



18 October 2017

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Our ref: 2219058-42015  
Your ref:

Dear Radu

## **PFAS Contamination Assessment - Summary Report Newcastle Mines Rescue Facility, Argenton**

### **1 Introduction**

GHD Pty Ltd (GHD) was engaged to assess the potential for per- and poly-fluoroalkyl substances (PFAS) contamination at the Newcastle Mines Rescue Facility located 533 Lake Road, Argenton NSW 2284 (the Site). The Site location and site layout is presented in Figures 1 and 2, Attachment A.

NSW Environment Protection Authority (EPA) has established a program of sampling to investigate the extent of PFAS contamination across the state as part of a broader precautionary approach to manage the legacy of PFAS use in NSW. To date, sampling completed by the EPA has focused primarily on sites which have been identified as having the greatest potential use of PFAS containing products including airports, fire fighting training facilities and some industrial sites.

The Site has historically been used and owned by Mines Rescue Pty Limited (Mines Rescue), a subsidiary of Coal Services Pty Limited (Coal Services), for the training of mine personnel in emergency response and rescue procedures, which included the use of aqueous film forming foams (AFFF). The foams used may have contained PFAS including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), which are potentially harmful to human health and the environment. It is understood that AFFF was in general use for fire fighting training at Mines Rescue facilities from the 1970's until AFFF were banned by Mines Rescue and their use discontinued by 2002.

In May 2017, Mines Rescue completed targeted environmental investigations at the Site which included a desktop review of available information, a site inspection and targeted shallow soil sampling (Senversa, 2017). The results of the preliminary sampling identified PFAS in shallow soils at the Site.

Given the history of use of AFFF at the Site and based on the testing undertaken to date, Mines Rescue required additional investigations to be completed to assess the potential extent of PFAS contamination at the Site.

GHD completed a desktop review and intrusive site investigations between June and September 2017. Details of the works undertaken and the outcomes of the investigations are presented in GHD's report *Argenton Mines Rescue Station, PFAS Contamination Assessment, October 2017*.

This letter provides a summary of the findings of the investigations completed by GHD and should be read in conjunction with the GHD (2017) report and the limitations presented in Section 10 of this letter report.

## **2 Objectives and scope of works**

The overall objective of the intrusive investigation was to further investigate the PFAS impacts identified during the previous investigations, and to assess the potential risks to human health and key environmental receptors.

To address the investigation objectives outlined above, this assessment was designed to assess:

- Groundwater on-site to confirm whether PFAS impacted groundwater is present and if it has potentially migrated off-site at concentrations which may pose a risk to human health.
- Whether PFAS impacted soils are present on-site at concentrations which may pose a risk to human health or the environment.
- Sampling of off-site water bodies which may receive surface water drainage from the Site.

The scope of work comprised:

- Desktop review of available information including the Senversa 2017 report.
- Site inspection and interviews with site personnel to gain an understanding of current site conditions, ground truth information obtained during the desktop review and to understand historical training practices at the Site.
- Drilling and installation of three on-site groundwater wells (MW001 to MW003) and collection and analysis of six soil samples from these boreholes.
- Collection of one sediment sample from an on-site stormwater pit and five sediment samples from the down-gradient water courses.
- Collection of one on-site water sample from the storm water collection system and two off-site surface water samples.
- Collection of groundwater samples from the three installed groundwater wells and one existing offsite groundwater well.
- Preparation of a report summarising the findings of the desktop review and intrusive investigations (GHD, 2017).

### 3 Site history

The Site has historically been used by Mines Rescue for the training of mine personnel in emergency response and rescue procedures, including the use of AFFF which may have contained PFAS.

GHD understands that AFFF was in general use for fire fighting training at Mines Rescue facilities from the 1970's until AFFF was banned by Mines Rescue and their use discontinued by 2002. Training exercises reportedly occurred both outdoors and within purpose built training facilities such as the gallery and fire cell (igloo). Training occurred approximately once a fortnight inside and approximately once or twice a year outside. Firefighting foams were used inside the galley, the fire cell and outside in the vicinity of the fire cell in the area either to the north aiming back toward the fire cell or within the north western grassed area.

### 4 Sampling program and rationale

The sampling program was based on the preliminary Conceptual Site Model (CSM) which was developed based on the findings of the desktop review (GHD, 2017). Table 4-1 summarises the sampling program and rationale. In summary, the following activities were conducted in August 2017:

- 17 and 18 August 2017 – installation of three groundwater wells and associated soil sampling (MW001 to MW003), surface water, sediment and soil sampling at five locations (Pond 1, Pond 2, Swale 1, Swale 2, and Bridge 1) off-site.
- 25 August 2017 – groundwater sampling of all monitoring wells (MW001 to MW003), surface water and soil sampling at one locations (SW Pit 01) on-site.
- 29 August 2017- resampling of surface water at one location (SW Pit 01) on-site due to missing sample.

In addition to the above works, gauging of all monitoring wells was undertaken on the 9 October 2017 to confirm groundwater flow direction.

Sample locations are presented in Figure 3, Attachment A.

Sampling methodologies were completed with reference to the procedures outlined in the Western Australia Department of Environment Regulation (WA DER) 2017 *Interim Guideline on the assessment and management of perfluoroalkyl and polyfluoroalkyl substances* Attachment 1 (PFAS specific sample collection methods, equipment and equipment decontamination methods).

**Table 4-1 Sampling Program**

Matrix	Monitoring location		Rationale	Number of samples	Laboratory analysis *
	ID	Location description			
Soil	MW01	Within area of PFAS application	Assess PFAS concentration in soils within areas of application.	2	PFAS,  ASLP – PFAS (2 samples with highest concentrations)
	MW02			2	
	MW03	Down hydraulic gradient MW01 and MW02		2	
Groundwater	MW01	Sampling of newly installed groundwater wells	Assess impacts within and off site. Confirm groundwater flow direction.	1	PFAS
	MW02			1	
	MW03			1	
Soil and Sediment	Swale 1, Swale 2, Bridge 1, Pond 1, Pond 2 SW Pit01	In drainage lines adjacent to the training areas.  Within stormwater pits on-site	Assess PFAS concentration in soil and sediment with drainage pits on-site and down gradient from site.	6	PFAS  ASLP – PFAS ( 2 samples with highest concentrations)
Surface water	Swale 1, Bridge 1, Pond 2	Collection of water samples from down gradient drainage line and from on-site stormwater pits	Assess PFAS concentrations in surface water within drainage pits on and down gradient from the site.	3	PFAS

\* - PFAS = full suite

## 5 Results

Analytical results and field parameters are summarised in the following tables in Attachment B:

- Table A: Soil analytical results
- Table B: Sediment analytical results
- Table C: Groundwater and surface water analytical results and field parameters
- Table D: ASLP analytical results

### 5.1 Soil and sediment results

All PFAS concentrations in the soil and sediments<sup>1</sup> were less than the nominated assessment criteria for residential and commercial human health and ecological receptors.

### 5.2 Groundwater and surface water results

A summary of the groundwater and surface water results is presented in Table 5-1 and in Attachment A, Figure 5. Groundwater contours are presented in Figure 4.

**Table 5-1 Summary groundwater and surface water results**

On-site		Off-site
Groundwater data		
Drinking water guidelines	<p><b>PFHxS + PFOS:</b></p> <ul style="list-style-type: none"><li>- Reported at concentrations of 0.10 µg/L and 0.79 µg/L in MW001 and MW003 respectively, exceeding the drinking water criteria of 0.07 µg/L</li><li>- Concentrations in groundwater at MW002 were at or below the laboratory LOR</li></ul> <p><b>PFOA:</b></p> <ul style="list-style-type: none"><li>- In all instances, concentrations of PFOA were below the drinking water criteria of 0.56 µg/L</li></ul>	<p><b>PFHxS + PFOS:</b></p> <ul style="list-style-type: none"><li>- Reported at concentration of 1.56 µg/L reported in OS5, exceeding the drinking water criteria of 0.07 µg/L</li></ul> <p><b>PFOA:</b></p> <ul style="list-style-type: none"><li>- The concentration of PFOA at OS5 was below the drinking water criteria of 0.56 µg/L</li></ul>

<sup>1</sup> sediment samples collected from the internal drainage system on-site and drainage lines leaving the site have been classified as soils for the purpose of data interpretation and comparison with available guidelines.

	On-site	Off-site
Recreational water guidelines	<b>PFHxS + PFOS:</b> <ul style="list-style-type: none"> <li>- Reported at concentrations of 0.79 µg/L reported MW003, exceeding the recreational water criteria of 0.7 µg/L</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- In all instances, concentrations of PFOA were below the recreational water criteria of 5.6 µg/L</li> </ul>	<b>PFHxS + PFOS:</b> <ul style="list-style-type: none"> <li>- Reported at concentrations of 1.56 µg/L reported in OS5, exceeding the recreational water criteria of 0.7 µg/L</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- The concentration of PFOA at OS5 was below the recreational water criteria of 5.6 µg/L</li> </ul>
Ecological guidelines	<b>PFOS:</b> <ul style="list-style-type: none"> <li>- Reported at a concentration of 0.18 µg/L in MW003, exceeding the ecological screening level of 0.13 µg/L)</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- Reported below the ecological screening level (220 µg/L) in all on-site groundwater samples</li> </ul>	<b>PFOS:</b> <ul style="list-style-type: none"> <li>- Reported at a concentration of 0.55 µg/L in OS5, exceeding the ecological screening level of 0.13 µg/L)</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- Reported below the ecological screening level (220 µg/L) in the off-site groundwater sample.</li> </ul>
	Stormwater system data	Surface water data
Drinking water guidelines	<b>PFHxS+PFOS:</b> <ul style="list-style-type: none"> <li>- Reported in water sample at location SW Pit 01 at a concentrations of 0.69 µg/L exceeding the drinking water criteria of 0.07 µg/L</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- The concentration of PFOA at SW Pit 01 was below the drinking water criteria of 0.56 µg/L</li> </ul>	<b>PFHxS+PFOS:</b> <ul style="list-style-type: none"> <li>- Reported in off-site surface water at locations POND 2 and Bridge 1 at concentrations of 4.11 µg/L and 5.02 µg/L respectively, exceeding the drinking water criteria of 0.07 µg/L</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- Reported below the drinking water criteria (0.56 µg/L) in both off-site surface water samples</li> </ul>
Recreational water guidelines	<b>PFHxS + PFOS:</b> <ul style="list-style-type: none"> <li>- The concentration of PFOA at SW Pit 01 was below the recreational water criteria of 0.7 µg/L</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- The concentration of PFOA at SW Pit 01 was below the recreational water criteria of 5.6 µg/L</li> </ul>	<b>PFHxS + PFOS:</b> <ul style="list-style-type: none"> <li>- Reported in off-site surface water at locations POND 2 and Bridge 1 at concentrations of 4.11 µg/L and 5.02 µg/L respectively, exceeding the recreational water criteria of 0.7 µg/L</li> </ul> <b>PFOA:</b> <ul style="list-style-type: none"> <li>- Reported below the recreational water criteria of 5.6 µg/L</li> </ul>

	On-site	Off-site
Ecological guidelines	<p><b>PFOS:</b></p> <ul style="list-style-type: none"> <li>- Reported at a concentration of 0.38 µg/L in SW Pit 01, exceeding the ecological screening level of 0.13 µg/L)</li> </ul> <p><b>PFOA:</b></p> <ul style="list-style-type: none"> <li>- Reported below the ecological screening level (220 µg/L) in the on-site water sample.</li> </ul>	<p><b>PFOS:</b></p> <ul style="list-style-type: none"> <li>- Reported in off-site surface water at locations POND 2 and Bridge 1 at concentrations of 2.09 µg/L and 2.15 µg/L respectively, exceeding the ecological screening level of 0.13 µg/L</li> </ul> <p><b>PFOA:</b></p> <ul style="list-style-type: none"> <li>- Reported below the ecological screening level (220 µg/L) in both off-site surface water samples</li> </ul>

## 6 Discussion of Results

Table 6-1 and Table 6-2 presents a discussion of results reported during this investigation.

**Table 6-1 Summary discussion – soil and sediment results**

Media	Summary discussion
Soils on site	<p>Human health:</p> <ul style="list-style-type: none"> <li>- No on-site soil samples reported PFAS concentrations exceeding the nominated screening criteria for human health.</li> </ul> <p>Ecological receptors:</p> <ul style="list-style-type: none"> <li>- No on-site soil samples reported PFAS concentrations exceeding either the nominated ecological screening criteria for commercial/industrial land use.</li> </ul> <p>Results were within the ranges previously reported by Senversa (2017).</p>
Sediment samples in on site stormwater pit	<p>One sediment sample was collected from on-site stormwater pit (SW Pit 01).</p> <p>Human health:</p> <ul style="list-style-type: none"> <li>- Concentrations of PFAS were below nominated health based investigation levels for contaminants of concern.</li> </ul> <p>Ecological receptors:</p> <ul style="list-style-type: none"> <li>- Concentrations of PFAS were reported below the indirect ecological screening criteria for commercial/industrial land use.</li> </ul>
Sediment samples in surface water drainage lines down-gradient of the site	<p>Human health:</p> <ul style="list-style-type: none"> <li>- Concentrations of PFAS were below nominated health based investigation levels for contaminants of concern.</li> </ul> <p>Ecological receptors:</p> <ul style="list-style-type: none"> <li>- Concentrations of PFAS were reported below the indirect ecological screening criteria for parks and open space.</li> </ul> <p>Whilst the data indicates that PFAS has migrated off-site, in all instances, PFAS concentrations were below both the health based and ecological investigation levels for the individual contaminants of potential concern. Further, the potential for human exposure to sediments within the drainage lines leading from the site is considered to be low.</p>

**Table 6-2 Summary discussion – groundwater and surface water**

Media	Summary discussion
Groundwater on site	<p>The inferred direction of groundwater flow was calculated to be south west/ west which is consistent with the findings of the desktop review.</p> <p>MW001 and MW003 reported concentration of PFHxS+PFOS above the nominated drinking water criteria. However, no extraction of groundwater for drinking purposes takes place on Site and there is no pathway for exposure to PFAS in groundwater for Site users. In addition, the surrounding area is well serviced by municipal water, no registered groundwater abstractions bores are located within 1 km of the Site and it is also understood that groundwater extraction is restricted in the area.</p> <p>MW003 also reported concentrations of PFHxS + PFOS above the nominated recreational water criteria. As for the reasons above, it is unlikely that groundwater is being extracted in the area for recreational purposes.</p> <p>Concentrations of PFOS were above the ecological screening levels in groundwater sampled from MW003. However, given the depth of groundwater it is unlikely that groundwater discharges to surface water on site.</p>
Groundwater – potential for off-site migration	<p>OS5 reported concentration of PFHxS+PFOS above the nominated drinking water criteria. However, while the potential for unregistered bores cannot be discounted, it is unlikely that groundwater is being used off site for drinking water purposes given the surrounding area is well serviced by municipal water, no registered groundwater abstractions bores are located within 1 km of the Site and that groundwater extraction is restricted in the area. Further, GHD notes that the inferred direction of groundwater flow is to the south west / west, whilst the closest residential premises are located to the north and east of the site. Anecdotal information indicates that groundwater is also not being extracted by the nearby golf course.</p> <p>OS5 also reported concentrations of PFHxS + PFOS above the nominated recreational water criteria. As for the reasons above, it is unlikely that groundwater is being extracted in the area for recreational purposes. While Cockle Creek, located to the west, may be a receptor to groundwater given the low concentrations of PFAS in groundwater the risk to ecological receptors is considered to be low.</p>
Surface water in on-site drainage systems discharging to stormwater	<p>Human Health:</p> <ul style="list-style-type: none"> <li>- Whilst concentrations were reported above the drinking water criteria, incidental contact with surface water in the drains would not be expected to present an increased risk of adverse health effects.</li> </ul>



Media	Summary discussion
	<p>Ecological receptors:</p> <ul style="list-style-type: none"> <li>- The concentration of PFOS was reported above the ecological investigation levels. However, as discussed, the infrastructure sample locations are not considered to represent an environment suitable for aquatic ecosystems and ecological risks associated the presence of PFOS in on-site surface water are considered to be low.</li> </ul>
Off-site surface water	<p>Human Health:</p> <ul style="list-style-type: none"> <li>- Whilst concentrations were reported above the drinking water criteria, incidental contact with surface water within these areas is considered unlikely and the recorded concentrations of PFOS + PFHxS are not deemed to present a potential risk of exposure to humans.</li> <li>- However, surface water would ultimately drain to Cockle Creek which is used for recreational purposes. Further investigations are required to assess potential risks to human health. In addition, trends due to seasonal variation and wet weather events would be required.</li> </ul> <p>Ecological receptors:</p> <ul style="list-style-type: none"> <li>- The concentration of PFOS reported in samples collected from the off-site drainage line were above the ecological investigation levels. As discussed above, this creek ultimately drains to Cockle Creek and further sampling is required to assess potential risks to ecological ecosystems.</li> </ul>

## 7 Conceptual site model

Based on the information collected in August 2017, the CSM presented in Table 7-1 and Figure 7-1 was developed for potential on-site sources of contamination.

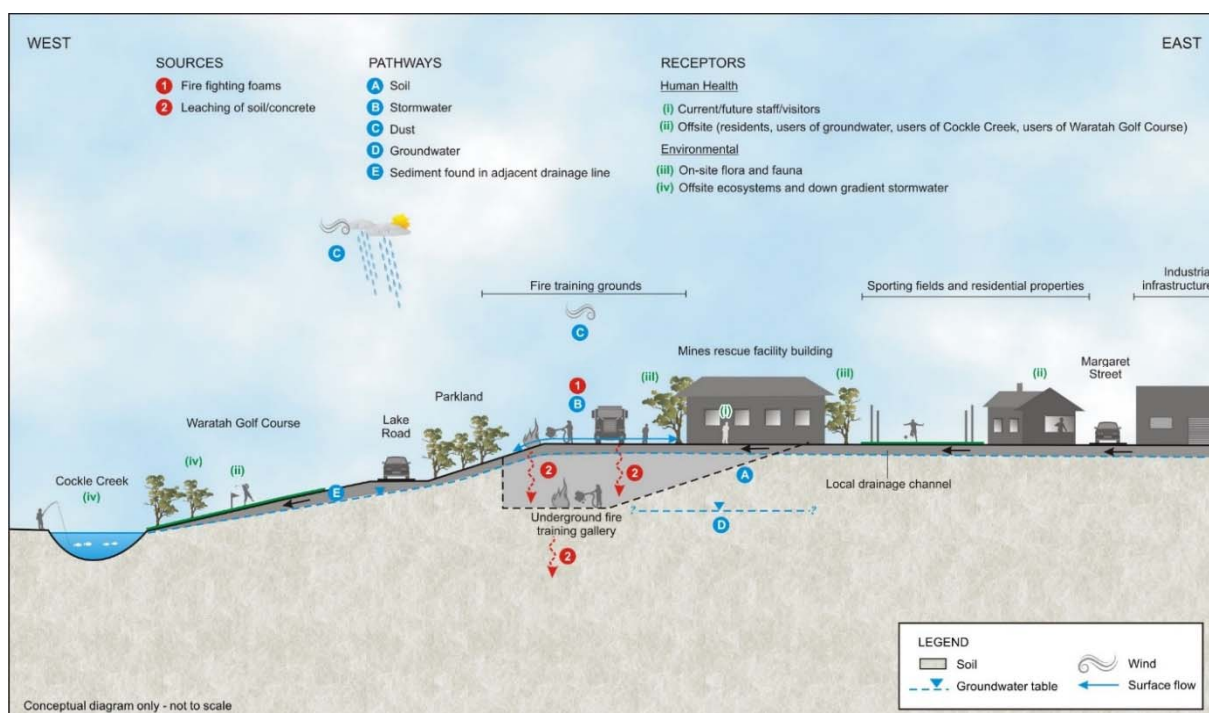
**Table 7-1 Refined CSM**

Potential Source	Primary pathway	Receptor	Pathway present?
Firefighting foams in the fire training areas	Incidental ingestion of impacted soils/sediments	Residents occupying house to the north	<b>No</b> – Samples were collected from areas of potential concern and concentrations were reported below the nominated health based investigation levels for all soil and sediment samples.
		Site staff, intrusive maintenance workers	<b>No</b> – Samples were collected from areas of potential concern and concentrations were reported below the nominated health based investigation levels for all soil and sediment samples.
	Vertical/horizontal migration of leachate through unsaturated zone	On-site ecological communities	<b>No</b> – Samples were collected from areas of potential concern and concentrations were reported below the indirect ESL. Vegetation on-site appeared to be healthy and did not exhibit any undue signs of distress.
		Groundwater – subsequent migration in groundwater (secondary source)	<b>Yes</b> – PFAS impact was reported in groundwater beneath the site at concentrations exceeding the drinking water criteria at MW003 and off site at OS5. Further consideration of potential linkage via secondary sources is presented below.

Potential Source	Primary pathway	Receptor	Pathway present?
	Surface runoff and sediment transport	On-site surface waters (including drainage systems – secondary source)	<b>Unlikely</b> – Although off-site surface water recorded PFAS concentrations above recreational and drinking water screening criteria, these exposure routes would not be plausible for the drainage line. Exposure of golf course users to PFAS in surface water would be infrequent and of limited duration (retrieving golf ball from channel). Concentrations of PFAS in surface water near Cockle Creek is not yet known.
		Off-site surface waters	<b>Yes</b> – PFAS was reported in off site surface waters sampled down gradient of the site at concentrations above the ecological screening criteria. Further consideration of potential linkage via secondary sources is presented below.
		Off-site ecosystems and surface waters (including drainage systems – secondary pathway)	<b>No</b> –PFAS detected in all source soil samples below the adopted direct and indirect ESL. Current training practises do not comprise use of PFAS containing AFFF. Majority of the site is covered in grass, buildings or sealed, limiting potential of this pathway.
Vertical/horizontal migration of leachate through unsaturated zone	Groundwater – subsequent migration in groundwater (secondary)	Offsite users of groundwater	<b>Unlikely</b> – Given the region is serviced by municipal water supplies, the lack of registered users of groundwater down gradient of the site and the restriction on groundwater extraction in the area.
		Off-site ecosystems	<b>Unlikely</b> – Although groundwater from MW003 and OS5 had PFAS concentrations above ecological screening criteria, there is no evidence that groundwater discharges to surface water.

Potential Source	Primary pathway	Receptor	Pathway present?
<b>Secondary Sources</b>			
Secondary source - PFAS In surface Water	Incidental ingestion of PFAS impacted surface waters	Site staff and intrusive maintenance workers.	<b>Unlikely</b> – whilst concentrations of PFAS were reported above the drinking water guidelines, site personnel are unlikely to come into contact with on-site surface water contained within stormwater infrastructure and drainage lines on a daily basis and the potential for incidental ingestion of this water is considered to be low.
		Users of surface water down-gradient of the site	<b>Potential</b> —concentrations of PFAS were reported above the drinking water and recreational guidelines in off-site surface water samples. While it is unlikely that personnel will come into regular contact with surface water in this area, surface water ultimately drains to Cockle Creek which is used for recreational purposes. Further investigations are required to assess potential impacts to human health.
		Ecological communities down-gradient of the site	<b>Potential</b> – whilst concentration of PFOS reported in surface water samples collected from the off-site drainage line were above the ecological investigation levels. Further sampling of surface water is required to assess the potential risks to ecological ecosystems.
Secondary source – PFAS in groundwater	Vertical/horizontal migration	Down-gradient surface water receptors recharged by groundwater	<b>Potential</b> –PFAS was reported in groundwater at concentrations above ecological screening criteria. Surface water courses in the area may potentially be a receptor to groundwater, however, given the low concentrations, it the risk to ecological receptors is considered low. Further sampling of surface water receptors are required to assess potential risks to ecological systems.

Potential Source	Primary pathway	Receptor	Pathway present?
		Abstraction bore (domestic, irrigation and/or stock use	<b>Unlikely</b> – The area is serviced by municipal water supplies and no registered groundwater bores were identified within a 1 km radius of the site. Whilst the potential for unregistered bores can not be discounted, based on the concentrations of PFAS reported in groundwater at the site boundary, the potential for use of groundwater for domestic or stock purposes is considered to be low.



**Figure 7-1 Conceptual Site Model**

## 8 Conclusion

With reference to these objectives, and the conceptual site model, the key findings of these works are summarised below:

### ***Objective 1: Potential for PFAS in Groundwater***

- PFAS was reported in groundwater at concentrations exceeding the nominated drinking water and ecological screening criteria near the western boundary off Site (MW003) and to the south west off site (OS5).
- The inferred direction of groundwater flow was to the south west/west.
- Whilst a complete pathway for migration of PFAS to groundwater was identified, groundwater is not extracted on-site and groundwater extraction is restricted within the surrounding area. Whilst the potential for unregistered bores cannot be discounted, GHD notes that the area is serviced by municipal water supply. Accordingly, the potential for use and ingestion of groundwater is low.
- In regards to the ecological screening levels, surface water receptors were identified down-gradient of the site where groundwater recharge to surface water may occur. The potential risk to ecological receptors associated with PFAS in groundwater is considered to be low.

### ***Objective 2: PFAS In soils and sediments***

- PFAS was reported in soil samples collected on and off site however all samples reported PFAS concentrations which were below the nominated screening criteria for human health and ecological screening levels indicating that site soils do not present a risk to either users of the site under the current land use scenario or ecological receptors.
- Leachability testing showed that PFAS within soils on and off site have limited potential to release PFAS, and based on the concentrations reported during these works, this pathway is not considered to represent a significant on-going source of PFAS to groundwater and surface water across the Site.

### ***Objective 3 – PFAS in surface water***

- Surface water flow is managed by an onsite drainage system which discharges to the south west into a drainage channel which flows into a drainage line located to the south. This creek acts as a method of surface water transport down gradient of the site. This creek discharges into Cockle Creek, which ultimately flows to Lake Macquarie.
- PFAS in surface water on-site:
  - PFAS was reported in surface water samples collected from the on-site pit (SW Pit 01) which discharges to stormwater. Whilst concentrations were reported above the drinking water criteria, incidental contact with surface water in the would not be expected to present an increased risk of adverse health effects.
  - PFOS concentrations were reported for surface water sample collected from on-site pit (SW Pit 01) was above the ecological investigation levels. However, the infrastructure is not considered to

represent an environment suitable for aquatic ecosystems and ecological risks associated with the presences of PFOS in on-site surface water are considered to be low.

- PFAS in surface water off site:
  - Off-site surface water samples reported PFAS concentrations above the drinking water and recreational criteria. However, noting the nature of these sampling locations, incidental contact with surface waters in this area of the drainage line is considered unlikely. However, surface waters from this creek discharges to Cockle Creek which is likely used for recreational purposes. Further sampling of surface waters is required to assess the potential impacts to human health.
- PFOS concentrations were reported in off site surface water samples above the ecological investigation levels. Further surface water sampling is required to assess the potential impacts to ecological receptors.
- GHD understands that DPI will be conducting a program of biota sampling, which will include locations within Lake Macquarie and stopping at the mouth of Cockle Creek. GHD understands that the results of these investigations will be available in 2018 and the results of these works will provide a better indication of potential PFAS impacts, if any, within surface water receptors.

## **9 Recommendations**

Based on the findings of these works, the following recommendations are made:

- Installation of additional groundwater wells down gradient of the Site and an additional round of monitoring to confirm off-site PFAS concentrations and assess the potential for seasonal variation of PFAS concentrations in groundwater. All wells to be sampled for PFAS and major cations and anions.
- Complete a survey of water use within the area to better characterise groundwater and surface water use in the area, including understanding of the potential for domestic users of groundwater in proximity of the site and refine the CSM with respect to migration of PFAS at concentrations above the drinking water criteria.
- An additional round of surface water and sediment sampling from existing monitoring locations to assess the potential for seasonal variation in PFAS concentrations. Sampling should include a wet weather sampling event to assess PFAS concentrations in surface water and sediments during wet weather flow.
- Controlled removal of residual sediment from on-site infrastructure collection points.

## 10 Limitations

This report has been prepared by GHD for Coal Services and may only be used and relied on by Coal Services for the purpose agreed between GHD and the Coal Services as set out in this report.

GHD otherwise disclaims responsibility to any person other than Coal Services arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described throughout this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Where data supplied by Mines Rescue, Coal Services or other external sources, including previous site investigation data and site plans, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by GHD for incomplete or inaccurate data supplied by others.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

Regards



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## **Attachments**

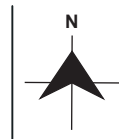
A – Figures

B – Results Summary Tables



Paper Size A4  
0 20 40 60 80  
Scale (metres)

LEGEND  
— Site boundary



Mines Rescue Pty Ltd  
Argentton Mines Rescue Station  
533 Lake Road, Argentton, NSW

Site Location

Job Number	22-19058
Revision	0
Date	7 Sep 2017

Figure 1





Paper Size A4  
0 10 20 30  
Scale (metres)

#### LEGEND

- Site boundary
- Slight ridge (where surface flow splits)
- Surface flow
- Sewer discharge point
- Pits
- Underground storage tank
- Oil water separator
- Waste water pipework



Mines Rescue Pty Ltd  
Argenton Mines Rescue Station  
533 Lake Road, Argenton, NSW

#### Site Layout

Job Number	22-19058
Revision	0
Date	15 Sep 2017

Figure 2





Paper Size A4  
0 10 20 30  
Scale (metres)

#### LEGEND

- Previous drainage sediment sample location
- Soil/sediment/surface water sampling location
- Groundwater monitoring location (installed Aug 2017)
- Existing groundwater monitoring location
- Site boundary
- Previous surface sample location



Mines Rescue Pty Ltd  
Argenton Mines Rescue Station  
533 Lake Road, Argenton, NSW

#### Sample Locations

Job Number	22-19058
Revision	0
Date	7 Sep 2017

**Figure 3**





#### LEGEND

- Site boundary
- Groundwater monitoring location (installed Aug 2017)
- Existing groundwater monitoring location
- Groundwater flow direction
- 2.0 Groundwater contour



Mines Rescue Pty Ltd  
Argenton Mines Rescue Station  
533 Lake Road, Argenton, NSW

#### Groundwater Contours

Job Number	22-19058
Revision	0
Date	10 Oct 2017

Figure 4





Paper Size A4  
0 10 20 30  
Scale (metres)

#### LEGEND

- Previous drainage sediment sample location
- Soil/sediment/surface water sampling location
- Groundwater monitoring location (installed Aug 2017)
- Existing groundwater monitoring location
- Site boundary
- Previous surface sample location



Mines Rescue Pty Ltd  
Argenton Mines Rescue Station  
533 Lake Road, Argenton, NSW

## Groundwater & Surface Water Results Summary

Job Number 22-19058  
Revision 0  
Date 7 Sep 2017

Figure 5





**Table A**  
**Analytical Results Summary - Soil**

	% Moisture	PFAS														
		N-Ethyl perfluorooctane sulfonamidoacetic acid	Perfluoroheptane sulfonic acid	Perfluorodecanesulfonic acid (PFDS)	10:2 Fluorotelomer sulfonic acid	4:2 Fluorotelomer sulfonic acid	Perfluorobutane sulfonic acid	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorohexane sulfonic acid (PFHxS)	PFHxS and PFOS (Sum of Total) Lab Calc	Perfluoropentanoic acid	8:2 Fluorotelomer sulfonic acid	N-Ethyl perfluorooctane sulfonamide	N-Ethyl perfluorooctane sulfonamidoethanol	N-Methyl perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamidoethanol
		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	1	0.0002	0.0002	0.0002	0.0005	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0005	0.0005	0.0005	0.0005
OEHS Science DRAFT ESL Soil direct Comm./Ind.																
OEHS Science DRAFT ESL Soil direct Res. Parkland																
OEHS Science DRAFT ESL Soil indirect Comm./Ind.																
OEHS Science DRAFT ESL Soil indirect Res. Parkland																
OEHS Science DRAFT Soil Comm/ Ind.										20						
OEHS Science DRAFT Soil Residential										0.009						

Location Code	Date/ Time	Field ID															
MW001	17-Aug-17	MW001 0.0-0.1	7.8	<0.0002	<0.0002	<0.0002	0.0031	<0.0005	<0.0002	<0.0002	<0.0002	0.0013	0.0009	0.0052	<0.0005	<0.0005	<0.0005
MW001	17-Aug-17	MW001 0.2-0.3	3.9	<0.0002	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	0.0003	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005
MW002	17-Aug-17	MW002 0.0-0.2	4.1	<0.0002	<0.0002	<0.0002	0.0046	<0.0005	<0.0002	<0.0002	<0.0002	0.0040	0.0023	0.0054	<0.0005	<0.0005	<0.0005
MW002	17-Aug-17	MW002 0.2-0.4	19.8	<0.0002	<0.0002	<0.0002	0.0006	<0.0005	<0.0002	<0.0002	0.0010	0.0024	0.0052	0.0006	<0.0005	<0.0005	<0.0005
MW002	17-Aug-17	FD002	22.5	<0.0002	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	0.0010	0.0029	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005
MW003	18-Aug-17	MW003 0.0-0.1	3.0	0.0010	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	0.0038	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005
MW003	18-Aug-17	MW003 0.5-0.6	17.7	<0.0002	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	0.0010	0.0010	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005
POND 1	17-Aug-17	POND 1	60.1	<0.0002	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	0.0016	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005
POND 2	17-Aug-17	POND 2	67.3	<0.0002	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	0.0002	0.0039	<0.0002	0.0006	<0.0005	<0.0005	<0.0005
SWALE 1	17-Aug-17	SWALE 1	15.2	<0.0002	<0.0002	<0.0002	0.0103	<0.0005	<0.0002	<0.0002	0.0005	0.0025	0.0019	0.0014	<0.0005	<0.0005	<0.0005
SWALE 2	17-Aug-17	SWALE 2	13.0	<0.0002	<0.0002	<0.0002	0.0051	<0.0005	<0.0002	<0.0002	0.0003	0.0020	<0.0002	0.0007	<0.0005	<0.0005	<0.0005
SW Pit 01	25-Aug-17	SW PIT 01	75.9	<0.0002	<0.0002	<0.0002	0.0013	<0.0005	<0.0002	<0.0002	<0.0002	0.0040	<0.0002	0.0013	<0.0005	<0.0005	<0.0005



**Table A**  
**Analytical Results Summary - Soil**

			PFAS (continued)															
			6:2 Fluorotelomer Sulfonate (6:2 FTS)	Perfluorooctanoic acid (PFOA)	Perfluoropentane sulfonic acid	Perfluorobutanoic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid	Perfluorooctane sulfonic acid (PFOS)	Perfluorooctane sulfonamide (FOSA)	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid	PFAS (Sum of Total)	PFAS (Sum of Total)(WA DER List)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			0.0005	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0002	0.0002	0.0002
OEHS Science DRAFT ESL Soil direct Comm./Ind.				48								60						
OEHS Science DRAFT ESL Soil direct Res. Parkland				17								32						
OEHS Science DRAFT ESL Soil indirect Comm./Ind.												0.14						
OEHS Science DRAFT ESL Soil indirect Res. Parkland												0.01						
OEHS Science DRAFT Soil Comm/ Ind.				100														
OEHS Science DRAFT Soil Residential				0.1														

Location Code	Date/ Time	Field ID																
MW001	17-Aug-17	MW001 0.0-0.1	0.0016	0.0008	<0.0002	<0.001	0.0027	0.0003	0.0010	0.0006	0.0018	0.0013	<0.0002	<0.0005	<0.0002	0.0012	0.0205	0.0114
MW001	17-Aug-17	MW001 0.2-0.3	<0.0005	<0.0002	<0.0002	<0.001	0.0003	<0.0002	0.0002	<0.0002	0.0003	0.0003	<0.0002	<0.0005	<0.0002	<0.0002	0.0011	0.0005
MW002	17-Aug-17	MW002 0.0-0.2	0.0022	0.0009	<0.0002	<0.001	0.0014	<0.0002	0.0011	0.0012	0.0013	0.0040	<0.0002	<0.0005	<0.0002	0.0004	0.0248	0.0171
MW002	17-Aug-17	MW002 0.2-0.4	0.0008	0.0009	<0.0002	<0.001	0.0003	<0.0002	0.0037	0.0055	0.0005	0.0014	<0.0002	<0.0005	<0.0002	<0.0002	0.0205	0.0191
MW002	17-Aug-17	FD002	<0.0005	0.0009	<0.0002	<0.001	<0.0002	<0.0002	0.0028	0.0042	0.0003	0.0019	<0.0002	<0.0005	<0.0002	<0.0002	0.0111	0.0108
MW003	18-Aug-17	MW003 0.0-0.1	<0.0005	0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0038	<0.0002	<0.0005	<0.0002	<0.0002	0.0053	0.0040
MW003	18-Aug-17	MW003 0.5-0.6	<0.0005	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0002	0.0010	0.0010
POND 1	17-Aug-17	POND 1	<0.0005	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0016	<0.0002	<0.0005	<0.0002	<0.0002	0.0016	0.0016
POND 2	17-Aug-17	POND 2	<0.0005	0.0004	0.0008	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	0.0037	<0.0002	<0.0005	<0.0002	<0.0002	0.0059	0.0049
SWALE 1	17-Aug-17	SWALE 1	0.0035	0.0006	<0.0002	<0.001	0.0014	0.0004	0.0007	0.0006	0.0007	0.0020	<0.0002	<0.0005	<0.0002	0.0015	0.0255	0.0112
SWALE 2	17-Aug-17	SWALE 2	<0.0005	0.0002	<0.0002	<0.001	0.0008	0.0003	0.0002	<0.0002	0.0003	0.0017	<0.0002	<0.0005	<0.0002	0.0008	0.0104	0.0031
SW Pit 01	25-Aug-17	SW PIT 01	<0.0005	<0.0002	<0.0002	<0.001	<0.0002	0.0004	<0.0002	<0.0002	0.0007	0.0040	<0.0002	<0.0005	0.0018	0.0013	0.0108	0.0053





**Table B**  
**Sediment Analytical Results**

**Mines Rescue - PFAS Investigations**  
**Coal Services - Mines Rescue**  
**Argenton Mines Rescue Station**

		PFAS															
		% Moisture	N-Ethyl perfluorooctane sulfonamidoacetic acid	Perfluoroheptane sulfonic acid	Perfluorodecanesulfonic acid (PFDS)	10:2 Fluorotelomer sulfonic acid	4:2 Fluorotelomer sulfonic acid	Perfluorobutane sulfonic acid	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorohexane sulfonic acid (PFHxS)	PFHxS and PFOS (Sum of Total) - Lab Calc	Perfluoropentanoic acid	8:2 Fluorotelomer sulfonic acid	N-Ethyl perfluorooctane sulfonamide	N-Ethyl perfluorooctane sulfonamidoethanol	N-Methyl perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamidoethanol
		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	1	0.0002	0.0002	0.0002	0.0005	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0005	0.0005	0.0005	0.0005
OEH Science DRAFT ESL Soil direct Comm./Ind.																	
OEH Science DRAFT ESL Soil direct Res. Parkland																	
OEH Science DRAFT ESL Soil indirect Comm./Ind.																	
OEH Science DRAFT ESL Soil indirect Res. Parkland																	
OEH Science DRAFT Soil Comm/ Ind.											20						
OEH Science DRAFT Soil Residential											0.009						
Location Code		Date/Time	Field ID														
BRIDGE 1	17-Aug-17	BRIDGE 1	70.5	<0.0002	<0.0002	0.0003	0.0068	<0.0005	<0.0002	<0.0002	0.0002	0.0013	<0.0002	0.0010	<0.0005	<0.0005	<0.0005
BRIDGE 1	17-Aug-17	FD003	75.8	<0.0002	<0.0002	<0.0002	0.0082	<0.0005	<0.0002	<0.0002	0.0002	0.0009	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005

8/09/2017



**Table B**  
**Sediment Analytical Results**

**Mines Rescue - PFAS Investigations**  
**Coal Services - Mines Rescue**  
**Argenton Mines Rescue Station**

			PFAS (continued)															
			6:2 Fluorotelomer Sulfonate (6:2 FTS)	Perfluorooctanoic acid (PFOA)	Perfluoropentane sulfonic acid	Perfluorobutanoic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid	Perfluorooctane sulfonic acid (PFOS)	Perfluorooctane sulfonamide (FOSA)	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid	PFAS (Sum of Total)	PFAS (Sum of Total)(WA DER List)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR			0.0005	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0002	0.0002	0.0002
OEH Science DRAFT ESL Soil direct Comm./Ind.				48								60						
OEH Science DRAFT ESL Soil direct Res. Parkland				17								32						
OEH Science DRAFT ESL Soil indirect Comm./Ind.												0.14						
OEH Science DRAFT ESL Soil indirect Res. Parkland												0.01						
OEH Science DRAFT Soil Comm/ Ind.				100														
OEH Science DRAFT Soil Residential				0.1														
Location Code	Date/Time	Field ID																
BRIDGE 1	17-Aug-17	BRIDGE 1	<0.0005	<0.0002	<0.0002	<0.001	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0011	<0.0002	<0.0005	<0.0002	<0.0002	0.0096	0.0023
BRIDGE 1	17-Aug-17	FD003	<0.0005	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0007	<0.0002	<0.0005	<0.0002	<0.0002	0.0091	0.0009

8/09/2017



**Table C**  
**Analytical Results Summary- Groundwater and surface water**

	Water Levels			Field Parameters					PFAS											
	Top of Casing Elevation	Depth to water	Standing Water Level	Purge Volume	DO (mg/L) (Field)	Electrical conductivity (field)	pH (Field)	Temperature (Field)	N-Ethyl perfluorooctane sulfonamidoacetic acid	Perfluoroheptane sulfonic acid	Perfluorodecanesulfonic acid (PFDS)	10:2 Fluorotelomer sulfonic acid	4:2 Fluorotelomer sulfonic acid	Perfluorobutane sulfonic acid	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorohexane sulfonic acid (PFHxS)	PFHxS and PFOS (Sum of Total) - Lab Calc	Perfluoropentanoic acid	8:2 Fluorotelomer sulfonic acid	N-Ethyl perfluorooctane sulfonamide
	mAHD	mb TOC	mAHD	L	mg/L	µS/cm	pH Units	°C	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR									0.02	0.02	0.02	0.05	0.05	0.02	0.02	0.02	0.01	0.02	0.05	0.05
OEHS Science DRAFT Drinking Water																	0.07			
OEHS Science DRAFT ESL FW/MW 95%																				
OEHS Science DRAFT Recreational Water																	0.7			

**Location Date/**

**Code Time Field ID**

MW001	25-Aug-17	MW001	5.835	5.44	0.395	6.1	4.31	2,687	4.31	20.6	<0.02	<0.02	<0.02	<0.05	<0.05	0.18	<0.02	0.08	0.10	0.70	<0.05	<0.05
MW002	25-Aug-17	MW002	6.102	4.225	1.877	7.6	3.16	3,285	5.97	20.1	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05
MW002	25-Aug-17	FD001	-	-	-	-	-	-	-	-	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05
MW003	25-Aug-17	MW003	5.677	4	1.677	5.6	0.87	4,880	5.81	21	<0.02	<0.02	<0.02	<0.05	<0.05	0.07	<0.02	0.61	0.79	0.92	<0.05	<0.05
OS5	25-Aug-17	OS5	4.244	2.055	2.189	4.9	5.18	3,227	7.11	18.5	<0.02	0.04	<0.02	<0.05	<0.05	0.09	<0.02	1.01	1.56	1.55	<0.05	<0.05
<b>Onsite stormwater system</b>																						
SW Pit 01	29-Aug-17	SW PIT 01	-	-	-	-	-	-	-	-	<0.02	0.04	<0.02	<0.05	<0.05	0.05	<0.02	0.31	0.69	0.22	<0.05	<0.05
<b>Offsite surface water</b>																						
POND 2	17-Aug-17	POND 2	-	-	-	-	-	-	-	-	<0.02	<0.02	<0.02	<0.05	<0.05	0.30	<0.02	2.02	4.11	0.19	<0.05	<0.05
BRIDGE 1	17-Aug-17	BRIDGE 1	-	-	-	-	-	-	-	-	<0.02	<0.02	<0.02	<0.05	<0.05	0.36	<0.02	2.87	5.02	0.16	<0.05	<0.05



**Table C**  
**Analytical Results Summary- Groundwater and surface water**

	PFAS (continued)																	
	N-Ethyl perfluorooctane sulfonamidoethanol	N-Methyl perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamidoethanol	6:2 Fluorotelomer Sulfonate (6:2 FTS)	Perfluorooctanoic acid (PFOA)	Perfluoropentane sulfonic acid	Perfluorobutanoic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid	Perfluorooctane sulfonic acid (PFOS)	Perfluorooctane sulfonamide (FOSA)	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid	PFAS (Sum of Total)
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR	0.05	0.05	0.05	0.05	0.01	0.02	0.1	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.05	0.02	0.02	0.01
OEHS Science DRAFT Drinking Water					0.56													
OEHS Science DRAFT ESL FW/MW 95%					220								0.13					
OEHS Science DRAFT Recreational Water					5.6													

**Location**   **Date/**  
**Code**       **Time**       **Field ID**

MW001	25-Aug-17	MW001	<0.05	<0.05	<0.05	<0.05	<0.01	0.10	0.1	<0.02	<0.02	0.04	0.35	<0.02	0.02	<0.02	<0.05	<0.02	<0.02	1.57	1.47
MW002	25-Aug-17	MW002	<0.05	<0.05	<0.05	<0.05	<0.01	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01
MW002	25-Aug-17	FD001	<0.05	<0.05	<0.05	<0.05	<0.01	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01
MW003	25-Aug-17	MW003	<0.05	<0.05	<0.05	2.27	0.16	0.08	0.1	<0.02	<0.02	0.21	0.54	<0.02	0.18	<0.02	<0.05	<0.02	<0.02	5.14	5.06
OS5	25-Aug-17	OS5	<0.05	<0.05	<0.05	1.24	0.29	0.14	0.2	<0.02	<0.02	0.42	1.00	<0.02	0.55	<0.02	<0.05	<0.02	<0.02	6.53	6.35
<b>Onsite stormwater system</b>																					
SW Pit 01	29-Aug-17	SW PIT 01	<0.05	<0.05	<0.05	<0.05	0.08	0.04	<0.1	<0.02	<0.02	0.12	0.15	0.14	0.38	<0.02	<0.05	<0.02	<0.02	1.53	1.31
<b>Offsite surface water</b>																					
POND 2	17-Aug-17	POND 2	<0.05	<0.05	<0.05	<0.05	<0.01	0.38	<0.1	<0.02	<0.02	<0.02	0.85	0.02	2.09	<0.02	<0.05	<0.02	<0.02	5.85	5.45
BRIDGE 1	17-Aug-17	BRIDGE 1	<0.05	<0.05	<0.05	<0.05	<0.01	0.44	<0.1	<0.02	<0.02	<0.02	0.72	<0.02	2.15	<0.02	<0.05	<0.02	<0.02	6.70	6.26



**Appendix E**  
**Table D**  
**Analytical Results Summary- Leachate**

**Mines Rescue Pty Ltd**  
**Argenton Mines Rescue Station**  
**PFAS Contamination Assessment**

	pH (Final)	PFAS															
		N-Ethyl perfluorooctane sulfonamidoacetic acid	Perfluoroheptane sulfonic acid	Perfluorodecanesulfonic acid (PFDS)	10:2 Fluorotelomer sulfonic acid	4:2 Fluorotelomer sulfonic acid	Perfluorobutane sulfonic acid	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorohexane sulfonic acid (PFHxS)	PFHxS and PFOS (Sum of Total) - Lab Calc	Perfluoropentanoic acid	8:2 Fluorotelomer sulfonic acid	N-Ethyl perfluorooctane sulfonamide	N-Ethyl perfluorooctane sulfonamidoethanol	N-Methyl perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamidoethanol	6:2 Fluorotelomer Sulfonate (6:2 FTS)
LOR	0.1	0.02	0.02	0.02	0.05	0.05	0.02	0.02	0.01	0.02	0.05	0.05	0.05	0.05	0.05	0.05	0.05
NSW EPA 2016 EnRisks surface water Trigger point 1																	
NSW EPA 2016 EnRisks surface water Trigger point 2																	
NSW EPA 2016 EnRisks surface water Trigger point 3																	

**Location Code   Date/Time   Field ID**

MW001	17-Aug-17	MW001_0.0-0.1	6.6	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	0.05	<0.02	0.05	<0.05	<0.05	<0.05	<0.05
MW002	17-Aug-17	MW002_0.0-0.2	6.4	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	0.22	<0.02	0.11	<0.05	<0.05	<0.05	<0.05
SWALE 1	17-Aug-17	SWALE1	6.7	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	0.02	0.09	<0.02	<0.05	<0.05	<0.05	<0.05	0.06
BRIDGE 1	17-Aug-17	BRIDGE 1	6.4	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05

8/09/2017



**Table D**  
**Analytical Results Summary- Leachate**

	PFAS (continued)														
	Perfluorooctanoic acid (PFOA)	Perfluoropentane sulfonic acid	Perfluorobutanoic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid	Perfluorooctane sulfonic acid (PFOS)	Perfluorooctane sulfonamide (FOSA)	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid	PFAS (Sum of Total)	PFAS (Sum of Total)(WA DER List)
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR	0.01	0.02	0.1	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.05	0.02	0.02	0.01	0.01
NSW EPA 2016 EnRisks surface water Trigger point 1														10	10
NSW EPA 2016 EnRisks surface water Trigger point 2														0.1	0.1
NSW EPA 2016 EnRisks surface water Trigger point 3														0.05	0.05

**Location Code Date/Time Field ID**

MW001	17-Aug-17	MW001_0.0-0.1	0.04	<0.02	<0.1	0.08	<0.02	0.05	0.03	0.10	0.05	<0.02	<0.05	<0.02	<0.02	0.40	0.22
MW002	17-Aug-17	MW002_0.0-0.2	0.06	<0.02	<0.1	0.05	<0.02	0.06	0.07	0.08	0.22	<0.02	<0.05	<0.02	<0.02	0.65	0.52
SWALE 1	17-Aug-17	SWALE1	0.03	<0.02	<0.1	0.02	<0.02	0.04	0.04	0.03	0.07	<0.02	<0.05	<0.02	<0.02	0.31	0.26
BRIDGE 1	17-Aug-17	BRIDGE 1	<0.01	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01



**Table E**  
**Analytical Results Summary- Field Duplicates**

EQL		%	PFAS															
			N-Ethyl perfluorooctane sulfonamidoacetic acid	Perfluoroheptane sulfonic acid	Perfluorodecanesulfonic acid (PFDS)	10:2 Fluorotelomer sulfonic acid	4:2 Fluorotelomer sulfonic acid	Perfluorobutane sulfonic acid	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorohexane sulfonic acid (PFHxS)	PFHxS and PFOS (Sum of Total) - Lab Calc	Perfluoropentanoic acid	8:2 Fluorotelomer sulfonic acid	N-Ethyl perfluorooctane sulfonamide	N-Ethyl perfluorooctane sulfonamidoethanol	N-Methyl perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamidoethanol	6:2 Fluorotelomer Sulfonate (6:2 FTS)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	1	0.0002	0.0002	0.0002	0.0005	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	

**Location Date/**  
**Code Time Field ID**

BRIDGE 1	17-Aug-17	BRIDGE 1	70.5	<0.0002	<0.0002	0.0003	0.0068	<0.0005	<0.0002	<0.0002	0.0002	0.0013	<0.0002	0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BRIDGE 1	17-Aug-17	FD003	75.8	<0.0002	<0.0002	<0.0002	0.0082	<0.0005	<0.0002	<0.0002	0.0002	0.0009	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
RPD			7	0	0	40	19	0	0	0	-	0	67	0	0	0	0	0	0
MW002	17-Aug-17	MW002_0.2-0.4	19.8	<0.0002	<0.0002	<0.0002	0.0006	<0.0005	<0.0002	<0.0002	0.0010	0.0024	0.0052	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	0.0008
MW002	17-Aug-17	FD002	22.5	<0.0002	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002	0.0010	0.0029	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
RPD			13	0	0	0	18	0	0	0	-	185	18	0	0	0	0	0	46

		%	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	1		0.02	0.02	0.02	0.05	0.05	0.02	0.02	0.02	0.01	0.02	0.05	0.05	0.05	0.05	0.05	0.05

MW002	25-Aug-17	MW002	-	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
MW002	25-Aug-17	FD001	-	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
RPD			-	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0

12/09/2017



**Table E**  
**Analytical Results Summary- Field Duplicates**

			PFAS (continued)														
			Perfluorooctanoic acid (PFOA)	Perfluoropentane sulfonic acid	Perfluorobutanoic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid	Perfluorooctane sulfonic acid (PFOS)	Perfluorooctane sulfonamide (FOSA)	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid	PFAS (Sum of Total)	PFAS (Sum of Total)(WA DER List)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0002	0.0002	0.0002

Location Code	Date/Time	Field ID															
BRIDGE 1	17-Aug-17	BRIDGE 1	<0.0002	<0.0002	<0.001	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0011	<0.0002	<0.0005	<0.0002	<0.0002	0.0096	0.0023
BRIDGE 1	17-Aug-17	FD003	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0007	<0.0002	<0.0005	<0.0002	<0.0002	0.0091	0.0009
RPD			0	0	0	0	0	0	0	0	44	0	0	0	0	-	-
MW002	17-Aug-17	MW002_0.2-0.4	0.0009	<0.0002	<0.001	0.0003	<0.0002	0.0037	0.0055	0.0005	0.0014	<0.0002	<0.0005	<0.0002	<0.0002	0.0205	0.0191
MW002	17-Aug-17	FD002	0.0009	<0.0002	<0.001	<0.0002	<0.0002	0.0028	0.0042	0.0003	0.0019	<0.0002	<0.0005	<0.0002	<0.0002	0.0111	0.0108
RPD			0	0	0	40	0	28	27	50	30	0	0	0	0	-	-

			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL			0.01	0.02	0.1	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.05	0.02	0.02	0.01	0.01

MW002	25-Aug-17	MW002	<0.01	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01
MW002	25-Aug-17	FD001	<0.01	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01
RPD			0	0	0	0	0	0	0	0	0	0	0	0	0	-	-





Table F  
Analytical Results Summary- Blanks

PFAS																
N-Ethyl perfluorooctane sulfonamidoacetic acid	Perfluoroheptane sulfonic acid	Perfluorodecanesulfonic acid (PFDS)	10:2 Fluorotelomer sulfonic acid	4:2 Fluorotelomer sulfonic acid	Perfluorobutane sulfonic acid	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorohexane sulfonic acid (PFHxS)	PFHxS and PFOS (Sum of Total) - Lab Calc	Perfluoropentanoic acid	8:2 Fluorotelomer sulfonic acid	N-Ethyl perfluorooctane sulfonamide	N-Ethyl perfluorooctane sulfonamidoethanol	N-Methyl perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamidoethanol	6:2 Fluorotelomer Sulfonate (6:2 FTS)	Perfluorooctanoic acid (PFOA)
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L

Date/ Time    Field ID    Sample Type

18-Aug-17	JF_TB01	Trip Blank	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01
25-Aug-17	RB001	Rinsate	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01
25-Aug-17	TB001	Trip Blank	<0.02	<0.02	<0.02	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01

8/09/2017



**Table F**  
**Analytical Results Summary- Blanks**

**Mines Rescue - PFAS Investigations**  
**Coal Services- Mines Rescue**  
**Argenton Training Facility**

PFAS (continued)													
Perfluoropentane sulfonic acid	Perfluorobutanoic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid	Perfluorooctane sulfonic acid (PFOS)	Perfluorooctane sulfonamide (FOSA)	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid	PFAS (Sum of Total)	PFAS (Sum of Total)(WA DER List)
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L

**Date/ Time    Field ID    Sample Type**

18-Aug-17	JF_TB01	Trip Blank	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01
25-Aug-17	RB001	Rinsate	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01
25-Aug-17	TB001	Trip Blank	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.02	<0.05	<0.02	<0.02	<0.01	<0.01

8/09/2017