposits (created by similar activities) at the workshops regularly contained asbestos in the form of AF/FA. As such, if AF/FA is present, it may pose a potential risk through activities such as grass slashing, vehicle movements and excavations in the areas of the former ash deposits, which may release the AF/FA into the atmosphere. Additional works is required to characterise the presence/absence of AF/FA within the ash deposits. It is understood that ash deposits contain some elevated metal concentrations exceeding the EIL criteria. Given the lack of current onsite ecological receptors no current SPR linkage is considered to be present. However, future management of ecological receptors (i.e. new gardens/vegetation) may be appropriately managed via the addition of new soil material or plantation of tolerant species and/or a SMP.

TABLE M: SPR LINKAGE ASSESSMENT

Source	Pathway and Transport Mechanism	Receptor	SPR Linkage?	Justification
• (S4) Historical infrastructure that has not been demolished correctly and impacted the soil	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P7) Atmospheric migration of odours/contaminants.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R4) Offsite residents and general public down gradient of the Site.	Potentially Complete	Several historical structures have been identified to have existed or may have existed onsite and are no longer present, this includes the former Workshop, Shunting Crew Buildings, Boiler Shed, Hot and Cold Water Tanks. As a result, it is not unreasonable to conclude that these structures were demolished. There are no known records of how they were demolished and in the case of the Wagon Repair Shed footprint C&D waste has been identified. As such, further assessment is deemed required to assess for the potential presence of ACM fragments and assess if it poses a risk.
• (S5) Site Inspection Identified Stockpiles	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P7) Atmospheric migration of odours/contaminants.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments.	Potentially Complete	Nine small stockpiles were identified during the site inspection. Stockpiles SP1 and SP7 were noted to contain evidence of C&D waste and as such investigation into the presence of asbestos should be considered, however it is noted that no ACM or PACM was observed on the surface of the stockpiles during the site inspection. Stockpiles SP8 and SP9 were noted to contain rusted metal waste, including potential old drums. Investigation is considered appropriate to ascertain if elevated metal or petroleum hydrocarbons are present which may pose a potential unacceptable risk.
• (S6) C&D Waste	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P7) Atmospheric migration of odours/contaminants.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R4) Offsite residents and general public down gradient of the Site.	Potentially Complete	During the site inspection C&D waste was observed to the east of the Site gate entrance. Some rare ACM fragments were identified on the surface of the stockpile, no stains or odours were noted. Sampling of the material is deemed appropriate to ascertain whether the asbestos concentrations present an unacceptable risk. Consideration to the aesthetic nature of ACM fragment distribution should also be considered regarding the future use.
• (S7) Impacted soil/water as a result of historical leaks/activities	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow. • (P7) Atmospheric migration of odours/contaminants.	• (R4) Offsite residents and general public down gradient of the Site; and	Potentially Complete	It is understood that the underground stormwater drain network may have potentially collected impacted material, water and AF/FA with flows releasing to an offsite secondary source, which is accessible to the general public. The status of the drain network is somewhat unknown, as Golder (2013a) indicated that some points have been filled in or caved in, whilst during the site inspection the water was observed in the TIT, which suggests some functioning capacity. No odours or stains were noted during the site inspection at the release location. However, no sampling to date has been undertaken at the offsite outflow point to assess if it has been impacted by historical activities. Sampling is deemed appropriate to ascertain the presence/absence of soil impacts. If gross contamination is identified further investigation into the underlying groundwater conditions may be warranted.

TABLE M: SPR LINKAGE ASSESSMENT

Source	Pathway and Transport Mechanism	Receptor	SPR Linkage?	Justification
• (S8) Elevated nitrate concentrations in groundwater	• (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow; • (P5) Abstraction of impacted groundwater. • (P6) Uptake of COPCs by flora/fauna.	• (R3) Users of groundwater abstraction bores. • (R5) The ecology of the Collie River.	Unlikely	Elevated nitrate concentrations in groundwater have been detected below the Site exceeding the freshwater criteria, but below the NPUG criteria. Given the nitrate concentrations in groundwater are below the NPUG criteria, no unacceptable risk to human health is considered to be present. Whilst the nitrate concentrations indicate a potentially unacceptable risk to freshwater receptors, given the lack of onsite freshwater receptors the risk onsite is considered to be low. The closest freshwater receptor being the Collie River (noting that the ephemeral creek to the north is considered very unlikely to be hydraulically connected and is up/cross gradient) is at a distance of approximately 800m down hydraulic gradient would not likely receive the same concentrations identified below the Site, as natural attenuation factors would likely reduce concentrations to acceptable level prior to reaching the Collie River. As such the risk is considered to be acceptable. However, further investigation is considered necessary to validate the historical data (noting only one GME analysed for nutrients) and the extents of the Site has changed. As such, the western Site boundary should be assessed to ensure nitrate concentrations are consistent with the historical groundwater dataset, to confirm the current inference that the groundwater concentrations of nutrients do not present an unacceptable risk.
• (S9) Potential OCP impacted soils below onsite building pads	• (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow; • (P5) Abstraction of impacted groundwater.	• (R1) Future Site workers and workers in excavations. • (R3) Users of groundwater abstraction bores.	Unlikely	It is unknown if elevated concentrations of OCPs are present in soils below existing onsite buildings and if it represents an unacceptable risk. Based on review of the historical soil and groundwater data, there does not appear to be an over application of OCPs onsite given the absence gross impacts of OCPs present onsite in either soil or groundwater. However, the presence of OCPs in soils below the building pads (existing) cannot currently be discounted. Given that the building pads do not allow direct access to the underlying soils no complete SPR linkage is considered present at this time. Should the buildings be significantly altered in the future (removal of the building pad) than this may need to be assessed in the future. It is understood that this potential risk could be managed via a Site Management Plan. Historical buildings that have been demolished (40+ years ago) may have also had OCPs below the buildings pads, whilst this soils have a higher likelihood to have limited OCP concentration given that at least three half-life periods have passed (since the time of buildings being removed), as the starting concentration is unknown any unacceptable risk although considered unlikely, cannot be discounted. Given the OCP concentrations in groundwater have been below the assessment criteria, no unacceptable risk is considered present.
• (S10) Historical Stockpiles	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow; • (P5) Abstraction of impacted groundwater. • (P6) Uptake of COPCs by flora/fauna.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R3) Users of groundwater abstraction bores. • (R4) Offsite residents and general public down gradient of the Site.	Unlikely	Based on review of the historical photography a portion of Lot 560 can clearly be observed to store soil stockpiles. Whilst the source of the material was not able to be unequivocally confirmed as part of this investigation, it is considered likely to have originated from the vacant land just north of the rail lines and the Site. The purpose of the material being placed onsite is also not clear however it may have been imported to aid in the establishment of the proposed miniature railway which was never established. Based on information provided by CRSG, it is understood that the stockpiles were levelled out onsite, prior to NTWA being granted the management order for the Site. This is considered likely given the observations made during the Site walkover in the inferred area of the stockpiles where it was noted to undulate and be slightly elevated relative to the remaining portion of the Site. Review of historical aerial photography of where the imported material is inferred to have originated, remained vegetated for a large period of time of site operations and does not appear to have been subject to historic railway operations and/or activities associated with the DC power station and/or any other contaminating activities. Nor were there any signs of contamination (dark stains) noted in the aerial photography of the stockpiles, which showed substantial vegetation growth in later photos indicating that there was no substance (i.e. gross contamination) present to inhibit growth. Additionally, there were no obvious signs of contamination noted in the stockpiling area during the site inspection.

TABLE M: SPR LINKAGE ASSESSMENT

Source	Pathway and Transport Mechanism	Receptor	SPR Linkage?	Justification
	• (P7) Atmospheric migration of odours/contaminants.			However, given that the stockpiled material cannot be confirmed to have originated from north of the Site, and there is some uncertainty to relating to its origin, potential risk to receptors cannot currently be eliminated, albeit considered unlikely.
• (S11) Buried tip rubbish	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow; • (P5) Abstraction of impacted groundwater. • (P6) Uptake of COPCs by flora/fauna.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R3) Users of groundwater abstraction bores.	Unlikely	During the installation of groundwater monitoring wells MB2 and MB2A, HGM (2002b) noted the presence of tip rubbish described as glass, pottery and bottles along with a sulphur odour. No sampling of the soils from the wells were collected and HGM (2002b) inferred that the immediate area around the wells was investigated however, based on their logs there is some uncertainty in regards to the accuracy of the delineation and the extent of the rubbish tip material. During the site inspection there was no evidence of the rubbish tip material being present on the surface. Based on the analytical data from MB2, there does not appear to be gross contamination in groundwater as a result of the rubbish tip material. Whilst it is considered unlikely to pose an unacceptable risk to human health given the lack of COPCs in groundwater at MB2 and lack of receptors onsite, should the Site be developed in the future, there may be a risk to human health, should the material not have been delineated and/or include other COPCs not noted within the well construction logs.
• (S12) Oil stained soil	• (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow; • (P5) Abstraction of impacted groundwater. • (P6) Uptake of COPCs by flora/fauna.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R3) Users of groundwater abstraction bores.	Unlikely	It is understood that Golder (2002) identified a small isolated area of inferred stained soil. The soils at the time were not sampled. The inferred area of the soil staining was not identified as part of the site inspection, and this was not unexpected. Given the absence of soil sampling, there is a potential risk to human health given there is some level of inferred impact, however the risk is considered to be low, given the time that has passed since the material was observed (~18 years) and that it could not be identified. Noting that the inferred area of impact is in close proximity to established vegetation, with no notable signs of stress, it is not considered to represent an unacceptable risk to ecological receptors.
• (S13) Offsite APEC which may act as a source of potential contamination	• (P2) Direct contact (dermal) and/or incidental ingestion of impacted soils, sediments or groundwater. • (P3) Vertical migration of contaminants to groundwater. • (P4) Horizontal groundwater flow; • (P5) Abstraction of impacted groundwater. • (P6) Uptake of COPCs by flora/fauna.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R3) Users of groundwater abstraction bores.	Unlikely	Several other offsite APEC have been identified to the west of the Site, which is located up hydraulic gradient of the Site that may contribute to potential groundwater contamination below the Site. Based on historical groundwater data, the majority of the APEC have not impacted upon groundwater below the Site (based on low TDS and hydrocarbon concentrations), however the source of nitrate is unknown. The offsite sources that are considered most likely to have contributed to nitrate include the WWTP, Septic Tanks and the Nitrate Tanks. As previously discussed, no there are freshwater receptors onsite and concentrations of nitrate are below the NPUG criteria. Noting the time that has lapsed since the last GME (approximately 7 years), it is considered worthwhile to assess the current groundwater conditions to ensure impacts from other offsite sources have not negatively impacted upon the Site and to assess the source of the nitrate in groundwater.

TABLE M: SPR LINKAGE ASSESSMENT

Source	Pathway and Transport Mechanism	Receptor	SPR Linkage?	Justification
• (S14) Diffuse AF/FA across the former levels of the operational yard	• (P1) Release of asbestos fibres and potential inhalation of the asbestos fibres. • (P7) Atmospheric migration of odours/contaminants.	• (R1) Future Site workers and workers in excavations. • (R2) General public, visitors and patrons of future establishments. • (R4) Offsite residents and general public down gradient of the Site.	Potentially Complete	As noted, there is a potential for residual AF/FA to be present on the former level of the operational depot through the release from brake pads. Given no investigation to date has assessed the presence/absence of AF/FA, a potential for an unacceptable risk cannot be discounted.

9 DATA GAPS

The following data gaps were identified as part of this PSI.

Data Gap 1 – What are the groundwater conditions entering into the Site?

Elevated nitrate concentrations have been detected in onsite groundwater monitoring wells (MB1 to MB4) exceeding the freshwater criterion and is considered to be above that of the local conditions based on low concentrations detected in the onsite groundwater monitoring well MB5.

Elevated concentrations of metals (copper and zinc) above the freshwater criteria have also been detected however; this is considered however likely to be associated with background conditions. Whilst the nitrate and metal concentrations in groundwater are not considered to pose an unacceptable risk further assessment is considered appropriate to:

- assess whether the nitrate concentrations originate onsite or offsite (i.e. to the west);
- assess if other COPC concentrations are lower or higher on the western Site boundary to assess any potential changes in risk; and
- confirm the current groundwater conditions below the Site and assess if they are similar to historical conditions.

Data Gap 2 – Do the ash deposits contain AF/FA and does that require future management/remediation?

The ash deposits are considered to have been well characterised to date. Elevated metal concentrations (copper and zinc) have been detected exceeding the EIL-URPOS criteria however are not considered to pose an unacceptable risk given the lack of onsite ecological receptors. This can be appropriately managed into the future with a SMP.

To date no assessment has yet been completed regarding the potential presence/absence of AF/FA within the ash deposits. Previous contamination assessment works by Aurora indicate that AF/FA may be present. As such, if AF/FA is present, it may pose a potentially unacceptable risk if disturbed in an unmanaged manner. Further works are considered to be required to characterise the presence/absence of AF/FA within the ash deposits and define the extents of the ash deposits.

Data Gap 3 – Do the identified stockpiles or areas of C&D waste present an unacceptable risk?

During the site inspection nine minor stockpiles were identified onsite along with three areas where C&D waste was observed.

SP1 and SP7 were noted to contain evidence of C&D waste, with the source of the waste unknown. The site inspection did not identify any stains, odours or ACM or PACM on the surface of the stockpiles. However, the presence/absence of asbestos at depth cannot be confirmed and as such warrants further investigation.

Stockpiles SP8 and SP9 were noted to contain rusted metal waste, including potential old drums, and investigation is considered required to ascertain if elevated metal or petroleum hydrocarbon concentrations are present which may pose a potential unacceptable risk.

C&D waste was also observed on surface soil in three areas across the Site; this included in the vicinity of the former Wagon Repair Shed, west of MB04 and to the east of the Site gate entrance.

The site inspection did not identify any stains, odours or ACM or PACM, within these areas with the exception of rare ACM fragments co-mingled with the C&D waste near the Site entrance gate. Given the potential presence of asbestos associated with C&D waste further investigation is also warranted in the three C&D waste locations to assess the potential human health risk.

Additionally, historic stockpiles have also been identified to have been present onsite and may have been spread across the Site. Whilst the risk of contamination is considered to be low, further assessment is deemed required to confirm the risk to human health and the environment.

Data Gap 4 – Are there any unacceptable risks present associated with current and or former infrastructure onsite and offsite?

Both the Roundhouse and Compressor Shed structures are understood to contain ACM (with FA present at some locations in the Roundhouse) with ACM fragments present on the surrounding soil surface. It is understood that NTWA are currently tendering building remediation works including the removal of hazardous materials to make safe for the Roundhouse and Turntable with the works potentially expanding to include the Compressor Shed and demountable building west of the Compressor Shed.

It is understood that these works will also include an emu-bob to remove any visible surface ACM fragments. In addition, the works include the removal of the inferred impacted timber floor boards and underlying sand, in the Roundhouse with both materials to be stockpiled onsite and for further assessment of management options. Both of these items will require assessment in terms of potential risks prior to determining if they can stay onsite or if offsite disposal is required.

Further investigation is also considered to be required where limited assessment or characterisation works have been undertaken. This includes the soils in the Arc Corridor area and the soils in and around specific structures were no soil sampling has been previously undertaken or only limited sampling has been undertaken, such as the Roundhouse, Turntable, Compressor Shed, Workshop, Boiler Shed and Hot and Cold Tanks.

Given that the Roundhouse and Turntable stormwater infrastructure join to the underground drainage network which is understood to discharge water to the north in the ephemeral creek, further investigation should be undertaken to ensure that no offsite impacts have occurred at the outfall point

Data Gap 5 – Are there existing soil impacts onsite that present an unacceptable risk?

As described earlier, both rubbish tip material and oil stained soil has been previously identified onsite, these materials where not noted during the site inspection and considered unlikely to pose an unacceptable risk to human health and/or the environment. However, additional works are deemed required to assess the absence/presence and if present what risk they pose.

Additionally, the presence of diffuse AF/FA across the former level of the operational yard cannot be discounted and requires further investigation.

10 CONCLUSIONS AND RECCOMMENDATIONS

Aurora completed a desktop review of existing available information and conducted a site inspection of the Collie Roundhouse Redevelopment Area to characterise the Site, identify the APECs, develop a CSM identifying any existing data gaps as part of this PSI.

The desktop review identified the Site had been extensively used as part of railway operations, primarily related to the transport of coal and to a lesser extent for passenger transport. It is understood that the original Collie railway depot used to service and maintain the steam locomotive fleet was to the east of the Site, however due to increased demands and the ageing structure a new depot was proposed. This resulted in the establishment of the new depot in the late 1950's which included the Roundhouse and Turntable structures amongst others, that extended across the Site and its surrounds. However, operation use of the new depot was relatively short-lived when oil replaced coal as a preferred fuel for locomotive power. Steam locomotives last used the depot operationally in 1971 with the associated buildings going out of use and becoming derelict after that time. By the 1980s, the declining use of rail for transporting coal and other goods saw the buildings progressively removed by the 1990s, most of the sidings in the rail reserve were removed and many structures demolished. No other potentially contaminating activities were identified onsite other than those related to the rail operations.

Review of historical plans/maps identified various structures that may have existed onsite and review of aerial photography confirmed the presence of several structures onsite, which included the Roundhouse, Turntable, Workshop, Compressor Shed, Shunting Crew Buildings and Accommodation Building. Based upon the plans and potential building footprints identified in previous investigation inspections several other structures may have been present onsite such as the Boiler Shed, Cool and Hot Water Storage Tanks. However other structures such as the Coal Testing Shed and Single Men's Quarters may not have existed based on the locations indicated in the plans reviewed and the lack of confirmatory evidence from the site inspection.

Several environmental investigations were accessed and reviewed as part of the desktop review which had completed extensive intrusive investigations to characterise the contamination status of the Site. Review of the historical reports and the associated soil and groundwater quality data collected showed that the historical data was suitable for use in characterising the Site (albeit often with different investigation boundaries) and assessing potential risks via comparison to current relevant guideline criteria. The Tier 1A risk assessment did not identify any gross contamination onsite that would present an unacceptable risk. However, several data gaps were identified as not all COPCs had been considered or assessed and some of the identified APEC, noted as part of the desktop assessment had not been assessed.

A site inspection was undertaken to assess for APEC and verify the presence of other APEC identified during the desktop assessment. A total of 18 onsite APECs were identified through the PSI with an additional 16 offsite APECs identified. The CSM identified seven potentially complete SPR linkages and six unlikely SPR linkages. As a result, the following data gaps were identified:

- Data Gap 1 – What are the groundwater conditions entering into the Site?
- Data Gap 2 – Do the ash deposits contain AF/FA and does that require future management/remediation?

- Data Gap 3 – Do the identified stockpiles or areas of C&D waste present an unacceptable risk?
- Data Gap 4 – Are there any unacceptable risks present associated with current and or former infrastructure onsite and offsite?
- Data Gap 5 – Are there existing soil impacts onsite that present an unacceptable risk?

Further works are considered warranted to assess these data gaps, such that the potential risks associated with the Site as identified though the CSM can be clarified and whether they subsequently require management in the context of the planned future use(s).

10.1 RECCOMENDATIONS

On the basis of the findings and conclusions made above the following recommendations are made for consideration:

- Provide this report to the appointed CS Auditor for endorsement;
- To target and address the data gaps identified by the PSI undertake preparation of a SAQP to guide a DSI aimed at more closely assessing potential risks associated with the proposed Site redevelopment; and
- Establishment of a legal land parcel which the DWER can reclassify based upon the findings of future investigations. This may be in the form of Interest Only Deposited Plan(s) that corresponds to the Collie Redevelopment Area. The current Site area fully encompasses two lots (lots 561 and 2680) and includes portions of other lots (lots 560 and 2856) and future works within the Site may not achieve reclassification of the subject lots (i.e. classifications are normally applied to entire lots and there may be other contamination issues on Lot 561 and 2865, which have not been assessed/resolved and are not within the Site boundary).

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