EMP Assessment Report - Cleanaway (Ravenhall)

Publication 1970 May 2021

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Contents

Abbreviations

ADWG	Australian Drinking Water Guideline
ANZECC	Australian and New Zealand Environment Conservation Council
AJJV	Aurecon-Jacobs Joint Venture
ASLP	Australian Standard Leaching Procedure
bgl	below ground level
CPB/JH JV	CPB John Holland Joint Venture
CQAP	construction quality assurance plan
CSM	conceptual site model
EES	environment effects statement
EMP	environment management plan
EP Act	*Environment Protection Act 1970*
EP MTBMS Regulations	*Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020*
FOS	Factor of Safety
[redacted]	[redacted]
[redacted]	[redacted]
HHERA	human health and ecological risk assessment
IWR Regulations	*Environment Protection (Industrial Waste Resource) Regulations 2009*
IWRG621	Industrial Waste Resource Guidelines - Soil Hazard Categorisation and Management
IWRG702	Industrial Waste Resource Guidelines - Soil Sampling
km	kilometre
Koc	organic carbon partition coefficient
LCM	loose cubic metres
[redacted]	[redacted]
LOR	limit of reporting
MRL	Melbourne Regional Landfill
m	metre
m^3	cubic metre
mg/kg	milligrams per kilogram
NAPL	non-aqueous phase liquid
NEMP	National Environmental Management Plan
NYMS	North Yarra Main Sewer

OMP	Operational Management Procedures
PAH	polycyclic aromatic hydrocarbon
PASS	potential acid sulfate soil
PFAS	per- and poly-fluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFCA	perfluorocarboxylic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexane sulfonate
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PFPeA	perfluoro-n-pentanoic acid
PFSA	perfluorosulfonic acid
PIW	prescribed industrial waste
QC	quality control
SAQP	sampling analysis quality plan
SEPP	State Environment Protection Policy
SPR	source pathway receptor
TBM	tunnel boring machine
TDS	total dissolved solids
foc	fraction organic carbon
UCL	upper confidence limit
µg/L	micrograms per litre
USEPA	United States Environment Protection Agency
VOC	volatile organic compound
WGTP	West Gate Tunnel Project
WTP	wastewater treatment plant

Summary

EPA received from Cleanaway Operations Pty Ltd (Cleanaway) an Environment Management Plan (EMP) application proposing to receive and manage soil and rock (spoil) generated from the West Gate Tunnel Project (WGTP). The EMP followed a series of technical documents submitted over previous weeks. In addition, EPA received a sample analysis quality plan from CPB/John Holland Joint Venture (CPBJH JV).

It is estimated that a total of 1.5 million cubic metres (m^3) (2.8 million tonnes) of spoil will be generated from the construction of the WGTP tunnel. Cleanaway proposes to receive the spoil at a Spoil Management and Reuse Facility (SMRF), at a site located at and adjacent to 227 Riding Boundary, Ravenhall (the Site).

Cleanaway's proposal is to:

- temporarily stockpile and temporarily store spoil generated from the WGTP within holding pads in order to collect and analyse soil samples for the purpose of categorisation and potential classification.
- permanently deposit categorised spoil into a containment cell area at the Site where suitable to do so, or transportation of spoil for either reuse elsewhere, treatment or disposal at an appropriate facility.

Groundwater investigations along the WGTP tunnel alignment have indicated the presence of per- and poly-fluoroalkyl substances (PFAS). However, the soil and rock from the tunnel alignment has not been sampled for PFAS. EPA therefore requires that the spoil be sampled and analysed prior to reuse, containment, or disposal to landfill. Due to the volume and rate of tunnelling, there will be insufficient storage capacity at the northern portal to store the waste spoil to sample and categorise it prior to reuse, containment, or disposal to landfill. Therefore, an off-site location such as that which Cleanaway is proposing will be required to temporarily stockpile, sample, and dry the waste soil prior to reuse, containment, or disposal to landfill.

To support its application, Cleanaway submitted a document titled *'Environment Management Plan - Soil Management and Reuse Facility for the West Gate Tunnel Project'* prepared by Senversa, and initially dated 1 April 2021. Further information was provided with the subsequent final version of the EMP (dated 12 May 2021). This submission comprised an environment management plan, operations management plan, conceptual site model risk assessment, leachate management system details and holding pen and containment cell detailed designs and technical specifications.

EPA's assessment focused on the follow areas:

- Spoil storage and categorisation procedures, including sampling and analysis plans.
- Potential environmental and human health impacts of:
    - temporary storage of the spoil within holding pads
    - permanent deposition to a containment cell.
- Assessment of risks of spoil management, and leachate to:
    - on-site operators and future site users
    - groundwater quality
    - surface water quality
    - stormwater management

- air quality
- noise.

EPA is satisfied that the proposed spoil management methods are in compliance with the relevant subordinate legislation and the relevant guidelines. EPA is satisfied that all the matters specified in regulation 6(2) of the Management of Tunnel Boring Machine Spoil Regulations are included in the EMP (this is outlined in Appendix A).

EPA is satisfied that the EMP, together with the Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020 (EP MTBMS Regulations) adequately protects human health and the environment from the harmful effects of pollution and waste (regulation 6(3)). EPA has reached this state of satisfaction having regard to conclusions 1-37 set out in this summary (see below), as well as the other conclusions addressed throughout the assessment report. In particular, EPA has considered:

- assessment of the spoil (conclusions 1-6)
- conceptual site model (conclusions 7-11)
- processing area (conclusions 12-18)
- the containment system (conclusions 19-22), and
- the environmental management (conclusions 23-37).

On that basis EPA approves the EMP under the EP MTBMS Regulations. EPA provides the following conclusions from its assessment of the applications.

Soil (spoil) assessment

1. The total and leachable concentrations of PFAS will be measured in samples of spoil taken from the holding pad/s. The concentrations of PFAS in water that drains from the soil may differ significantly from those in in-situ groundwater or in the water in the spoil immediately after production of spoil from the tunnel boring activities.
2. Overall, the total mass of dissolved and adsorbed PFAS per unit bulk volume of spoil and spoil water placed in the containment cell should be lower than the equivalent mass within the soil and groundwater prior to excavation, due to the drainage of the liquid component that would have occurred.
3. PFOS PFHxS (perfluorooctanesulfonic acid and perfluorohexane sulfonic acid) have been identified as the main PFAS compounds likely to be present. The leachable concentrations in spoil are likely to range between below laboratory detection (<0.01 µg/L) up to approximately 0.7 micrograms per litre (µg/L), based on the groundwater data provided.
4. PFOA (perfluorooctanoic acid) has also been considered due to its potential presence.
5. Based on the design, the site-specific risk assessment, and nationally accepted criteria, Cleanaway proposes a containment cell leachability acceptance criteria of [redacted] PFOS PFHxS and [redacted] PFOA.
6. The proposed spoil categorisation and disposal management procedure are considered appropriate, and in compliance with the relevant subordinate legislation and the guidelines.

Conceptual site model

7. The Conceptual Site Model considered the risk in relation to each of the exposure pathways listed as relevant to on-site workers and determined the risk to be low. It identified risk control measures as personal protective equipment (PPE), hygiene control measures, dust mitigation measures and

the limited need for workers to have contact with water. EPA has assessed the risk as low, provided risk control measures are maintained.

8. The Conceptual Site Model considered it unlikely that the off-site use of groundwater would be a route of PFAS exposure and risks to be negligible, due to the risk control measures in place, (that is, the lining of holding pens, cells, sediment ponds and evaporation ponds). This assessment is supported by the infiltration modelling provided. This assessment is acceptable to EPA provided risk control measures are maintained.
9. The Conceptual Site Model considered it unlikely that the off-site use of surface water would be a route of PFAS exposure and risks to be negligible, due to the risk control measures in place, that is, runoff/spoil water drainage will be captured and transferred to lined sediment and evaporation ponds, and then treated prior to reuse or discharge to a licensed facility. This assessment is acceptable to EPA provided risk control measures provided risk control measures are maintained.
10. The Conceptual Site Model considered that off-site receptors may be exposed to dust from the Site, but risks are negligible, due to the risk control measures in place. Soil is also expected to remain saturated at most locations due to water content. This assessment is acceptable to EPA provided risk control measures provided dust mitigation measures are maintained.
11. The assessment considered off-site exposure of terrestrial biota (flora, fauna, soil dwelling organisms) by use of livestock health as the receptor. It reasonably assumed an incomplete source – pathway - receptor (SPR) linkage based on liner performance modelling.

Processing area

12. EPA is satisfied that the Auditor assessed holding pens and [redacted] design documents, included in the EMP, contain sufficient provisions to adequately manage environmental risks that may arise during construction and operation. The design documents also include sufficient information to ensure that the holding pens and [redacted] are constructed in accordance with the design intent.
13. The holding pens, [redacted], settlement pond and spoil water holding pond liner profiles were also modelled to assess their ability to protect the beneficial uses of the underlying groundwater. The modelling outcomes support the liner profiles chosen for these facilities over the periods modelled.
14. EPA is satisfied that the settlement pond and spoil water holding pond designs included in the EMP, contain sufficient provisions to adequately manage environmental risks that may arise during their construction and operation. The design documents also include sufficient information to ensure that the settlement pond and spoil water holding pond are constructed in accordance with the design intent.
15. The holding pens, [redacted], settlement pond and spoil water holding pond liner profiles were also modelled to assess their ability to protect the beneficial uses of the underlying groundwater. The modelling supports the liner profiles chosen for these facilities over the periods modelled.
16. A suitable construction quality assurance plan (CQAP) to ensure the liner materials perform to specifications is proposed. This is important for the outcomes of the modelling to be realised.
17. Leachate is proposed to be treated through a water treatment plant consisting of [redacted].

The proposed criteria for reuse of treated water are the Australian Drinking Water Guidelines. The system has been designed to treat water down to between [redacted] [redacted] for total PFAS.

18. EPA is satisfied that the proposed treatment system will sufficiently treat the spoil water so that concentrations of potential contaminants will be reduced to allow reuse of the water on site.

Containment system

19. The proposed liner for the containment cell consists of a [redacted] and [redacted]. Both Tier 1 and Tier 2 modelling approaches indicate that the proposed liner and acceptance criteria will be protective of the beneficial uses of the underlying groundwater, within the 100-year model time (for Tier 2 approach). These conclusions should be considered in combination with the inherent conservatisms of the approach detailed above, which do not consider the further control of capping or PFAS removal from the cell and treatment.
20. Suitable Technical Specification and a CQAP have been provided to ensure the liner materials perform to specifications. This is demonstrated in the containment cell detailed designs. In addition, the EMP includes provisions to facilitate leachate management in the cell.
21. EPA is satisfied that the containment cells design, included in the EMP, contain sufficient provisions to adequately manage environmental risks that may arise during containment cell construction and operation. The design documents also include sufficient information to ensure that the containment cells are constructed in accordance with the design intent.
22. A suitable CQAP to ensure the liner materials perform to specifications is proposed. This is important for the outcomes of the modelling to be realised.

Environmental management

Groundwater

23. The background concentrations of target analytes in groundwater will be established in the existing and proposed monitoring bore array prior to receiving spoil at the facility.
24. The EMP addresses the risk to groundwater through appropriate leachate management and treatment and by proposing a monitoring plan for this aspect. All leachate management will be undertaken within appropriately bunded areas to prevent potential groundwater contamination.
25. A suitable groundwater monitoring program is proposed which will monitor and assess for potential changes in groundwater conditions during and following operation of the proposed facility.

Surface water

26. If surface water infiltration is mitigated as per the engineered elements of the SMRF, it is highly unlikely that migration of contaminants to sensitive receptors will occur and hence effects on downstream will be negligible. The monitoring program will detect issues should they occur.
27. Background concentrations of PFAS in surface water and sediments will be established at the off-site locations (Skeleton Creek, at Leakes Road Wetland, lower reaches of Laverton Creek) prior to receiving tunnel spoil.
28. A detailed summary of the environmental monitoring plan is included in the EMP. EPA is satisfied that local surface water will be appropriately monitored.

Air quality

29. Generation of dust will be minimised as far as reasonably practicable – for both construction activities and operations. Suitable dust prevention and management procedures are described in the EMP. These measures are described for the whole facility.
30. Dust monitoring points to the south and west of the Site will be established. These are in addition to existing dust monitoring and will be used to trigger additional dust mitigation as required.
31. The existing dust monitoring program is being revised to address the potential for generation of additional potential dust from the project. This will include a greater emphasis on real time dust observations by operators being used to trigger dust mitigation practices.

Noise/vibration

32. Noise is proposed to be minimised as far as reasonably practicable – for both construction works and operations – prior to considering compliance to the relevant noise limits or criteria.
33. EPA is satisfied with the noise management approach provided in the EMP. Based on the information provided, the addition of the [redacted] and the SMRF will comply with SEPP N-1.
34. Appropriate noise mitigation measures are proposed. Regular noise monitoring will also occur to measure the effectiveness of the proposed controls.

Decommissioning

35. The Site is proposed to be decommissioned to facilitate the proposed expansion of landfilling activities at the Site. An assessment of the soils beneath the temporary structures such as the holding pens are proposed to be undertaken on completion of the use of the area.

Auditing

36. EPA is satisfied that an Auditor has undertaken an audit of the suitability of the detailed designs, technical specifications, construction quality assurance plan, monitoring program and pollution incident plan.
37. EPA is also satisfied with the proposed future scope of audits during and after both construction and operation of the proposed facility.

1. Introduction

EPA received an Environment Management Plan (EMP) from Cleanaway Operations Pty Ltd (Cleanaway) proposing to receive and manage soil, rock and water (spoil) generated from the West Gate Tunnel Project (WGTP). This application was followed by a sample analysis quality plan (SAQP) from CPB/John Holland Joint Venture (CPB/JH JV). CPB/JH JV will be responsible for the generation of the spoil, transportation to a site with an approved EMP and for sampling and characterisation of the spoil and spoil water prior to containment, reuse or disposal. A receiving site such as Cleanaway will be responsible for the temporary stockpiling, containment and management of environmental controls at the receiving site.

It is estimated that a total of 1.5 million cubic metres (m^3) (2.8 million tonnes) of spoil will be generated from the construction of the WGTP tunnel. Cleanaway proposes to receive the spoil at a Spoil Management and Reuse Facility (SMRF) at its premises located at 227 Riding Boundary, part 304 Riding Boundary Road, Part 714 and 1198 Christies Road, Ravenhall, Part Christies Road and part middle Road, Truganina (the Site).

Cleanaway's proposal is to:

- temporarily stockpile and temporarily store spoil generated from the WGTP within holding pads to collect and analyse spoil samples for the purpose of categorisation and potential classification.
- permanently deposit categorised spoil into a containment cell area at the Site where suitable to do so, or transportation of spoil for either reuse elsewhere, treatment or disposal at an appropriate facility.

The processing area and containment cell is proposed for construction within a former basalt quarry.

In accordance with the *Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020*, Cleanaway has submitted the following documentation for EPA's assessment:

- 'Environment Management Plan – Soil Management and Reuse Facility for the West Gate Tunnel Project', prepared by Senversa, dated 30 April 2021. An initial EMP was provided (dated 1 April 2021) which was subsequently superseded by a revised final copy with further information (dated 12 May 2021).

EPA has reviewed the applicant's documents and critically assessed the data and information to inform this assessment.

1.1 Background

The WGTP is a project that will provide an upgrade to the West Gate Freeway and a connection from the West Gate Freeway to the CityLink toll road.

Approximately 1,500,000 m^3 of the spoil, which can include soil, rock and water excavated from the tunnel alignment, is expected to be generated from two tunnel boring machines.

Assessment reports indicate that groundwater is likely to be contaminated with per- and poly-fluoroalkyl substances (PFAS) along the tunnel alignment. Coastal acid sulfate soils are also potentially present in small quantities in the area of the former Stony Creek Alignment.

Cleanaway has applied under the *Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020* to receive and manage spoil form the tunnel alignment.

1.2 West Gate Tunnel Project roles and responsibilities

1.2.1 Waste producer (CPB/JH JV)

The waste producer will be responsible for:

- managing the waste spoil, and treatment of excess wastewater at the northern portal/Pivot site
- daily observation of odour and visual appearance of spoil
- daily sampling of the soil and water released from the spoil at Cleanaway's site as per the SAQP and classification
- transport of the spoil from the northern portal/Pivot site to the Cleanaway site
- daily tracking of waste spoil volumes and movements
- disposal of waste spoil unsuitable for reuse or storage in containment cell to a licensed facility
- production of EPA classification compliance reports.

1.2.2 Waste receiver (Cleanaway)

The waste receiver will be responsible for:

- managing the temporary storage of the waste spoil prior to disposal, permanent containment or reuse
- tracking of material received
- construction of temporary storage pads and containment cell
- general site management, including potential air quality, noise, surface water and other environmental impacts on the Site
- management, including treatment of waste waters including leachate and surface water generated for the storage and management of the waste soils
- monitoring groundwater and surface waters for potential changes in environmental conditions.

2. Assessment approach

The EPA assessment process has considered the following key issues (with a generic conceptual site model giving an overview in Figure 1):

- the characterisation of the WGTP spoil, including potential contaminants within extracted spoil and groundwater
- the proposed spoil management including:
    - storage of the spoil within holding pads
    - spoil sampling and analysis regime and methodology
    - suitability of the spoil deposition.
- environmental and human health risks of the proposed deposition of spoil to a containment cell
- human health risks, including:
    - risk to human health of on-site operational activities associated with the management of the spoil
    - off-site impacts of the on-site operational activities associated with the management of the spoil
    - potential impacts to the future use of the Site.
    - noise impacts
- environmental risks, including potential environmental impacts of the proposed temporary spoil storage in holding pads and permanent deposition to a containment cell. The assessed approaches include leachate treatment and management, stormwater management and groundwater management.
- environmental management and monitoring of:
    - spoil characteristics
    - groundwater quality
    - surface water quality
    - leachate management
    - air quality
    - noise
- rehabilitation of the Site.

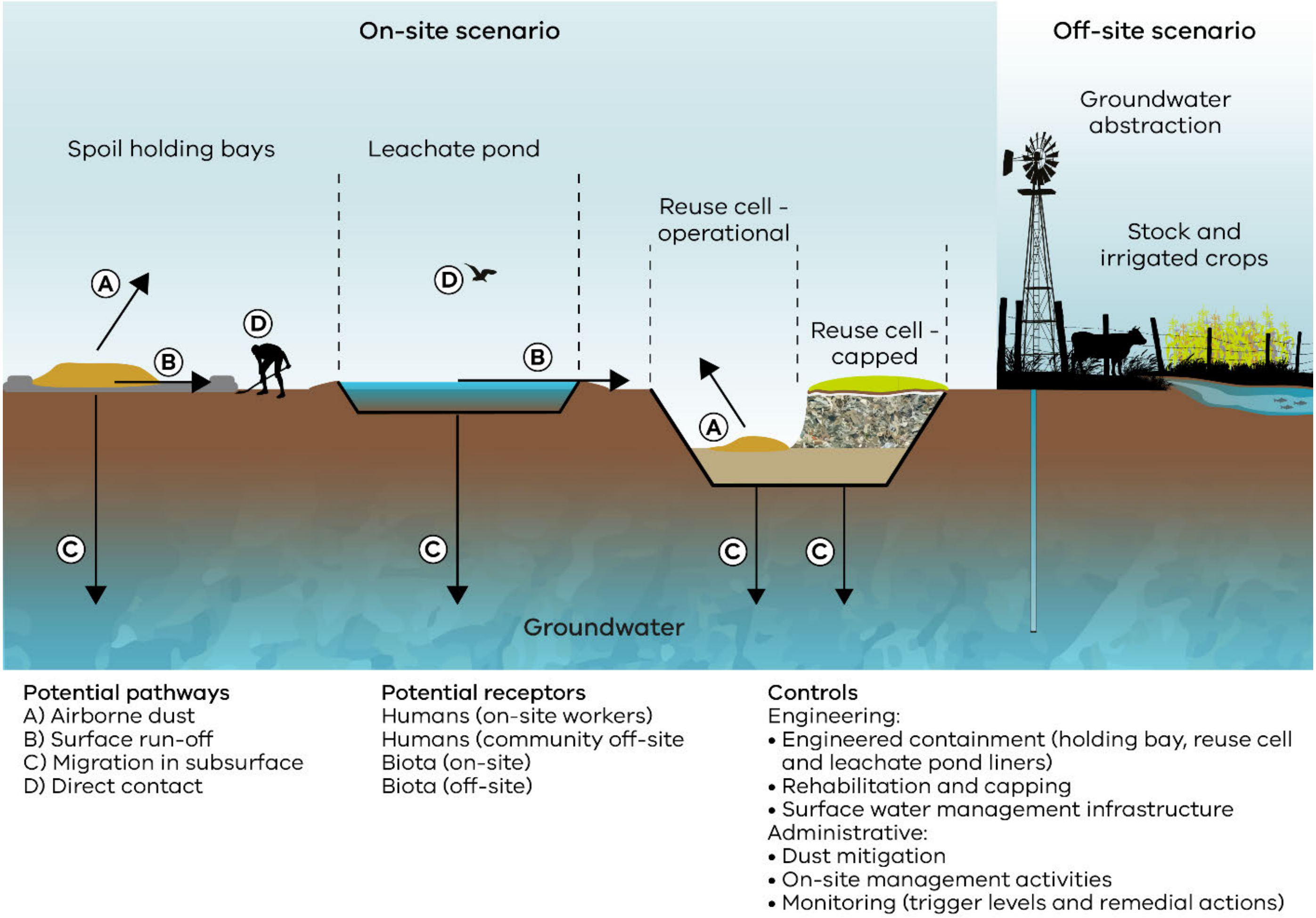


Figure 1: A generic conceptual site model of the spoil receiving site.

Figure 1, above, highlights potential pathways and receptors, in addition to the controls that will be assessed.

2.1 The Environment Protection Act 1970

Management of contaminated soil is not specifically addressed in the *Environment Protection Act 1970* (EP Act). However, the EP Act contains a range of relevant regulatory requirements.

Contaminated soil generated by infrastructure projects is industrial waste. Therefore, the excavations and management of such soil must be conducted in accordance with the EP Act, including the principles of the EP Act, relevant subordinate legislation and instruments under the EP Act.

The principles of the EP Act of relevance for this proposal are:

1B principle of integration of economic, social and environmental considerations

1C the precautionary principle

1D principle of integrational equity

1I principle of wastes hierarchy, and

1K principle of integrated environmental management.

2.2 Environment effects statement requirement

On 23 December 2015, the Victorian Minister for Planning declared the works proposed for the WGTP as 'public works' requiring an environment effects statement (EES).

The key regulatory instruments that govern the management of contaminated soil in Victoria are identified in the EES prepared for the WGTP.

The EES, issued in November 2017, identified an extensive list of environmental performance requirements to ensure any adverse local effects are minimised.

2.3 Relevant subordinate legislation and guidance

EPA has assessed the project's compliance with applicable Regulations, waste management policies and Victorian State Environment Protection Policies (SEPP) including but not limited to:

- *Environment Protection (Industrial Waste Resource) Regulations 2009*
- *Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020*
- *Environment Protection (Scheduled Premises and Exemptions) Regulations 2017*
- *Interim Position Statement on PFAS* (EPA Publication 1669.4)
- *Industrial Waste Resource Guidelines – Soil Hazard Categorisation and Management* (EPA Publication IWRG621)
- *Industrial Waste Resource Guidelines – Sampling and analysis of waters, wastewaters, soils and wastes* (EPA Publication IWRG701)
- *Industrial Waste Resource Guidelines – Soil sampling* (EPA Publication IWRG702)
- *Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999*
- *National Environment Protection (Assessment of Site Contamination) Measure 2013*
- Relevant Industrial Waste Resources Guidelines
- SEPP – Air Quality Management 2001 (in respect of odour)
- SEPP – Prevention and Management of Contaminated Land, 2002

2.4 Management of Tunnel Boring Machine Spoil Regulation

Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020 (EP MTBMS Regulations), which took effect from 30 June 2020, apply to TBM spoil. The new EP MTBMS Regulations provide a mechanism for the management and disposal of TBM spoil to protect human health and the environment. While TBM spoil is mostly virgin excavated spoil, some of the WGTP spoil is likely to contain low levels of contaminants including PFAS.

EP MTBMS Regulations set up a framework to appropriately manage spoil ensuring the process is safe for the community and the environment. In accordance with the EP MTBMS Regulations, a site occupier wishing to receive TBM spoil can submit an EMP demonstrating that TBM spoil can be managed in a safe manner so that its risks to the groundwater, surface water and air quality are mitigated.

Key components of the EMP must be verified by an auditor appointed under "Industrial Facilities Category" or "Contaminated Land Category". EPA's role under the EP MTBMS Regulations is to review, approve and ensure compliance. The auditor is required to conduct a risk of harm audit and assess the suitability of key plans in achieving the requirements of the Regulations. Clause 6(2)(q) of the regulation reflects section 53V of the EP Act 1970. Moving forward, the auditor may conduct the environmental audit under the EP Act 1970 or EP Act 2017.

2.5 Legislative basis

The tunnel components of the WGTP will involve excavations of significant volumes of potentially contaminated soil that cannot be deposited or reused at the point of excavation.

The EP Act contains various provisions which, depending on the circumstances, may apply to the management of contaminated soil.

The *Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020* provides a mechanism for the management and disposal of tunnel boring machine spoil to protect human health and the environment. They provide for the occupier of a premises to apply to EPA for approval of an Environment Management Plan (EMP) and requires the occupier to manage tunnel boring machine spoil in accordance with an approved plan. It specifies the elements that must be included in the plan and specifies further parameters that must be complied with.

It is considered that an EMP approved under the *Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020* is the appropriate regulatory tool to manage the receipt, dewatering, and containment of the waste.

3. The West Gate Tunnel Project

3.1 Project overview

The WGTP consists of three zones and three portals (one Northern portal and two Southern Portals). The three zones are described as follows:

- The West Zone (W200) comprises an upgrade and widening of the West Gate Freeway from the M80 interchange to Williamstown Road, Yarraville
- The East Zone (E400) comprises an elevated road structure from the tunnel's northern portal in Footscray to the CityLink toll road in North Melbourne.
- The Tunnel Zone (T300) comprises two 15.6 metre (m) wide tunnels to be excavated beneath Yarraville using tunnel boring machines (TBMs) (refer to Figure 2 and Figure 3).

One of the tunnels is approximately 4 kilometres (km) long, the other is 2.8 km long, and both are excavated to a depth between approximately 10 m and 40 m below the ground. The TBMs will start at the northern portal and progress south towards the two separate southern portals at an average rate of 9 m per day. It is estimated that a total of 1.5 m^3 (2.8 million tonnes) of spoil, as well as groundwater, will be generated and/or extracted from the construction of the tunnel.

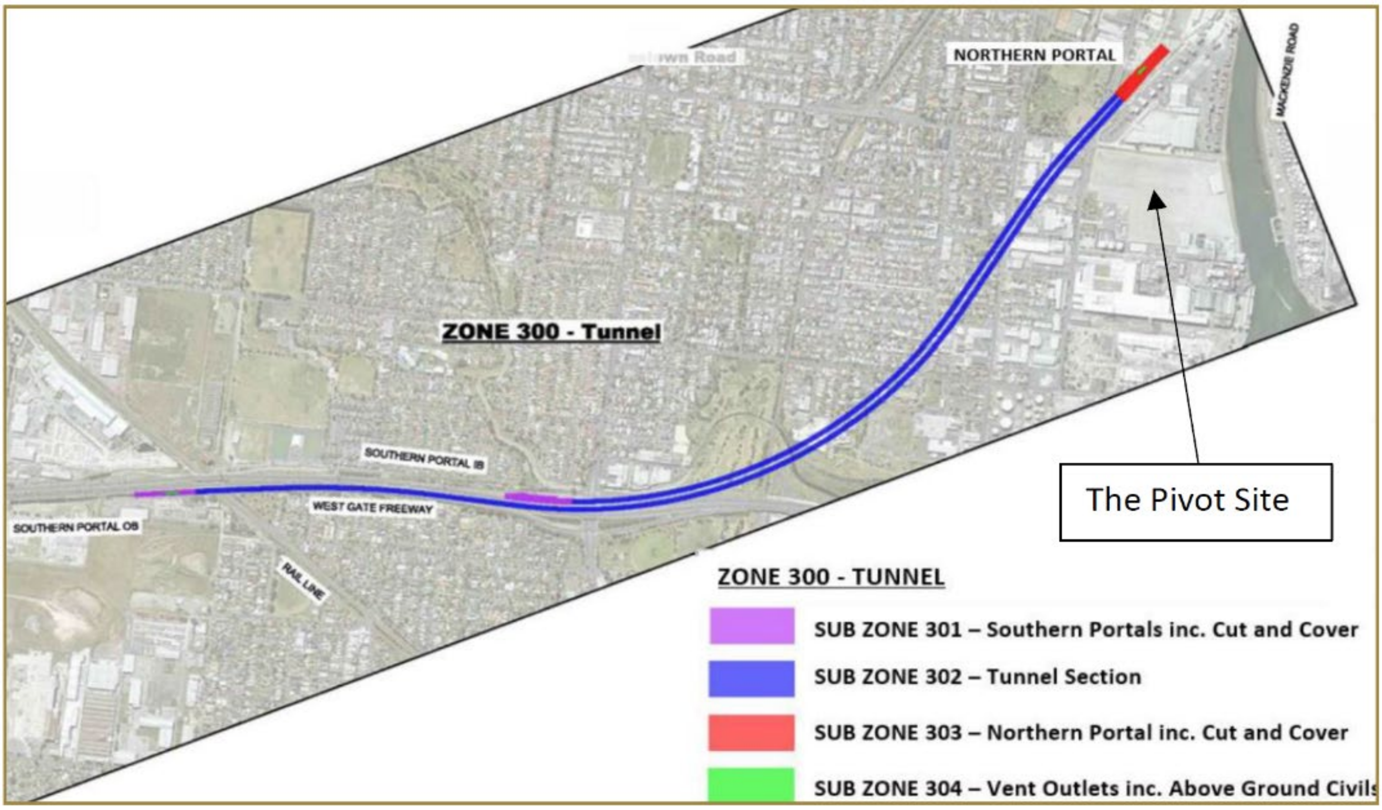


Figure 2: Extent of WGTP tunnel alignment (Zone 300)

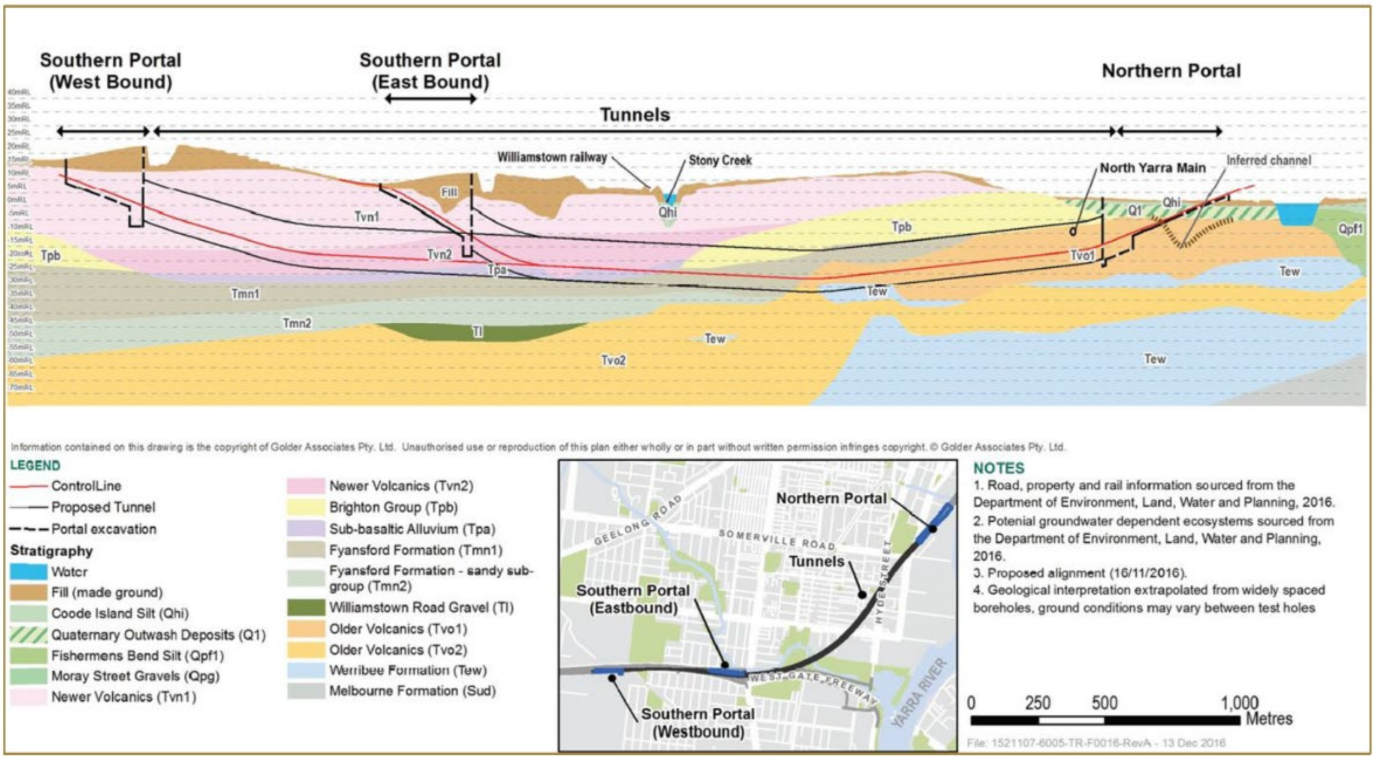


Figure 3: Cross section profile of WGTP tunnel alignment

To maintain air pressure within the cutting head of the TBM, a foaming polymer is added to the cutting fluids which enables an airtight seal as the drill cuttings are passed onto a conveyor belt within the TBM. The spoil is carried along the tunnel to a storage shed at the northern portal. The storage shed has one spoil storage bin per TBM. Each storage bin can hold up to approximately 10,000 m^3 or two to three days' production of waste spoil during peak operation.

Groundwater investigations along the tunnel alignment have indicated the presence of per- and poly-fluoroalkyl substances (PFAS). However, the soil and rock from the tunnel alignment has not been sampled for PFAS. The spoil is therefore required to be sampled and analysed prior to reuse, containment, or disposal to landfill. Due to the volume and rate of tunnelling, there will be insufficient storage capacity at the northern portal to store the waste spoil to sample and categorise it prior to containment, disposal to landfill or reuse. Therefore, an off-site location is required to temporarily stockpile, sample, and dry the waste spoil prior to containment, reuse or disposal to landfill.

3.2 Estimated volume of spoil

An estimated 1.5 million m^3 of spoil is expected to be excavated from the tunnel alignment. The spoil generated from the TBM is expected to contain between 50 per cent and 58 per cent moisture, which equates to approximately 3 million tonnes of waste spoil to be generated. The TBM is anticipated to generate an average of 5,900 m^3/day (8,400 tonnes/day) of waste spoil which will include a water component, with a peak operation period which will produce approximately 7,600 m^3/day (11,000 tonnes/day) of waste spoil.

3.3 Spoil and groundwater characteristics

The WGTP tunnel spoil will consist of soil and rock fragments, capturing the associated groundwater.

The WGTP tunnel intercepts areas which may have been contaminated by historical and legacy industrial activities undertaken at and within the vicinity of Zone 302. Due to access limitations, limited information is available regarding the full range of potential contaminants. Therefore, it is not possible to delineate the lateral and vertical extent of contaminants to a sufficient degree.

Previous sampling confirmed that groundwater beneath the project site is contaminated in some sections of the alignment. Groundwater conditions at the project site would assist in establishing mitigation measures applicable to excavated spoil. Based on the investigations of groundwater conditions, PFAS is the main contaminant of concern in both solid and water fractions of the tunnel waste. PFAS have been detected in bore water samples within the project area. The management of PFAS-contaminated soil and groundwater is important due to the environmental persistence of PFAS.

In addition, Potential Acid Sulfate Soils (PASS), hydrocarbons, chlorinated hydrocarbons, volatile organic compounds (VOCs), naturally occurring metals and metalloids are expected to be present within a few domains of the tunnel alignment. Other contaminants in groundwater may include hydrocarbons, benzene, chlorinated solvents, PAHs and organochlorine pesticides at low concentrations.

EPA recognises that TBM will create a homogeneous material mixing the different lithology. Therefore, there is the potential for a change in contaminant concentrations once the material is removed from the tunnel. During project works, the temperature of the spoil in the TBM excavation chamber may rise up to 50 degrees Celsius. This temperature is expected to reduce the concentrations of some VOCs which may be present in soil.

3.3.1 Geology

The ground conditions include anthropogenic fill, upper basalt rock, soft ground and lower basalt rock. There is a correlation between geological characteristics and spatial and vertical distribution of contaminants. Some attenuation is likely, via differential dispersion, diffusion, sorption and degradation of the different contaminants. Some of the geological formations are likely to contain naturally elevated nickel and arsenic.

The tunnel intersects geological formations such as Newer Volcanic, Older Volcanic, Brighton Group and Fyansford Formation. Older Volcanic outcrops occur across the northern portal. These geological and hydrological settings influence the fate and transport of contaminants at the project site.

3.3.2 Potential contaminants - Soil

Based on the results of previous soil investigations, CPB/JH JV has reported that apart from identifiable zones of the project (see section 3.3.5 below), the solids fraction of the in-situ ground in the tunnel alignment has no potential contaminants, except for PFAS.

Elevated concentrations of metals were reported in soil samples collected by the project. However, based on the geology and depth, these were deemed to be naturally occurring.

Anthropogenic chemicals have been detected at low levels in some of the groundwater wells. These include petroleum hydrocarbons, chlorinated solvents, polycyclic aromatic hydrocarbons (PAHs) and pesticides. Several aqueous-phase contaminants were present in sampled groundwater. The concentrations of some heavy metals in groundwater and soil samples are deemed by the project as being reflective of ambient conditions, and the concentrations of other groundwater contaminants are likely to be too low to affect the waste classification of soils/rock to be excavated as tunnel spoil.

3.3.3 Sources of PFAS in soil

Based on the observed pattern of PFAS in the groundwater within the tunnel alignment, PFAS have originated from a mix of multiple, dispersed, point and diffuse sources. The exact sources of PFAS plumes cannot be determined without extensive investigations.

PFAS is associated with historic fire-fighting activities and training activities involving the use of aqueous film forming foam that contained PFOS, PFHxS and PFOA. PFOS is expected to be a dominant contaminant in the soil. Groundwater samples near the tunnel alignment contain reported concentrations of PFAS (total) up to 1.12 µg/L, PFOS up to 0.43 µg/L, PFHxS up to 0.21 µg/L and PFOA up to 0.07 µg/L. Higher concentrations have been reported further from the tunnel alignment as described below.

All the West Gate Tunnel Project domains along the tunnel alignment are considered potentially contaminated with PFAS for the purposes of managing the tunnel spoil. The concentrations are likely to be spatially and vertically variable. Shallow soils are likely to contain higher PFAS concentrations than the bulk of the soil to be removed along the alignment at the depth of the tunnel.

3.3.4 Sources of other contamination in soil

A desktop assessment has been carried out by the CPB/JH JV's consultants to determine if acid sulfate soil may be present in the tunnel alignment. Specific geological formations such as Fyansford Formation (Newport Formation), which overlies the Coode Island Silt, may consist of PASS. PASS is geological material containing metal sulfides exceeding criteria in EPA Publication 655 – Acid Sulfate Soil and Rock. PASS may become oxidised following excavation. PASS may be present in black coloured soil with high organic content, enriched with iron monosulfide. The SAQP includes interpretation of the field indicators and action required. Acid sulfate soil may be present in the tunnel alignment. The percentage of the tunnel face that would encounter the Fyansford Formation is conservatively reported as being significantly less than 50 per cent. PASS generally occurs at very low concentrations. However, at elevated concentrations, the risk of harm if not managed appropriately becomes greater. The tunnel soil is clay rich, and clay rich soils generally have a higher natural pH buffering capacity than clay-poor soils. If required, soil alkalinity must be maintained by chemical means to reduce oxidation rate.

Residual soil in Newer Volcanic basalt and Older Volcanic basalt is enriched with nickel, ranging in concentrations from 90 to 450 mg/kg. The maximum concentration of arsenic within residual soil in Older Volcanic basalt is 860 mg/kg. Arsenic concentrations in soil derived from Fyansford Formation are also high. The distribution of arsenic and nickel is influenced by specific adsorption of metals on iron oxide. Newer Volcanic and Older Volcanic occurs west of Maribyrnong River, and outcrops across the majority of the tunnels. The leachability of naturally elevated arsenic and nickel is unlikely to be an issue provided such waste is deposited in a composite-lined cell.

North Yarra Main Sewer (NYMS), which directly intersects the tunnel alignment, is a potential contamination source. Construction would involve relocation of some utilities including a segment of the NYMS between Sommerville Road and Youell Street, Yarraville. This area has been identified as Domain 2, and a relatively small volume soil that is contaminated with other chemicals is likely to be generated from this domain.

Historical activities within northern portal include filling of the former Footscray depression (up to ~10 m) and former use of the Site as a State Electricity Commission terminal/depot, gasworks, smelting works, and fertiliser manufacturing plant. The material used to infill the swamp may include waste materials from nearby chemical sites.

The tunnel passes through a highly disturbed area of Yarraville, which has a history of chemical manufacturing and petroleum storage. The south inbound portal is associated with the filling of Stony Creek and the industrial activities which have occurred within the surrounding area. The south outbound portal area occurs where James Hardie and Bradmill manufacturing plants were located.

Characteristics and potential contaminants of concern near the portals include pH, metals (lead, arsenic, copper, zinc), petroleum hydrocarbons, phenolic compounds, chlorinated hydrocarbons, aromatic hydrocarbons, benzo(a)pyrene, organochlorine pesticides, polychlorinated biphenyls, PFAS and asbestos.

As shown in the conceptual cross section of Figure 3, the geochemical and stratigraphical conditions of the ground at the level of, and in the tunnel alignment, are variable. This would create local scale variability in the distribution and concentration of adsorbed and dissolved anthropogenic contaminants.

Based on results from groundwater sampling, PFAS is likely to be present in the tunnel alignment at concentrations that would be above the PFAS reuse criteria concentrations in EPA publication 1669.4. The spoil would therefore require deposition in a composite-lined containment or landfill cell.

EPA does not regulate the use of soil categorised as natural Fill Material (as per EPA Publication IWRG 621). However, soil with elevated levels of metals still requires careful management. Soil with elevated levels of metals may be required to be disposed to landfill to prevent adverse impacts on the environment and on human health.

A series of conceptual site models have been produced by CPB/JH JV's consultants that demonstrate potential contaminants and geological formations along the alignment. These are described below. Conceptual site model cross sections are presented in Figures 4–10.

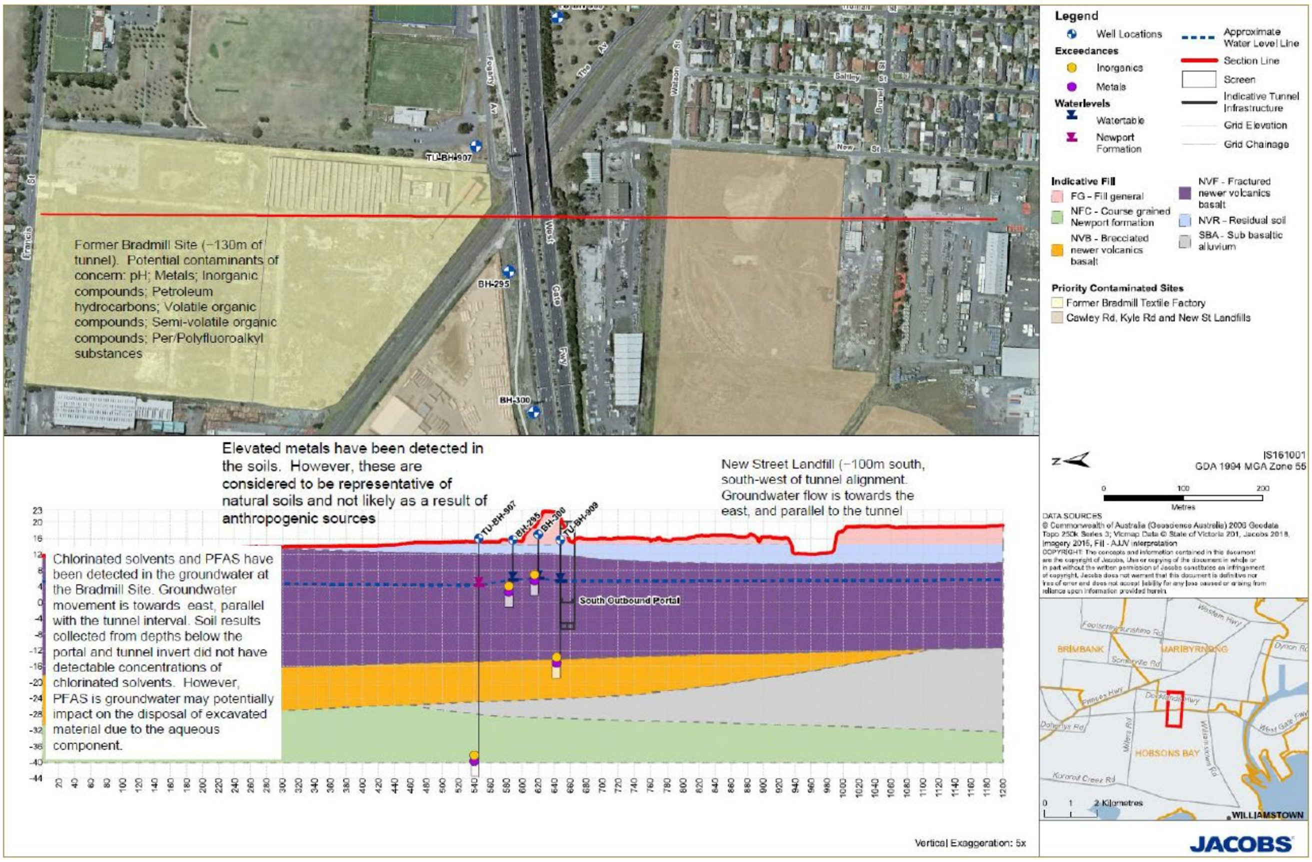


Figure 4: Conceptual site model cross section 1 – south westbound portal

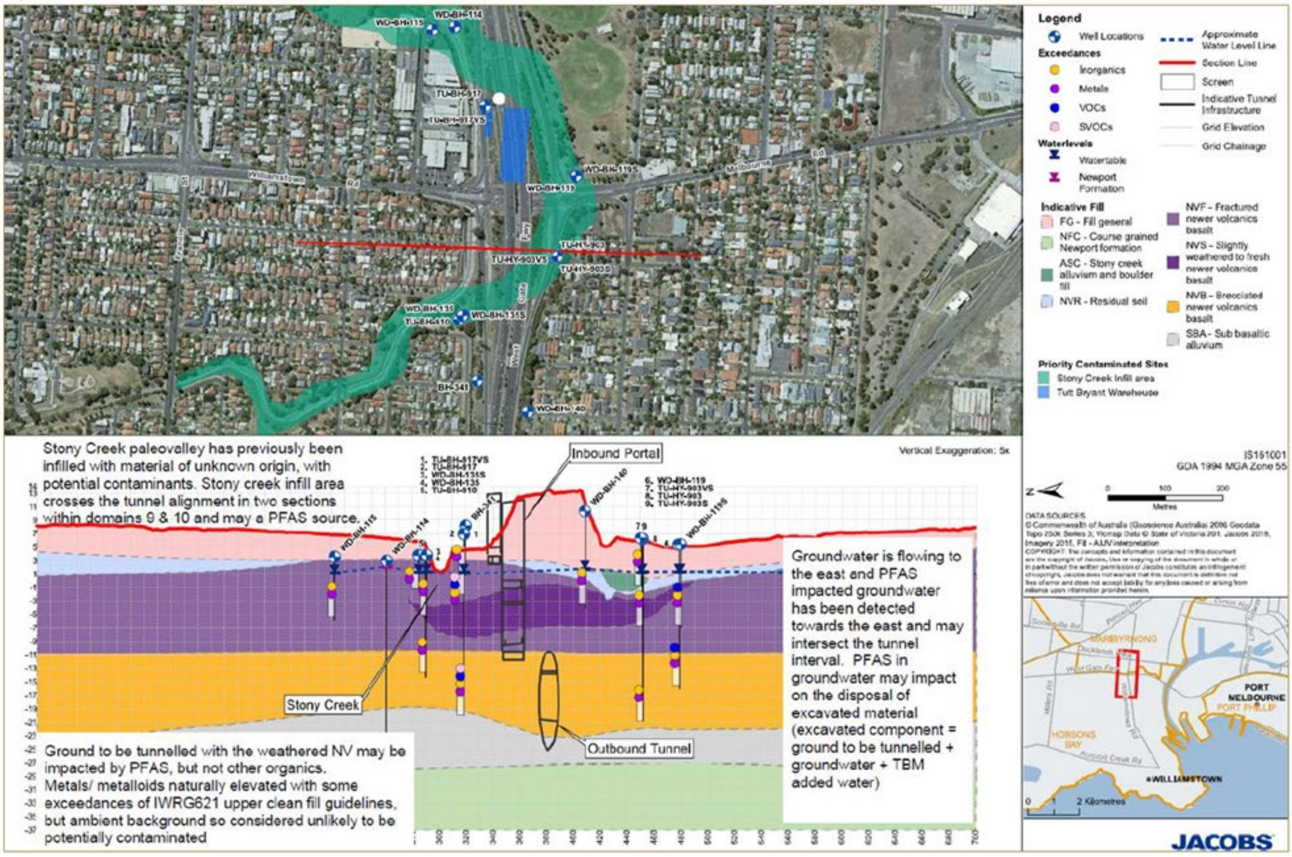


Figure 5: Conceptual site model cross section 2 – south eastbound portal

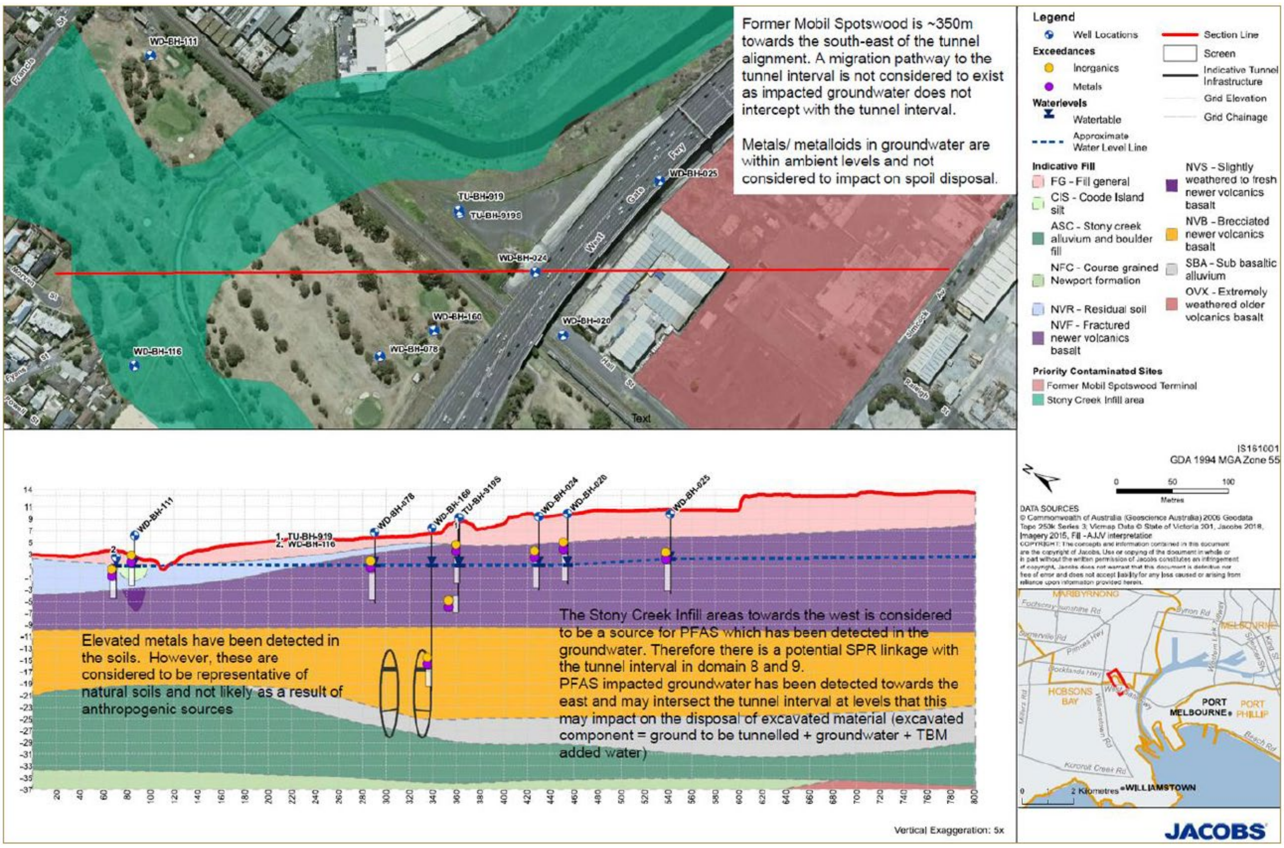


Figure 6: Conceptual site model cross section 3 – tunnels and Stony Creek

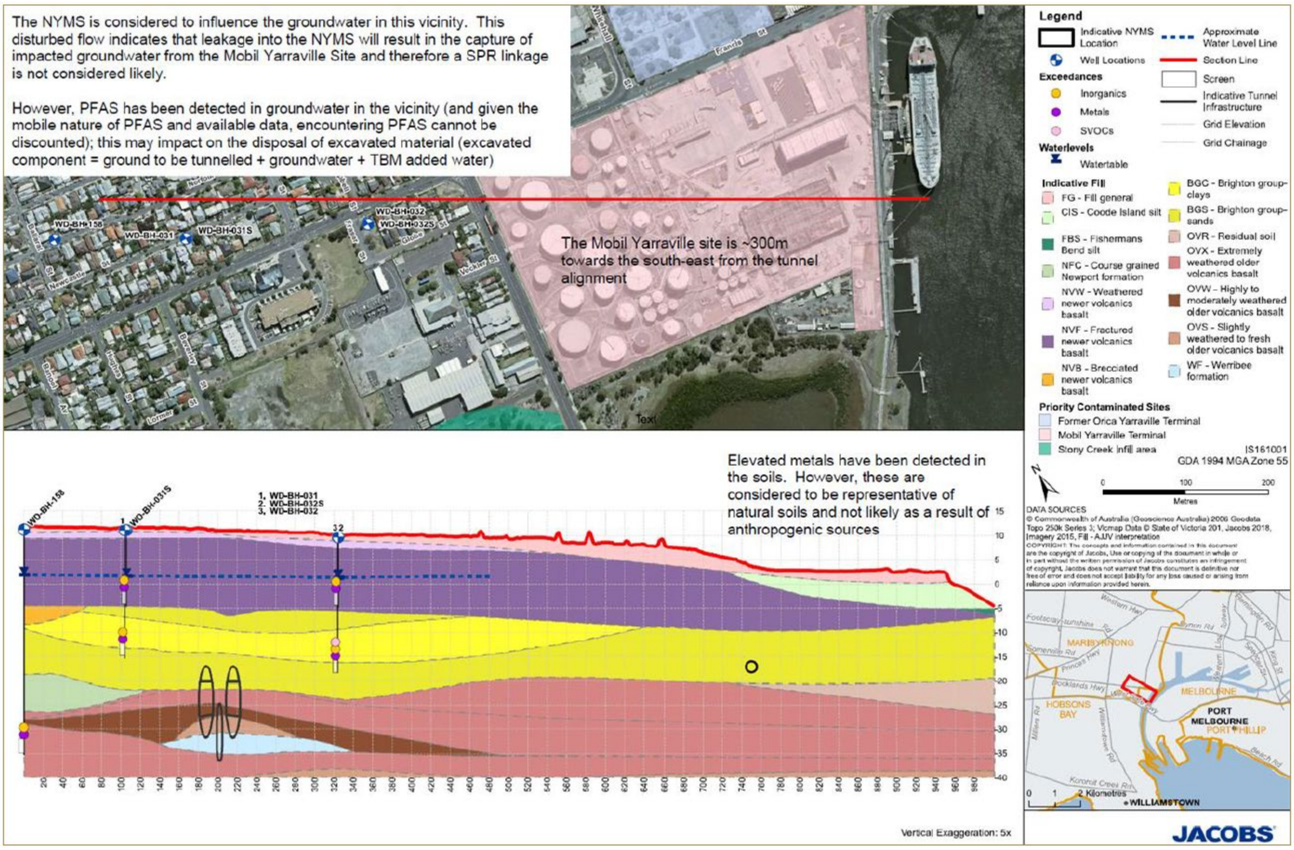


Figure 7: Conceptual site model cross section 4 – Mobil Yarraville

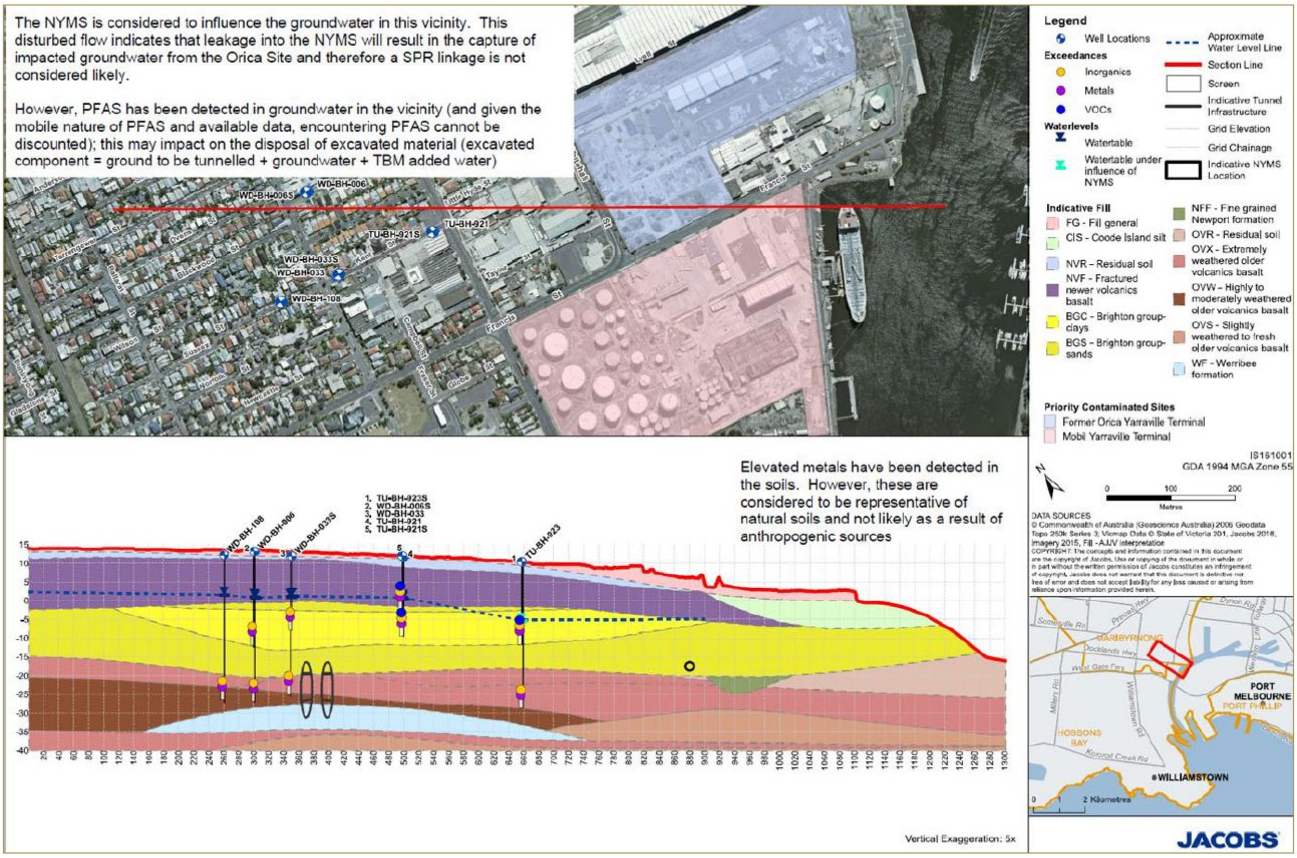


Figure 8: Conceptual site model cross section 5 – Orica site

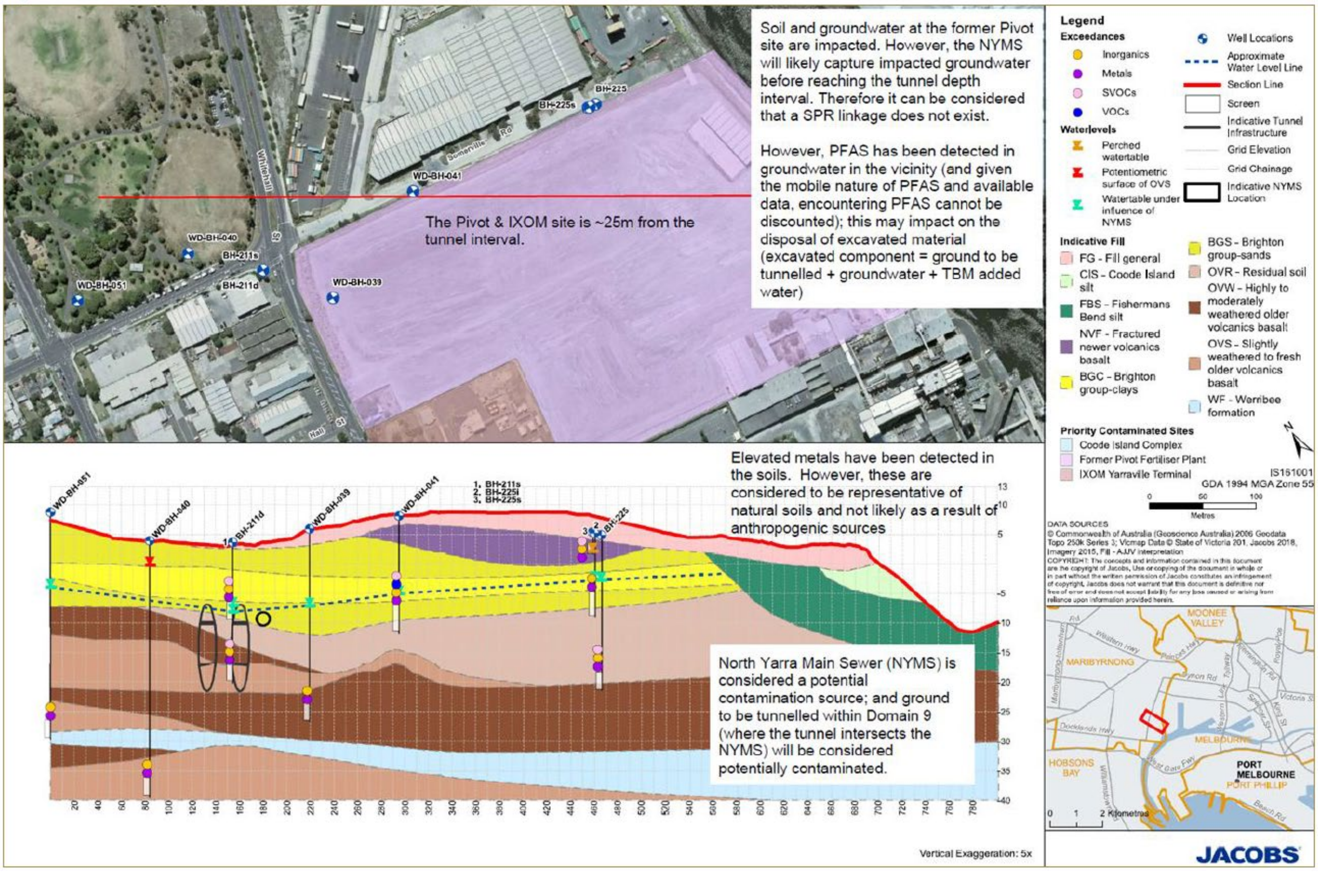


Figure 9: Conceptual site model cross section 6 – former Pivot plant

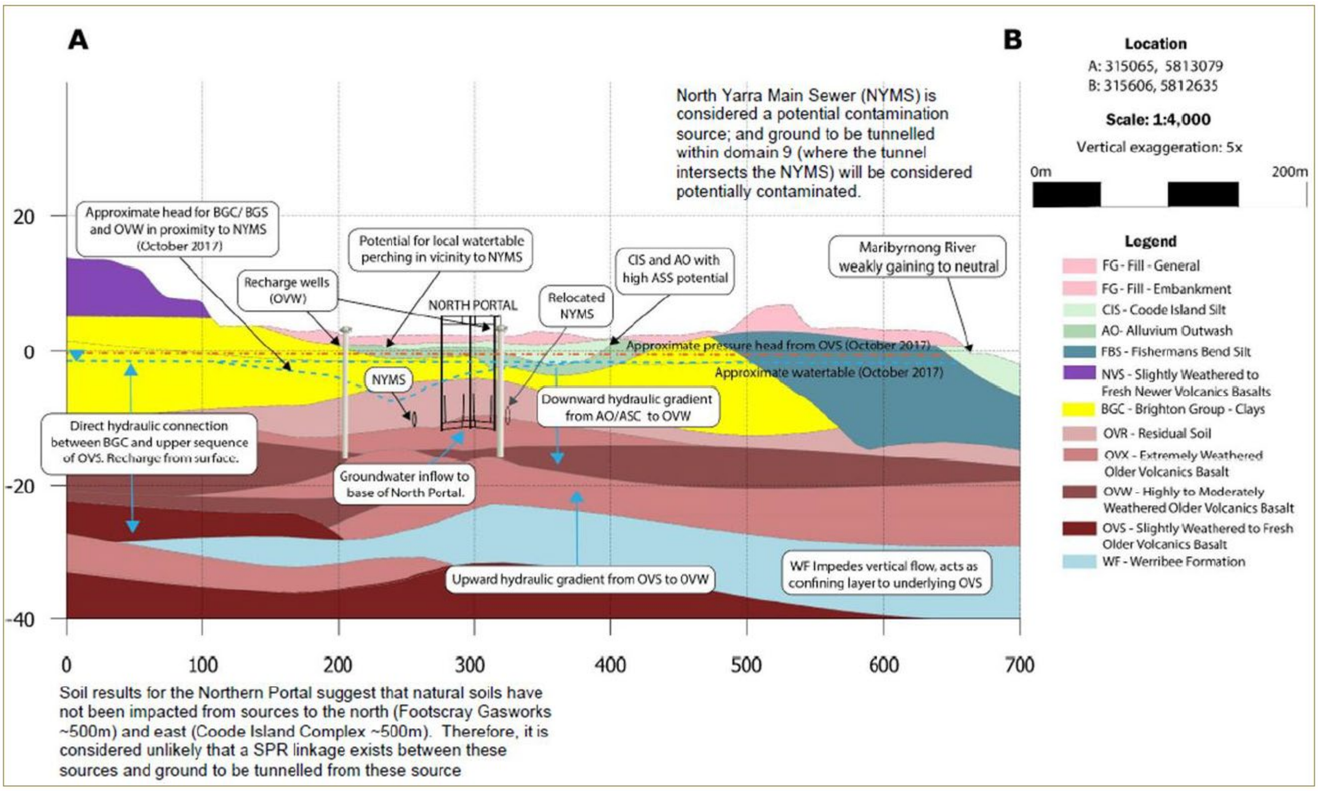


Figure 10: Conceptual site model cross section 7 – north portal

3.3.5 Tunnel alignment exceptions

The following areas have been identified as likely being an exception to the bulk of the tunnel alignment, with regards to the presence and combination of potential contaminants.

Original North Yarra Main Sewer alignment

The North Yarra Main Sewer extends for about 50 m and approximately between Tunnel Rings 83 and 115 for the outbound tunnel and between Tunnel Rings 60 and 83 inclusive for the inbound tunnel. This equates to approximately 19,100 m^3 of tunnel spoil.

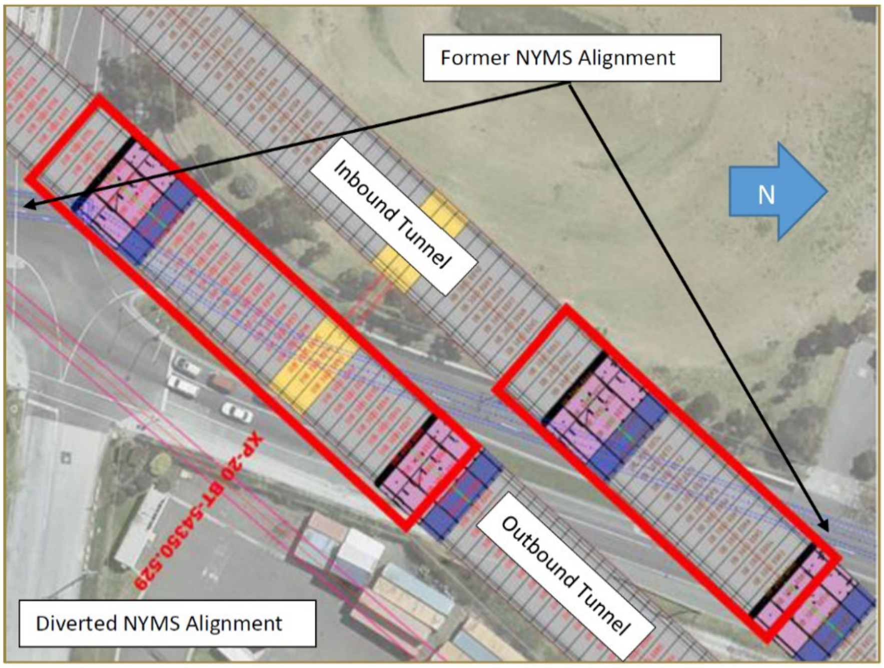


Figure 11: Exception zone of the North Yarra Main Sewer

The soil from this section of the tunnel is reported to be contaminated with old bricks, timber and the backfill grout pumped into the closed section of sewer. It is also possible that the soil could contain light non-aqueous phase liquid (NAPL), hydrocarbons, solvents, benzene, toluene, ethylbenzene and xylene, volatile organic compounds, metals and PFAS. It is unlikely that asbestos-containing material is present, based on the age of the sewer structure and its form of construction. However, the presence of asbestos-containing material cannot be discounted.

Grout blocks

The first ring (1.2 m) at the northern portal will be reinforced by a concrete pile wall. The last six rings (14.4 m) of each tunnel at the southern portals will be reinforced with cement-treated soil/rock.

Potential acid sulfate soils

A short section of the tunnel alignment intersects some of the Newport formation. Specific geological formations such as Fyansford Formation (Newport Formation), which overlies the Coode Island Silt, may contain soil/ rock which could be classified as potential acid sulfate soil. However, the proportion of the tunnel face that would encounter the Newport formation is very small. Therefore, it is likely that most of the spoil produced when the Newport formation is encountered would have extensive capacity to neutralise the acidity potential of the Newport formation materials in the spoil. However, this assertion will need to be confirmed with some testing and analysis.

3.3.6 PFAS in Groundwater

PFAS has been reported in the groundwater at concentrations ranging from below the laboratory's limits of reporting (<0.0002 micrograms per litre (µg/L)) to 9.7 µg/L across the broader project area (Figure 12). Concentrations of perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS) in groundwater have been estimated to range from <0.0002 to 0.7 µg/L along the tunnel alignment.

Groundwater results indicate an increase in concentrations to the southwest.

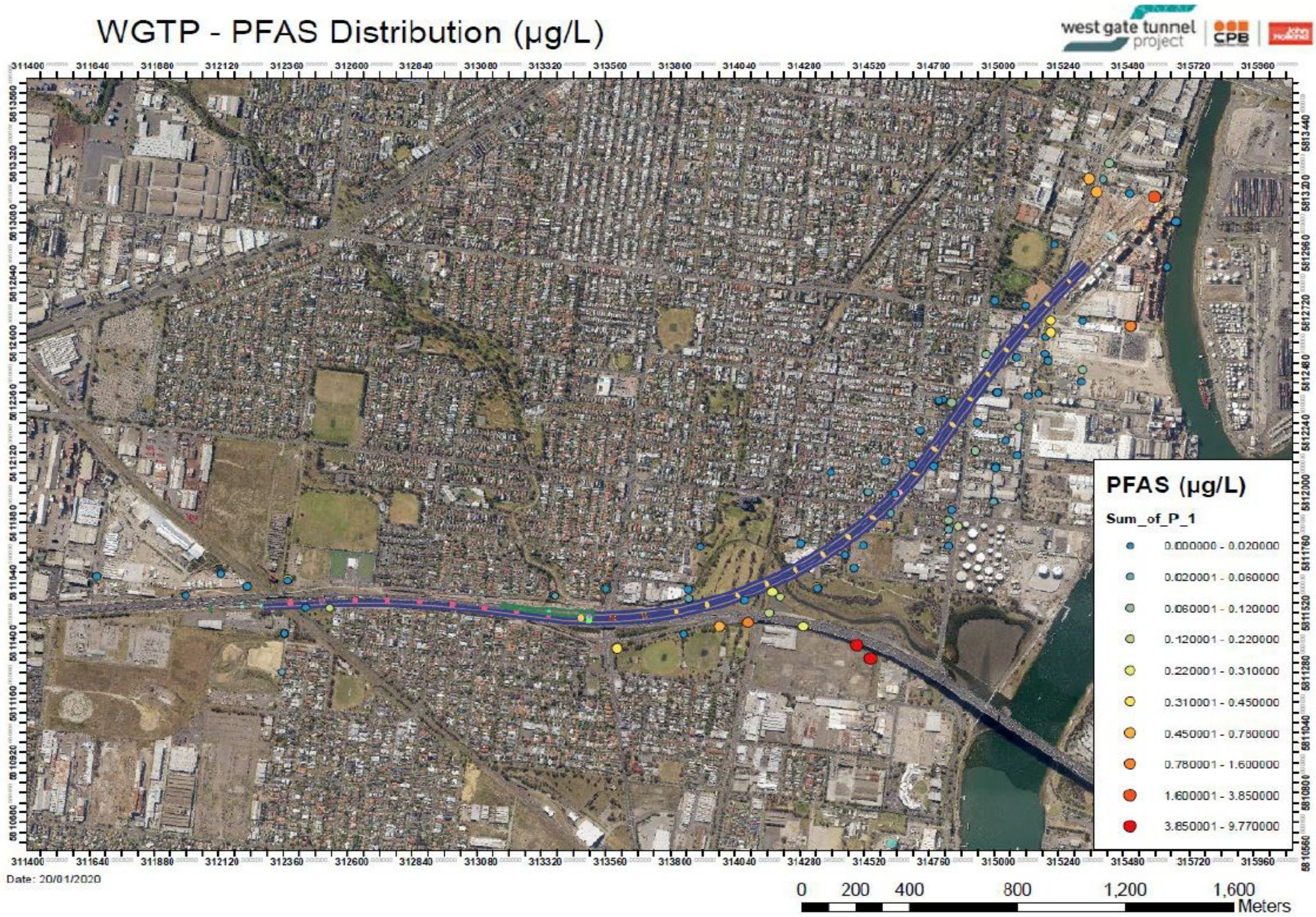


Figure 12: Map of PFAS groundwater concentrations along and adjacent to the tunnel alignment

Concentrations of PFOS and PFHxS in groundwater monitoring wells down hydraulic gradient of the tunnel alignment are up to 4.5 µg/L, however, this area will not be subject to tunnelling activities.

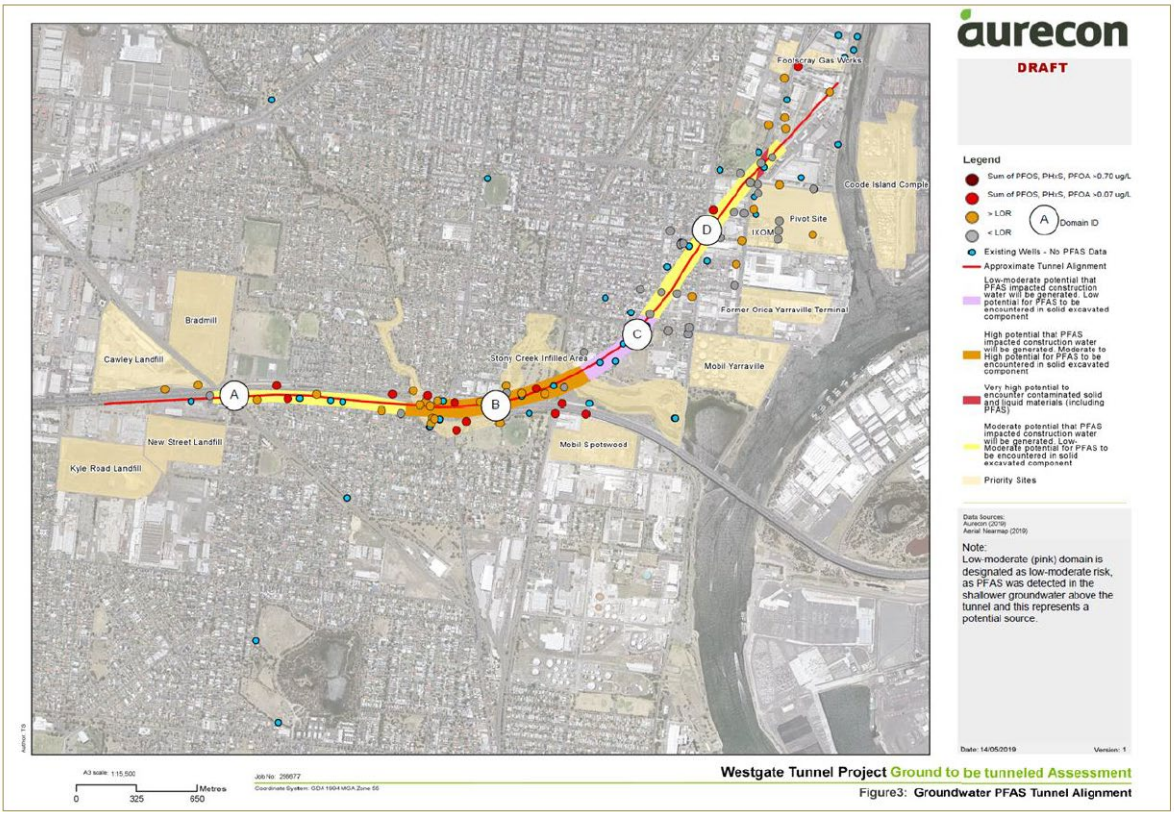
The project has divided the tunnel alignment into four domains based on expected PFAS concentrations identified in the groundwater and the potential for other contaminants, as shown in Table 1 and Figure 13.

Soil samples collected along the tunnel alignment at the depth of excavation were not analysed for PFAS compounds.

Table 1: Summary of volume of spoil in relation to each PFAS classification zone

Length	Insitu Volume (m^3) @ 191 m^3/ m	Gross Spoil Volume (m^3)	Gros Spoil Tonnes	PFAS Classification
1,010	192,910	208,857 to 247,606	414,235 to 452,999	Low-moderate potential that PFAS impacted groundwater will be generated; with a low potential for PFAS to be encountered in the solid excavated component. This is based on potential for reported detections of PFOS + PFHxS.
1,745	333,295	360,846 to 427,795	715, 683 to 782,656	High potential that PFAS impacted groundwater will be generated; with a moderate to high potential for PFAS to be encountered in the solid excavated component. This is based on potential for reported detections of 0.07 µg/L or greater for PFOS + PFHxS.
3.224	615,784	666,687 to 790,378	1,322,270 to 1446,008	Moderate potential that PFAS impacted groundwater will be generated; with a low-moderate potential for PFAS to be encountered in the solid excavated component. This is based on potential for reported detections of 0.01 µg/L or greater for PFOS + PFHxS.
100	19,100	20,679 to 24,515	41,103 to 44,851	Exception Zone Tunnel Domain 2 North Yarra Main Sewer
6,079	**1,161,089**	**1,257,069 to 1,490,294**	**2,493,200 to 2,726,515**	**TOTALS**

Note: Tab e extracted from CPB/JH JV SAQP report



Note: F gure extracted from CPB/JH JV SAQP report

Figure 13: Approximate distribution of PFAS zones along the tunnel alignment

3.3.7 Other contaminants

Samples from groundwater wells contain the following maximum concentrations of potential contaminants in the vicinity of the tunnel alignment, but not necessarily at the same depth or location of tunnelling. The results are summarised below.

Table 2: Groundwater Results Summary

Potential Contaminant	Analyte	Reported Concentration Range (µg/L)	Trigger values for Freshwater (µg/L)[1]
Petroleum Hydrocarbons	Benzene	<LOR – 120	950
	TRH (F1 fractions)	<LOR – 16,000	NE
	TRH (F2 Fractions)	<LOR – 1,800	NE
Chlorinated Solvents	1,1-dichloroethene	<LOR – 320	0.3 [2]
	1,1-dichloroethene	<LOR – 37	0.3 [2]
	1,1-dichloroethane	<LOR – 740	0.3 [2]
	1,2-dichloroethane	<LOR – 6	10 [2]
	carbon tetrachloride	<LOR – 6	3
Polycyclic Aromatic Hydrocarbons (PAH's)	naphthalene	<LOR – 23	16 [3]
	benzo(a)pyrene	<LOR – 0.73	0.01
	Total PAH's	<LOR – 680	NE
Pesticides	alpha-BHC	<LOR – 6.7	0.2
	beta-BHC	<LOR – 1.1	0.2
	chlordane	<LOR – 2	0.8
	aldrin	<LOR – 0.2	1
	endrin	<LOR – 0.2	0.02
	methoxychlor	<LOR – 110	0.005 [2]

LOR = L m ts of report ng

NE Not estab shed

1. ANZECC (2000) Austra an and New Zea and Gu de nes for Fresh and Mar ne Water.
2. ANZECC (2000) Austra an and New Zea and Gu de nes for Fresh and Mar ne Water. Low re ab ty tr gger va ue
3. ANZECC (2000) Austra an and New Zea and Gu de nes for Fresh and Mar ne Water. Moderate re ab ty tr gger va ue

The guideline values are designed to protect ambient waters from sustained exposure to contaminants.

The maximum values recorded are typically from isolated locations and not representative of the groundwater more broadly. Concentrations of potential contaminants are typically report at or below the laboratory's limits of reporting.

The tunnelling method introduces freshwater and pressurised air at the cutting head, which may prevent groundwater ingress. Therefore, there is likely to be a degree of reduction in potential contaminants within the spoil water. The wastewater generated from the spoil at the Pivot site will be treated through an onsite treatment system prior to discharge to sewer under a trade waste agreement.

Foaming agent species protection. Concentrations were reported below the laboratory's limits of reporting for the chemicals listed.

4. Cleanaway Environment Management Plan

4.1 Spoil management proposal

The WGTP TBM is anticipated to generate an average of 5,900 m^3/day (8,400 tonnes/day), with a peak operation period which will produce approximately 7,600 m^3/day (11,000 tonne/day). Peak truck movements of spoil are expected to be up to 360 trucks per day (15 per hour).

The spoil will be delivered from the TBM onto its conveyor for transport to a purpose-built soil handling facility located at the former Pivot site, at Whitehall St, Yarraville. From the Pivot site the soil will be loaded into trucks and potentially taken to Cleanaway's proposed Spoil Management and Reuse Facility (SMRF), where they propose to store and categorise the spoil at its site located at 227 Riding Boundary Road, part 304 Riding Boundary Road, part 714 and 1198 Christies Road, Ravenhall, part Christies Road and part Middle Road, Truganina in the Ravenhall Industrial Precinct.

Spoil will be held in one 34 holding pens for a maximum of 21 days until the soil is categorised. Categorised spoil will either be deposited in a containment cell at the Site, be reused within the SMRF or Melbourne Regional Landfill (MRL) or be transported for either treatment or disposal at an appropriate facility.

The classification issued to the waste producer provides that:

The waste must be transported to premises for which the occupier holds an environment management plan approved by the Authority under the *Environment Protection (Management of Tunnel Boring Machine Spoil) Regulations 2020* for the containment of tunnel boring machine spoil.

Paragraph 6 of the Classification sets out the management options for the waste.

4.2 Spoil storage

From the Pivot site the spoil will be loaded into trucks and transported to the Site into holding pads where it will be sampled for categorisation. The volume held in each pad is expected to not exceed [redacted]³. Some draining and drying will have occurred since the spoil was produced by the TBM. There will be one set of pads for each tunnel.

At the Site, spoil will be stored in pads for up to [redacted] while awaiting categorisation for containment on-site or disposal. During this period, the spoil will release water and partially dry.

4.3 Soil sampling regime

4.3.1 Sampling at the source

Details of the primary spoil sampling requirements are documented in the SAQP prepared by CPBJH JV. In a 24-hour period, there will be six occasions when excavators pause, and soil can be sampled at the Pivot site. At this time, their buckets can be lowered onto the ground and made accessible for safe sampling. This will provide per tunnel a minimum of 12 primary samples plus 2 or 3 duplicate and 2 or 3 triplicate samples. Average daily production is 5,800 to 7,600 loose cubic metres (LCM). This equates to 1 sample per 240 LCM for average production and 1 per 315 LCM for peak production rates.

For anomalous spoil or spoil from exception zones that needs to attain the 1 sample per 250 m^3 sampling rate using primary samples no additional samples are required at average production rates and 3 additional samples are required at peak production rates.

Sampling is proposed to be undertaken by suitably qualified consultants appointed by the duty holder.

4.3.2 Sampling at Cleanaway

Soil volumes greater than 2,500 m^3 require sampling at a density of one sample per 250 m^3. For homogeneous material, the SAQP indicates that sampling at that rate may not be required.

Consistent with EPA publication IWRG 702, the SAQP preferentially employs the 95 per cent upper confidence interval plus arithmetic level mean concentration (contracted to '95 per cent upper confidence limit $(UCL)_{average}$' or 'UCL95', where UCL represents upper confidence limit) as a measure of central tendency in chemical test data comparison with the soil acceptance criteria or waste categorisation criteria.

The field pH will be compared with EPA Publication *Acid Sulfate Soil and Rock* (publication 655.1).

Cleanaway propose to undertake additional sampling above what is proposed in the SAQP. Further soil samples are proposed to be analysed for of the full suite of EPA publication IWRG 621 parameters at a ratio of one sample per TBM per day. In the event the initial sampling identifies concentrations of potential contaminants above the upper limit of fill material, then a second round of sampling is proposed to be undertaken. The second round increases the sampling frequency for the chemicals exceeding the upper limit for field material and any parameter that has a concentration higher than 80 per cent of the fill material threshold. The EMP clearly defines the responsibilities between the two parties with regards to what is sampled and when.

In addition, quality control samples will be collected at a frequency of 1 in 20, which is consistent with best practice.

4.3.3 Spoil water sampling locations and frequency

Water derived from spoil will be sampled from the lowest point in each filled holding pad's drainage system, between 7 and 14 days after filling, in accordance with the SAQP.

EPA considered that the sampling and analysis approach taken by the project is appropriate. The statistical analysis approach presented is based on comparing the confidence intervals to waste thresholds.

Spoil water will also be sampled following treatment to ensure it meets the reuse criteria. Section 5.3 of the monitoring program provides details of the treated water pond sampling.

4.3.4 Spoil from exception zones

There are three exception zones. Spoil derived from these zones requires specific sampling and analysis.

- Exception zone 1: Potential contaminants from the former North Yarra Main Sewer.
- Exception zone 2: Cement grout from the portal grout blocks.
- Exception zone 3: Potential ASS from the Fyansford Formation (in Domains 7 and 8).

Anomalous spoil will be segregated and managed separately. The anomalous spoil will initially be assessed to determine if the material requires further processing or treatment to enable disposal at MSPF or alternatively disposal off-site to a suitably licensed facility.

Spoil from the identified zone of exception or that has spoil with visual/odour indicators of contamination observed during loading or delivery will require analysis for EPA publication IWRG 621 full screen suite.

Potential acid sulfate soils (PASS) will be sampled and assessed to determine if the soil has the potential be waste acid sulfate soils (WASS). If WASS is indicated, then it will be managed by application of lime. WASS or PASS will be spread in [redacted] lifts with lime applied at the rate required to neutralise any acid generation.

EPA conclusions

- The maximum leachable PFOS PFHxS (perfluorooctanesulfonic acid and perfluorohexane sulfonic acid) concentration in spoil is likely to be approximately 0.7 micrograms per litre (µg/L), based on the groundwater data provided.
- The total and leachable concentrations of PFAS will be measured in samples of spoil taken from the holding pad/s. The concentrations of PFAS in water that drains from the soil may differ significantly from those in in-situ groundwater or in the water in the spoil immediately after production of spoil from the tunnel boring activities.
- Overall, the total mass of dissolved and adsorbed PFAS per unit bulk volume of spoil and spoil water placed in the containment cell should be lower than the equivalent mass within the soil and groundwater prior to excavation, due to the drainage of the liquid component that would have occurred.

4.3.5 PFAS testing regime

The total and leachable concentrations of PFAS will be measured in samples of spoil taken from the holding pads. The concentrations of PFAS in water that drains from the spoil may differ significantly from those in situ groundwater or in the water in the spoil immediately after production in the TBM.

Overall, the total mass of dissolved and adsorbed PFAS per unit bulk volume of spoil and spoil water placed in the holding pad should be lower than that in the produced spoil, due to the drainage that would have occurred.

Spoil from all domains will be analysed for total and leachable concentrations of all PFAS analytes, referred to as PFOS, PFHxS and PFOA. The reference procedure is in AS 4439.3 – 1997, with US EPA Method EPA- 821-R-11-007 for the solid component and US EPA 537 for the liquid component. PFOS/PFHxS and PFOA testing will be undertaken using the method described in Table 16 of the SAQP.

Testing regime:

- First 10 pads of spoil from each geologic domain – all samples (plus QC samples) are to be tested.
- If trends in the maximum data values from each of these 10 pads indicate that results are trending at <75 per cent of the soil acceptance criteria, then testing is reduced to two primary samples plus 2 duplicate and 2 triplicate samples per 2,500 to 3,500 m3 per pad (minimum testing regime).
- Subsequently, as each next pad is filled, trends over the previous 10 pads will continue to be monitored.

To provide greater confidence in the reproducibility of results, blind replicates, split samples and rinsate blanks shall be collected at a rate of at least one for every ten primary samples.

Appropriate numbers of quality control (QC) samples as outlined in Table 4 of AS 4482.1-2005 (Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds) are required to be taken from the site of origin.

4.3.6 Assumptions

The waste categorisation will be based on what was measured in the samples taken from the spoil when placed in the holding pad. The true leachable concentrations are likely to be lower than these values.

It is assumed that that the maximum PFAS concentrations in the tunnel spoil are likely to be less than those in the groundwater. At such concentration, PFAS contained in spoil does not pose an unreasonable risk to the environment when contained as per the proposed method.

By the time spoil is placed in the containment cell, the total and leachable concentrations may have changed from what were measured in the samples taken from the spoil when placed in the holding pad.

The tunnel is unlikely to be contaminated with anthropogenic contaminants other than PFAS. The exception to this is spoil from Domain 1, 2 and 3. Therefore, the containment or disposal of spoil from other domains may be determined by its total and leachable PFAS concentrations.

4.4 TBM spoil deposition

Following, and depending on, the final spoil categorisation results, TBM spoil may be deposited into a containment cell at the Site. For the purposes of assessment, this containment cell has been compared to and considered in accordance with EPA Publication 788.3 (Siting, design, operation and rehabilitation of landfills).

4.4.1 PFAS thresholds for containment cell

All other waste management options have been evaluated before off-site containment of low level PFAS contaminated spoil was considered. The containment cell is to be lined and capped with a composite liner designed in accordance with a Type 2 landfill in EPA Publication 788.3. The assessment of the suitability of the containment cell is further discussed below.

EPA has determined that the threshold criteria for PFAS should primarily be based on the leachability criteria rather than total mass concentrations. The mobility of PFAS is related to how leachable it is compared with what the total mass may be in the soil. However, the total concentrations of PFOS PFHxS and PFOA in spoil entering the cell will not exceed human health-based guidance values applicable to industrial/commercial land use application of spoil (for example, PFOS PFHxS <20 mg/kg; PFOA <50 mg/kg).

The following table summarises thresholds for containment of TBMS containing PFAS, and the waste fitting the criteria outlined in Table 3 may only be reused within the containment cells.

Table 3: Site specific PFAS trigger levels for the containment areas

	Acceptance criteria (ASLP leachable concentration)		Sum of PFOS + PFHxS and PFOA (mg/kg)
	PFOS + PFHxS (µg/L)	PFOA (µg/L)	
SMRF Containment	[redacted]	[redacted]	[redacted]

The above leachable criteria of [redacted] for PFOS PFHxS and [redacted] for PFOA were deemed appropriate due to the following reasons:

- The proposed cells will not be located on a vulnerable groundwater system.

- Performance of landfill liner and leachate management system.
- Leachate management procedure.
- Treatment of leachate prior to release or reuse on-site.

Further assessment and consideration of these values are provided in section 6.2, below.

EPA conclusions

- PFOS PFHxS (perfluorooctanesulfonic acid and perfluorohexane sulfonic acid) have been identified as the main PFAS compounds likely to be present. The leachable concentrations in spoil are likely to range between below laboratory detection (<0.01 µg/L) up to approximately 0.7 micrograms per litre (µg/L), based on the groundwater data provided.
- PFOA (perfluorooctanoic acid) has also been considered due to its potential presence.
- Based on the design, the site-specific risk assessment, and nationally accepted criteria, Cleanaway proposes a containment cell leachability acceptance criteria of [redacted] PFOS PFHxS and [redacted] PFOA.

4.4.2 Soil categories A, B and C

Only the following soil categories will be allowed to be in the containment cell without further evaluation:

- Soils that are not contaminated with manufactured chemicals other than PFAS (below the acceptance criteria concentrations).
- Excavated natural material that meets EPA publication IWRG 621 Fill material criteria except for naturally elevated elements.
- Soil that does not contain sulfidic natural material.

Each pad will be provided with a categorisation and disposed of as follows:

- If pad result is < IWRG621 fill material criteria, then spoil is categorised as suitable to be placed in the containment cell.
- If pad result is > IWRG621 fill material criteria, and < IWRG621 Category C upper thresholds, and is < IWRG621 Category C PFAS disposal classification limits, then spoil is categorised as Category C and placed in Cleanaway's Category C cell.
- If pad results are categorised as Category B, then the spoil will be transported to an appropriate Category B landfill for deposition to an appropriate cell under a separate Classification.
- If pad results are categorised as Category A PFAS, then the spoil will be transported to an appropriately licensed thermal treatment facility for destruction.
- Potential Category C PIW from North Yarra Main Sewer and the grout blocks will be processed at Cleanaway's licensed facility.
- In the event that the North Yarra Main Sewer and the grout blocks material is identified as Category B or A PIW, the material must only go to a facility licensed to receive such waste.

EPA conclusions

The proposed spoil categorisation and disposal management procedure are considered appropriate, and in compliance with the relevant subordinate legislation and the guidelines.

4.4.3 Reuse of soils

The EMP proposes off-site reuse pathways for the management of spoil received by Cleanaway. For reuse to occur analysis of the spoil must demonstrate that concentrations of all potential contaminants are below the upper limit for fill material, as per EPA publication IWRG 621 and below the PFAS reuse thresholds presented in EPA's publication 1669.4. In addition, reuse of material in the licensed area must be in accordance with the EPA licence for the area. Use of soils for scenarios such as cell construction, capping or daily cover must also be undertaken in accordance with the site's licence and works approval conditions. The proposed activity may constitute deposition of industrial waste at sites not licensed to receive industrial waste.

Under s27A(2) of the EP Act, it is an offence to deposit industrial waste at unlicensed sites. The sampling and analysis program, as outlined in the classification, is not appropriate for immediate reuse of spoil at offsite locations. However, it is noted that additional testing is proposed by the applicant to confirm the presence or absence of other potential contaminants.

4.5 Spoil

EPA will use the following as the basis for assessing sampling procedures:

- EPA's Industrial Waste Resource Guidelines, 2009 – *Sampling and Analysis of Waters, Soils and Waste* (publication IWRG701)
- EPA's *Industrial Waste Resource Guidelines*, 2009, *Soil Sampling* (publication IWRG702)
- Any other relevant methods or guidelines approved by the Authority.

Average daily production per tunnel is approximately 5,900 m^3, and peak average production is about 7,600 m^3 in total across the two tunnels. A base level of sampling would occur at the Pivot site. In a 24-hour period there will be six occasions when excavators pause. Safe sampling would occur during this time. This will provide a minimum of 12 primary samples plus 2 or 3 duplicates and 2 or 3 triplicates. This equates to 1 sample per 180–240 LCM.

Cleanaway's proposed works will involve additional sampling of the soil to enable segregation and processing the spoil so that the appropriate management options can be decided (that is, reuse, containment or disposal in a licensed facility). As such, the proposed works will effectively reduce the material going to landfills for disposal.

The deposition of spoil material in the cell will occur in a series of progressive lifts to raise the level of the land, commensurate with the surrounding topography. This assessment considers the first lift and the capping of the cell.

The SAQP document reference procedure for total PFAS concentration in soil is US EPA Method EPA-821-R-11-007.

4.6 Leachate

Water that drains from the spoil in the holding pads, and leachate that drains from the spoil when placed in the containment cell, will be directed to the settlement ponds to remove suspended solids before being treated in the onsite water treatment plant to remove PFAS compounds to a concentration of [redacted] or lower. Spent filter and adsorption media will be thermally treated to destroy PFAS.

EPA considers that leachate criteria will be protective of groundwater and surface water quality and aquatic ecosystems at the site of containment, and protective of sensitive receptors and environmental values. This is because a [redacted] will be constructed for spoil containment, leachate can be effectively drained from the spoil and then extracted from the cells and all extracted leachate will be treated for PFAS. The lining system is specified as suitable to contain category C prescribed industrial waste (PIW) in BPEM, as such will be suitable to contain any such PIW should it arise from the zones of exception along the tunnel alignment.

Supporting the leachate management strategy for the Site is a water balance calculation that include appropriate meteorological data and conservative assumptions regarding spoil water and leachate generation volumes and evaporation rates.

The water balance indicates [redacted] is required with the proposed treatment plant capable of [redacted] with [redacted] also proposed to be provided in the spoil water holding pond. The calculations appear appropriately conservative as they do not take into account reuse of treated water, the capacity of the treated water pond or the ability to discharge water to a licensed facility. These additional elements would mean that capacity of the spoil water holding pond would unlikely be reached.

The treated water monitoring program is summarised in the EMP. Laboratory parameters include pH, dissolved oxygen, electrical conductivity, total suspended solids, PFOS, PFHxS and PFOA.

The frequency of leachate sampling is outlined in the monitoring program (Appendix C) and is deemed appropriate.

4.7 Groundwater

On a regional scale, groundwater flows towards Port Phillip Bay. Groundwater in the area is within Segment C as defined in SEPP (Waters), and this based on average concentrations of salinity and Total Dissolved Solids across the Site. Groundwater discharges into surface environments to the south and southeast.

Long-term undisturbed groundwater fluctuations in groundwater elevations been determined by Senversa by using highest groundwater levels in wells MB03, MB04 and MB11 which are located closest to the proposed SMRF.

It is proposed to place tunnel spoil 2 m above the groundwater contours as shown in Figure 8 of the EMP. This will enable to achieve a 2 m separation between waste and the long-term undisturbed groundwater level in compliance with the Landfill WMP.

EPA conclusions

- The placement of PFAS-impacted spoil and wastewater are considered to be appropriately controlled, and hence, the potential impacts on groundwater and surface water are mitigated.

4.8 Surface water

Stormwater will be diverted away from the holding pens using a surface drainage system. Being located in the floor of a quarry, most of rain that falls onto the Site is captured within the quarry and used various ways.

The natural surface water flow in the area is in a north to south direction. Skeleton Creek is approximately 1.2 km south of the Site. It was considered that given the distance to the Creek, surface water is unlikely to be discharged into the tributary of Skelton Creek. The regional importance of Skeleton Creek is rated by MW as low.

Prior to commencement of SMRF operations, baseline surface water conditions of Skeleton Creek, Leakes Road Wetland and Laverton Creek are to be monitored. The EMP provides details of the proposed analytical and field parameters and the frequency of monitoring program.

EPA conclusions

- If surface water infiltration is mitigated as per the engineered elements of the SMRF, it is likely that migration of contaminants to sensitive receptors will be controlled, and the downstream users will not be affected. The monitoring program will detect issues should they occur.

5. Site Description

5.1 Location and site layout

The Site is located at 227 Riding Boundary Road, part 304 Riding Boundary Road, part 714 and 1198 Christies Road, Ravenhall, part Christies Road and part Middle Road, Truganina in the Ravenhall Industrial Precinct, located west of Melbourne.

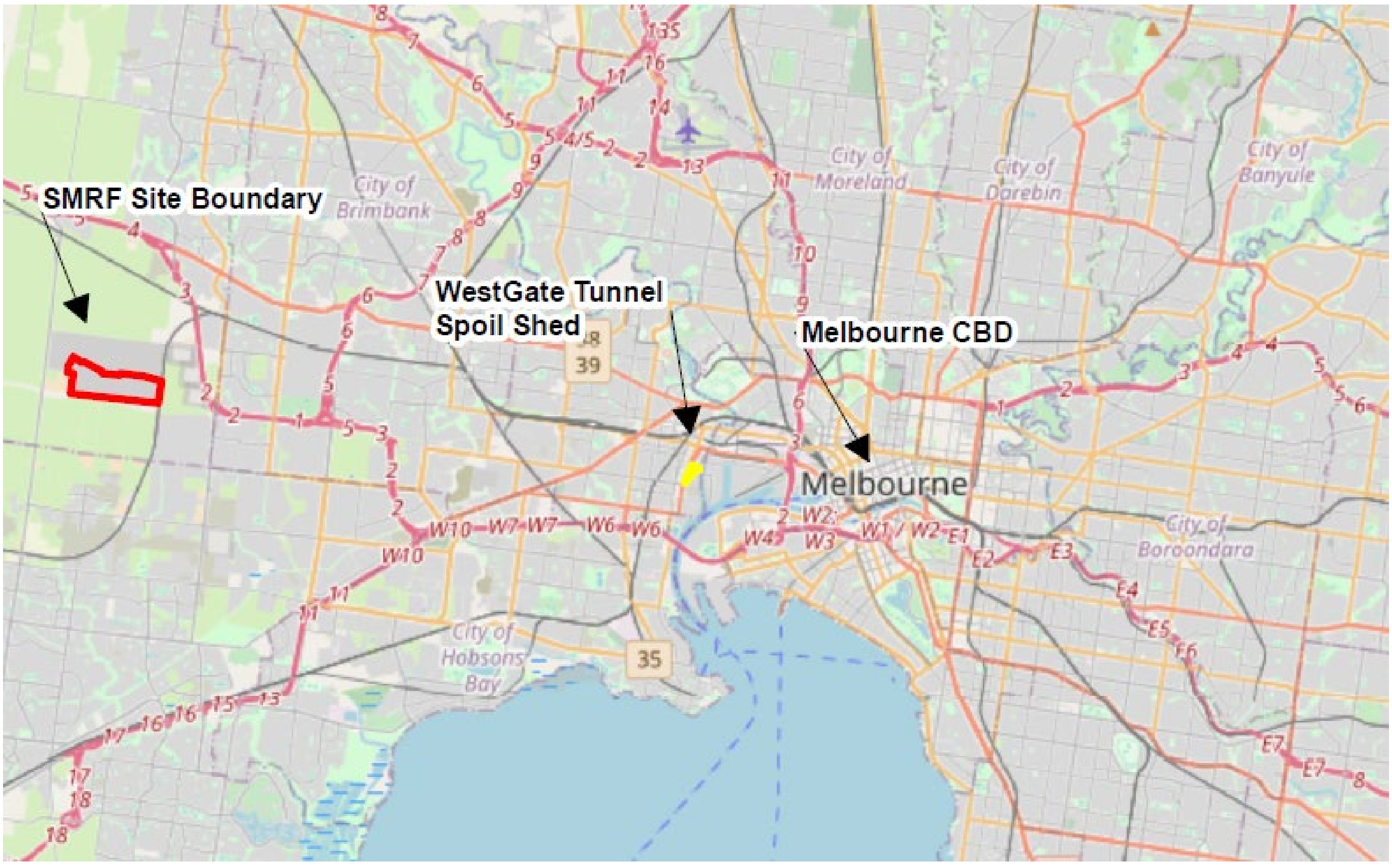


Figure 14: Site location

The proposed location and lay out of the Soil Management and Reuse Facility (SMRF) is shown in Figure 15. This includes the temporary [redacted] and holding pad area, two containment cells, sedimentation ponds, leachate holding ponds, wastewater treatment plant and treated water holding pond. The facility is adjacent to the existing Cleanaway MRL landfill and the Boral Quarry, bounded by Middle Road to the south. The surrounding land use is detailed in the Environmental Management Plan (EMP) (Table 4).

Table 4. The surrounding land uses of the SMRF, taken from the EMP.

Direction	Land use
North	• MRL licensed landfill – Stage 3 and Stage 4 putrescible waste and PIW cells defines the site to the north. • The Ravenhall precinct boundary (Melbourne to Ballarat rail line) is approximately 2.8 km from the north-west corner of the SMRF boundary. • The nearest dwelling is over 3 km from the proposed SMRF.
South	• The Ravenhall precinct boundary (Middle Road) defines the site to the south. • The nearest dwelling is over 1.7 km from the proposed SMRF.
East	• MRL licensed landfill – Stage 2 closed putrescible waste and PIW cells defines the site to the east. • The Ravenhall precinct boundary (Christies Road) is approximately 800 m the SMRF boundary. • The Metropolitan Remand Centre is approximately 1.6 km from the SMRF.
West	• The basalt quarry borders the SMRF to the west. • The Ravenhall precinct boundary (Hopkins Road) is approximately 2.5 km from the SMRF boundary. • The nearest dwelling is at 522 Middle Road. The Southern boundary of the Fast Start Holding Pens are approximately 600 m from the house and the western boundary of the Spoil Water Holding Pond is approximately 250 m from the house. The closest internal haul road to 522 Middle Road is approximately 520 m being the haul road at the eastern boundary of the Spoil Water Holding Pond.

The SMRF will occupy land that is zoned as a Special Use Zone (SUZ1). The closest residential dwelling is described in the EMP as being approximately 250 m from the western boundary of the spoil water holding ponds and 600 m from the [redacted]. These distances are greater than the minimum listed for buildings and structures for solid inert landfills, but within that for putrescible landfills in EPA Publication 788.3 (not including on-site buildings and structures). The recommended buffer distance for putrescible landfill is primarily related to issues with putrescible waste such as landfill gas, litter and odour which are not of concern with TBM spoil.

The nearest surface water feature is Skeleton Creek located to the west of the Site, which appears to be an ephemeral drainage feature in this area. The EMP notes that, based on groundwater level information, the nearest point of potential connectivity with the water table is 1.2 km south of the Site. The distance to permanent surface water features and the distance to where Skeleton Creek is likely hydraulically connected to groundwater are in excess of buffer distances in EPA Publication 788.3 (100 m to surface water), the distance proposed in the NEMP for spoil reuse (200 m) and the distance to surface water discussed for landfills receiving PFAS waste in NEMP (1000 m).

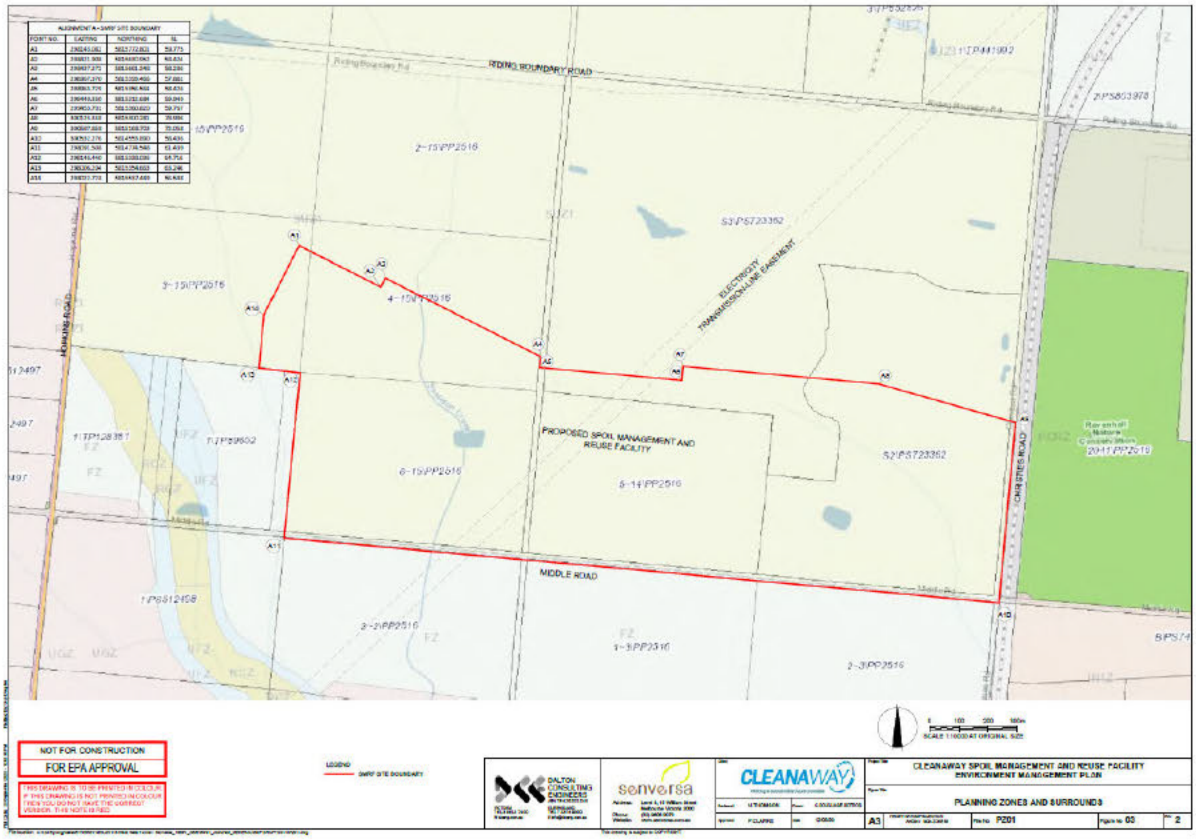


Figure 15. Location and planning zones of the proposed spoil processing facility at MRL Cleanaway.

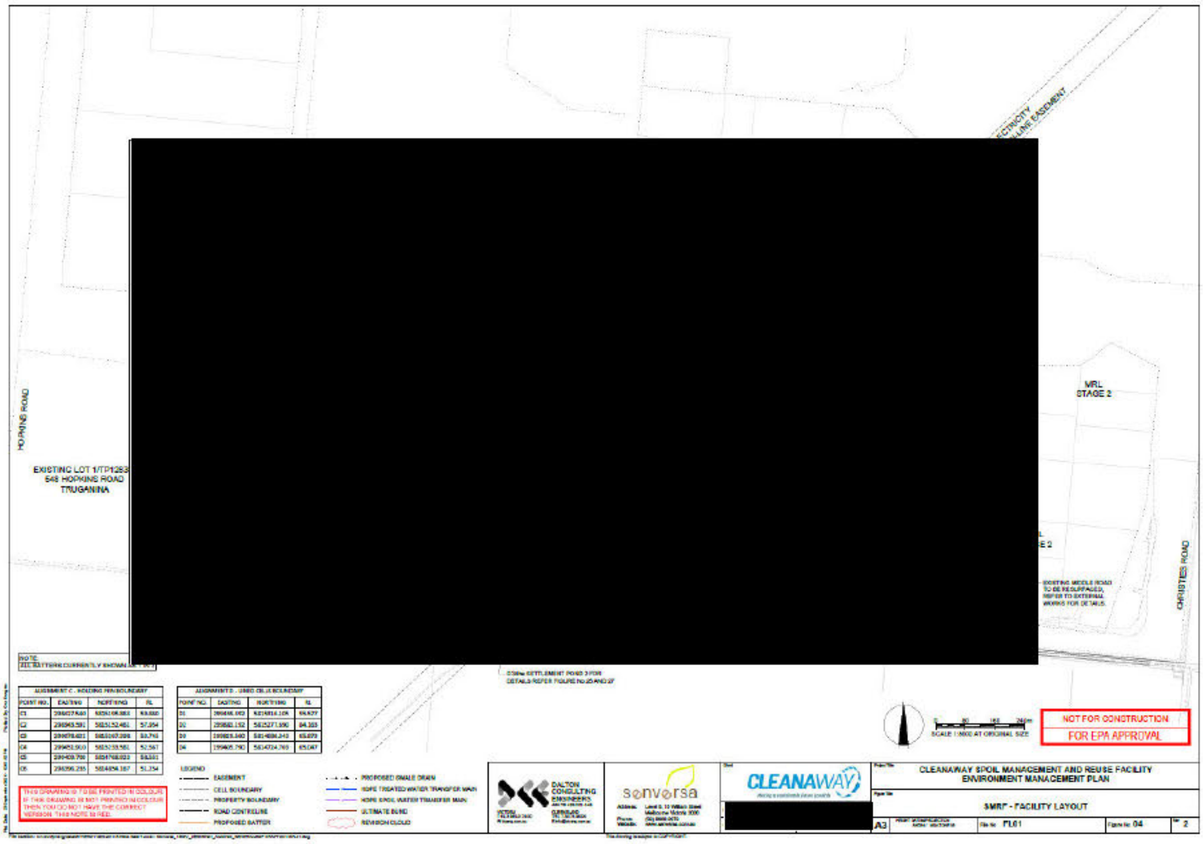


Figure 16. Plan and layout of the proposed spoil processing facility at MRL Cleanaway.

5.2 Topography

The Site topography is detailed in the EMP and is located in an area generally sloping to the south, towards Port Phillip Bay. The Site is an existing quarry and the proposed SMRF will be located within the quarry void at the Site (base at approximately 52 m AHD), below natural ground level (62-64 m AHD). The proposed infrastructure at the Site will be raised up from the base of the quarry by approximately [redacted] for the holding pens and haul roads. The existing landfill cells to the east and north of the proposed SMRF containment cells, rise to 95 m AHD in the east and 73 m in the north.

The proposed infrastructure does not appear to be included in areas prone to flooding. It is not included in the floodway overlay of the VicPlan planning mapping tool. In addition, the location of the SMRF in the quarry means that all stormwater is contained within the quarry void and cannot drain off-site via the surface. Stormwater is proposed to be allowed to infiltrate or evaporate as is the current practice at the landfill. The raised nature of the spoil containment infrastructure means that stormwater is effectively separated from spoil, limiting the generation of leachate and preventing the contamination of stormwater.

5.3 Geology

The Site geology is described in the EMP (see Figure 16 for geological cross section), from shallowest to deepest, as follow:

- Quaternary-aged Newer Volcanics consisting at least four flows of fresh to moderately weathered olivine basalt, intermittently separated by fossilised soil layers (paleosols) and scoria. Drilling in 2005 by Lane Consulting (2005), indicated that the Newer Volcanics are 56 m thick in the southeast corner of the Site.
- Tertiary-aged Brighton Group sediments comprising non-marine sands and clays. A bore drilled at the southeast corner of MRL indicated Brighton Group sediments occurring between 56 m and 70 m depth below ground level (m bgl).
- Tertiary-aged Fyansford Formation sediments consisting of clay, ligneous clays and sandy clay. The Fyansford Formation sediments extended from 70 m to 141 m bgl in the bore in the southeast corner of MRL.
- Tertiary-aged Werribee Formation consisting of sand, sandy and silty clay. The Werribee Formation is likely to be between 100 m and 150 m thick beneath the Site.
- Silurian-aged Melbourne Formation consisting of siltstone, mudstone, sandstone and shales, which form the bedrock of the Port Phillip area.

The quarrying of the Site has removed the basaltic clay soil profile and the uppermost basaltic flow of the Newer Volcanics is the primary quarried material at the Site. The base of the quarry is typically composed of the layers underneath this upper basaltic flow, consisting of paleosols and scoria.

The description of the geology of the Site does not indicate any underlying geology that may be unconducive to waste containment or highly erosional lithology, for example karst settings. The MRL site is used for landfilling already and has not encountered any problematic geology. The area does not appear to be seismically active and as per the recommendation in EPA Publication 788.3 is over 100 m from a fault line displaced in the Holocene period, with no neotectonic features close to the Site (https://earthquakes.ga.gov.au/).

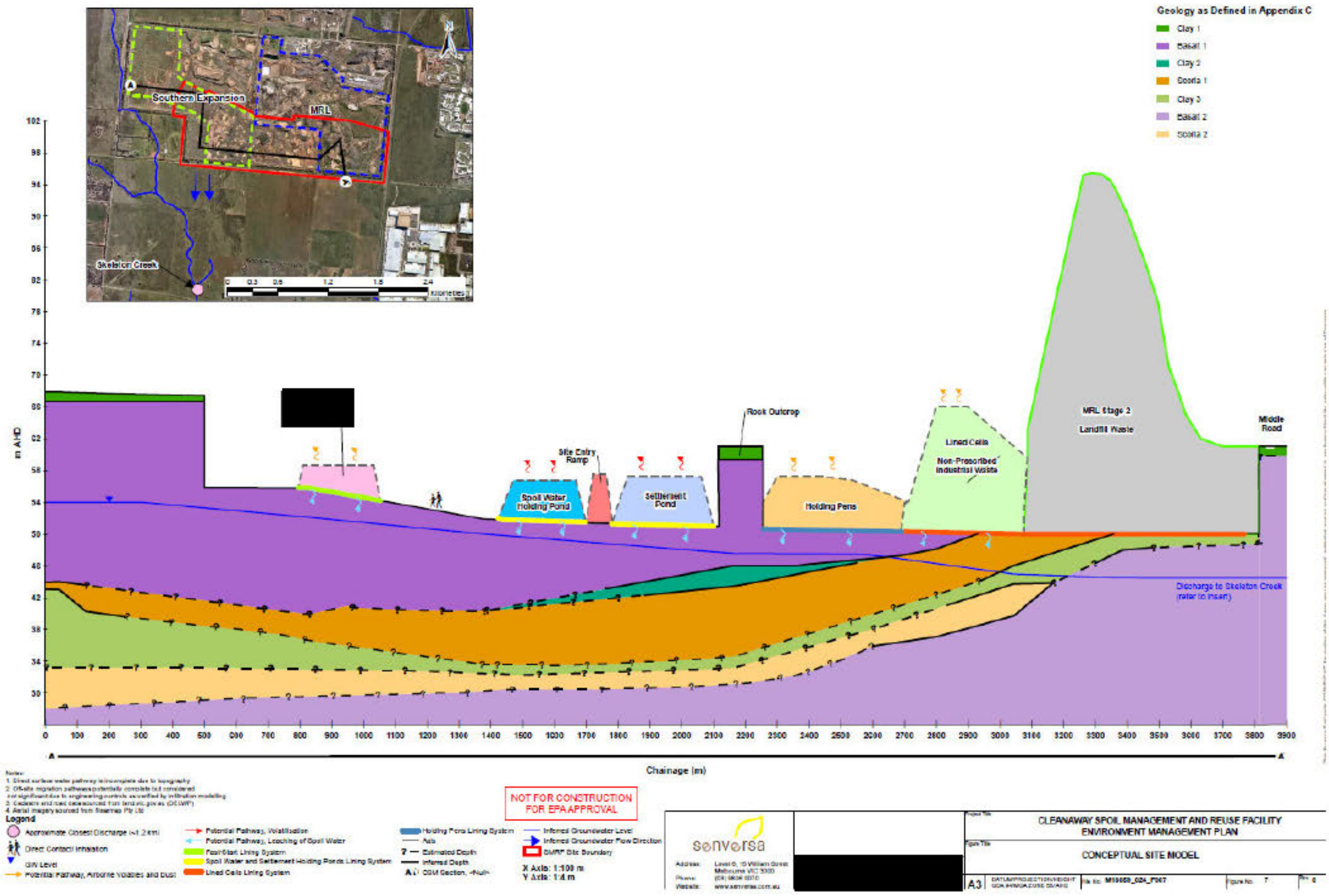


Figure 17. Geological cross section of the southern section of the MRL Cleanaway site, including proposed SMRF infrastructure.

5.4 Hydrogeology and groundwater

5.4.1 Hydrogeological setting

Two principal aquifers are identified in the EMP, the Upper Newer Volcanics Aquifer (UNVA) and the Lower Newer Volcanics Aquifer (LNVA). The former forms a water table aquifer and is recharged by rainfall infiltration. The LNVA is separated from the UNVA by a 5 m thick clay layer, which confines or semi-confines the aquifer at the Site. The primary aquifer of concern in terms of the potential for impact of seepage from containment of spoil at the Site is the second basaltic flow of the UNVA (the first being quarried at the Site).

The groundwater flow in the UNVA and LNVA aquifers is primarily via secondary porosity and the reported hydraulic conductivities in the UNVA are 0.1 m/day to 0.5 m/day and in the LNVA, 5 m/day to 10 m/day. Regional groundwater flow in this area is from the northwest to the southeast, which also appears to be the case of the UNVA from groundwater elevation data from the Site. The depth to groundwater in the UNVA, within the quarry is estimated to be 3.5 m to 5.5 m beneath the containment cells. The EMP notes that the nearest surface expression of the UNVA downgradient from the Site is likely to be where Skeleton Creek is incised down into the UNVA approximately 1.2 km to the south of the Site. Groundwater may also supply wetlands at Laverton Creek, approximately 10 km to the southeast of the SMRF.

The latest hydrogeological assessment for the MRL site, AECOM 2016, identified 45 boreholes with registered uses within 5 km of the Site covering the last 25 years. These are primarily screened within the

Newer Volcanics basalt, and the majority located to the west and northwest, upgradient of the Site, with few bores downgradient. The majority of these bores are registered for use as stock water with the remaining with mixed uses.

5.4.2 Beneficial uses

Groundwater salinity within the vicinity of the Site is reported in the EMP to range from 3,000 to 15,000 mg/L total dissolved solids (TDS). The groundwater is defined at Segment C according to SEPP (waters) and the following beneficial uses are listed as:

- water dependent ecosystems
- potable mineral water supply
- agriculture and irrigation (stock watering)
- industrial and commercial
- water-based recreation (primary contact recreation)
- traditional owner cultural values
- cultural and spiritual values
- buildings and structures
- geothermal properties.

The area is not known to have mineral spring use and thus the beneficial use "potable mineral water supply" is not realised.

5.5 Background PFAS concentrations

Background levels of potential contaminants within the aquifer are not discussed in the EMP and no existing PFAS levels are provided for the existing MRL landfill monitoring array. Baseline of PFAS concentrations would need to be established prior to any spoil being accepted at the Site. Baseline sampling and monitoring of the soil, groundwater and of the nearest off-site surface water (Skeleton Creek) are proposed to be undertaken prior to receipt of spoil.

6. Risk assessment

6.1 Conceptual Site Model

The Conceptual Site Model (CSM) (Appendix E) has identified relevant exposure scenarios for on-site and off-site sensitive receptors to PFAS-contaminated soil, dust and water. EPA has reviewed the exposure scenarios relevant to human health in the following sections.

All exposure pathways are relevant to Cleanaway personnel and contractors and it was considered that a complete source pathway receptor (SPR) linkage existed with a particular focus on:

- direct contact with spoil and water
- inhalation of dust derived from spoil
- inhalation of volatiles derived from spoil or water.

Table 5 below provides further assessment of the conceptual site model risk assessment provided.

Table 5: CSM Assessment Conclusions

Potential receptor	Potential pathways	EPA Conclusion
Off-site human users of groundwater.	Direct or indirect contact with water following extraction for protected beneficial uses.	The CSM (Appendix E) considered it unlikely that the off-site use of groundwater would be a route of PFAS exposure and risks to be negligible, due to the risk control measures in place, that is, the lining of holding pens, cells, sediment ponds and evaporation ponds. This assessment is supported by infiltration modelling provided in Appendix G and is assessed further in section 6.2. This Assessment is acceptable to EPA provided risk control measures are maintained.
Off-site human users of surface water.	Direct contact with water during recreational use. Other indirect/ bioaccumulation pathways.	The CSM (Appendix E) considered it unlikely that the off-site use of surface water would be a route of PFAS exposure and risks to be negligible, due to the risk control measures in place, that is, runoff/spoil water drainage will be captured and transferred to lined sediment and evaporation ponds, and then treated prior to discharge to reuse or discharge to a licensed facility. This Assessment is acceptable to EPA provided risk control measures provided risk control measures are maintained.
Off-site receptors to which dust might migrate.	Off-Site receptors to which dust might migrate.	The CSM (Appendix E) considered that off-site receptors may be exposed to dust from the Site, but risks are negligible, due to the risk control measures in place. Soil is also expected to remain saturated at most locations due to water content. This Assessment is acceptable to EPA provided risk control measures provided dust mitigation measures are maintained.

Potential receptor	Potential pathways	EPA Conclusion
Off-site aquatic ecological receptors (flora, fauna and other organisms in receiving surface water bodies).	Direct and indirect contact of aquatic ecological receptors (flora and fauna) with water and sediment in Skeleton Creek, at Leakes Road Wetland and at the lower reaches of Laverton Creek has be considered. Biota (fish, macroinvertebrates) are proposed to be sampled, before operations commence and if a pathway is identified post operation.	Biota (fish, aquatic invertebrates) are proposed to be sampled to obtain a baseline. If a discharge occurs that could have caused an impact to surface waters, or if PFAS concentrations increase over time in surface water at off-site locations (Skeleton Creek, Leakes Road Wetland and lower reaches of Laverton Creek), then additional biota sampling will occur.
Off-site terrestrial biota (flora, fauna, soil dwelling organisms.	None applicable	The risk assessment used livestock health as the receptor to consider this pathway. The assessment reasonably assumes an incomplete SPR linkage based on liner performance modelling.

EPA conclusions

- The CSM (Appendix E) considered the risk in relation to each of the exposure pathways listed as relevant to on-site workers and determined the risk to be low. It identified risk control measures as personal protective equipment (PPE), hygiene control measures, dust mitigation measures and the limited need for workers to have contact with water. EPA has assessed the risk as low, provided risk control measures are maintained.

6.2 Hydrogeological assessment

6.2.1 Groundwater risk assessment – containment cell, holding pads, [redacted] and spoil water holding and settlement ponds

The application seeks to establish a site-specific risk-based criterion for the acceptance of tunnel boring spoil to the containment cell in relation to the leachable PFAS concentration. Modelling is provided of PFAS transport from the spoil in the holding pens, [redacted] and containment cell or the spoil water in the settlement and storage ponds, to groundwater across various liner profiles and site specifications (Appendix D of the EMP). This is then used to inform the suitability of the liner configuration and the leachable fraction (as ASLP or leachate concentration) of contaminants that can be contained within the various spoil and spoil water containing infrastructure, without precluding the adopted beneficial use in the groundwater.

Two different approaches are taken for the groundwater risk assessment. The first is a simple dilution factor modelling approach (Tier 1), using Environment Agency (2006): Remedial Targets Methodology. This approach accounts for seepage across the liner and dilution in the receiving aquifer. It also assumes a constant source of PFAS and that a steady state has been reached. This approach was only applied to the containment cells.

A more detailed assessment was then undertaken (Tier 2) for all leachate containing infrastructure, which uses the POLLUTEv7 program to consider time dependent seepage and mixing in the underlying groundwater. The POLLUTEv7 software is a widely used program for understanding the fate and transport of contaminants across landfill liner components. The program uses a finite layer formulation to implement a one-and-a-half-dimension solution to the advection-diffusion equation, in addition to considering various retardation processes, waste characteristics, contaminant concentrations, site dimensions, leachate removal, leakage through geomembranes, liner properties, subsurface properties and aquifer properties.

For both approaches a deterministic approach was used for the various input parameters. These were informed by either literature references or site-specific specifications informed by previous work characterising the Site. For the Tier 1 assessment, to understand the impact of uncertainty, sensitivity analysis was performed on selected parameters.

The proposed conceptual model for the groundwater risk assessment considered the transport of PFAS across the liner and subgrade (via advection and diffusion), in addition to the initial dilution in the receiving aquifer. Degradation and retardation of PFAS was not considered in either Tier 1 or 2 approaches, due to the recalcitrance of PFAS in the environment and reflective of the hydrogeological setting, respectively. Although the proposed design has a relatively low separation from groundwater, it will meet the >2 m specified in EPA Publication 788.3 for landfills. This separation from groundwater is likely composed of fractured rock. Both factors mean that it is correct to assume minimal retardation in the unsaturated zone and that the engineering provisions are the primary barrier to impact in the groundwater.

The receiving aquifer underneath the source zone (holding pens, [redacted], containment cell or spoil water ponds) is assumed to be the point at which the beneficial use is realised (and cannot be exceeded) – that is, no lateral transport downgradient within the aquifer is considered (no attenuation zone). The selection of this point for considering the beneficial use of the groundwater is consistent with SEPP (Waters) 2018 and the approach detailed in EPA Publication 788.3.

The ADWG criteria values of 0.07 µg/L PFOS PFHxS and 0.56 µg/L PFOA were adopted to assess potential risk to beneficial uses of the aquifer. This approach is inconsistent with SEPP (Waters), which indicates that where natural background levels are better than environmental objectives, the background levels become the objectives (the natural background level of PFAS is below the detection limit). However, it should also be noted that the proposed liner for the containment cell is consistent with a Type 2 liner for a landfill, as per EPA Publication 788.3 and therefore, assuming suitable construction procedures are adhered to, approaches best practice in containment for landfills and would form the basis of "minimising risks to the extent practicable" in accordance with SEPP (Waters).

6.2.2 Model input parameters

Both Tier 1 and Tier 2 approaches to the groundwater risk assessment require a number of input values reflective of the site setting, the proposed engineering and geochemistry.

Model run parameters

The Tier 1 approach, for the containment cell, assumes a constant source concentration and does not consider the time it takes for breakthrough to occur in the receiving groundwater. The Tier 2 approach, for all the spoil containing infrastructure, accounted for the time it takes for PFAS to transit the liner and impact the underlying groundwater. This is considered over a 100-year timeline for the cell, 3 years for the settlement ponds and spoil water holding ponds, 1 year for the [redacted] and 60 days for the holding pens. These timelines were chosen based on the expected design life of the infrastructure in question, to demonstrate that the concentration in the groundwater is not in excess of the adopted beneficial use value (ADWG).

For the containment cell, the logic for the 100-year timeline is not provided, despite it being a permanent feature. However, the approach assumes a constant source of PFAS over this timeline, which is conservative given PFAS will be removed from the system via leachate extraction and treatment prior to disposal. In addition, both approaches assume that the containment cell will not be capped over this period, an activity that would greatly decrease the generation of leachate available for seepage and limit the required leachate management post-capping.

The 3 years for the settlement ponds and spoil water holding ponds are specified based on the likely primary leachate generation period anticipated for the holding pads and the containment cell. The actual service life of the spoil water holding pond is unclear, as the containment cells will still produce leachate after the project time, due to consolidation and rainfall infiltration, the latter likely greatly decreasing after capping of the cell.

The 60-day period for the holding pens is somewhat unclear as the total operational period of this part of the facility is estimated to be 16 months. The expected holding period for individual loads is anticipated to be [redacted], but potentially up to [redacted]. Therefore, the modelled period, which also assumes a leachate head of 3.5 m, would likely cover multiple consecutive loads, not accounting for breaks between loads or the removal of leachate once classified. The 60-day modelled timeframe is significantly lower than the 2-year project timeline. Given the above variable leachate heads and storage times it is unclear what the average leachate head and storage time will be over the project. However, the interpretation of this should be considered alongside the results for the chosen liner, discussed in section 6.2.3.

Geochemical parameters

Minimal geochemical parameters were assumed for both Tier 1 and Tier 2 approaches. As noted above, this was due to the omission of degradation or attenuation processes in the models. Diffusion through the liner was accounted for in the Tier 2 assessment. Little literature is currently available on PFAS diffusion coefficients through [redacted]. *In lieu* of peer reviewed literature values on the diffusion coefficients specifically for PFAS diffusion through [redacted], values for chloride through [redacted] were used. Given PFAS are known to behave differently to chloride in the subsurface, this assumption should be regarded with uncertainty. However, these values are in line with diffusion coefficients presented for other contaminants through similar materials and in the paucity of specific published information are likely a necessary assumption.

A diffusion coefficient must also be adopted for PFAS transport through the [redacted]. The proposed values adopted for the risk assessment are for chloride (Rowe et al

2004) and from recently published diffusion coefficients for PFOS and PFOA through [redacted] [redacted]. For the latter, it is noted that the proposed [redacted] is [redacted] however, it is expected that results for [redacted] will be higher due to the lower degree of crystallinity of [redacted] As above for [redacted], PFAS is expected to behave differently to chloride, however, as the chloride diffusion coefficients are higher, they do provide some degree of sensitivity for this parameter. Conservatively, the higher chloride diffusion coefficients are used for all models apart from the cell, which uses both. No literature diffusion coefficient values are currently available for PFHxS and it is assumed in the models to behave similar to PFOS. In the absence of alternative information this is likely a necessary assumption.

The models were undertaken with varying leachate concentrations depending on the infrastructure in question:

- [redacted] PFOS (for Lined Cells)
- [redacted] PFOS for Holding Pens, Settlement Pond and Spoil Water Holding Pond, and
- [redacted] PFOS for the [redacted].

The higher values for the containment cells and the holding pens/ponds are likely conservative given that reported groundwater concentrations, from the WGTP tunnel alignment to date, typically had an upper end of approximately [redacted] PFOS PFHxS, with some isolated higher concentrations. It should be noted though that as reuse is being pursued by the proponent, the material that is categorised as fill material will potentially be used elsewhere and the containment cell may only receive the higher impacted material, although this is still likely far lower than the requested acceptance criteria. The [redacted] modelling assumed [redacted] PFOS PFHxS which is in line with the upper bound of PFAS reported for groundwater in the tunnel alignment to date.

Both Tier 1 and Tier 2 approaches assumed a constant leachate source concentration. This is a reasonable assumption for the temporary infrastructure, where there is no expected decrease in PFAS concentration over the course of the project. For the containment cell, this is a conservative assumption, as given the solubility of many PFAS compounds, it can be assumed they may be removed in the leachate depleting the source concentration over time.

Engineering parameters

Both Tier 1 and Tier 2 approaches utilise a variety of engineering input values. This includes the liner properties of the infrastructure in question, the maximum leachate head and length of the structure along the groundwater flow direction. The following low permeability liners are tested for the individual infrastructure:

- Holding pens – [redacted].
- [redacted], depending on the expected contamination of the spoil.
- Containment cells – [redacted].
- Leachate settlement and storage pond – [redacted].

In assessment of these parameters, they appear well justified and are supported by suitable literature sources, specified as part of the indicative designs or informed from previous assessments of the receiving site. It should be noted the length of the source for Tier 1 and Tier 2 approaches for the containment cell are not consistent: 200 m and 350 m respectively. However, given the impact to groundwater by the containment cell is addressed as part of the Tier 2 approach (where the 350 m appears correct) and the overall conservatisms it is unlikely to impact the conclusions.

For Tier 1, the estimation of leakage through the [redacted] is set at the maximum seepage for an indicative Type 2 landfill liner as specified in EPA Publication 788.3 (10 L/Ha/day). The approach to calculating the leakage through the [redacted] for Tier 2 undertakes calculations based on flow through [redacted] [redacted] (Giroud et al 1992). The input parameters adopted in these calculations appear acceptable and supported by literature. The modelling results are contingent on these parameters being realised and, therefore, dependent on the technical specifications and a suitable construction quality assurance plan (CQA) plan being enacted, which are provided in the EMP and assessed here in section 7.

All the proposed liner combinations for each of the spoil or leachate containing infrastructure were tested in the Tier 2 approach. This is used to test all options for liner materials and supported the choice of liner in the detailed designs (see section 7).

Hydrological and hydrogeological parameters

The models for Tiers 1 and 2 require various hydrological and hydrogeological parameters to be input, including thickness of the aquifer, hydraulic conductivity, hydraulic gradient and porosity.

The base of the quarry void is discussed in the EMP to represent the lower section of the upper basalt flow, just above the underlying paleosol (eastern portion of the Site) and the scoria (western portion of the Site). It is noted that the hydrogeology of the Site is likely complex due to multiple basalt flows and confining lower permeability layers. The assumptions made here are, therefore, a simplification of the likely complex flow regimes actually occurring at the Site. The scoria layer is assumed to be the receiving aquifer in the area occupied by the containment cells and have an aquifer depth of 20 m, based on the provided cross sections. It is unclear from what has been provided as to the accuracy of this assumption as Table 1 indicates a depth of 14 m, the value therefore may include some of the overlying or underlying basalt. The scoria is noted to be weathered, vesicular and fractured, with a hydraulic conductivity of 0.5 m (AECOM 2016). The uncertainty involved in the hydraulic conductivity tests is not provided. However, the adopted values appear to be reasonable assumptions for fractured volcanic material. The hydraulic gradient is informed by observations from bores installed in the SMRF area and appears to be a reasonable assumption in line with those presented elsewhere in the EMP.

The mixing zone in the receiving aquifer is assumed to be across the whole of the 20 m saturated zone underneath the cell. This is supported by the mixing zone calculation and is greater than the aquifer depth. This is likely a simplification as it assumes that mixing is also possible across this full depth and not constricted by anisotropy of hydraulic conductivity or internal confining layers.

6.2.3 Liner suitability results

Containment cell

The containment cell was assessed using both Tier 1 and Tier 2 approaches. The Tier 1 assessment concluded that, using the input parameters in Table 2 (Appendix D of the EMP), the resulting dilution factor would be x180. This exceeds the x100 required for the requested acceptance criteria and, therefore, should be protective of the beneficial use value in the receiving groundwater. It is also noted that the groundwater impacts from the tunnel alignment to date indicate that PFAS concentrations are typically below [redacted] L PFOS PFHxS and would not require such large dilution factors to be protective of beneficial uses. The resulting concentrations in groundwater would, therefore, be assumed even under the general conservatisms of the approach to be far lower than the beneficial use value adopted.

As above, it is noted that the containment cell footprint for Tier 1 is less than that assumed in Tier 2 and does not consider the full groundwater flow path through both cells. This should, however, be considered alongside the conservative nature of this assumption, as leachate will be managed in the cell likely reducing the leachate depth below the 300 mm assumed for the seepage calculation over much of the cell for the majority of the time.

Uncertainty analysis is provided for the Tier 1 approach. This independently assessed the impact of the two most sensitive parameters for this approach; the infiltration rate (controlled by seepage through the liner) and the hydraulic conductivity of the aquifer which controls the groundwater flux. Both parameters indicate that despite the relatively conservative assumptions, some degree for higher seepage or reduced groundwater flow could be tolerated for the requested acceptance criteria to remain protective.

The Tier 2 assessment of the containment cell indicates that the beneficial use (ADWG PFAS values) would not be precluded in the receiving aquifer within the 100 years model time. This was the case for the higher diffusion coefficient [redacted]) and the lower diffusion coefficient ([redacted]). This indicates some potential for tolerance of higher diffusion coefficients, which is important given the limited literature studies for PFAS compounds in the literature, including the absence of data for PFHxS.

Spoil water storage pond and settlement pond

The Tier 2 assessment for the spoil water storage and settlement ponds indicate minimal impact to groundwater over the operational time of this infrastructure (assumed to be 3 years). This is even under the assumption of higher PFAS concentrations being realised, despite the groundwater from the WGTP tunnel alignment indicating far lower PFAS concentrations. It is noted that the diffusion coefficient adopted was the more conservative (high diffusion coefficient) for chloride ([redacted]) as opposed to the recently published PFOS and PFOA diffusion coefficients ([redacted]), which is also a conservative approach.

Holding pens

Although both a [redacted] overlying [redacted] and a [redacted] were tested, the detailed designs adopted the [redacted]. The Tier 2 assessment indicates that if the liner adopted in the detailed designs ([redacted]) is used as the liner even under the modelled high heads and high PFAS concentrations the impact to groundwater is likely minimised over the modelled time period ([redacted]). At the end of this period the modelling indicates the PFAS concentration in groundwater is several orders of magnitude below the relevant beneficial use value.

Although the [redacted] is less than the operational timeframe for the project the assumptions of maximum leachate head and high PFAS concentration are conservative. The actual amount of time an individual holding pad will be in use, the PFAS concentration and the leachate head on the liner are likely highly variable. Given that a [redacted] results in low seepage and diffusion, it is likely to be protective of these conditions over the extended timeframes of the project.

[redacted]

The [redacted] will be split into two areas with different levels of engineering (that is, different liner materials/liner configuration). These are designed to be protective of the environment for the varying levels of expected (potential) contamination likely for the spoil to be received in these respective areas. The spoil from the portal to Domain 2 is anticipated, from groundwater PFAS concentrations in the tunnel alignment, to be unlikely to be contaminated. The modelled liner was for a [redacted], however, the detailed designs (assessed in section 7) are for a [redacted]. The modelled liner ([redacted]) was protective of the beneficial use in the receiving groundwater at the modelled

PFAS leachate concentration for a constant head of [redacted]. It should be noted that the adopted liner, will have lower seepage and diffusion and thus be more protective.

Domain 2 includes areas possibly contaminated with other contaminants of concern, in addition to PFAS. Therefore, the Domain 2 facility will have either: 1) [redacted]; or 2) a [redacted]. The proponent has modelled option 1 in their application given it has the lowest thickness of [redacted] and thus the most conservative option to model. However, the detailed designs specify that the liner is to be option 2, which is more protective. The Domain 2 facility liner configuration had lower breakthrough of PFAS when compared with the liner configuration in Domain 1, and PFAS concentrations were 1-2 orders of magnitude below the relevant beneficial use value within the 1-year timescales modelled.

The groundwater risk assessment provided was only for PFAS only and other potential contaminants of concern were not considered due to their unlikely or limited presence. The liners adopted are likely a protective option in the event of the presence of other contaminants of concern, given the limited timeframe of the facility.

6.2.4 Limitations and assumptions

A number of limitations and assumptions are noted in the report (Appendix D of the EMP) for the approach taken in Tier 1 and Tier 2. An inherent limitation is the paucity of data specific to the transport and fate of PFAS in relation to liner and subsurface material. Any modelling should be viewed in the context of this uncertainty. However, the assumptions used by the proponents for their modelling appear to be reasonable and often conservative. Where they relate to a specific input, they are discussed in more detail above. A number of these are conservative and any conclusion should be interpreted bearing these in mind:

- The receptor is set as the receiving groundwater directly below the infrastructure, where the ADWG values become valid. Therefore, no lateral transport (with associated attenuation and dispersion) is considered. In reality, the nearest receptors downgradient are possible stock water groundwater bores (approximately 1.5 km to the south) or Skeleton Creek (hydraulically connected to groundwater approximately 1.2 km south of the Site).
- For the containment cell, it is assumed in the model that the leachate will be reflective of the maximum proposed acceptance criteria [redacted]) in the leachate. This is unlikely given the low concentrations in groundwater detected in the tunnel alignment to date. It is also assumed this is constant over time, which is conservative given leachate with dissolved PFAS will be removed from the system, depleting the source.
- The containment cell has been modelled using a constant 0.3 m head across the cell base. This is despite the EMP detailing provisions to minimise leachate heads and promote transfer of leachate to the sump, which would maintain a 0.3 m head only in the sump area most of the time. The actual head in the remainder of the cell would, therefore, typically be minimised most of the time.
- No consideration of capping (intermediate or final) on the reduction of leachate generation is taken into account over the 100-year timespan. This significantly overestimates leachate available for leakage once capping has occurred and is a highly conservative assumption.

6.2.5 Conclusions

EPA conclusions

- The proposed liner for the containment cell has a [redacted]. Both Tier 1 and Tier 2 modelling approaches indicate that the proposed liner and acceptance criteria would be protective of the beneficial uses of the underlying groundwater, within the 100-year model time (for Tier 2 approach). These conclusions should be considered in combination with the inherent conservatisms of the approach detailed above, which do not consider the further control of capping or PFAS removal from the cell and treatment.
- Suitable Technical Specification and a CQAP have been provided to ensure the liner materials perform to specifications. This is demonstrated in the containment cell detailed designs. In addition, the EMP includes provisions to facilitate leachate management in the cell.
- The holding pens, [redacted], settlement pond and spoil water holding pond liner profiles were also modelled to assess their ability to protect the beneficial uses of the underlying groundwater. The modelling appears to support the liner profiles chosen for these facilities over the periods modelled.
- A suitable construction quality assurance plan to ensure the liner materials perform to specifications is included. This is important for the outcomes of the modelling to be realised.

6.3 Noise assessment

A comprehensive assessment of cumulative noise levels from the existing and proposed operations has been undertaken by Marshall Day Acoustics Pty Ltd (MDA) to assist with the assessment for the necessary approval applications. Based on the information provided, including all measurements, assumptions, modelling, noise limits and mitigation measures implemented, the addition of the [redacted] and the SMRF to the Site will comply with SEPP N-1.

6.3.1 Locality

Noise impacts will be significantly mitigated as the operations are on the floor of the existing quarry. The nearest residence is about 470 m away. This gives a reduction of about 50 dBA. Any larger distances will have further reductions.

Additional traffic from the SMRF will be along Middle Rd up to the site entrance from Christies Rd. Noise impacts are considered manageable within the existing buffers around the Site.

There will be two 25 m long weighbridges located in an acoustic shed to mitigate engine noise.

SMRF operations about 8 m below existing grade level provide a buffer to the receptors in the south. Receptors to the north, east and west are sheltered by the operation quarry and landfill cells.

Operationally, Cleanaway will use noise mitigation including noise walls, sheds and abatement equipment on machinery if required, and trucks with tonal reverse alarms will be prohibited from the SMRF during the night-time period.

The monitoring plan will document the required environmental monitoring requirements to each applicable environmental segment (such as air quality, dust, noise, surface water or groundwater). It will specify the location, frequency, type and quality control requirements required in order to demonstrate compliance with the SMRF approvals. The monitoring plan will include daily auditing against the control measures and the trigger levels/indicators for further assessment.

6.3.2 Potential impacts

Based on the assessment undertaken by Marshall Day Acoustics, the following potential exceedances were identified:

- an exceedance of 1 dB during the evening period and 3 dB during the night period at 522 Middle Road during the [redacted] case
- an exceedance of 2 dB during the evening period and 3 dB during the night period at 522 Middle Road during the SMRF case.

These are not considered to be a significant risk as they are likely to only occur in the most adverse conditions. For example, wind direction being more than 5 m/s towards the nearest sensitive receptor, including all plant operating at the same time.

Noise operational assumptions are based on worst case 30-minute assessment, with both [redacted] and SMRF operating at full capacity. This is a highly unlikely scenario. If noise proves to be consistently over the limit at 522 Middle Rd further noise monitoring/measuring will need to be conducted, which may trigger the need for further noise mitigation measures to be implemented.

6.3.3 Heavy vehicle noise

All mobile plant is to be fitted with broadband reversing alarms. During evening and night periods operations will be restricted to receiving and emptying third-party trucks. Third-party trucks with tonal reverse alarms will not be accepted on-site during the evening and night period. All third-party trucks accessing the Site during the evening and night-time will be fitted with broadband reverse alarms. No Holding Pen unloading activities to occur. Site plant will be fitted with exhaust and/or intake attenuation. Compaction equipment will be fitted with sound panels and exhaust attenuation.

Road traffic noise

EPA understands that the operations of the spoil processing and management facility at peak periods will increase the road traffic on surrounding roads by 36 heavy vehicle movements per hour (18 vehicle movements in each direction) with typical operations involving 26 heavy vehicles movements per hour (13 vehicle movements in each direction) across all periods (day, evening and night) for weekdays and weekends.

6.3.4 Noise Conclusions

The conclusions of the noise assessment are:

- EPA is satisfied with the noise management approach provided in the EMP.
- Noise is proposed to be minimised as far as reasonably practicable – for both construction works and operations – prior to considering compliance to the relevant noise limits or criteria.

7 Detailed Design Assessment

7.1 Holding pens design overview

The design of the holding pens and [redacted] is summarised in the EMP (sections 6.6 and 6.8 respectively). Detailed design information is provided in Appendix A of the EMP, and includes design plans, Design Report, Technical Specifications and CQAP. The detailed design documents were assessed by the Auditor, provided in the Auditor Assessment Report (Appendix K). The Auditor concludes:

> *I also consider that adequate control measures have been designed to ensure that the acceptance of Tunnel Spoil at the site would not present an environmental or safety risk at the site.*

The design plans, Design Report, Technical Specifications and a CQA Plan are prepared in accordance with relevant information detailed in Appendices 9, 10, 11 and 13 of EPA publication 1323.3, where relevant to this application. The design plans demonstrate how the infrastructure will meet the design objectives. The Design Report demonstrates the rationale behind the holding pens and [redacted] design elements. The Technical Specifications contain assessable specifications for the primary elements used in construction. The CQA Plan provides information to demonstrate that the holding pens and [redacted] are constructed to meet their design requirements.

The holding pens are proposed to consist of individual contained pens with dimensions of [redacted], with a depth of [redacted] including a [redacted] freeboard. Each pen is designed to contain at least [redacted] of spoil, with lined separation bunds between the individual pens. The spoil will be deposited from a [redacted] and be emptied from the shallower unloading batter [redacted]). In the EMP, the holding pens are separated into two areas, Holding Pens East and Holding Pens West, with [redacted] holding pens respectively. These two areas are divided by a basalt rock plinth which has high voltage power lines. The current detailed design only addresses the Holding Pens East area (holding pens [redacted]), which occupies an [redacted] footprint (Figure 16). The holding pen area will also have internal roadways (tipping and excavation lanes), drainage system and settlement ponds.

The holding pens are designed to have a low permeability base, limiting seepage, and a wearing surface to protect the underlying liner material. They will also include a drainage [redacted] across the base of the pen, leading to a spoil water drainage pipe and sump, where it will be removed using a [redacted].

To facilitate a start to tunnelling prior to the completion of the wider SMRF infrastructure, single use temporary holding pads are proposed (termed the [redacted]. The facility consists of four single use spoil holding pens:

1. *A C&D Holding Pen for spoil from the tunnel portals.*
2. *A TBM 1 Holding Pen for Tunnel Spoil from the Outbound Tunnel between the portal and Domain 2.*
3. *A TBM 2 Holding Pen for Tunnel Spoil from the Inbound Tunnel between the portal and Domain 2.*
4. *A Domain 2 Holding Pen.*

The different spoil types in these pads have different risk profiles and therefore require different engineering controls to be in place. The pens receiving wastes from Domain 2 will have a lower design seepage rate than the other [redacted] pens. The four pens are varying sizes, based on estimates on the volume of tunnel spoil produced during the initial tunnel boring phases and will occupy a footprint of [redacted] The individual pens will have a flat base surrounded by sidewall bunds ([redacted]) and have a [redacted] excavation slope on one end. The pens will be lined with a low permeability base and a wearing surface to protect the underlying liner material.

7.1.1 Design

7.1.1.1 Plans and design drawings

The EMP and the detailed designs in Appendix A, include maps and design drawings that detail the relevant aspects included in Appendix 9 of EPA publication 1323.3 ("Preparation of plans (designs) for a new landfill cell"), where relevant to this application (noting the different design objectives of the holding pens and the [redacted]). This includes location maps, premises maps, holding pens (eastern only) and [redacted] plans (Figure 18 and Figure 19), cross sections, liner profiles and leachate collection system plans.

The design drawings indicate that the proposed facility shall meet the design objectives and that the holding pens and [redacted] can adequately contain spoil and segregate stormwater and leachate. They also detail the key environmental protection measures incorporated in the design.

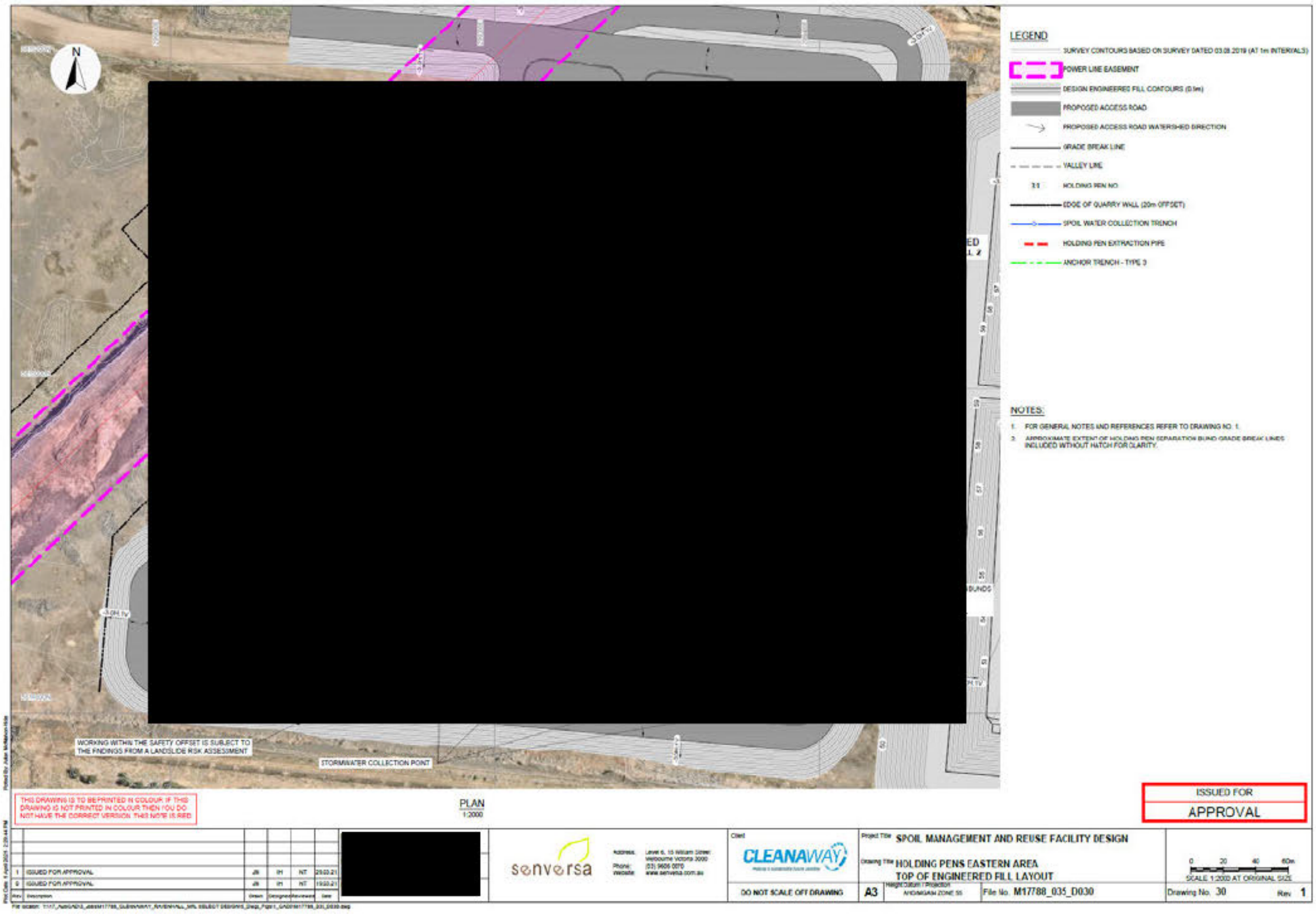


Figure 18. Plan of the eastern holding pen area of the SMRF.

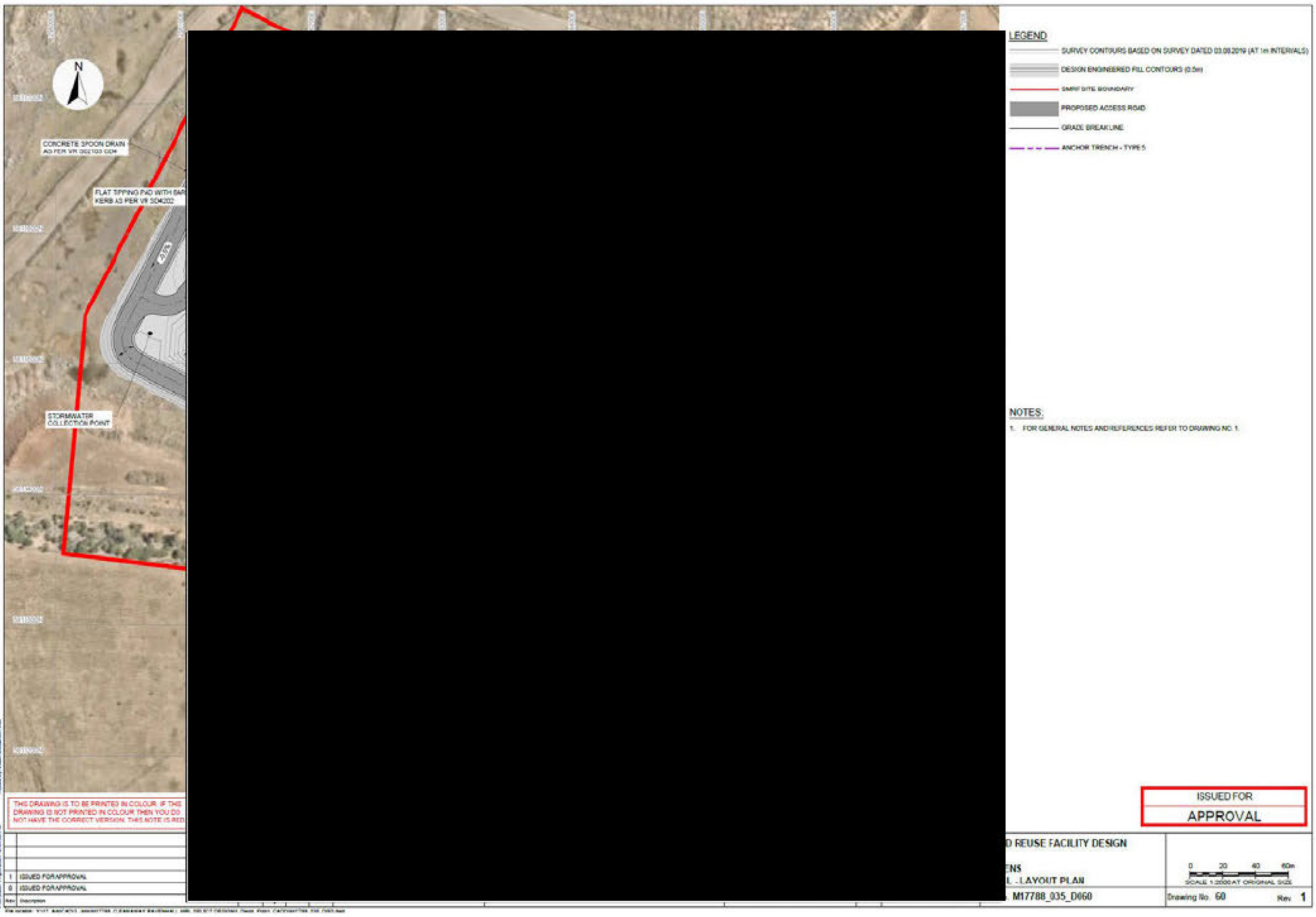


Figure 19. Plan of the [redacted] *area of the SMRF.*

7.1.1.2 Subgrade

Earthworks and subgrade preparation are detailed in the design plans, Design Report, Technical Specifications and CQAP, submitted as part of the EMP (Appendix A of the EMP). The holding pens and the [redacted] are to be constructed in a quarry void. The *in-situ* subgrade is composed of basalt rock, scoria and clay. The holding pens and the [redacted] will be constructed by building up from the quarry base using fill material, to maintain a separation from groundwater and aid segregation of spoil water from stormwater. The information provided indicates that a geotechnically stable platform can be achieved for the construction of the overlying liner which will be suitable for subsequent trafficking.

7.1.1.3 Liner system

The holding pens and the [redacted] are designed with a low permeability liner over the full extent of the base and sidewalls, anchored in place using anchor trenches. The liner profile for the holding pens (Figure 20) is detailed in the EMP and the detailed design documents (Appendix A of the EMP), consisting of (from bottom to top):

- [redacted]

The primary liner is the [redacted], with the secondary liner component of a [redacted] layer that must have a hydraulic conductivity of [redacted]. The liner performance in relation to the key contaminants of concern (PFAS) is considered as part of the hydrogeological risk assessment, which used numerical modelling to support the use of the liner (see section 6.5). This indicates that the proposed liner may sufficiently protect groundwater beneficial uses directly below the infrastructure, during the project. Therefore, and bearing in mind that no practicable surface can be fully impervious, EPA considers that the surface (being the liner system outlined in this section) is adequately impervious for the purposes of the receipt, consolidation and dewatering of the spoil. The drainage [redacted] is to assist in the removal of spoil water, once classification of the material is obtained. The reinforcement geotextile is specified to improve veneer slope stability. The surface protection layer specifications are to be determined through the use of a trial pad, as specified in the Technical Specifications, to ensure they can protect the underlying geosynthetics given anticipated placement, compaction and trafficking.

[redacted]

Figure 20. Liner cross sections for the holding pens, as provided in Appendix A of the EMP.

The [redacted] is to include pens with two different liner systems, consists of (from bottom to top):

- [redacted]

Due to the higher potential for contaminants of concern being present in Domain 2, the pen receiving this waste includes a [redacted] in addition to the [redacted] (Figure 21). This liner is consistent with a Type 2 landfill liner, as per EPA Publication 788.3, and has multiple layers in the case of failure of one of the components. The liner without the [redacted], where the clay rich fill material (hydraulic conductivity of [redacted] m/s) makes up the secondary barrier, will have higher seepage. The performance of this liner is supported by the hydrogeological risk assessment (see section 6.5), which indicates that the proposed liner can sufficiently protect groundwater beneficial uses directly below the infrastructure, during the project. As with the holding pens a protection layer ([redacted]) is included to protect the underlying geosynthetics and the reinforcement geotextile is specified to improve veneer slope stability.

[redacted]

Figure 21. Liner cross sections for the [redacted] *holding pens, as provided in Appendix A of the EMP.*

7.1.1.4 Leachate collection system

The design of the holding pens leachate collection system is summarised in section 6.6.1 of the EMP and the detailed designs (Annex A of the EMP), which includes the Design Report, Technical Specifications and the design drawings and plans. This includes designs of the drainage [redacted] and the spoil water pipes. Specifications for materials used in construction, construction approaches and CQC/CQA processes are included.

The holding pens are designed with a slope to the lowest point at the toe of the tipping face. The base of the pen includes a drainage [redacted], to facilitate drainage to this low point. At the toe of the tipping face a perforated spoil water collection pipe is located, surrounded by drainage aggregate. This pipe slopes to a corner of the pen, where a spoil water extraction pipe is located, allowing removal of spoil water. It is noted in the EMP that spoil water will not be removed until classification of the spoil has been completed.

No leachate collection provisions are included for the [redacted] pens other than removal is free liquid through the use of a vacuum truck. These are to temporarily store tunnel spoil until the lined cells are constructed, at which point the spoil water will be removed and the spoil emptied.

7.1.1.5 Groundwater separation

The separation from groundwater in the vicinity of the holding pads is addressed in the EMP in section 3.12. The holding pens and the [redacted] are to be raised up from the base of the quarry floor. This equates to a separation of >2 m from current standing water levels.

7.1.2 Technical Specifications and CQAP

The general method of construction of the preparatory earthworks, subgrade and liner components, are sufficiently detailed in the Technical Specifications. The provisions are in general accordance with relevant standards and industry best practice.

The proposed properties for the materials are in line with those of EPA Publication 788.3, industry best practice and other relevant standards. The properties of preparatory earthworks and subbase appear to be sufficient to enable the construction of a stable base for the construction of the liner. The [redacted] layer underlying the [redacted] in the holding pens (in exception of the Domain 2 holding pen in the [redacted]) also acts as the second containment layer. However, this layer does not meet the specifications of a [redacted], as per EPA Publication 788.3, including a higher maximum hydraulic conductivity of [redacted]. This deviation from a typical [redacted] specification is supported by the hydrogeological risk assessment. The [redacted] properties are broadly in line with the specifications provided in EPA Publication 788.3, and Geosynthetic Research Institute (GRI)-[redacted] Standard Specification, GRI – GM13 Standard Specification and GRI -GT12(a) - ASTM Version Standard Specification, respectively.

The Construction Quality Assurance (CQA) testing of materials proposed to be used in construction of the holding pens liner are broadly in line with the specifications detailed in EPA Publication 788.3. The [redacted] CQA testing protocol differs from the specifications detailed in EPA Publication 788.3, to reflect the short-term nature of the application here. The Technical Specifications and CQA plan also detail Construction Quality Control (CQC) and CQA procedures for the construction of the liner, broadly meeting the intent of EPA Publication 788.3. This includes appropriate independent third-party involvement in the construction to verify that this is in accordance with the design intent, via involvement of a Geotechnical Inspection and Testing Authority (GITA) (Level 1 Responsibility), CQA Inspector and Auditor. The Auditor will verify the construction works meets EPA s approved design documents. Relevant Auditor hold points are included in the CQAP, broadly in accordance with those detailed in Appendix 12 of EPA Publication 1323.3.

In summary, the Technical Specifications and CQAP, address all the relevant aspects typically required for landfill cell designs as per Appendix 10, 11 and 12 of EPA Publication 1323.3, where relevant to the design intent of the holding pens and [redacted]. The Technical Specifications demonstrate the specifications for the primary elements used in construction and construction approaches are broadly in line with best practice. The CQAP provides sufficient provisions to demonstrate that the holding pens and [redacted] liner will be constructed to meet its design requirements.

7.1.3 Holding pen and [redacted] design conclusions

EPA conclusions

EPA is satisfied that the Auditor assessed holding pens and [redacted] design documents, provided in the EMP, contain sufficient provisions to adequately manage environmental risks that may arise during construction and operation. The design documents also include sufficient information to ensure that the holding pens and [redacted] are constructed in accordance with the design intent.

7.2 Containment cell design assessment

The design of the containment cells (including their cap) is summarised in the EMP (section 6.7). Detailed design information is provided in Appendix A of the EMP, and includes design plans, design report, technical specifications and a CQAP for the containment cells and cap. These documents were assessed by the Auditor and their assessment is provided in the EMP (Appendix K). The Auditor notes a number of deviations from EPA Publication 788.3 and provides a risk assessment of these deviations. The Auditor concludes:

> *I also consider that adequate control measures have been designed to ensure that the acceptance of Tunnel Spoil at the site would not present an environmental or safety risk at the site.*

The detailed design documents are broadly prepared in accordance with relevant information detailed in Appendices 9, 10, 11, 12 and 13 of EPA Publication 1323.3 (where relevant to this application). The designs broadly meet the relevant required outcomes and suggested measures detailed in EPA Publication 788.3. Where deviations are noted, a risk-based assessment is provided to support the proposed alternative measure.

The containment cells are designed to contain spoil that meets the acceptance criteria for the cells in regards PFOS PFHxS and PFOA. The cells are to be located within the existing quarry void at the Site and their construction will require cutting and filling of this existing area to the cell requirements. Two cells are proposed to be constructed, partitioned by an internal bund. They are proposed to be constructed in stages, with the first lift having an airspace of [redacted] and the ultimate airspace of [redacted] Design drawings for the subsequent stages have not been assessed as part of this assessment. To limit seepage and PFAS migration through the base of the cell, the cell design incorporates a composite liner (consistent with a Type 2 liner in accordance with EPA Publication 788.3), with the liner choice supported by modelling, assessed further in section 6.2 of this report. To manage spoil water drainage, the designs have increased provisions for leachate collection compared to a typical landfill cell, facilitating drainage to the four leachate sumps.

The containment cells will lay back onto existing cells in MRL Stages 1 and 2. The MRL cells have a liner of comparable performance to that proposed for the SMRF cells. The liner is required to tie into the existing liner of these cells. As there is no hydraulic separation proposed between the SMRF and the MRL cells, to limit PFAS migration into the MRL cells, constraints on the placement of waste [redacted] PFOS PFHxS and [redacted] PFOS PFHxS are detailed in the EMP (section 6.7.7):

> *As such, Tunnel Spoil with concentrations of PFOS and PFHxS [redacted] will only be placed in the following locations in the Lined Cells:*
>
> - *Anywhere within the [redacted] and shown in the detailed designs in Appendix A-2. The eastern bund of the first lift of Cells 1 and 2 [redacted].*
> - *West of the potential internal bunds shown in Figures 16 to 19. The internal bunds will be constructed on the [redacted] within the Lined Cells. Spoil Water drained from the Tunnel Spoil will still pass beneath the internal bunds to the sumps in the southeast corner of each cell. As such, any Spoil Water which drains from Tunnel Spoil on the [redacted].*
> - [redacted].

7.2.1 Designs

7.2.1.1 Plans and design drawings

The EMP includes maps and design drawings of the containment cells and cap, that have been prepared in general accordance with Appendix 9 of EPA publication 1323.3 ("Preparation of plans (designs) for a new landfill cell"). This includes location maps, premises maps, cell plans (Figure 22), cell cross sections, liner profiles (Figure 23), anchor trench details, tie in to existing MRL cells and leachate collection system plans. Indicative concept cap contours and capping profile are provided in the EMP.

The maps and plans of the containment cells appear to confirm the cell is designed broadly in line with requirements typically applied to Type 2 landfill cells as per EPA Publication 788.3. The maps and plans indicate that the design meets the design objectives and that the cell can adequately manage environmental risks. This is reliant on the additional design aspects addressed in the Design Report, Technical Specifications and the CQA Plan (see section 7.2.2).

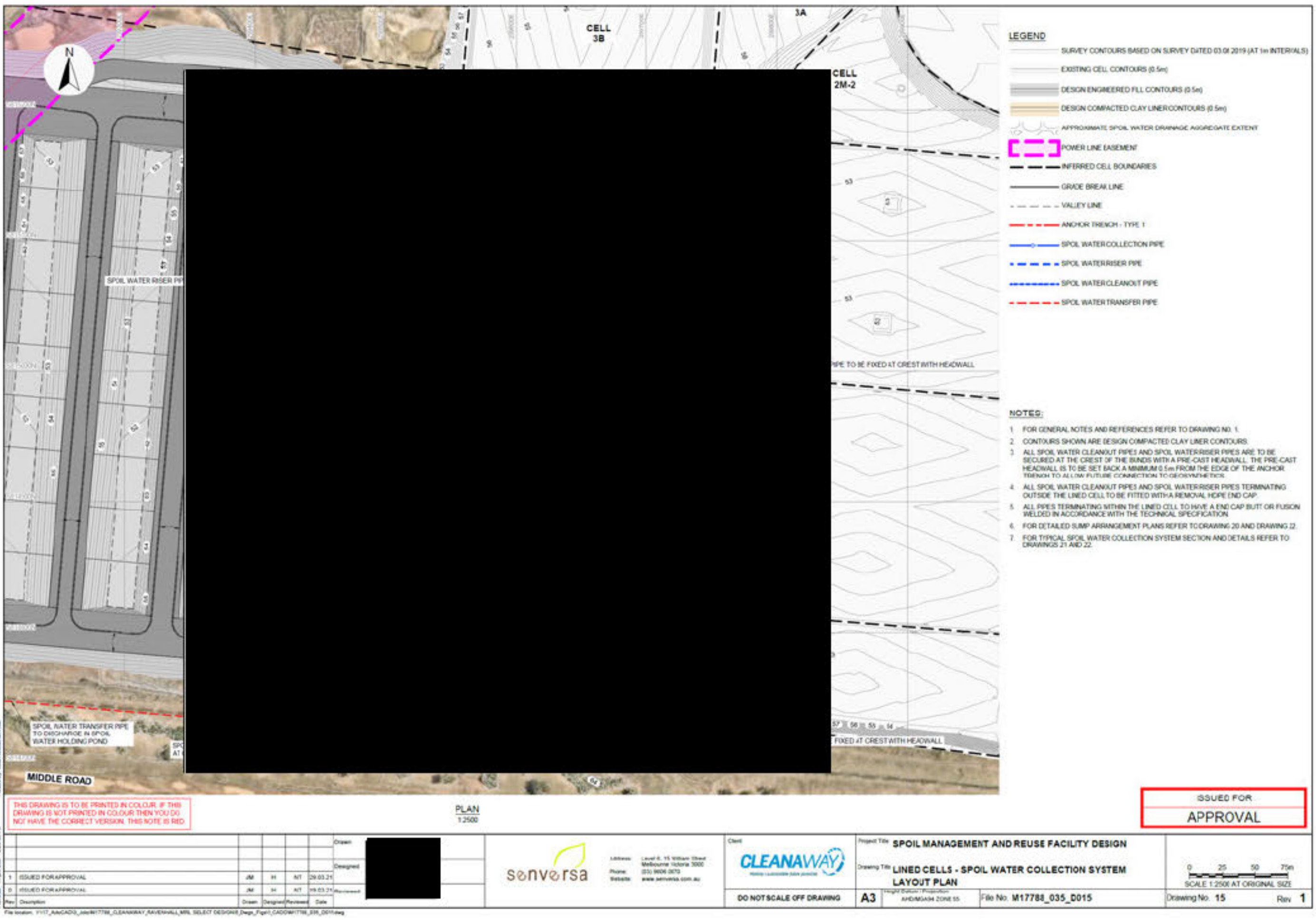


Figure 22. Plan of the SMRF containment cells, including leachate collection design elements.

[redacted]

Figure 23. Liner profiles for the SMRF containment cells.

7.2.1.2 Subgrade

The geotechnical stability of the subgrade is a key consideration for waste containment as per EPA publications 788.3 and 1323.3. The Design Report, Technical Specifications and CQA Plan include relevant information on the subgrade, which has been prepared in accordance with Appendices 9, 10 and 11 of EPA publication 1323.3.

The containment cells are to be built in the quarry void at the Site and will require excavation of the natural subgrade and filling with sub-base fill material. The natural subgrade is likely to be composed of basalt, scoria or clay, and is likely to form a stable subgrade for construction. The Technical Specifications and CQA Plan include appropriate specifications for the preparation of the subgrade and placement of the sub-base fill material to achieve adequate strength and settlement. The separation from groundwater (assessed further in section 7.1.1.5), indicates that depressurisation of groundwater will not be required.

7.2.1.3 Basal and sidewall liner system

The liner profile adopted for the containment cell base and sidewall are provided in Figure 23 and consists of (from bottom to top):

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

The profile is consistent with a Type 2 landfill liner as per EPA publication 788.3 and the proposed liner profile is supported by the HRA (see section 6.4). Therefore, EPA considers that the liner is adequately impervious for the purposes of containing the spoil.

The Technical Specifications and CQA Plan provisions for the liner components are addressed further in section 7.2.2. In addition, the Design Report has been prepared in accordance with EPA publication 1323.3. The design report appears to adequately address the key objectives of the liner and, therefore, meets the intent of the required outcomes and suggested measures detailed in EPA publication 788.3.

7.2.1.4 Cap design

The liner profile adopted for the containment cell cap is discussed in section 6.7.8 of the EMP. The cap is proposed to be consistent with a Type 2 cap in EPA publication 788.3, utilising a [redacted]. This design would be consistent with the baseliner and would likely meet <75 per cent infiltration as seepage through the base. The materials for use in the cap and the construction approach are adequately addressed in the Technical Specifications and CQA Plan (addressed further in section 7.2.2).

7.2.1.5 Spoil water collection system

The details of the containment cell spoil water collection system are summarised in section 6.7.3 of the EMP, and details provided in the maps and plans, Design Report, Technical Specifications and CQA Plan (Appendix A of the EMP). The containment cells include a [redacted]. Above the spoil water collection aggregate (separated by a geotextile) a layer of [redacted] is included to filter fines to prevent clogging of the spoil water collection system. The cell floor is designed to shed water to spoil water collection pipes located in valleys, which are in turn directed to the spoil water collection sumps (two per cell). It is noted that in cell 2 the spacing of the spoil water collection pipe from the ridge line is in excess (29 m) of that recommended in EPA Publication 788.3 (25 m). This minor deviation is justified based on calculations provided in the designs, for the maximum pipe spacing to achieve a maximum spoil water head of <300 mm.

Spoil water is to be removed using a submersible pump installed in the spoil water sump risers. The spoil water is then directed to a spoil water holding pond. The sizing of the leachate storage pond is addressed as part of the water balance and assessed here further in section 7.4.

Broadly, the provided designs meet the required outcomes and suggested measures detailed in EPA publication 788.3. The spoil water collection provisions are generally in excess of those typically used for landfills in Victoria, as detailed in EPA Publication 788.3, and indicate the cell is designed to effectively manage.

7.2.1.6 Groundwater separation

Section 3.12 of the EMP and section 4.1.1 of the Design report addresses the separation of the lowest point in the cell and the long-term undisturbed depth to groundwater, to satisfy the EPA Publication 788.3 required outcome:

> *All new landfills must deposit waste at least two metres above the long-term undisturbed depth to groundwater, unless the operator satisfies EPA Victoria that sufficient additional design and management practices will be implemented and EPA determines that regional circumstances exist that warrant the new landfill.*

The EMP determined this based on the hydrogeological assessment report prepared for MRL Southern Expansion Works Approval Application (AECOM). This adopted the highest reported values for the gauging data of proximal boreholes, adding a further 0.8 m to account for the potential of evaporative losses in the quarry void depressing groundwater. This assessment indicates that a minimum of 2 m from the long-term undisturbed groundwater level will be achieved.

7.2.1.7 Surface water management

The containment cells are proposed to be located in the quarry void at the SMRF Site. As such stormwater cannot leave the quarry void and it can pool prior to evaporation or infiltration. The bund walls of the containment cell will effectively segregate stormwater from spoil water and be high enough that run in of stormwater is not likely to occur.

7.2.2 Technical Specifications and CQAP

The general method of construction of the preparatory earthworks, subgrade and liner components for the containment cell and cap, are detailed in the Technical Specifications. The provisions are in general accordance with relevant standards and industry best practice, including considerations detailed in EPA publication 788.3.

The proposed properties for the materials are in general accordance with those of EPA publication 788.3, industry best practice and other relevant standards. The properties of preparatory earthworks and subgrade appear to be sufficient to enable the construction of a stable base for the construction of the liner. The properties of the [redacted] are broadly in line within the intent of EPA Publication 788.3. An allowance for a higher maximum particle size is included for lower layers of the clay, while still maintaining the hydraulic conductivity and preventing damage to the overlying geosynthetics. It is noted that the hydraulic conductivity of the [redacted] as is typically required for landfill applications. The amended value likely encompasses the concentrations anticipated from the tunnel alignment. The [redacted] and [redacted] properties are broadly in line with the relevant specifications provided in EPA publication 788.3, and [redacted], respectively.

The Construction Quality Assurance (CQA) testing of materials proposed to be used in construction of the containment cells liner and cap are broadly in line with the specifications detailed in EPA Publication 788.3. The Technical Specifications and CQA plan also detail Construction Quality Control (CQC) and CQA procedures for the construction of the liner, broadly meeting the intent of EPA Publication 788.3. This includes appropriate independent third-party involvement in the construction to verify that this is in accordance with the design intent, via involvement of a Geotechnical Inspection and Testing Authority (GITA) (Level 1 Responsibility), CQA Inspector and Auditor. The Auditor will verify the construction works meets EPA s approved design documents. Relevant Auditor hold points are included in the CQAP, broadly in accordance with those detailed in Appendix 12 of EPA Publication 1323.3.

The Technical Specifications and CQA Plan address the relevant aspects typically required for landfill cell designs as per Appendix 10, 11 and 12 of EPA publication 1323.3. The Technical Specifications demonstrate the specifications for the primary elements used in construction and construction approaches are broadly in line with best practice. The CQA Plan provides sufficient provisions to indicate that the containment cell liner will be constructed to meet the design requirements.

In summary, the containment cell and cap Technical Specifications and CQA Plan, EPA concur with the assessment and conclusions of the Auditor. The documents provide sufficient detail to adequately manage environmental risks that may arise during cell construction, operation and closure, and ensure the cell is constructed in accordance with the design.

7.2.3 Containment cell design conclusions

EPA conclusions

- EPA is satisfied that the containment cells design, included in the EMP, contain sufficient provisions to adequately manage environmental risks that may arise during containment cell construction and operation. The design documents also include sufficient information to ensure that the containment cells are constructed in accordance with the design intent.

7.3 Spoil water storage and settlement ponds

The design of the spoil water settlement ponds and the spoil water holding ponds is summarised in the EMP (section 7). Detailed design information is provided in Appendix A of the EMP, and includes design plans, Design Report, Technical Specifications and a CQA Plan. The detailed design documents were assessed by the Auditor, provided in the Auditor Assessment Report (Appendix K). The Auditor concludes:

> *I also consider that adequate control measures have been designed to ensure that the acceptance of Tunnel Spoil at the site would not present an environmental or safety risk at the site.*

EPA consider that the design plans, Design Report, Technical Specifications and a CQA Plan are broadly prepared in accordance with relevant information detailed in Appendices 9, 10, 11 and 13 of EPA publication 1323.3, where relevant to this application. The design plans demonstrate how the infrastructure will meet the design objectives. The Design Report demonstrates the rationale behind the settlement and holding ponds design elements. The Technical Specifications contain assessable specifications for the primary elements used in construction. The CQA Plan provides information to demonstrate that the settlement and holding ponds liners are constructed to meet their design requirements.

A leachate water balance was provided in the EMP, which informs the capacity of the spoil water holding ponds and other aspects of the spoil water management system (assessed further in section 7.4 of this report).

All spoil receiving areas, prior to classification, are lined to varying degrees to prevent impact to groundwater. Any water that arrives at the SMRF in contact with spoil, incident rainfall onto spoil, or separated spoil water will be managed as leachate. Upon classification, if classified as non-prescribed industrial (NPI) waste (according to the criteria specified in the EMP), the supernatant spoil water will be removed using a vacuum truck from the top of the spoil and the spoil water pumped from the collection sump. This will then be discharged into the spoil water sedimentation ponds. The spoil water from the sedimentation ponds and the containment cell sump will then be pumped to the leachate storage pond. This water will then be treated in a purpose-built water treatment plant (WTP), to remove PFAS from the leachate to [redacted] [redacted] of PFOS and PFHxS).

7.3.1 Designs

7.3.1.1 Plans and design drawings

The EMP includes maps, plans and design drawings that detail the relevant aspects in accordance with Appendix 9 of EPA publication 1323.3, where relevant to the settlement and holding ponds design. This includes location maps, premises maps, settlement pond plans (Figure 24), spoil water holding pond plans, cross sections, liner profiles (Figure 25) and anchor trench details.

The plans, maps and designs broadly indicate that the design of the settlement pond and spoil water holding pond meet the design objectives and can adequately contain spoil water and segregate this from stormwater. This assessment is reliant on the additional design aspects addressed in the Design Report, Technical Specifications and the CQA Plan, and a consideration of the liner performance.

[redacted]

Figure 24. Plan, liner profile and anchor trench details of the SMRF settlement pond.

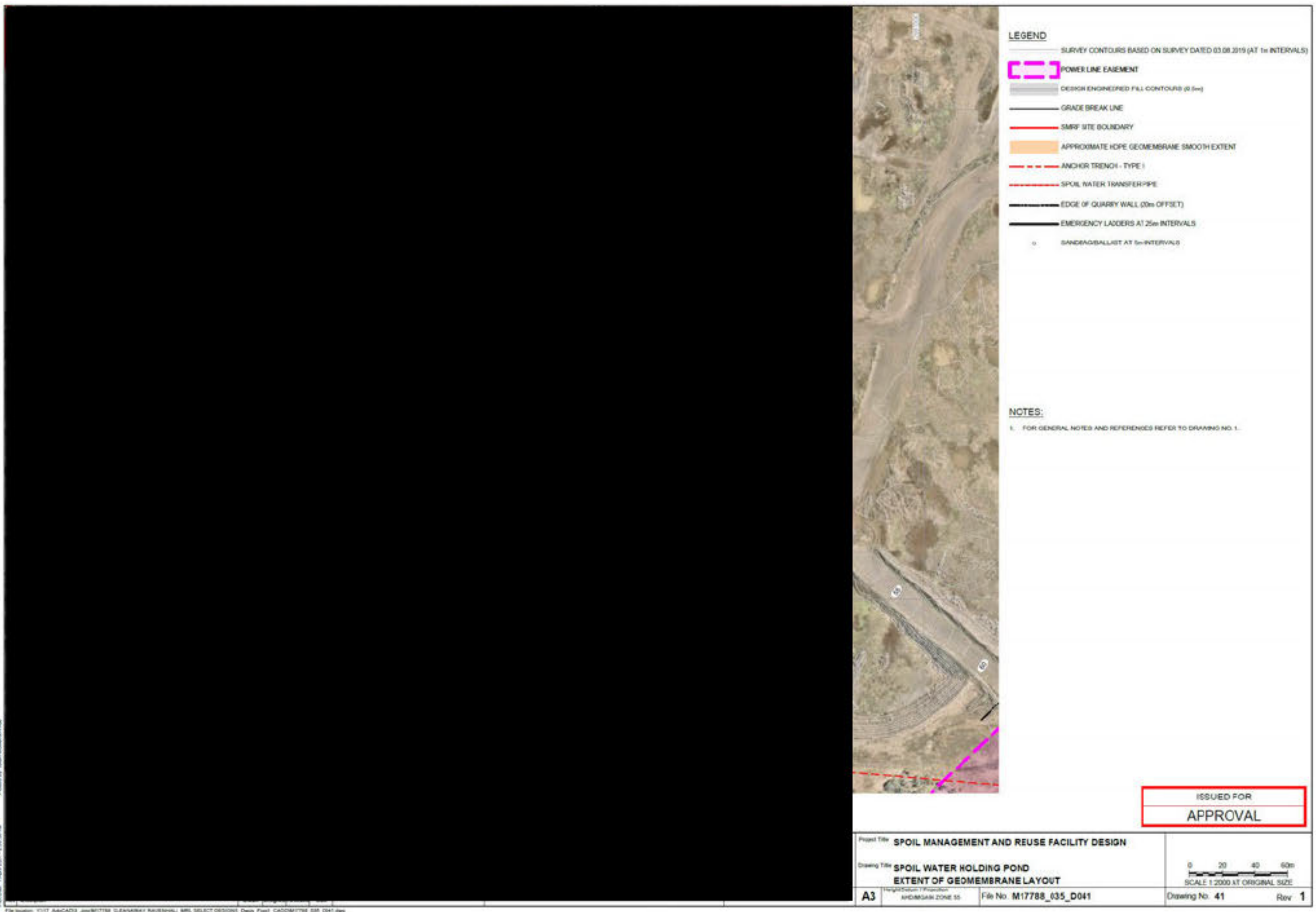


Figure 25. Plan of the SMRF spoil water holding pond.

7.3.1.2 Subgrade

Earthworks and subgrade preparation for the settlement and spoil water holding ponds is detailed in the design plans, Design Report, Technical Specifications and CQAP, submitted as part of the EMP (Appendix A of the EMP). The ponds are proposed to be constructed in a quarry void and the *in-situ* subgrade is composed of basalt rock, scoria and clay. The information provided indicates that a geotechnically stable platform can be achieved for the construction of the overlying liner suitable for storage of the spoil water. The separation from groundwater (assessed further in section 7.2.1.6) indicates that depressurisation of groundwater will not be required.

7.3.1.3 Liner system

The liner profile adopted for the settlement pond and the spoil water holding pond (Figure 26) is provided is summarised below (from bottom to top):

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted].

The profile is consistent with a Type 2 landfill liner as per EPA Publication 788.3, with a [redacted]. The liner profiles are supported by the modelling provided in the HRA (see section 6.4). Therefore, EPA considers that the liner is adequately designed and impervious for the purposes of managing leachate. The spoil water holding pond also includes ballasting that considered wind uplift.

The Technical Specifications and CQA Plan provisions for the liner components are addressed further in section 7.3.1.5. The Design Report includes all aspects for consideration of liners detailed in EPA publication 1323.3, where relevant to this application. The considerations provided adequately address the key objectives of the liner and meet the intent of the required outcomes and suggested measures detailed in EPA publication 788.3, where relevant to this infrastructure.

[redacted]

Figure 26. Liner profile for the spoil water holding pond.

7.3.1.4 Groundwater separation

The separation from groundwater in the vicinity of the settlement pond and spoil water holding pond is addressed in the EMP in section 3.12. The ponds are to be raised up from the base of the quarry floor. This equates to a separation of a minimum of 2 m from current groundwater level and is considered in the hydrogeological risk assessment.

7.3.2 Technical Specifications and CQAP

The general method of construction of the preparatory earthworks, subgrade and liner components, for the settlement pond and spoil water holding pond, are sufficiently detailed in the Technical Specifications. The provisions are in general accordance with relevant standards and industry best practice.

The proposed properties for the materials, used in construction of the settlement pond and spoil water holding pond, are in line with those of EPA Publication 788.3, industry best practice and other relevant standards. The properties of preparatory earthworks and subbase appear to be sufficient to enable the construction of a stable base for the construction of the liner. The [redacted] properties are broadly in line with the specifications provided in EPA Publication 788.3, and [redacted] - ASTM Version Standard Specification, respectively.

The CQA testing of materials proposed to be used in construction of the settlement pond and spoil water holding pond liner are broadly in line with the specifications detailed in EPA Publication 788.3. The Technical Specifications and CQA plan also detail CQC and CQA procedures for the construction of the liner, broadly meeting the intent of EPA Publication 788.3. This includes appropriate independent third-party involvement in the construction to verify that this is in accordance with the design intent, via involvement of a Geotechnical Inspection and Testing Authority (GITA) (Level 1 Responsibility), CQA Inspector and Auditor. The Auditor will verify the construction works meets EPA s approved design documents. Relevant Auditor hold points are included in the CQAP, broadly in accordance with those detailed in Appendix 12 of EPA Publication 1323.3.

In summary, the Technical Specifications and CQAP, address all the relevant aspects typically required for landfill cell designs as per Appendix 10, 11 and 12 of EPA Publication 1323.3, where relevant to the design intent of the settlement pond and spoil water holding pond. The Technical Specifications demonstrate the specifications for the primary elements used in construction and construction approaches are broadly in line with best practice. The CQAP provides sufficient provisions to demonstrate that the holding pens and [redacted] liner will be constructed to meet its design requirements.

7.3.3 Settlement pond and spoil water holding pond design conclusions

EPA conclusions

- EPA is satisfied that the settlement pond and spoil water holding pond designs included in the EMP, contain sufficient provisions to adequately manage environmental risks that may arise during their construction and operation. The design documents also include sufficient information to ensure that the settlement pond and spoil water holding pond are constructed in accordance with the design intent.

7.4 Leachate water balance

The leachate storage pond is [redacted] in footprint and will be designed to have a leachate depth of [redacted] with a freeboard of [redacted] The EMP states that a 1 in 100-year rainfall event for the area is expected to be [redacted] over a 24-hour period. Given there is no uncontrolled run-in of rainwater into this structure the [redacted] freeboard could accommodate even extreme rainfall events. The total storage capacity will be [redacted], with an operational capacity of approximately [redacted] (minus the [redacted] m freeboard volume). The capacity of this pond is informed by a water balance for the Site, provided in the EMP (Appendix H).

The water balance considers the spoil containing infrastructure footprints, in exception of the [redacted], for receiving rainfall and for evaporation in areas where leachate can pond. It is noted that the water balance uses a staged approach to estimate this, whereby only parts of the footprint are available to allow evaporation at different times in the project. Local climate data from the BOM weather station at Laverton was used in the assessment. The pond sizing was chosen based on the assumption of two consecutive 90th percentile rainfall years, in accordance with the requirement for landfills in EPA Publication 788.3. This took into consideration seasonal variations and also assessed two scenarios for where the peak spoil production rate will coincide, with the maximum in summer and in winter.

The water balance took into consideration leachate generated by the spoil once at the Site. Calculations are provided assessing the rainfall, free spoil water, evaporation and treatment plant capacity in determining the maximum requirements for storage volume required. The water balance uses values for the spoil moisture content on arrival provided by CPBJH JV and the assumed final moisture content based on the lithology in question. This assumes that all of this excess water will drain within a short time period once arrived at the Site, which is likely an over estimation of the volume of water that will be generated. The treatment of leachate is also factored into the leachate balance, with an average treatment rate of [redacted] adopted which accounts for down time for maintenance and replacing filters, which appears reasonable.

The required storage for the various scenarios (rainfall, project start date, with and without treatment) are presented in the EMP. The leachate storage pond capacity could accommodate the leachate generation of two consecutive 90th rainfall years and a July start time, assuming WTP allowing for disposal of treated leachate. If a November start time is assumed, the required capacity would exceed that of the pond operational capacity ([redacted]) but meet that of the total volume ([redacted]), again assuming two consecutive 90th rainfall years and an operational WTP allowing for disposal of treated leachate. This water balance has conservatively assumed that during the 16-month operation of the facility 90 h percentile rainfall will occur, further, only the mean evaporation factor was applied and no account was made for use of treated water at the adjoining Melbourne Regional Landfill. The water balance produced a storage requirement of [redacted] The EMP states that [redacted] is provided, the justification for the [redacted] difference between these volumes is the conservatism in the water balance modelling described above.

7.5 Leachate Treatment

A suitable water treatment plant (WTP) has been proposed to be used to treat the leachate that is collected from the processing area and containment system. Details of the proposed treatment system are provided in Appendix A-4 of the EMP. The proposed leachate treatment system consists of [redacted] which are typical for PFAS treatment. The overall process selected for the WTP is to collect the supernatant from the settlement ponds as raw water, then [redacted], then the clear water will be treated by [redacted]. EPA assessed the proposed water treatment system and has determined that it is adequate and has the ability to achieve the required PFAS quality of [redacted]

After treatment of the leachate to remove PFAS to the level of [redacted], the treated leachate will be stored in tanks and a suitably designed holding pond prior to onsite reuse. Every batch of the treated leachate will be tested for PFAS and documentation will be submitted to EPA for review. If trigger value ([redacted]) is exceeded or other potential contaminants are detected, treated leachate should not be reused and will either be retreated or disposed to a licensed facility.

Waste generated by the WTP will be managed by destroying PFAS impacted treatment media rather than disposal to landfill. Spent media, whether [redacted] is proposed to be thermally treated to remove PFAS at an appropriately licensed treatment plant.

Sludge waste is proposed to be treated on site by the [redacted] and then removed to a suitably licensed Prescribed Industrial Waste treatment facility for further treatment or destruction.

EPA conclusions

- Leachate is proposed to be treated through a water treatment plant consisting of [redacted] The system has been designed to treat water down to between [redacted] for total PFAS.
- EPA is satisfied that the proposed treatment system will sufficiently treat the spoil water so that concentrations of potential contaminants will be reduced to allow reuse of the water on site.

8 Environmental management and monitoring

The EMP identifies various operations undertaken at the SMRF and containment cell, including:

- initial processing of spoil
- management of leachate
- classification of spoil
- reuse, containment, or disposal of spoil
- reuse or disposal of treated water.

Various requirements for operations were identified as part of EPA's assessment. They are reproduced below as sub-headings, with the extent that the application met them, discussed.

8.1 Spoil

Details are provided on the process for receiving the spoil at the SMRF in the EMP. This includes a clear process for the arrival of loads at the Site through a dedicated entrance, weighing, sampling and the allocation and deposition of spoil in the holding pens. This information appears to be sufficient and the processes clearly set out.

The EMP clearly sets out the concentration criteria for PFAS and other contaminants of concern in spoil that require different management activities in Table 3.1. This details the proposed acceptance criteria for the cell, the thresholds for reuse within MRL cells, unrestricted reuse at MRL and that requiring disposal at a licensed facility.

Details on the management of the spoil in the holding pads are provided in the EMP. This information includes unloading of trucks within the pad and load out protocols, to ensure that spoil is contained within the holding pads and limit trafficking of spoil out of the pad.

Once categorised the spoil will be removed from the holding pens and routed to the appropriate destination according to its classification. If the spoil meets Fill material and PFAS concentrations consistent with EPA Publication 1669.4 the spoil and entrained water will be moved to the – NPI Reuse at MRL Storage Area. This area is not lined but is bunded to contain entrained spoil water. This material will have entrained water that may infiltrate to groundwater. Therefore, consideration has been given to the potential ability to impact on groundwater and how the beneficial uses of the groundwater shall be protected. The EMP details the process for considering this risk to groundwater by analysing the spoil water for IWRG parameters to screen for potential contaminants not highlighted as an issue by analysing the spoil itself.

A number of potential reuse options are detailed in the EMP in section 11. These reuses typically include materials for use within containment of other MRL landfill cells and meet the acceptance criteria for those cells in regard to PFAS or material that meets the unrestricted use criteria as per EPA Publication 1669.4 and can be used outside of containment at MRL.

Material that meets the containment cell acceptance criteria will be transported there and deposited in the cell. As it is anticipated that this material will be of relatively high moisture content, additional bunds are provided for the cell, in addition to concrete tipping aprons around the cell. This is to aid uniform placement of spoil in the cell should it be of high moisture content. The EMP notes that spoil may be mined out of the cell at a future date for reuse. It should be noted that if this is the case, further approvals may be required from EPA in regards the specific reuse in question.

8.1.1 Containment cell compliance sampling

Cleanaway proposes additional compliance sampling of spoil in section 9.0 of the EMP for EPA publication IWRG 621 parameters but excludes PFAS. EPA recommends that PFAS is included in additional compliance sampling for additional oversight of the spoil classifications provided by the SAQP sampling. This accords with the stated intent of section 9.0 in the EMP of appropriately classifying the material for EPA approval. It is acceptable to reduce sampling frequency if results remain consistent giving confidence in the classifications provided by the SAQP sampling.

8.1.2 Prescribed industrial waste disposal (PIW)

Section 6.3.3 of the EMP sets out the protocol for management of spoil that is categorised as Category A, B or C PIW according to EPA publication IWRG621. Category C PIW which contains PFAS that is within the thresholds in the NEMP for the MRL landfill cell construction type will be transported to active cells at the MRL landfill, passing over the weighbridge in the northern end of the SMRF. The EMP also states that this will be subject to EPA's waste tracking and transport requirements and appears to be adequate. Category B or A PIW will be removed from the holding pad and transported to a suitable licensed facility to receive such waste. This will also be subject to EPA's waste tracking and transport requirements.

There is some potential for spoil to be potential acid sulfate soil (PASS) associated with the Newport Formation sediments. Management contingencies are in place for this material in the holding pads through the use of a AgLime guard layer and testing for PASS.

8.2 Leachate

An overview of the leachate management infrastructure is provided in section 7 of the EMP and is discussed further in section 6.6 above. This includes the primary flows of leachate through the management infrastructure. To summarise, all water that is entrained within the spoil or incident rainfall that contacts spoil is treated as leachate. On arrival at the SMRF and placement in the holding pads or [redacted], leachate will not be removed until classification is obtained. The management will then be dependent on the classification of the spoil. If analysis indicates that the leachate will not contain any contaminants that cannot be treated or reused, the leachate will be removed and disposed to a licensed facility, according to the EMP:

> Spoil Water in the Holding Pens will be removed by vacuum truck accessing the pens from the unloading batter and from sumps connected to the drainage [redacted] under the trafficable layer in the pens (refer to Figure 14).

If the spoil is found to be Fill material according to EPA publication IWRG621 and PFAS compounds are below the EPA Publication 1669.4 values for unconditional reuse, the material including entrained leachate may be moved to the Reuse at MRL area. For material that is classified as PIW, the leachate will not be directed to the leachate management system but will instead be collected and disposed of off-site, at a facility licensed to accept the waste.

An assessment and summary of the provisions for leachate management within the containment cell are provided in section 6.5.3. In summary the cell includes extra provisions for management of leachate within the cell, including extra drainage [redacted] materials for directing leachate to the sump for removal from the cell. It is noted in the EMP that a maximum leachate head of 300 mm will be maintained in the containment cell through extraction of water from the sump. This will be monitored monthly and maintained using the leachate sump pump.

Leachate removed from the holding pads, [redacted] and the containment cell will be directed, via a sedimentation pond, to the leachate storage pond (spoil water holding pond). The leachate will be stored here, prior to treatment in the dedicated WTP. The EMP also includes provisions for the reuse of treated water (to below [redacted]) at the SMRF or at the MRL. This includes a number of proposed uses, including (as per the EMP):

- dust suppression in the SMRF and surrounds.
- wheel wash and truck washing water in the SMRF
- wash water for cleaning out of the holding pens
- water source for moisture conditioning for engineered fill and [redacted] lining in the SMRF and wider MRL landfill construction activities.

These uses are acceptable based on the proposed water treatment for PFAS and removal of any spoil water impacted by identified PIW.

Table 8-2 of the EMP contains a monitoring schedule for leachate within the containment cells of [redacted] for level/depth and for quality/composition [redacted], then [redacted] for the remainder of the SMRF operation and [redacted] thereafter. The proposed level/depth monitoring is equivalent to a typical landfill and the quality/composition exceeds that of a typical landfill.

8.3 Groundwater

An environmental monitoring and inspection program is proposed in section 8.8 of the EMP and in further detail in Appendix C. It contains all of the information for a monitoring program that is required of landfills as per EPA landfill licensing guidance. The monitoring information includes sampling location, frequency, analytical parameters, methodology, QA/QC information and trigger levels. This information appears to be well informed by existing guidance and adequate for the monitoring required. No background PFAS concentrations are provided in the EMP, however, section 8.8 of the EMP states:

Prior to commencement of SMRF operations it is also proposed to complete water and sediment monitoring at off-site locations in the event that accidental discharge of waste from the SMRF occurs.

The current and proposed groundwater monitoring networks are presented in Figure 25. Groundwater is to be sampled from the 10 existing groundwater bores at the Site, in addition to six new proposed bores at the southern boundary of the SMRF. The new bores must be installed and developed prior to any spoil acceptance. Based on the groundwater flow directions in the upper aquifer a number of up-gradient bores already exist at the Site and the new bores appear to be sufficient to detect potential downgradient impacts from the SMRF. The proposed bores are all sampling the upper water table aquifer in the Newer Volcanics as this is the aquifer likely to receive any seepage from the SMRF. The EMP states this is the primary target aquifer to be monitored as the lower aquifer is confined and that this is consistent with the MRL southern expansion works approval.

The sampling frequency is included in the EMP and is stated to be:

- [redacted]
- [redacted]
- [redacted].

This frequency appears to be sufficient to detect potential impacts from operations at the Site for the groundwater flow velocities anticipated at the Site. The sampling methodology and analytes list appears to be appropriate and encompasses PFAS compounds and other key potential contaminants of concern.

As noted above, no background concentrations for potential contaminants of concern are presented in the EMP. The background PFAS levels in the groundwater monitoring network are proposed to be established prior to the potential development of the facility and prior to the facility potentially receiving spoil.

Figure 27. Existing and proposed monitoring locations for the SMRF.

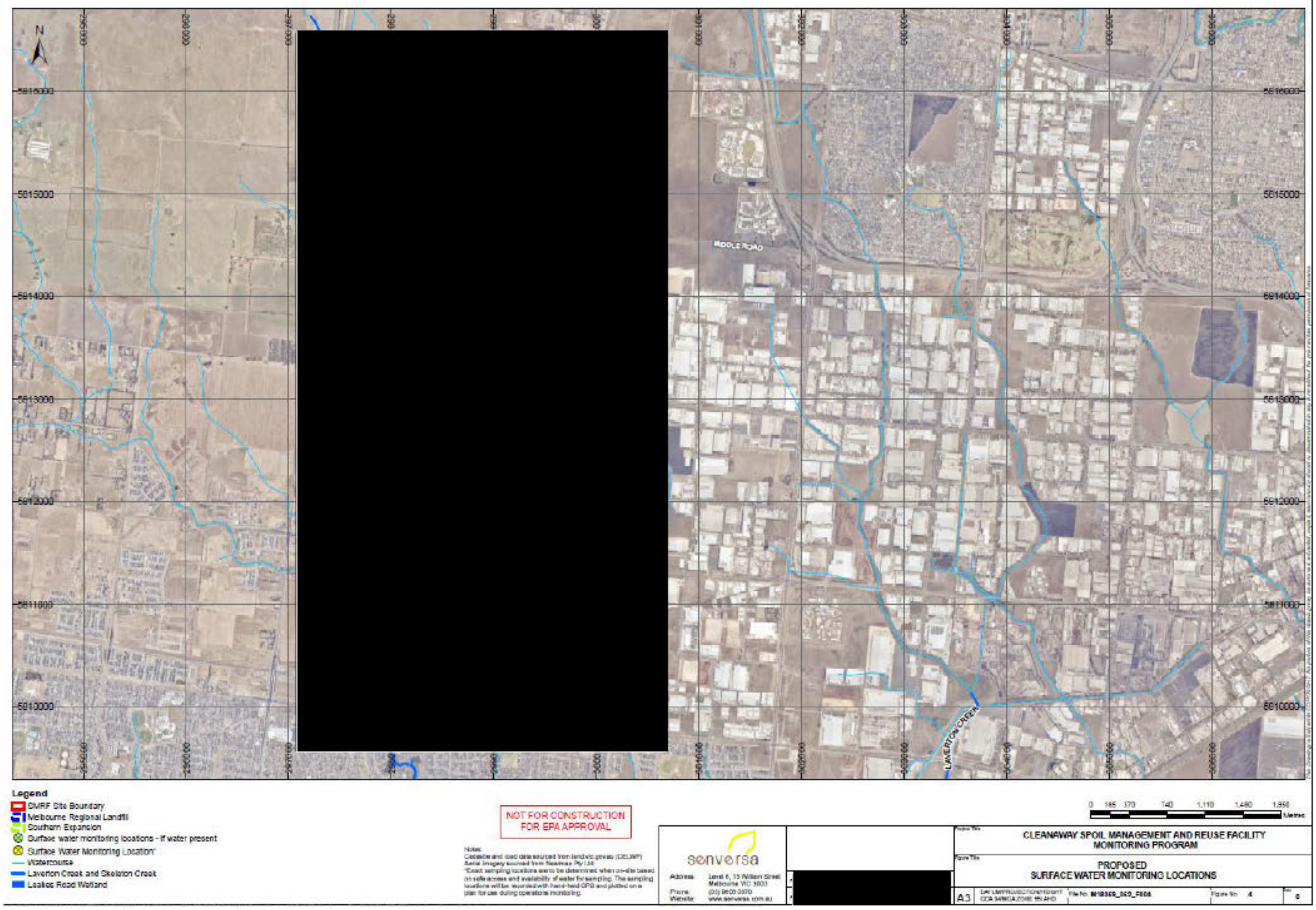
EPA conclusions

- The background concentrations of target analytes will be established in the existing and proposed monitoring bore array prior to receiving spoil at the facility.
- The EMP addresses the risk to groundwater through appropriate leachate management and treatment and by proposing a monitoring plan for this aspect. All leachate management will be undertaken within appropriately bunded areas to prevent potential groundwater contamination.
- A suitable monitoring program is proposed which will monitor and assess for potential changes in groundwater conditions during and following operation of the proposed facility.

8.4 Surface water

Prior operations, baseline testing of surface water and sediment will be conducted to establish background conditions (including PFAS) at off-site locations (that is, Skeleton Creek, at Leakes Road Wetland and at the lower reaches of Laverton Creek). A summary of the proposed environmental monitoring is provided in the EMP. PFAS-analysis is to be completed to ultra-trace level.

Biota sampling will be undertaken along with surface water and sediment sampling at off-site locations (that is, Skeleton Creek, at Leakes Road Wetland and at the lower reaches of Laverton Creek), to establish a baseline of existing conditions. A commitment is made to continue off-site surface water monitoring and inclusion of biota sampling, if PFAS concentrations increase overtime (that is, are higher than the established baseline levels) or if there is an event that has the potential impact the surface waters.



[redacted]

Figure 28 Off-site surface water sampling locations

The sampling frequency for surface water and sediment on-site and off-site locations is included in the EMP and is stated to be:

- [redacted]
- [redacted]
- [redacted].

EPA conclusions

- If surface water infiltration is mitigated as per the engineered elements of the SMRF, it is likely that migration of contaminants to sensitive receptors will be controlled, and the downstream users will not be affected. The monitoring program will detect issues should they occur.
- Background concentrations of PFAS in surface water and sediments will be established at the off-site locations (Skeleton Creek, at Leakes Road Wetland, lower reaches of Laverton Creek) prior operations.
- Detailed summary of the environmental monitoring plan is provided in the EMP. EPA is satisfied that local surface water will be appropriately monitored.

8.5 Air quality

Given the high moisture content of the material (50-58 per cent), it is not expected that there would be a significant risk of additional dust impacts at the Site. Cleanaway has considered the potential sources of dust emissions, which include the transportation and unloading of material as well as the unsealed road surfaces. The measures that have been proposed are considered to be sufficient to deal with any potential dust. According to the submitted documents, additional monitoring points to the south and west of the Site will be established, these will be used to assess off-site dust impacts and trigger additional dust mitigation as specified in the dust monitoring program. Additional sampling rounds are also proposed to supplement the existing dust monitoring program. There will also be a greater emphasis on real time dust and weather observations by operators being used to trigger dust mitigation practices.

EPA conclusions

- Dust is to be minimised as far as reasonably practicable – for both construction activities and operations. Suitable dust prevention and management procedures are described in the EMP. These measures are described for the whole facility.
- Monitoring points to the south and west of the Site will be established in addition to existing dust monitoring, this will be used to trigger additional dust mitigation as required.
- The existing dust monitoring program is being revised to address the potential for additional potential dust from the project. This will include a greater emphasis on real time dust observations by operators being used to trigger dust mitigation practices.

8.6 Noise/vibration

Where EPA guidelines do not provide noise criteria, the most appropriate approach is to demonstrate application of requirements and measures implemented to reduce the impacts. EPA publication 1254 lists in section 2 provisions regarding community consultation, work scheduling, and work requirements which includes requirements and measures to be applied.

The intent of EPA guidelines for construction noise is that the first consideration is to minimise construction noise as far as reasonably practicable. The requirements listed in section 2 of EPA publication 1254 provide requirements and measures to be applied in the first instance prior to considering compliance to specific noise levels.

Measures to attenuate noise include broadband reversing beacons, exhaust noise attenuators on-site plant and scheduling works majority of works to daytime hours.

EPA understands that evening and night operations will be restricted to receiving and emptying of trucks into the holding pens. All other proposed movement spoil around the facility or other operational activities will only occur during daytime hours.

We also note that the current pandemic situation has resulted in more people working from home during the day period than usual, and people having to stay at home in the evening/weekend periods. It can be expected that the opportunities for people to cope with the noise are limited. It is likely that this will remain the case in the foreseeable future, even when lockdown restrictions are lifted.

EPA conclusions

- Based on the information provided the addition of the [redacted] and the SMRF will comply with SEPP N-1.
- Noise is proposed to be minimised as far as reasonably practicable – for both construction activities and operations – prior to considering compliance to the relevant noise limits or criteria.
- Appropriate noise mitigation measures are proposed. Regular noise monitoring will also occur to measure the effectiveness of the proposed controls.

8.7 Other management activities

The EMP includes information on the daily environmental checklist which is used to audit the above management and control measures enacted for the SMRF (section 8.8.5 of the EMP). This checklist includes inspection of all of the spoil or leachate holding infrastructure (holding pens, lined cells, settlement ponds and leachate storage ponds). For this infrastructure, the checklist will record aspects such as the freeboard, evidence of loss of containment, presence of leachate (as supernatant or in drainage system), dust, noise or odours. The checklist will also include housekeeping factors such as leaks, spills and mud on haul roads, and inspection of key amenity indicators at the perimeter. The proposed checklist appears adequate, although details on this are somewhat limited.

Many of the above inspection items are related to further trigger values and contingency actions detailed in section 8.9.1 of the EMP. These appear adequate and are discussed elsewhere in detail where necessary.

8.8 Decommissioning

Section 15 of the EMP discusses the future uses of the proposed facility and includes specifics on the proposed decommissioning,

[redacted]:

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

The plan for decommissioning the facility (section 15.3 of the EMP) indicates that all materials that have come into contact with spoil or leachate will be tested to confirm their waste categorisation. If meeting the acceptance criteria of the containment cell, these materials may be disposed of there. These provisions appear to be appropriate.

An assessment of the soils imported as engineered fill beneath the temporary structures such as the holding pens are proposed to be undertaken on completion of the use of the area. Results will be compared with the baseline assessment undertaken during construction. This is required to determine whether there has been any impact to the sub surface has a result of the activities and to determine if any clean-up is required.

EPA conclusions

The Site is proposed to be decommissioned to facilitate the proposed expansion of landfilling activities at the Site. An assessment of the soils beneath the temporary structures such as the holding pens is proposed to be undertaken on completion of the use of the area.

8.9 Reporting

Reporting details are provided in section 7 of the operations management plan (Appendix B of the EMP). Reporting is proposed to include pollution and safety incidents, environmental monitoring events, tracking of waste volumes and disposal locations, quantity of leachate removed, treated and either disposed or reused, non-compliance incidents and complaint investigations. This is consistent with EPA's expectation with regards to the type of information to be reported or recorded.

It is expected that EPA will receive a copy of the reporting of environmental monitoring events following each monitoring event (for example, quarterly).

It is stated that records will be kept on-site for a minimum of two years following completion of works, in accordance with the Regulations.

8.10 Pollution Incident Plan

A pollution incident plan is provided in Appendix C of the operation management plan (Appendix B of the EMP). The plan supports a broader site emergency management plan for the Site. The pollution incident plan identifies the key environmental hazards, risks and both site and procedural controls. The plan identifies EPA as a key contact and that EPA will be informed of any pollution incidents or escape, spill or leak of waste outside of the containment areas as soon as practicable. This meets EPA's expectations for potential pollution response. The plan summarises adequately details for response for each of management of waste soils, loss of containment, groundwater, leachate, treated water, surface water and dust.

EPA is satisfied with the details provided related to the pollution incident management plan in the EMP.

8.11 Auditing

An independent Environmental Auditor has been engaged to review the EMP, including detailed design documents, technical specifications and construction quality assurance plan. A report prepared by the auditor assessing the suitability of the detailed designs, technical specifications, construction quality assurance plan, monitoring program and pollution incident plan is presented in Appendix K of the EMP. The auditor's assessment was undertaken against the requirements of the Regulations and supports the EMP, concluding:

"*…the Design Report, Design Drawings, Technical Specification and CQA Plan for the earthworks and lining system components of the SMRF, together with the MP and PIP have been prepared to achieve the requirements and objectives of the Regulations.*

…that adequate control measures have been designed to ensure that the acceptance of Tunnel Spoil at the site would not present an environmental or safety risk at the site."

An independent auditor is also proposed to be engaged to undertake an audit of the construction of the spoil management infrastructure. A report is to be prepared and provided to EPA on completion of construction, prior to receipt of waste spoil.

A risk of harm audit is proposed to be undertaken during the potential operation of the facility, as required by clause 6 (2)(q) of the Regulations. Reporting is currently proposed to be 6-monthly, following operations commencing. Issues identified during the audits are proposed to be rectified.

EPA conclusions

- EPA is satisfied that an Auditor has undertaken an audit of the suitability of the detailed designs, technical specifications, construction quality assurance plan, monitoring program and pollution incident plan.
- EPA is also satisfied with the proposed future scope of audits during and after both construction and operation of the proposed facility.

9 References

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Appendix A: EMP Checklist Assessment

Requirement (under the Environment Protection (Management of Tunnel Boring Machine Soil) Regulations 2020, Part 6(2)	Assessment/Comment
(a) Description and map of the location of the premises at which tunnel boring machine spoil is to be received.	A description of the location of the premises at which tunnel boring machine spoil is to be received is included at section 3.2 of the EMP. A map of that location is included at Figures 1 and 2.
(b) A plan of the premises identifying the location of the processing area for the purposes of regulation 5(b) and the location of the containment system.	A plan of the premises is included at Figures 2 and 4. A description of the processing area is included in section 3.3, and a description of the containment system is included in section 3.4. That plan identifies: (i) the location of the processing area for the purposes of regulation 5(b) (defined by the blue outlined areas on Figure 2); and (ii) the location of the containment system (defined as the purple outlined area on Figure 2).
(c) Description of the physical characteristics of the premises and elements or segments of the environment adjacent to the premises.	A description of the physical characteristics of the premises have been provided in section 3.6, 3.8 and 3.11. A description of the elements or segments of the environment adjacent to the premises is included at section 3.11 and Appendix E, which includes a description of the physical characteristics of those elements or segments.
(d) The existing and proposed uses of the premises and elements or segments of the environment adjacent to the premises.	The existing uses of the premises are included at section 3.8. The proposed uses of the premises are included at sections 15.1 and 15.2. The elements or segments of the environment adjacent to the premises are included at section 5.2 and in Appendix E (Conceptual Site Model Table).
(e) A description of the activities to be undertaken at the premises.	A description of the activities to be undertaken at the premises is included at sections 3.1, 3.7, 6.1 and 6.2.
(f) A description of the tunnel boring machine spoil to be received at the site.	A description of the tunnel boring machine spoil to be received at the Site is included at sections 4.1 to 4.4 of the EMP.
(g) The specifications for containment of tunnel boring machine spoil at the premises.	The specifications for the containment of tunnel boring machine spoil at the premises are included at sections 3.1.2.

(h) The methodology for determining if tunnel boring machine spoil meets the specifications for containment of tunnel boring machine spoil.	The methodology for determining if tunnel boring machine spoil meets the specifications for containment of tunnel boring machine spoil is provided in sections 5.3 and 9.1 to 9.3.
(i) An assessment of the risk of adverse impacts from the receipt, storage, treatment, reprocessing, containment, handling or discharge or deposit onto the premises of tunnel boring machine spoil ("the Activities") on any beneficial uses of the environment.	An assessment of the risk of adverse impacts from the receipt, storage, treatment, reprocessing, containment, handling or discharge or deposit onto the premises of tunnel boring machine spoil ("the Activities") on any beneficial uses of the environment is included at section 5, Appendix D (Groundwater Quality Impact Assessment), and Appendix F (Potential acid sulfate soil (PASS) risk and recommended contingency).
(j) Management arrangements and operating conditions designed to minimise the risk of adverse impacts from the Activities on any beneficial uses of the environment.	Management arrangements and operating conditions designed to minimise the risk of adverse impacts from the Activities on any beneficial uses of the environment are included at sections 6.2, 7, 8, Appendix B (Operations Management Plan) and Appendix C (Monitoring Program).
(k) Detailed designs and technical specifications of the processing area for the purpose of regulation 5(b) and the containment system at the premises, including features intended to minimise the risk of adverse impacts from the Activities on any beneficial uses of the environment.	Detailed designs and technical specifications of the processing area for the purposes of regulation 5(b), including features intended to minimise the risk of adverse impacts from the Activities on any beneficial uses of the environment are included at sections 6.2, 6.6, 6.8, 7.3, 7.4, and Appendix A-1 (Design Report), Appendix A-2 (Technical Specifications and Drawings) and A-4 (Water Treatment Plant Designs). Detailed designs and technical specifications of the containment system at the premises, including features intended to minimise the risk of adverse impacts from the Activities on any beneficial uses of the environment, are included at sections 6.2 and 6.7 and sections 4.1, 5, 6 and Appendix A-1 (Design Report) and Appendix A-2 (Technical Specifications and Drawings).
(l) A construction quality assurance plan for the containment system at the premises.	A construction quality assurance plan for the containment system is included in Appendix A-3 (Construction Quality Assurance Plan).
(m) Requirements for leachate sampling and analysis.	Requirements for leachate sampling and analysis are included at sections 8.1.1 and 8.8 and sections 5.2 and 5.3 of Appendix C (Monitoring Program).
(n) The specifications of the qualities and characteristics of leachate that is suitable for reuse and an identification of activities for which that leachate can be reused.	The specifications of the qualities and characteristics of leachate that is suitable for reuse is included at section 7.1. The identification of activities for which that leachate can be reused is included at section 7.7.

(o) Details of the method to be used to measure and record the information required to be recorded and retained under regulation 5(p).	Details of the method to be used to measure and record the information required to be recorded and retained under regulation 5(p) are included at sections 8.1.1 and 13 of the EMP and section 7.3 of Appendix B (Operations Management Plan).
(p) A monitoring program to demonstrate compliance with the environment management plan.	A monitoring program to demonstrate compliance with the environment management plan is included at sections 8 and Appendix C (Monitoring Program).
(q) Requirements for an environmental auditor to audit the risk of harm actually or potentially arising from the activities at the frequency specified in the environmental management plan.	Requirements for an environmental auditor to audit the risk of harm actually or potentially arising from the Activities at the frequency specified in the environment management plan are included at section 2.5.3.
(r) A pollution incident plan setting out how any pollution incident will be responded to	A pollution incident plan setting out how any pollution incident will be responded to is included at Appendix C of Appendix B (Operations Management Plan).
(s) A report prepared by an environmental auditor assessing the suitability of the detailed designs, technical specifications, construction quality assurance plan, monitoring program and pollution incident plan in achieving the requirements and objectives of these Regulations.	A report prepared by an environmental auditor assessing the suitability of the detailed designs, technical specifications, construction quality assurance plan, monitoring program and pollution incident plan in achieving the requirements and objectives of these Regulations is included at Appendix K-1 and K-2. • Design documents at section 4.1 to 4.3, 4.5.3 and 4.5.4 of Appendix K-1 • Technical specifications at section 4.5.1 of Appendix K-1 • Construction quality assurance at section 4.5.2 of Appendix K-1 • Monitoring program at section 5 of Appendix K-1 • Pollution incident plan at section 6 of Appendix K-1
(t) How the environment management plan is to be reviewed.	How the environment management plan is to be reviewed is included at section 2.6.