Compliance Report 2021-2022

Kooragang Island Waste Emplacement Facility, Area 2 Closure Works

EPBC 2016/7670

Revision 1

9 November 2022

Document history and status

Revision	Date	Description	By	Checked	Approved
A	27 Oct 2022	Draft	G. Moylan	M. Bardsley	M. Bardsley
1	9 Nov 2022	Final	G. Moylan	M. Bardsley	M. Bardsley

Hunter & Central Coast Development Corporation

Declaration of Accuracy

In making this declaration, I am aware that sections 490 and 491 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) make it an offence in certain circumstances to knowingly provide false or misleading information or documents. The offence is punishable on conviction by imprisonment or a fine, or both. I declare that all the information and documentation supporting this compliance report is true and correct in every particular. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed	
Full name (please print)	Michael Bardsley
Position (please print)	Environmental Manager
Organisation	Hunter & Central Coast Development Corporation ABN 94 688 782 063
Date	9 November 2022

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1. Purpose of the Report

The Kooragang Island Waste Emplacement Facility (KIWEF) Area 2 Closure Works Project was undertaken by Daracon Contractors Pty Ltd (Daracon) between August 2019 and July 2020. The Hunter and Central Coast Development Corporation (HCCDC) was acting as the agent of the New South Wales (NSW) Government for the closure of KIWEF, a former landfill site that received waste from the former Broken Hill Proprietary (BHP) Company Limited Mayfield steelworks and associated operations.

KIWEF is a 179-hectare site located on the western portion of Kooragang Island, approximately 7km north west of Newcastle's city centre. The site is bounded by Newcastle Coal Infrastructure Group to the south, the Port Waratah Coal Services – Kooragang Coal Terminal railway line to the west and north and adjacent industrial land consisting of third part waste facilities to the east. The action involves the closure of a 32-hectare portion of referred to as Area 2, shown on Figure 1.

In 2019, HCCDC completed an assessment of impact to matters of national environmental significance (MNES) under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. The Department of Agriculture, Water and Environment (DAWE, previously Department of Environment and Energy) granted approval for the project (EPBC 2016/7670) under sections 130(1) and 133(1) of the EPBC Act, on 22 March 2019.

The Area 2 closure works consisted of the construction of an engineered cap over the former landfill. The site is complicated by presence of MNES including Wetlands of International Importance and listed threatened species including the *Litoria aurea*, Green and Golden Bell Frogs (GGBF) and migratory wading birds.

This report documents HCCDC's compliance with the conditions of the approval issued under the EPBC Act for the action (EPBC 2016/7670) and to satisfy Condition 15 of that approval, which states:

Annual compliance reporting

15. The approval holder must prepare a compliance report for each 12 month period following the date of the commencement of the proposed action, or as otherwise agreed to in writing by the Minister. The approval holder must:

- *a) publish each compliance report on the website within 60 business days following the relevant 12 month period;*
- *b) notify the Department by email that a compliance report has been published on the website within five business days of the date of publication;*
- *c) keep all compliance reports publicly available on the website until this approval expires;*
- *d) exclude or redact sensitive ecological data from compliance reports published on the website; and*
- *e) where any sensitive ecological data has been excluded from the version published, submit the full compliance report to the Department within five business days of publication.*

Note: The first compliance report may report a period less than 12 months so that it and subsequent compliance reports align with the similar requirement under state approval. Compliance reports may be published on the Department's website.

The action was commenced on 21 August 2019 and works on site were completed within a single reporting period. **Section 2** provides further detail on the activities completed within the current reporting period (nominally between September 2021 and August 2022). **Section 3** demonstrates the sites compliance throughout the current maintenance period, against the conditions granted under EPBC 2016/7670.

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Figure 1: Project Locality

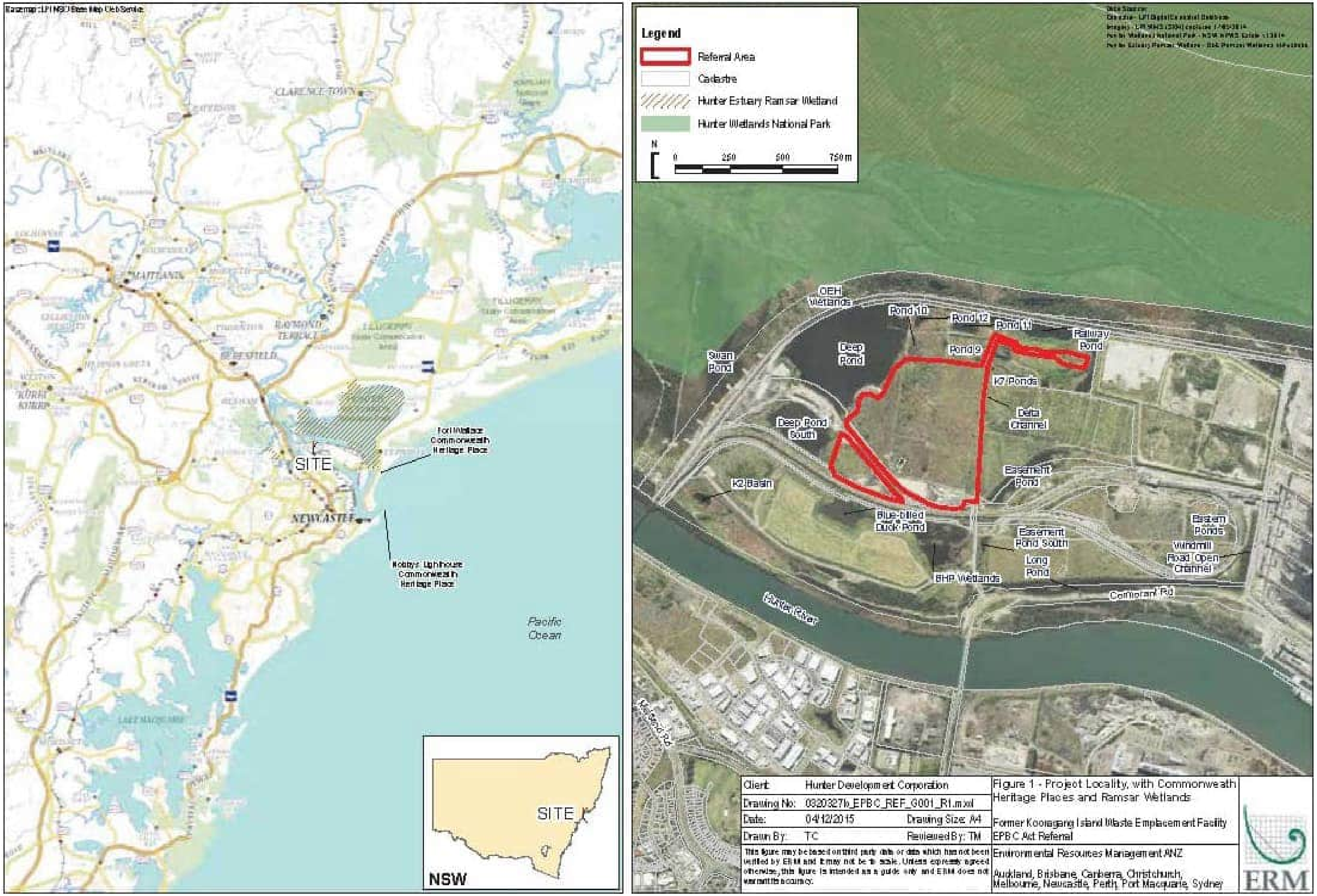

Figure 2: Footprint of the Action area

2. Description of Activities

Civil works for the controlled activity were completed by the contractor (Daracon) on 10 July 2020. Since then, the site has been managed by HCCDC to conduct the required monitoring and maintenance of the site, including establishment of vegetation, removal of weeds or vegetative species that could damage the capping layer and repair any damage caused by stormwater erosion.

A breakdown of works undertaken within Area 2 during the current period are summarised below in Table 1.

Table 1: 2021-2022 Activities

Works Undertaken	Date of Works
Annual GGBF Monitoring – A team of amphibian researchers from the University of Newcastle (UoN) undertook three complete rounds of KIWEF/Ash Island ecological surveys across 2021/2022 summer season as required by the KIWEF GGBF Management Plan and condition 3 of the EPBC 2016/7670. In addition, UoN undertook several smaller targeted surveys of selected pond areas, including around the Area 2 site (7 additional targeted surveys). The complete monitoring program includes (but is not limited to) the survey of 80 ponds (and their surrounds) across the KIWEF site and adjacent national park area in Ash Island, for the following: • Presence/absence of GGBF (and other frog species); • GGBF distribution; • Habitat utilisation; • GGBF behaviour; • GGBF size, age and gender; • Tagging/recapturing of GGBF to track movement patterns; • Presence/absence of predators including *Gambusia holbrooki*.	September 2021 to May 2022
Biannual Surface Water Datalogger Download – HCCDC's consultants (Robert Carr and Associates) undertook the third round of Continuous Datalogging as required by the Water Quality Management Plan and condition 6 of EPBC 2016/7670. The network of 13 continuous dataloggers installed within surface water bodies around the KIWEF were downloaded and the resultant data was compared to the established salinity threshold levels for chytrid protection. Results indicate receiving waters from footprint of the Area 2 action are slightly wetter and fresher than prior to construction, consistent with the hydro-salinity modelling results and underlying assumptions of the environmental assessment. It is also noted that increased rainfall had been experienced during this period as a result of climatic factors (*La Niña*).	October 2021
Biannual Cap Inspection – HCCDC conducted a site walkover to inspect capped areas for signs that the cap has eroded, degraded or slumped. The inspection identified several items requiring rectification including: • The growth of vegetation with root systems that can damage the capping layer; • Some areas identified with low density vegetation regrowth.	December 2021
KIWEF Annual Water Quality Monitoring – HCCDC's consultants (Hazmat Services) undertook the Annual Water Quality Monitoring as required by the Water Quality Management Plan and condition 6 of EPBC 2016/7670. The network of 50 groundwater monitoring locations and 5 surface water monitoring locations were sampled and analysed for a variety of parameters and pollutants as specified by the NSW EPA issued Surrender Notice.	June 2021

Works Undertaken	Date of Works
Biannual Surface Water Datalogger Download – HCCDC's consultants (Robert Carr and Associates) undertook the fourth round of Continuous Datalogging as required by the Water Quality Management Plan and condition 6 of EPBC 2016/7670. The network of 13 continuous dataloggers installed within surface water bodies around the KIWEF were checked to retrieve the units and download the data. Unfortunately, prolonged very wet weather conditions over consecutive months made several of the locations inaccessible (water levels too high to locate the units, or unsafe for personnel to access) and several units were non-communicable and have been returned to the supplier for repairs. The resultant data from the units that was able to be collected were compared to the established salinity threshold levels for chytrid protection and showed results consistent with expectations. The Water Quality Management Plan indicated the Continuous Datalogger Monitoring would continue for 2 years post construction, which would make this fourth download event the final round. However due to the inaccessibility of some locations in current round, HCCDC proposes to conduct one further download round (November/December 2022) before ceasing the datalogger monitoring.	June 2022
Biannual Cap Inspection – HCCDC conducted a site walkover to inspect capped areas for signs that the cap has eroded, degraded or slumped. The inspection identified several items requiring rectification including: • The growth of vegetation with root systems that can damage the capping layer; • Some areas identified with low density vegetation regrowth; • Areas of weed growth identified, particularly around basins. Rectification of all defects were completed under the Annual Cap Maintenance program	July 2022
Annual Cap Maintenance – HCCDC's contractors (Daracon) commenced the rectification issues identified by the HCCDC Biannual inspection. These works involved: • Removal of targeted vegetation species with roots that can impact capping layer. This was mechanical where possible with ecologists in attendance; otherwise removed individually by hand cutting and painted application of herbicide directly to the freshly cut stump. • Removal of weeds from boundaries of ponds using approved methods (no use of herbicides adjacent to watercourses).	August to October 2022

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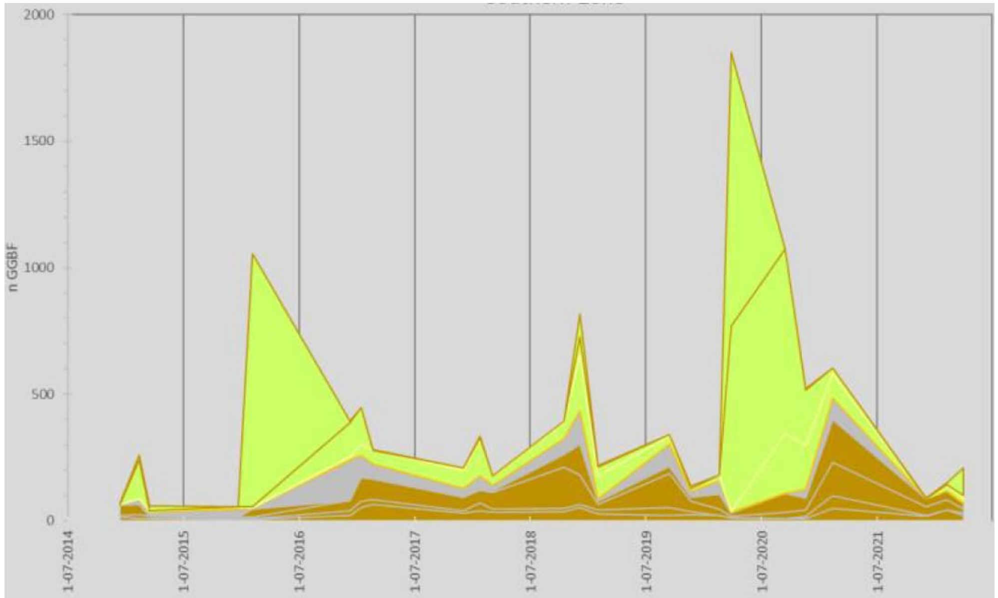
3. Approval Compliance

An assessment of the action's compliance with the conditions of the Commonwealth Approval under the EPBC Act (EPBC Ref: 2016/7670) during the 2021-2022 period is summarised in Table 2.

Table 2: Approval Conditions Compliance Table

Condition Ref	Condition	Compliance	Evidence/Comments
PART A – CONDITIONS SPECIFIC TO THE ACTION			
1.	The action must only be undertaken within the footprint.	Compliant	During the current period the only works that have disturbed the footprint of Area 2 is the cap maintenance works. As the works were limited to the extent of the cap installed during the construction phase, they are known to be within the footprint shown in Figure 2.
2.	The person taking the action must implement the Green and Golden Bell Frog Management Plan to avoid and mitigate impacts on the Green and Golden Bell Frog (Litoria aurea) (GGBF) population.	Compliant	The GGBF Management Plan was implemented through the reporting period. This included monitoring of the GGBF population by the University of Newcastle (UoN) researchers on behalf of the State, and the preparation of the 2021/22 Island Wide Survey (IWS). A graphical summary of the IWS is provided in Appendix C. In addition, during maintenance works that had the potential to harm protected species, the contractor Daracon were also required to have an ecological supervision and clearances prior to undertaking and activities that could injure protected species (and other fauna). Ecological clearance reports are provided as Appendix G.
3.	GGBF monitoring must be undertaken in accordance with the Green and Golden Bell Frog Management Plan within the KIWEF Site, including the temporary basins, aligned with NCIG monitoring program.	Compliant	As described in Section 2, the annual monitoring of GGBF in accordance with the GGBF Management Plan (refer to Appendix B) was undertaken by the University of Newcastle through the spring – summer period. A copy of the 2021/22 IWS Graphical Summary report is provided in Appendix C.
4.	GGBF monitoring data must be analysed following each round of monitoring to identify any changes to the GGBF population, as compared to the baseline data described in the Green and Golden Bell Frog Management Plan. Should a decline in population be attributed to the action, response measures must be developed and implemented in accordance with the Green and Golden Bell Frog Management Plan.	Compliant	The UoN 2019-20 IWS results (during Area 2 construction) observed a population increase that was thought to be associated with a mass breeding event in February 2020 that coincided with first significant rainfall after a very dry period. The 2020-21 IWS results observed the continued presence of the cohort from the mass breeding event in February 2020, which had grown large enough to be tagged (>40mm) and therefore resulted in a 5-fold increase in the population numbers that were observed. The UoN results during the current 2021-22 IWS (refer to Appendix C) has shown an overall population decrease following the mass breeding event in February

Condition Ref	Condition	Compliance	Evidence/Comments
			2020, back to the typical levels that were observed between 2016-19. The below chart shows the GGBF visual encounter survey results within the KIWEF since the 2014-15 season.  **GGBF Population Demographics at KIWEF** *Key: Green – Juveniles; Brown – Adults/Sub-Adults*
5.	The person taking the action must revegetate the area marked in yellow and identified as 'Area 2 Closure works' on Map 2 at Attachment A to restore Green and Golden Bell Frog habitat in accordance with the Revegetation Management Plan.	Compliant	At the completion of the Area 2 Closure Works, the site was topsoiled and seeded in accordance with the Revegetation Management Plan. Previous Cap Inspections identified several areas where vegetation growth was low. Rectification works conducted in July/August in 2021 included the placement of additional topsoil and reseeding of the area; consistent with the requirements of the Revegetation Plan. The below aerial images from Nearmap taken in October 2021 and October 2022 shows the continued improvement of vegetation establishment across the capped area, and the establishment of movement corridors along drainage lines consistent with the GGBF Management Plan (refer to Appendix B).

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Condition Ref	Condition	Compliance	Evidence/Comments
			 **October 2021**  **October 2022**

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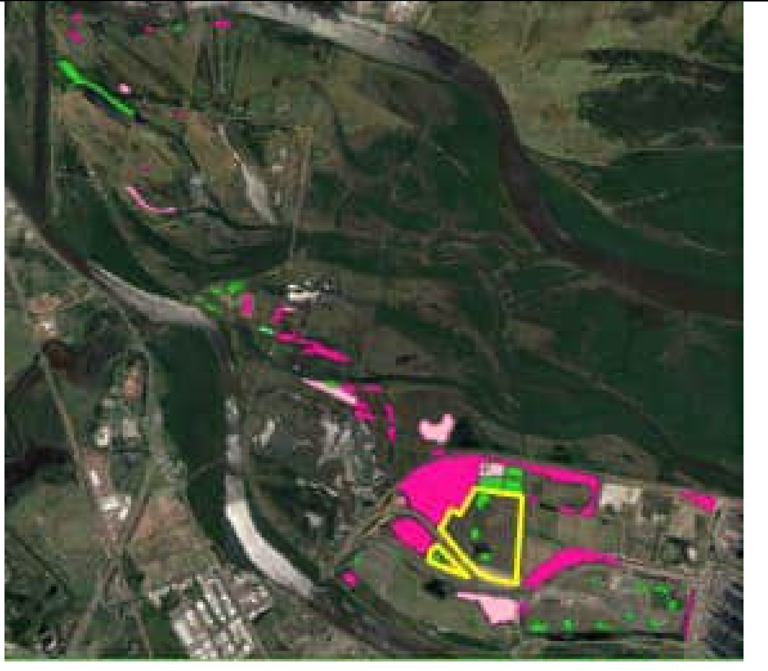
Condition Ref	Condition	Compliance	Evidence/Comments
6.	The person taking the action must undertake water quality monitoring for groundwater and surface water at the KIWEF Site in accordance with the Water Quality Management Plan.	Compliant	The continuous datalogging network were downloaded in October 2021 and June 2022. A copy of the October 2021 report and comparison against salinity threshold levels is provided in Appendix D; and the June 2022 report is provided as Appendix E. The continuous datalogger monitoring is required under the Water Quality Management Plan, to continue for 2 years post-construction and was therefore expected to end in July 2022. However, given recent prolonged very intense wet weather that has been experienced prior to the June 2022 event, several monitoring locations were completely submerged and could not be located. An additional download event will be undertaken prior to end of year 2022 to remove the dataloggers from the pond environments and complete the final download. No significant changes to the hydro-salinity results have been observed attributable to the Area 2 works. Changes are consistent with seasonal changes and responses to climatic conditions; also noting that increased rainfall had been experienced during this period as a result of climatic factors (*La Niña*). The Annual Groundwater and Surface Water monitoring program was completed in June 2022 a copy of the report is provided in Appendix F.
7.	At the completion of the project works, the approval holder must ensure:	-	-
i.	no increased distribution of Gambusia holbrooki due to the project works, within the area identified as 'Potential GGBF foraging or breeding habitat' as identified on Map 2 at Attachment A, and	Compliant	The preliminary results reported in the UoN IWS 2021-22 (Appendix C) show the current *Gambusia* distribution across KIWEF. The mapping (below) shows Gambusia distribution across the KI/Ash Island is currently at its highest levels since the 2015/16 survey period. The University of Newcastle specialists undertaking monitoring have advised that the driver of increased distribution is a consequence of consecutive years of *La Niña* providing very wet conditions that have increased pond water levels, allowed water to connect between ponds, and therefore providing gambusia with the opportunity to redisperse across the low-lying connected wetlands. The UoN mapping of gambusia distribution (shown below) indicate that the current gambusia free wetlands are predominantly those constructed by HCCDC as part of the KIWEF capping works, including Area 2. The increased distribution of gambusia is therefore not a result of the Action.

Condition Ref	Condition	Compliance	Evidence/Comments
			 **Gambusia Distribution 2021/22** *Key: Green – Gambusia absent; Light Pink – Gambusia appeared during survey season; Dark Pink – Gambusia present through survey season; Yellow outline – Area 2.*
ii.	no net loss of GGBF foraging or breeding habitat as an impact of the project works.	Compliant	Foraging habitat within the works footprint was temporarily reduced during the construction activities, however the site is being revegetated in accordance with the Revegetation Management Plan following construction completion. The Biannual Inspection identified continued establishment of vegetation across the capped areas in accordance with the Revegetation Management Plan. In addition, movement corridors (through additional aquatic habitat with connecting vegetated drainage lines) are continuing to establish, consistent with the GGBF Management Plan (refer to Appendix B). During the 2021/22 IWS, UoN ecologists captured and processed 81 adult GGBF's from the constructed ponds within Area 2 project (including the Peninsula wetlands), confirming no net loss of GGBF foraging habitat following the project works.

Condition Ref	Condition	Compliance	Evidence/Comments
8.	The approval holder must implement the KIWEF Site EMP.	Compliant	The Post Construction elements of the Construction Environmental Management Framework (CEMF, provided as Appendix A) including the preparation of the Construction Validation Report and Independent Auditors Report of the construction works have been completed and submitted to the NSW EPA in accordance with the requirements of the CEMF and Surrender Notice. The site has continued to implement the requirements of the GGBF Management Plan (Appendix B) throughout the Post-Construction period including the Island Wide Survey monitoring (Appendix C) and ecological pre-clearance surveys (Appendix G) prior to any ground disturbing activities or works that could potentially harm protected species. The Post-Completion Water Monitoring has also been conducted in accordance with the requirements of the CEMF (Appendix D to Appendix F)
PART B – STANDARD ADMINISTRATIVE CONDITIONS			
Notification of date of commencement of the proposed action			
9.	The approval holder must notify the Department in writing of the date of commencement of the action within 10 business days after the date of commencement of the action.	Compliant	HCCDC issued notification to the DCCEEW (previously DAWE) on commencement of works on 4 September 2019. The notification included a confirmation that earthworks had commenced on 21 August 2019
10.	If the commencement of the action does not occur within 5 years from the date of this approval, then the approval holder must not commence the action without the prior written agreement of the Minister.	Not Applicable	HCCDC commenced within one year of the approval being issued.
Compliance records			
11.	The approval holder must maintain accurate and complete compliance records.	Compliant	Reporting and analysis of groundwater, surface water, GGBF monitoring and cap inspection reports are maintained by HCCDC.
12.	If the Department makes a request in writing, the approval holder must provide electronic copies of compliance records to the Department within the timeframe specified in the request.	Not Applicable	No request has been made by the Department for compliance records to be provided
Note: Compliance records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, and or used to verify compliance with the conditions. Summaries of the result of an audit may be published on the Department's website or through the general media.			

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Condition Ref	Condition	Compliance	Evidence/Comments
Preparation and publication of plans			
13.	The approval holder must:	-	-
a.	publish all plans associated with the action on the approval holder's website within 30 business days of the date of approval of the action;	Compliant	Commonwealth and State approval documents/plans were uploaded to the HCCDC website: https://www.hccdc.nsw.gov.au/kooragang-island-waste-emplacement-facility
b.	exclude or redact sensitive ecological data from plans published on the website or provided to a member of the public; and	Not Applicable	No sensitive ecological data was required to be redacted from the documents.
c.	keep plans published on the website until the end date of this approval	Compliant	HCCDC will continue to maintain the project plans on the website until completion of the closure works and the approval is transferred to Port of Newcastle. Port of Newcastle will then be responsible for uploading project plans on their website when approval transfers.
14.	The approval holder must ensure that any monitoring data (including sensitive ecological data), surveys, maps, and other spatial and metadata required under a plan, is prepared in accordance with the Department's Guidelines for biological survey and mapped data (2018) and submitted electronically to the Department in accordance with the requirements of the plan.	Compliant	The data for the current 2021-22 monitoring season compliant with the Department Guidelines is ready to be submitted to the Department once the compliance report has been issued.
Annual compliance reporting			
15.	The approval holder must prepare a compliance report for each 12 month period following the date of the commencement of the proposed action, or as otherwise agreed to in writing by the Minister. The approval holder must:	Compliant	The Date of Commencement for the Action is 21 August 2019. The Annual Compliance Report for the Construction Period (2019/20) was prepared by an independent firm (Ramboll) who audited HCCDC and its Contractors (Daracon) compliance with the EPBC Approval requirements. The Annual Compliance Reports for the Project Works Period (2 years post-construction, ie 2020/21 and 2021/22 – this submission) were prepared by HCCDC.
a.	publish each compliance report on the website within 60 business days following the relevant 12 month period;	Compliant	The EPBC 2016/7670 Annual Compliance Reports were published on the HCCDC website, on the following dates: • 2019/20 Annual Compliance Report was published on 11 November 2020. • 2020/21 Annual Compliance Report was published on 11 November 2021. The Annual Compliance Report for 2021/22 is to be published prior to 15 November 2022

Condition Ref	Condition	Compliance	Evidence/Comments
b.	notify the Department by email that a compliance report has been published on the website within five business days of the date of publication;	Compliant	HCCDC notified DCCEEW (previously DAWE) that the Annual Compliance Reports were published on HCCDC's website, on the following dates: • 2019/20 Annual Compliance Report – DAWE notified 13 November 2020. • 2020/21 Annual Compliance Report – DAWE notified 15 November 2020. HCCDC expect to notify DCCEEW prior to 29 November 2022, that the 2021/22 Annual Compliance Report has been published.
c.	keep all compliance reports publicly available on the website until this approval expires;	Compliant	The Annual Compliance Reports for 2019/20, 2020/21 and 2021/22 will remain on the HCCDC website until the site and Commonwealth Approval are transferred to the Port of Newcastle at completion of the project works. Port of Newcastle will be responsible for uploading project plans on their website when approval transfers.
d.	exclude or redact sensitive ecological data from compliance reports published on the website; and	Not Applicable	No sensitive ecological data was required to be redacted from the documents.
e.	where any sensitive ecological data has been excluded from the version published, submit the full compliance report to the Department within five business days of publication.	Not Applicable	No sensitive ecological data was required to be redacted from the documents.
Note: The first compliance report may report a period less than 12 months so that it and subsequent compliance reports align with the similar requirement under state approval. Compliance reports may be published on the Department's website.			
Reporting non-compliance			
16.	The approval holder must notify the Department in writing of any: incident; non-compliance with the conditions; or non-compliance with the commitments made in plans. The notification must be given as soon as practicable, and no later than two business days after becoming aware of the incident or non-compliance. The notification must specify:	Not Applicable	There were no non-compliances during the current period; and a notification to the Department was therefore not required.
a.	the condition which is or may be in breach; and	-	-
b.	a short description of the incident and/or non-compliance.	-	-

Condition Ref	Condition	Compliance	Evidence/Comments
17.	The approval holder must provide to the Department the details of any incident or non-compliance with the conditions or commitments made in plans as soon as practicable and no later than 10 business days after becoming aware of the incident or non-compliance, specifying:	Not Applicable	There were no incidents or non-compliances during the current period; and a notification to the Department was therefore not required.
a.	any corrective action or investigation which the approval holder has already taken or intends to take in the immediate future;	-	-
b.	the potential impacts of the incident or non-compliance; and	-	-
c.	the method and timing of any remedial action that will be undertaken by the approval holder.	-	-
Independent audit			
18.	The approval holder must ensure that independent audits of compliance with the conditions are conducted:		
i.	Following the completion of onsite construction works and prior to the completion of the project works period;	Compliant	The Area 2 Independent Audit (Construction Phase) is In Progress. On 18 May 2022, HCCDC engaged EMM Consulting to act as the Independent Auditor for the project works period. Further details of the Independent Audit provided under Condition 19.
ii.	Within a 12month period from the completion of the action;	Not Applicable	Port of Newcastle to undertake Independent Audit at the completion of the project action (post-transfer of the Approval) 31 December 2030.
iii.	or as requested in writing by the Minister.	Not Applicable	No independent audit has been requested by the Minister.
19.	For each independent audit, the approval holder must:		
a.	provide the name and qualifications of the independent auditor and the draft audit criteria to the Department;	Compliant	EMM's nominated Audit team and their qualifications (with David Bone as Lead Auditor) and the draft Audit criteria; were submitted to DCCEEW on 10 June 2022.
b.	only commence the independent audit once the audit criteria have been approved in writing by the Department; and	Compliant	DCCEEW provided HCCDC with a Letter approving the nominated Auditor, Audit Team and the draft audit criteria on 19 August 2022.

Condition Ref	Condition	Compliance	Evidence/Comments
c.	submit an audit report to the Department within the timeframe specified in the approved audit criteria.	Compliant	The DCCEEW Letter Approving the Independent Auditor and Audit Criteria (dated 19 August 2022), confirmed that the Audit Report was to be submitted to DCCEEW by 28 January 2023.
20.	The approval holder must publish the audit report on the website within 10 business days of receiving the Department's approval of the audit report and keep the audit report published on the website until the end date of this approval.	Not Applicable	The Independent Audit (Construction Phase) is currently In Progress. The Audit Report will be published following submission to DCCEEW and receiving the Departments approval of the Audit Report.
Completion of the action			
21.	Within 30 days after the completion of the action, the approval holder must notify the Department in writing and provide completion data.	Not Applicable	Port of Newcastle will be taking over the Commonwealth Approval for the Area 2 Closure Works (Post-Construction Phase) and will be responsible for notifying the Department of the completion of the action in 2030, following completion of the necessary monitoring, maintenance and auditing required.

4. Conclusion

This report has been prepared to assess compliance with the conditions of the approval issued under the EPBC Act for the action (EPBC 2016/7670) and to satisfy Condition 15 of that approval. The undertaking of the action during the reporting period has been assessed to be compliant with the conditions of EPBC 2016/7670. No non-compliance issues were identified.

Onsite construction works were completed in July 2020. As such completion of the project works (defined as two years following completion of onsite construction works) will occur in August 2022.

An Independent Audit as required by condition 18 i) for the 'Completion of the Project Works' is currently In Progress. DCCEEW has approved the Audit Team and Audit Criteria and set a due date for delivery of the Audit Report to the Department by the 28 January 2023.

Appendix A – Construction Environmental Management Framework (Jacobs, 2019)

Kooragang Island Waste Emplacement Facility Area 2 Closure

Hunter and Central Coast Development Corporation

Construction Environmental Management Framework

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16 April 2019

HDC369

Kooragang Island Waste Emplacement Facility Area 2 Closure

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Contents

1. Introduction

1.1 Purpose and Scope

This Construction Environmental Management Framework (CEMF) sets out the environmental, stakeholder and community management requirements in relation to the Kooragang Island Waste Emplacement Facility (KIWEF) Area 2 Closure Works. The CEMF provides a link between the environmental and planning regulatory documentation and the construction environmental management documentation to be developed by the Principal Contractors relevant to their scope of works. The Principal Contractors will be required to implement and adhere to the requirements of this CEMF. The requirements of this CEMF will be included as a contract document in all design and construction contracts.

1.2 Project Overview

The endorsed approach to the closure of KIWEF is to implement minimal change in site processes by maintaining similar site hydrology, vegetation and surface soils while further isolating potential contaminants. The isolation of contaminants is to be achieved though the reduction of surface water infiltration resulting from the installation of capping with reduced permeability and a moderation of site surface gradients.

The basic principles of the closure works are to reduce surface water infiltration into the groundwater by the following means:

- Re-grading of the site to a minimum 1% grade to prevent ponding of surface waters;
- Drainage improvements;
- Provision of a 0.5 metre (m) thick, low permeability cap; and
- Rehabilitation using existing topsoil and alternative low nutrient and Chytrid free imported growth medium.

These closure works are to be undertaken within a sensitive and complex environmental context. In particular, the works need to be delivered in a manner which:

- Complies with regulatory requirements;
- Avoids direct impacts to Matters of National Environmental Significance (MNES) in particular Green and Golden Bell Frogs (GGBF) but also migratory wading birds;
- Carefully manages indirect impacts to MNES through avoidance of spread of chytrid fungus and predatory aquatic species and through avoiding impacts to water quality of surrounding waterbodies; and
- Manages fill material such that higher risk materials are appropriately isolated from surface waters.

The closure works area is relatively isolated from sensitive human receptors and standard, reasonable and feasible mitigation measures are also to be deployed to minimise environmental impacts.

1.3 Background

Extensive background information has been prepared in relation to the Project and in the first instance the Contractor should refer to the Tender Specifications. The following background is provided for environmental context only.

KIWEF is a former industrial waste disposal area located off Cormorant Road, Kooragang Island, Newcastle New South Wales (NSW). KIWEF ceased operation in 1999 and until this time was used by Broken Hill Proprietary Company Limited (BHP) as a landfill for disposal of waste from their Mayfield steelworks and associated operations. KIWEF was subject to Environment Protection Licence (EPL) 6437 issued under the

Protection of the Environment Operations Act 1997 (PoEO Act) for the scheduled action of "Waste disposal by application to land" first issued in 1999 to BHP and subsequently transferred to Regional Land Management Corporation Pty Ltd in May 2003 and then Hunter and Central Coast Development Corporation (HCCDC (also referred to as HDC in quoted text and reports commissioned by HCCDC prior to the merger of the Hunter Development Corporation with the Central Coast Development Corporation) in January 2008.

HCCDC surrendered EPL 6437 on 8 December 2010 and the NSW Environment Protection Authority (EPA) issued a conditional Surrender Notice 1111840 with subsequent variation notices being issued on 2 May 2013 (notice number 1510956) and 17 April 2014 (notice number 1520063) collectively referred to as the Surrender Notice for the remainder of this report. The Surrender Notice conditions relate primarily to the closure process, and describe the capping that is required across much of the area, and cross reference the GHD (2009) Revised Final Landform and Capping Strategy (the Capping Strategy).

HCCDC are the NSW Public Authority currently assigned responsibility for the closure of KIWEF on behalf of the NSW Government (the State). The land on which KIWEF is located (the closure works area) is owned by the Port of Newcastle Lessor (a NSW Government entity) who has contracted HCCDC as an agent of the State, to complete the KIWEF remedial works in accordance with a Binding Terms of Agreement.

For the purposes of closure, KIWEF has been divided into three areas with Area 2 being the subject of this CEMF while Areas 1 and 3 closure have been completed. Area 2 is further divided into sub areas K3 to K8 with some sub-areas further divided into specific disposal cells.

1.4 Delivery Mechanism

1.4.1 Closure Works

The closure works are to be delivered as a Construction only contract. As such the Contractor is to refer to the Tender Specifications and Design information provided by HCCDC which incorporates and supersedes any design information provided in this CEMF and supporting environmental assessment and management documentation.

1.4.2 Wedge and Peninsular Access

The access track to the Wedge and Peninsular Borrow Pit will be delivered as a design and construct contract so that the Contractor can design the access to cater to their specific equipment access requirements. In addition to complying with the specific environmental performance expectations and mitigation measures contained in this CEMF, the Wedge and Peninsular access will be required to be designed, constructed and used to the satisfaction of ARTC as the owner of the land accommodating the access track.

2. Regulatory Requirements

The key environmental obligations for the closure works arise under the following legislation:

- *Protection of the Environment Operations Act 1997* (POEO Act);
- *Environmental Planning and Assessment Act 1979* (EP&A Act); and
- *Environmental Protection and Biodiversity Conservation Act 2000* (EPBC Act).

Various environmental assessments and management plans have been prepared under these Acts as follows:

- **POEO Act -** NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063) and associated documents including:
  - Golders (2011), KIWEF Closure Works, Green and Golden Bell Frog Management Plan;
  - GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy; and
  - RCA (2012) Materials Management Plan – Kooragang Island Waste Emplacement Facility.
- **EP&A Act** – Hunter Development Corporation Determination under Division 5.1 of the EP&A Act and associated assessment documentation including:
  - ERM (2016), Review of Environmental Factors, KIWEF Area 2 Closure Works; and
  - Jacobs (2018) Addendum Review of Environmental Factors, KIWEF Areas 2 Closure Works.
- **EPBC Act** – Notice of determination of referral number 2016/7670 dated 22 March 2019 and associated documentation including:
  - ERM (2015), KIWEF Area 2 Closure Works, EPBC Referral;
  - ERM (2016), Response to Request for Information, KIWEF Area 2 Closure Works; and
  - Ramboll (2018), EPBC Referral, Preliminary Documentation Package – KIWEF Area 2 Closure Works.

The conditions and commitments of these documents are consolidated in the attached sub-plans.

The Closure Works design has been prepared to comply with these requirements and the Contractor is responsible for implementing these designs. Where departures are proposed by the Contractor, it is the Contractors obligation to demonstrate how compliance with all applicable environment regulations is achieved.

The Peninsular access track is to be designed and constructed by the Contractor to accommodate safe access for the Contractor’s equipment, in a manner that achieves the general environmental performance expectations within this CEMF and to the satisfaction of ARTC.

Various other environmental legislation and requirements apply to the site as documented in Appendix A and their requirements are generally captured in the attached sub-plans.

3. General Environmental Management Requirements

3.1 Environmental and Sustainability Management System

The Contractor is required to have a corporate Environmental Management System certified under AS/NZS ISO 14001:2015.

3.2 Environmental Training

All Contractor personnel and sub-contractors will undergo environmental training before commencing works on site. Training will be undertaken in the following forms:

- Project Induction; and
- Regular (daily) pre-start discussions on environmental topics.

Records of induction and training will be kept on the Contractor's database including the topic of the training carried out, dates, names and trainer details. Inductees will be required to sign-off that they have been informed of the environmental issues and that they understand their responsibilities.

3.2.1 Induction

Prior to working on site, the Contractor will ensure that all staff and sub-contractors working on site are appropriately inducted. The Contractors induction must communicate the environmental performance expectations of this CEMF and the specific mitigation measures to achieve these expectations as documented in the Contractors CEMP. Induction content is expected to include:

- Legal and regulatory requirements including duty of care and potential consequences of infringements;
- Environmental responsibilities with detailed training on the implementation of hygiene protocols and the importance of GGBF;
- Identification of sensitive areas including threatened species habitat, waterways, asbestos impacted waste and other hazardous waste;
- Identification of boundaries for vegetation clearing, washing, refuelling and maintenance areas for vehicles, plant and equipment;
- Environmental management techniques for noise, air, surface and ground water, waste generation, contaminated land etc;
- Emergency plans and incident management including the use of spill kits;
- Reporting processes for environmental harm or environmental incidents;
- Roles and responsibilities in achieving conformance with environmental policies and requirements, including emergency preparedness and response requirements; and
- Identification and management of non-conformances.

3.2.2 Daily pre-start talks

Pre-start talks will help to ensure that timely and relevant information is communicated to the workforce and that feedback can be provided on issues of interest or concern. Pre-start talks should address weather forecasts with implications for daily site environmental management (dust or rainfall response requirements) as a minimum, and where necessary, should be used to provide refresher information on the environmental induction topics and associated environmental procedures.

In the event of environmental near misses or incidents, or changes to procedures that could result in changed levels of environmental risks, pre-start talks may be used to deliver updates.

3.3 Emergency Contacts and Response

An emergency response plan would be prepared and implemented during the Project by the Contractor. The emergency response plan should document the contractor's approach to managing potential hazards and risks, incidents and emergencies. In undertaking planning for emergencies, learning from past incidents, applying risk assessments and training methods should be documented.

3.3.1 Emergency Preparedness

The key to effective prevention of environmental incidents involves selecting the right personnel and subcontractors, promoting a positive attitude to the importance of environmental issues, training, controls, monitoring, and surveillance. During construction activities, inspections and preventative action should include:

- Daily inspections of active work sites;
- Completion of routine environmental checklists;
- Issue and timely and effective close-out of maintenance and non-compliance notices;
- Maintenance of constant supervision on site;
- On-going environmental training; and
- Environmental audits of work sites, subcontractors and compliance issues.

Environmental and safety information on hazardous substances (e.g. safety data sheets) should be made available at the main site office and near to where such substances are stored and used. These locations will be communicated to all personnel.

Testing of and training in environmental response procedures should be conducted in areas where a pollution risk is present, such as on site and near re-fuelling areas for spill awareness, or worksites near environmentally sensitive areas. Personnel involved in emergency response activities should be provided with specific training.

An up-to-date list of emergency response personnel and organisations should be developed and maintained at the Contractor's main project office.

4. Implementation

4.1 Risk Assessment

The consideration of potential environmental risks has been undertaken through the Environmental Impact Assessment Process. This process has drawn on a significant volume of information. As a minimum, the Contractor is required to have read and understood the documents listed in Chapter 2 such that they have an adequate understanding of the environmental context and management expectations for the Closure Works. In preparing the Contractor's Construction Environmental Management Plan, the Contractor is required to undertake any additional risk assessment they deem necessary to manage environmental risks, such that the performance expectations of the CEMF are achieved when implementing their nominated construction methodology.

Based on HCCDC's understanding of the site, the following priority environmental factors and aspects were identified:

- Flora and Fauna Management;
- Erosion and Sediment Control, and Water Management;
- Contaminated Materials Management; and
- Rehabilitation.

In addition to the above priority environmental management requirements, suggested mitigation measures for environmental risks including traffic, air quality, lighting, noise, waste, rehabilitation and heritage are addressed in the attached sub-plans and are to be incorporated into the Contractor's work methods.

4.2 Environmental Management Activities and Controls

The documents listed in Chapter 2 identify environmental management and monitoring measures that apply to the Closure Works. These documents include:

- Hunter Development Corporation - Report on KIWEF - Revised Final Landform and Capping Strategy - August 2009 - Revision 2, prepared by GHD (the Capping Strategy);
- 'Green and Golden Bell Frog Management Plan – Kooragang Island Waste Emplacement Facility Closure Works' dated 19 April 2011 and prepared by Golder Associates;
- 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012 prepared by RCA Australia; and
- 'EPBC Referral Preliminary Documentation Package – KIWEF Area 2 Closure Works' June 2018 prepared by Ramboll (the PDP).

The Surrender Notice also requires that the implementation of these plans and strategies to be validated through a report provided to the NSW EPA to allow the lifting of the Surrender Notice obligations. The summary of the measures required to be implemented and when are presented in Appendix B.

Further detail on the above documents has been incorporated into sub-plans prepared as part of this CEMF. These have been prepared based on requirements of the Surrender Notice, EPBC Act Referral outcome, Review of Environmental Factors, previously completed capping works and current industry practice to provide guidance on how to manage certain aspects of environmental management during construction.

The suite of action plans addressing priority environmental aspects includes the following:

- Appendix C. Materials Management Plan
- Appendix D. Flora and Fauna Management Plan

- Appendix E. Revegetation Management Plan
- Appendix F. Water Quality Management Plan
- Appendix G. Traffic Management
- Appendix H. Air Quality Management
- Appendix I. Noise Management
- Appendix J. Heritage management

The Contractor is expected to be fully aware of the requirements of these sub-plans in preparing their tender and program and to be prepared such that extensive clearing and bulk excavation works on site do not commence prior to all required environment controls being in place for any given works area.

4.3 Environmental Control Plans or Maps

A Preliminary Environmental Control Map, reproduces Constraints Map prepared by SMEC, is provided below. This Preliminary Environmental Control Map is to be updated by the Contractor to address Contractor's specific work methods. The Environmental Control Map is to be specific to the site and outline the location of protection measures, monitoring requirements and environmentally sensitive areas. The Environmental Control Map forms the practical application of the proposed control measures contained within this CEMF.

The Environmental Control Map is to be used in project inductions, work site set-up, reviewing ongoing environmental performance and be included as information in tender documents to subcontractors where applicable.

The project Environmental Control Map is to be updated to include:

- The worksite layout and boundary, including entry/exit points and internal roads and clearing limits;
- Location of adjoining land-use and nearest noise sensitive receivers;
- Location and type of sediment and erosion control measures, including size / capacity of detention basins and wheel wash facilities;
- Location and type of fauna exclusion fences;
- Location of site offices;
- Location of spill containment and clean-up equipment;
- Location of worksite waste management facilities;
- Hours of work applicable to the worksite (including specific time windows for deliveries and any restrictions on high noise generating activities).
- Location of environmentally sensitive areas (e.g. threatened species, critical habitat, known contaminated areas, etc)
- Vegetation and trees to be protected;
- Location of stormwater drainage and watercourses leading to / from the worksite; and
- Summary of specific environmental management requirements from licenses, approvals or permit conditions.

The provisions of this plan apply in addition to any erosion and sediment control plans or other documentation that specify the location of environmental controls on site.

NOTE: HABITAT AREA EXTENDED TO INCLUDE ALL WETLANDS IN THIS AREA

REFER INSET

150 mm ON ORIGINAL

A1

DRAWING FILE LOCATION / NAME: D:\SMEC\30011921_KIWEF\CAD\DWG\0006_D.dwg

PLOT DATE: 16 Dec 2018 TIME: 16:51:10

EXTERNAL REFERENCE FILES:
X_AH_Kooragang Image
x_Newc_a1_30011034
x_SMEC MASTER BDY
x_SMEC MASTER HABITAT
x_SMEC MASTER GEO
x_M&P_Survey 160477A

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A1	27.09.18	ISSUED FOR 90% PROGRESS REVIEW	-	-
A2	5.10.18	ISSUED FOR 90% REVIEW	-	-
B	13.11.18	ISSUED FOR 100% REVIEW	-	-
C	28.11.18	ISSUED FOR PRE-TENDER ESTIMATE	-	-
D	17.12.18	ISSUED FOR TENDER	001	EW

TITLE	NAME
DRAFTER	MLC
DRAFTING CHECK	EW
DESIGNER	MLC
DESIGN CHECK	JH
PROJECT MANAGER	EW
PROJECT DIRECTOR	JK

SCALES AT A1 SIZE DRAWING
0 20 40 60 80 100m
SCALE 1:2000 AT ORIGINAL SIZE

DESIGNER
SMEC
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CLIENT
NSW GOVERNMENT
Hunter & Central Coast Development Corporation

TITLE
KOORAGANG ISLAND WASTE EMPLACEMENT FACILITY
STAGE 5 CLOSURE WORKS AREA 2 (K3/K5/K7) CONTRACT HCCDC 18/04
SEPARABLE PORTIONS 1 and 2 - GENERAL
CONSTRAINTS PLAN

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
1: 2000	TENDER	0006	D

4.4 Environmental Schedules

The Environmental Schedules set out below represent the records likely to be required to be kept during the Project.

- Weekly and post rainfall site inspection checklist;
- Daily materials tracking forms;
- Level 2 and Level 3 notification forms;
- Notified materials tracking register;
- Water quality monitoring results register;
- Dewatering form;
- Waste Register;
- Induction record;
- Internal Audit Register;
- Non-Conformance Register;
- Complaint Form; and
- Complaint Register.

The form and content of the Environmental Schedules is to be provided by the Contractor in accordance with their Environmental Management System.

5. Monitoring, Reporting and Review

5.1 Environmental Monitoring

As part of the overall environmental management of the site, during the landfill closure works, the Contractor is to conduct at least weekly inspections of all mitigation measures. The results of these inspections will be recorded on a weekly environmental inspection record. Should non-conformances be identified, the Contractor is required to undertake corrective action to address the issue.

The following construction monitoring is required:

- Daily prestart checks on amphibian-disease hygiene station functioning and supplies, and weather forecast noting predicted wind and rain;
- Real-time classification of materials to nominated thresholds in accordance with the Materials Management Plan decision matrix;
- Post rainfall checks of sediment dam water level and water quality, and erosion and sediment control functioning;
- Inspection covering sediment dam water levels and water quality, erosion and sediment control structures, frog fences, fuel and chemical storage, stockpile bunding and covers;
- Sediment basin discharge or dewatering water quality sampling and analysis suitable to demonstrate pollution of water has/will not occur;
- noise monitoring of any out of hours construction works in accordance with Interim Construction Noise Guidelines;
- visual observations of visible dust levels to confirm no off site dust impacts; and
- post capping defects and liabilities monitoring including revegetation success monitoring.

Where recommended actions are suggested, priorities should be set against these actions for site implementation. The list of actions should be distributed to the responsible personnel. A close out system must be included.

The defects and liabilities period is linked to a demonstration of performance against parameters to be negotiated with the HCCDC. These are likely to include revegetation success and surface water quality.

In accordance with notice of determination condition 11 and 12, accurate and complete compliance records are required to be maintained and provided to the Department of Environment and Energy on request.

5.1.1 Construction Water Quality Monitoring

The closure works are required to comply with the general duty not to pollute waters under section 120 of the POEO Act. The contractor will be required to take adequate precautions to ensure either that discharge/or dewatering is not required, or otherwise undertake sampling and analysis to demonstrate that pollution of water has or will not occur associated with water releases from sediment basins.

In the absence of an EPL, to avoid causing pollution and breaches of section 120, any water discharged from site must be of the same quality, or better, than the quality of the receiving waters (at the time of discharge) or able to be demonstrated to not have caused water pollution.

It is noted that water pollution or pollution of waters means:

- placing in or on, or otherwise introducing into or onto, waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, so that the physical, chemical or biological condition of the waters is changed, or
- placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any refuse, litter, debris or other matter, whether solid or liquid or gaseous, so that the change in the condition of the waters or the refuse, litter, debris or other matter, either alone or together with any other refuse, litter, debris or matter present in the waters makes, or is likely to make, the waters unclean, noxious, poisonous or impure, detrimental to the health, safety, welfare or property of persons, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters or unsuitable for use in irrigation, or obstructs or interferes with, or is likely to obstruct or interfere with persons in the exercise or enjoyment of any right in relation to the waters, or
- placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, that is of a prescribed nature, description or class or that does not comply with any standard prescribed in respect of that matter.

A summary of water quality monitoring including sample results is required to be submitted to the HCCDC following any dewatering or discharge event demonstrating that the Contractor has complied with the above obligations.

5.1.2 Environmental Auditing

Internal and external environmental audits should be undertaken throughout the construction process to ensure that the project environmental requirements and Contractors CEMP are implemented appropriately.

The auditing process should be designed to identify any non-conformances, providing an opportunity to apply corrective and / or preventative action where appropriate. The Audit schedule is to include:

- Internal environmental audit by the Contractor’s Environmental Manager on a three monthly basis during construction;
- Regular attendance at the site by the KIWEF Area 2 Closure Works Independent Auditor; and
- Independent audit of compliance with the notice of determination conditions following the completion of onsite construction works and prior to completion of the project works period.

5.2 Reporting

The implementation of the Closure Strategy and contract requires the following reporting on environmental performance:

- Daily record of material management including notification of identification of potential Level 2, Level 3 or otherwise hazardous materials;
- Monthly progress reporting;
- Validation reporting following practical completion; and
- Annual compliance reporting against the notice of determination.

Detailed requirements of these reports are included in the Tender Specifications. The following summarises the expected content of each level of reporting.

5.2.1 Daily Record of Material Management

The daily record of material management is required to summarise material interaction for the day and include:

- Description of earthworks activity undertaken;

- Description of cut to fill or cut to stockpile activities including locations;
- Notification of HCCDC of suspected contaminated or otherwise hazardous material encountered and description of handling, current location, further assessment required; and
- Summary of any handling of previously notified material including update on current location.

All notifications are also to be tracked through a notifications register to record final disposal location.

5.2.2 Monthly Progress Reporting

Monthly Progress Reporting is to include details of the implementation environmental management requirements including:

- Update on any environmental risks and opportunities, and significant environmental impacts associated with the work;
- Progress against environmental objectives, targets and measures of performance; and
- Management actions, including environmental controls, training, inspections and testing.

Specifically, the environmental monthly reporting is to include such items as:

- Characterisation, site management and fate of contaminated material, collated materials tracking information;
- Quality assurance on placed material;
- Non-compliances and corrective actions;
- Environmental monitoring requirements; and
- Monthly logs and photographs and other records of the progressive compilation of information that will be integrated into the Validation Report on completion.

5.2.3 Validation Report

The Validation Report is required to satisfy Condition 4h of the Surrender Notice which requires that there is written confirmation that the cap was established in accordance with relevant specifications as follows:

"Within three months of completion of the installation of the final cap, the licensee must provide the EPA with a written Validation Report that includes:

> *i) Advice that the final cap has been installed;*
>
> *ii) Advice from a suitably qualified and experienced person as to whether or not the cap was installed in accordance with Chapter 7 of the Landform and Capping Strategy and relevant conditions of this Notice, or future variations to this Notice;*
>
> *iii) Provision of the results of all relevant test results to validate that the permeability of the final capping layer is less than or equal to $K = 1 \times 10^{-7}$m/s. Permeability testing must be taken of the sealing layer material at a rate of not less than 1 per 2000T (or 1250m^3);*
>
> *iv) Provision of information that establishes the thickness of the installed sealing and revegetation layers in the format of either:*
>
> > *(i) As constructed drawings, including cross sections, of the surfaces of the coal washery reject layer; and*
> >
> > *(ii) The results of surveys undertaken for each capping layer by a registered surveyor".*

The Contractor is to allow for all effort necessary to assemble adequate validation evidence throughout the implementation of the Closure Works and for the preparation of the validation report. For the avoidance of doubt, the Contractor is required to validate that the Closure works have been delivered in accordance with the design and Tender Specification in relation to capping parameters and the Materials Management Plan in relation to materials handling and tracking. The environmental performance expectations within this CEMF must be achieved as part of the Contract but are not required to be incorporated into the Validation Report. Evidence of compliance is to be available on request by HCCDC.

5.2.4 Annual compliance reporting

During the performance of the contract, and as a condition of satisfaction of the care and maintenance obligations, the Contractor will be responsible for the preparation of an annual compliance report against the conditions of the notice of determination.

5.3 Corrective Action

Non-compliance may be identified through routine weekly site inspections, impromptu site inspections, via the CEMF or CEMP review or audit process or be incident based.

Environmental non-conformance include:

- non-compliance with environmental management controls or mitigation measures specified within the CEMP;
- environmental incidents not threatening material harm to the environment; and
- environmental emergencies threatening material harm to the environment.

Corrective actions may be triggered by any of the above and will include immediate steps taken to control event, investigation and development additional controls to prevent recurrence. Corrective actions will be developed in consultation with the HCCDC and will be assigned to the appropriate staff for close out. All corrective actions will be tracked through to completion through the non-conformance tracking register.

All environmental non-conformances with project approvals, this EMP or Contractor procedures is to be recorded as an incident, investigated and closed out by the Contractor. Close-out is required to include Construction supervisor sign-off that corrective actions have been implemented or alternative solutions substituted. A summary of all non-conformances and associated corrective actions is to be provided to the HCCDC.

In addition to the above, incidents causing or threatening material harm to the environment are regulated under the POEO Act, which defines material harm under section 147, as follows:

> *(1a) harm to the environment is material if*
>
> *(i) it involves actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial, or*
>
> *(ii) it results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000 (or such other amount as is prescribed by the regulations), and*
>
> *(1b) loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment;*
>
> *(2a) it does not matter that harm to the environment is caused only in the premises where the pollution incident occurs.*

The POEO Act requires incidents causing or threatening material harm to the environment to immediately notify the relevant authorities, which include:

- the EPA;
- Newcastle Council;
- the Ministry of Health;
- the WorkCover Authority; and
- Fire and Rescue NSW.

The POEO Act outlines responsibilities down to an individual level to notify incidents threatening material harm to the environment immediately. In general terms all individuals are responsible for reporting such incidents to the Construction Project Manager who in turn will inform HCCDC. HCCDC would then notify relevant authorities. It also requires that an individual notify the incident where they cannot make contact with their employer. Relevant authority contact details are included in the table below and should be displayed where all site workers can access them easily in the event of a notifiable incident occurring.

Table 1 Relevant Authority Contact Details

Contact	Phone Number
The EPA Environment Line	131 555
The Ministry of Health via the Public Health Unit	1300 066 055
SafeWork NSW	13 10 50
Newcastle City Council	02 4974 2000
Fire and Rescue NSW	000

Environmental incidents relating to the *Environmental Protection and Biodiversity Conservation Act 1999* must be notified to the Secretary of the Department of the Environment and Energy. Specifically, conditions 16 and 17 of the Notice of determination require the following:

16. The approval holder must notify the Department in writing of any: incident; non-compliance with the conditions; or non-compliance with the commitments made in plans. The notification must be given as soon as practicable, and no later than two business days after becoming aware of the incident or non-compliance. The notification must specify:

a. the condition which is or may be in breach; and

b. a short description of the incident and/or non-compliance.

17. The approval holder must provide to the Department the details of any incident or non-compliance with the conditions or commitments made in plans as soon as practicable and no later than 10 business days after becoming aware of the incident or non-compliance, specifying:

a. any corrective action or investigation which the approval holder has already taken or intends to take in the immediate future;

b. the potential impacts of the incident or non-compliance; and

c. the method and timing of any remedial action that will be undertaken by the approval holder.

5.4 CEMF Review

This CEMF forms the basis on which the contractor's CEMP should be prepared and as such is to be reviewed/adapted or superseded based on the contractor's specific work methods and approach to environmental management. The Contractor's CEMP should be reviewed in accordance with the requirements of their environmental management system but should also be reviewed during implementation as and when required, including when the following situations arise:

- Client recommendations for changes (particularly following initial review);
- Opportunities for improvement or deficiencies in the project system are identified; or
- Following an audit of the system or the occurrence of significant incidents and non-conformances.

Appendix A. Legislative requirements

Legislation and administering authority	Requirement	Application to Closure Works
Environment Protection and Biodiversity Conservation Act 1999 Commonwealth Department of the Environment and Energy	The relevant objective of the Act is to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance. A project may be defined as a controlled action under the Act due to impacts on matters of national environmental significance.	The Project was determined to be a Controlled Action due to potential impacts to the identified key population of Green and Golden Bell Frogs and associated impacts to the ecology of the Hunter Estuary Ramsar wetland should this population be threatened. The project was approved by the Commonwealth on 22 March 2019 on the basis of the preliminary documentation provided by HCCDC. Conditions of determination have been issued and are incorporated into this CEMF. Notwithstanding anything else within this CEMF and the contract documents, the Contractor is responsible for understanding and complying with the Conditions of determination.
Environmental Planning and Assessment Act 1979 Department of Planning and Environment	Encourages proper environmental impact assessment and management of development areas for the purpose of promoting the social and economic welfare of the community and a better environment.	The Project was assessed and determined under the former Part 5 (now referred to as Division 5.1) of the EP&A Act and found unlikely to significantly impact the environment subject to the implementation of a range of mitigation measures contained within the assessment documentation. These mitigation measures have been incorporated into this CEMF.
Protection of the Environment Operations Act 1997 Environment Protection Authority (EPA)	The relevant objective of the Act is to prevent environmental pollution.	The Project is regulated under the POEO Act through the Surrender Notice but does hold a current Environment Protection Licence (for activities listed under Schedule 1). In addition to complying with the conditions of the surrender notice the general duties to prevent air/ noise/ water pollution and manage waste correctly do apply. It is the contractor's obligation to undertake works in accordance with the surrender notice and in a manner that prevents pollution. Further, the Contractor is the occupant of the site under the POEO Act (as per HCCDC18/04 contract).
Contaminated Land Management Act 1997 NSW EPA	The Act provides a process for the investigation and remediation of land where contamination presents a significant risk of harm to human health or some other aspect of the environment.	While the site is known to contain contamination it is not currently regulated under this Act as it is regulated by the EPA through the POEO Act and it is not the intention of the EPA to regulate the same site under both Acts concurrently. It is the contractor's obligation to manage contaminated materials in accordance with the

Legislation and administering authority	Requirement	Application to Closure Works
		Materials Management Plan such that contaminated materials encountered is appropriately managed to avoid exacerbation and such that the fate of such material is documented.
Dangerous Goods (Road and Rail Transport) Act 2008 EPA / SafeWork NSW	A licence is required for the storage (SafeWork NSW) and /or transport (EPA) of prescribed quantities of dangerous goods.	The Contractor is required to ensure that the transport and storage of dangerous goods exceeding licensable quantities is lawfully undertaken.
Environmentally Hazardous Chemicals Act 1985 EPA	Management of Environmentally Hazardous Chemicals.	Should any material generated or encountered at the site contain chemicals that are the subject of NSW's five (5) current Chemical Control Orders (CCO), then the material will need to be managed in accordance with that CCO. Current CCO include: · Chemical control order in relation to aluminium smelter wastes containing fluoride and/or cyanide (1986) · Chemical control order in relation to dioxin-contaminated waste materials (1986) · Organotin waste materials chemical control order 1989 · Polychlorinated biphenyl (PCB) chemical control order 1997 · Scheduled chemical wastes chemical control order 2004.
Heritage Act 1977 NSW Office of Environment and Heritage (OEH)	The Act aims to encourage the conservation of the State's heritage and provides for the identification and registration of items of State heritage significance.	Not expected to impact any items on the State Heritage Register (SHR). Should the project unexpectedly find any heritage artefacts, the relevant notifications and management actions may need to be taken.
National Parks and Wildlife Act 1974 OEH	The objectives of the Act are for the conservation of nature and the conservation of objects, places or features (including biological diversity) of cultural value within the landscape.	The proposal would not affect any area declared as a National Park, historic site, nature reserve or Aboriginal area nor would it impact any historic Aboriginal object or place, threatened species, population or endangered ecological community. The potential exists for unexpected objects to be found of significance to Aboriginal people. The Chief Executive of the OEH is the authority responsible for the protection of all Aboriginal objects and places in NSW, whether they are on national park estate or not.

Legislation and administering authority	Requirement	Application to Closure Works
Threatened Species Conservation Act 1995 OEH	Provides for the protection of any threatened species on-site.	Impacts to Threatened Species are assessed through the REF and mitigation measures to prevent significant impacts are incorporated into this EMP. Any unexpected species encountered during construction may require further assessment.
Biodiversity Conservation Act 2016 OEH	The purpose of this Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The BC Act commenced on 25 August 2017 repealing the *Threatened Species Conservation Act 1995* (TSC Act).	The proposal would be considered a pending Part 5 assessment if it commences within 18 months of August 2017. Under Clause 29 of the BC (ST) Regulations, the former planning provisions continue to apply (and Part 7 of the new Act does not apply) to a pending Part 5 assessment, with the former planning provisions defined as the provisions of the EP&A Act that would be in force if that Act had not been amended by the BC Act and which call-up guidelines established under the TSC Act.
Biosecurity Act 2015 OEH	The primary object of this Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks which includes the management of plant and animal pests.	The following pests are known to be present on site and will require appropriate management · Bitou Bush (Chrysanthemoides monilifera subsp rotundata), · Crofton Weed (Ageratina adenophora); · Pampas Grass (Cortaderia selloana). · African Olive (Olea europaea), · Lantana (Lantana camara); and · Groundsel Bush (Baccharis halimifolia). In accordance with the Act all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. Surrounding ponds are also populated by Mosquito Fish (*Gambusia Holbrooki*) and the works are required to avoid any transfer or connection of water bodies that could lead to their spread.
Water Management Act 2000 Department of Lands - Water	The relevant objective of the Act is to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality.	Clause 38 or the Water Management (General) Regulation 2011 provides that a public authority is exempt from section 91E (1) of the WM Act in relation to all controlled activities that it carries out in, on or under waterfront land. As such a

Legislation and administering authority	Requirement	Application to Closure Works
		controlled activity approval is not required for the proposed activity. The water within the fill aquifer is not considered to occur naturally, no use of water in surface water bodies is proposed and no use of other naturally occurring water sources is proposed and as such a water use approval is not deemed necessary. The proposed works do not include aquifer interference and it is understood that the Aquifer interference requirements of the Act are yet to commence and as such aquifer interference approval is not deemed necessary.
State Environmental Planning Policy (Three Ports) 2013 Department of Planning and Environment	The aim of this Policy is to provide a consistent planning regime for the development and delivery of infrastructure on land in Port Botany, Port Kembla and the Port of Newcastle.	The closure works are within the land application area and Lease Area and Environmental Management Works / Environmental Protection works are permissible without consent in the Three Ports Lease Area. The Project has been assessed under the former Part 5 (Division 5.1) of the EP&A Act (refer above).
State Environmental Planning Policy 55 Department of Planning and Environment / Council	The object of this Policy is to provide for a Statewide planning approach to the remediation of contaminated land.	While the closure works also meet the definition of remediation works under this policy, the Three Ports SEPP prevails to the extent of any inconsistency. Clause 8 (4) requires that a person who carries out a remediation work must ensure that the Council notification requirements of clause 16, 17 and 18 are complied with in relation to the work. Notification of Council required 30 days in advance of commencement of Category 2 remediation. Notification of Council following completion.
State Environmental Planning Policy (Coastal Management) 2018	The aim of this Policy is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016, including the management objectives for each coastal management area, by: · managing development in the coastal zone and protecting the environmental assets of the coast, and	The closure works area is surrounded by, but does not include, land mapped as coastal wetlands. Parts of the closure works area are mapped as proximity area for Coastal Wetlands, Coastal Environment Area and Coastal Use Area. Importantly, the closure works area is within the Lease Area under the Three Ports SEPP and the Coastal Management SEPP does not apply through the workings of Clause 7 of the Coastal Management SEPP.

Legislation and administering authority	Requirement	Application to Closure Works
	· establishing a framework for land use planning to guide decision-making in the coastal zone, and · mapping the 4 coastal management areas that comprise the NSW coastal zone for the purpose of the definitions in the Coastal Management Act 2016.	
Newcastle Local Environment Plan Newcastle Council	This Plan aims to make local environmental planning provisions for land in the City of Newcastle in accordance with the relevant standard environmental planning instrument under the EP&A Act.	While located within the Newcastle Local Government Area the site is not located on land to which the *Newcastle Local Environmental Plan 2012* (NLEP) applies.

Appendix B. Environmental Obligation Interface

Sequence of Work Activities	Controls/Mitigation Measures	Primary Responsible
Tender and award	· Establish all required approvals under EPBC Act and EPA Act. · Finalise Closure Works design to comply with approvals. · Integrate above requirements into CEMF and Tender Specifications. · Scheduling works to the extent possible to occur outside of the core GGBF breeding period (that is, September to March), especially in areas adjacent to known and potential breeding habitat.	State. Contractor responsible for review of approvals in place and obtaining any additional necessary approvals.
Peninsular / Wedge Access	· Complete access upgrade design to accommodate Contractor equipment in agreement with ARTC.	Contractor in consultation with ARTC
Pre-earthworks monitoring and ongoing EPL Surrender Notice monitoring.	· Update relevant GGBF abundance survey data and water level and salinity logger data. · Undertake annual surface and groundwater monitoring as per EPL Surrender notice.	State Contractor to facilitate access through Closure Works Area as required.
Auditor oversight	· Undertake all necessary site inspections, provide input into materials management decision making to allow auditor sign-off of Closure Works completion.	State to appoint auditor. Contractor to facilitate access and provide validation information as requested by Auditor.
Site Establishment	· Implement hygiene protocol as required for the closure works area (NSW Threatened Species Management Information Circular No.6 (April 2008)). · Establish any controls necessary to prevent works from occurring outside the referral boundary. · Temporary frog exclusion fencing to surround the Closure Works site and ensure GGBF habitat protected from unauthorised access prior to works commencing in those works areas or their parts. · Conduct pre-clearance surveys by a qualified ecologist in week prior to works commencing in works areas or their parts. · Apply erosion and sediment controls as per sensitive environments (Managing Urban Stormwater – Soils and Construction (Landcom 2004)) and complete and line permanent basins as per designs provided by the State.	Contractor

Sequence of Work Activities	Controls/Mitigation Measures	Primary Responsible
	· Prepare stockpile area with adequate space for 'topsoil' level 1, 2 and 3 material and erosion and sediment controls as per ESCP and Materials Management Plan (RCA Australia 2012). · Level 2 and level 3 stockpile areas are to be lined in accordance with materials management plan (RCA Australia 2012) as necessary. · Store all hazardous liquids and chemicals in covered, bunded areas with capacity to retain 110% of largest container in the event of a spill. Proprietary available spill mats, drip trays and pallets can be used as appropriate. · Provide fully stocked spill kit/s and ensure that operators are aware of the location of these kits and are trained in their use.	
Bulk earthworks	· Undertake weed management in advance of broad scale clearing and bulk earthworks. · Win and transport site derived capping and land forming materials. · Use of imported capping material assessed as having a low risk of containing Chytrid Fungus. · Use of revegetation medium materials demonstrated to be low in nutrients and assessed as having a low risk of containing Chytrid Fungus. · Works are to be staged to reduce area of exposure and minimise dust, infiltration and sediment laden run-off. · Qualified ecologist to be available on call during earthworks in the event that any GGBF individuals are encountered during works, the ecologist must be called in to capture and relocate the individuals. · Materials will be managed in accordance with the approved Materials Management Plan and GGBF management plan within each area and no transport of fill, capping or topsoil between areas is to occur. · Strip topsoil to a minimum of 100mm following material management plan decision matrix for suitability for re-use. · Topsoil to be stored separately in prepared stockpile areas as per detailed design documentation. · Stockpiles to be stored for long periods are to be wrapped, covered, re-seeded or wet to minimise dust generation. · Cut to base of excavations as per detailed design documentation insuring minimum 1% grade. Cut material to be used as fill and capping in accordance with materials management plan decision matrix. · The final surface of both capped and uncapped areas will be protected by a vegetative layer. The extent of the revegetation will depend on the proposed site use (i.e. undeveloped, commercial development or habitat areas).	Contractor

Sequence of Work Activities	Controls/Mitigation Measures	Primary Responsible
	· The use of imported topsoil is to be avoided where possible. · Upon completion of the works, the works areas must be rehabilitated in accordance with Rehabilitation Management Plan. · Dispose of materials unsuitable for reuse in accordance with materials management plan. · All waste to be removed upon completion. · Upon completion, site facilities, frog exclusion fencing and security fencing shall be removed as necessary. · Non-permanent erosion and sediment controls are to remain in place until they are no-longer required. · Sediment basins and drains will remain in place as landscape features until they are no longer required. · Refuelling is not to occur in the vicinity of sediment dams, drainage lines or water bodies. · Refuel plant using drip trays/spill mats and other spill containment devices. · Store all hazardous liquids and chemicals in covered, bunded areas with capacity to retain 110% of largest container in the event of a spill. Proprietary available spill mats, drip trays and pallets can be used as appropriate. · Do not leave chemical containers open outside or inside of the bunded areas. · Provide fully stocked spill kit/s and ensure that operators are aware of the location of these kits and are trained in their use. · Spills are to be immediately contained and absorbed using materials provided in the spill kit. · All personnel are to be trained in the appropriate use and disposal of spill kit materials.	
Construction Monitoring	· Daily prestart checks on amphibian disease hygiene station functioning and supplies and weather forecast noting predicted wind and rain. · Real-time classification of soils to nominated thresholds in accordance with the Materials Management Plan decision matrix. · Post rainfall checks of sediment dam water level and water quality and erosion and sediment control functioning.	Contractor

Sequence of Work Activities	Controls/Mitigation Measures	Primary Responsible
	· Weekly site inspection checklist covering sediment dam water levels and water quality, erosion and sediment control structures, frog fences, fuel and chemical storage, stockpile bunding and covers. · Pre-discharge physical water quality condition (temperature; dissolved oxygen; pH; electrical conductivity (EC)) and chemical water quality condition in sediment dams. · Noise monitoring of any out of hours construction works in accordance with interim construction noise guidelines. · Reference to available PWCS/NCIG dust monitoring results to determine off site dust levels.	
Defect Liability period	· Check and maintain the erosion and sediment controls regularly, especially after rainfall, to ensure that they remain effective including: o Collected sediment is to be removed from the controls as necessary to ensure they remain effective. o Collected sediment is to be combined with planting medium for reuse on the site – if appropriate. o All vehicle wheels, tracks and undercarriages must be cleaned prior to exiting the site and travelling on public roads. · Three month vegetation maintenance program to include, watering, weeding as appropriate but excluding the use of fertilisers and pesticides and herbicides. · Pre and post discharge surface water monitoring in sediment dams and receiving waters. · Revegetation monitoring and maintenance to ensure adequate cover. · Preparation of an annual compliance report against the conditions of the notice of determination.	Contractor

Appendix C. Materials Management Plan

Hazardous / Contaminated Material	
Objective	To comply with legislative requirements and ensure that hazardous / contaminated material from construction activities does not cause an environmental nuisance / harm and is handled, categorised, tracked and placed in accordance with the RCA (2012) Materials Management Plan.
Targets	No exacerbation of contamination during construction No environmental incidences involving contaminated/ hazardous materials No pollution events of the surrounding environmental and water ways by contaminated material The movement and ultimate fate of materials is fully tracked
Key Documents	**State Documents** NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063) GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy (Ref: 22/14371/85882 R4) RCA (2012) 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012.
Material Classification	**Level 1** material is any material not exhibiting characteristics indicative of other categories. **Level 2** material is identified as material with any of the following characteristics: strong hydrocarbon odour, ammonia odour, asbestos containing material, evidence of PCB impact (dark staining and phenolic odour), materials with an average concentration of >2,000 mg/kg PAH or material represented by individual PAH concentration >2,500 mg/kg. **Level 3** material is material containing Separate Phase Hydrocarbons.
Mitigation Measures and Controls	The following is generally reproduced from RCA (2012).
Contaminated material identification and management	The Contractors Materials Management Plan is to be adequate to ensure that material management is undertaken in accordance with RCA (2012) in addition to meeting the performance expectations of the Contract Specifications and this CEMF. The Contractors Materials Management Plan is to incorporate a protocol for identification and management of Contaminated Materials that is to include the following: · Appropriate resourcing for real-time supervision of all ground disturbance activities by a suitably qualified and environmental practitioner;

Hazardous / Contaminated Material	
	· Stop work requirements (localised) if any soils are encountered which have distinguishing Level 2 or Level 3 characteristics. · Characterising and delineated Level 2 and Level 3 materials in-situ or at the place of storage following excavation including input from occupational hygienist or other appropriately qualified specialist (Contractor's Specialist) to identify the substance. · Consultation with third party advisors, the State and the auditor to confirm management expectations. All contaminated material encountered during the landfill closure works will be assessed and categorised in accordance with RCA (2012). All material is to be adequately tracked such the that the composition and location of all Level 2, Level 3 and asbestos waste fate is documented and able to be validated. Uncovering of suspected level 2, level 3 or otherwise hazardous material requires the following steps to be undertaken: · Immediately cease work and contact the Site Supervisor · Demarcate the 'unexpected find' to prevent access and install appropriate environmental and safety controls. · Follow the management steps specified below in relation to each material classification; and · If substance is assessed as level 1 material not presenting an unacceptable risk to human health the Site Supervisor to remove controls and continue work.
Level 1 Material management	There is no specific management required for Level 1 material on the site and Level 1 material has unrestricted onsite re-use classification (Section 5.6.1 of RCA 2012). Level 1 material may be used for: · Topsoil where sourced from top 100mm of existing landform; · General land forming; · Buffer material to be placed above Level 2 and Level 3 Material; · Interim bunding for stockpiled material; and · Site capping material. Level 1 material properties are to be validated in accordance with the Tender Specifications for testing and analysis.
Level 2 Material management	Level 2 material is designated as having restricted site use and where encountered is to be managed as follows: · Where suspected Level 2 soils are encountered then the nature and extent of the materials should be validated by laboratory testing to assess whether the materials are still to be classified as Level 2 or Level 3 materials. · If Level 2 material is encountered but is to remain in place and will have sufficient cap (ie >500mm), the vertical extent does not need to be validated.

<table>
<tr><th>Hazardous / Contaminated Material</th><th></th></tr>
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The Contractor is to develop a notification detailing material type, location, estimated quantity and potential contaminants.
The Contractor is to notify the State or its representative within 24 hours of encountering Level 2 material.
Level 2 material may be relocated to a lined and covered short-term stockpiling or skip-bin for further quantification, characterisation and categorisation.
Confirmed Level 2 contaminated material is to be isolated by covering with at least 500mm of Level 1 material, plus 500 mm of cap with preference for material to be left in situ provided there is no immediate risk to the environment or community or otherwise be relocated to an on-site location.

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<tr><td>Level 3 Material Management</td><td>
Level 3 material is designated as having restricted site use and must managed as follows:

The Contractor is to develop a notification detailing material type, location, quantity and potential contaminants.
The contractor is to notify the HCCDC as soon as possible and on the day the material is encountered.
HCCDC will then notify the EPA;
Level 3 material may be relocated to a lined and covered stockpile or skip bin for further characterisation and categorisation and while a decision is made by HCCDC on the preferred manner of ultimate disposal.

The HCCDC will provide direction as to the required treatment of Confirmed Level 3 contaminated material which may include:

Isolated by covering with at least 1000mm of Level 1 material, plus 500mm of cap with preference for material to be left in situ provided there is no immediate danger to the environment or community or otherwise be relocated to an on-site location with the area having appropriate controls in place; or
Transported off-site for disposed in a legal manner.

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<tr><td>Asbestos Management</td><td>
Asbestos materials (and ACM) should be managed generally as follows as specified in RCA MMP (2012):

Where at all possible, materials containing bonded asbestos wastes would be fully delineated, be assessed to be at least 1m below final capping, and remain as undisturbed materials managed by in-situ containment;
Should any fill materials containing bonded asbestos wastes require excavation as they are not in-situ more than 1m from the final cap in the earthworks, then consideration would be given to removing the materials and emplaced at a depth of 1m;
Friable asbestos would be assessed and considered for emplacement at a depth of 2.5m below the underside of the capping layer within a purpose built excavation at a location to be agreed with HCCDC;
Final location of any asbestos discovered shall be thoroughly documented including accurate survey of the emplacement area;

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Hazardous / Contaminated Material	
	· Where asbestos waste is found in fill that also contains volatile organic compounds or separate phase hydrocarbons, appropriate treatment for recorded contaminants will be required; and · All asbestos is to be managed and handled in accordance with the recommendations of an appropriately licensed Asbestos Assessor/handler. The use of in-situ or ex-situ treatment approach for any materials containing bonded and friable asbestos wastes will be assessed on a case by case basis in relation to volume and risk to human health.
Other waste management	Minimal volumes of material requiring off-site disposal have been encountered in previous stages of KIWEF closure works. In the event that such material is encountered it will be classified in accordance with the Waste Classification Guidelines (2015) and disposed of to a landfill legally able to accept the waste. Wastes generated in completing the capping works are also required to disposed of off-site. All other contaminated materials will be managed on site in accordance with the Materials Management Plan. Waste management measures to be implemented include: · Licensed waste contractors will be utilised to remove waste. · All waste is to be disposed of at a lawful facility (Note: A lawful facility includes one that has the appropriate Development Consent, Environment Protection Licence or is complying with EPA approved conditions and requirements). · Waste must be classified prior to disposal – refer to NSW EPA Waste Classification Guidelines (2015). · Records of the quantity and final locations of all on and offsite waste will be maintained · Provision of skip bins (or equivalent) to be used to collect all general wastes generated during the works. · Provide an adequate number of skip bins on site to contain all general waste generated throughout the works. · Provide bins to enable waste segregation · Provide recycling services (e.g. Paper, Concrete, Steel, Cardboard, Timber). · Ensure housekeeping is maintained and waste is disposed of to the appropriate bin. · Retain waste disposal permits and figures on the amount of waste that has been removed from site.
Monitoring & Reporting	**Real-time Supervision -** Real-time observation of all ground disturbances by a suitably qualified environmental practitioner to identify and manage suspected contaminated material. **Sampling and analysis** of material properties for categorisation and validation purposes in accordance with the tender specifications. The **daily record of material management** is required to summarise material interaction for the day and include: · Description of earthworks activity undertaken;

Hazardous / Contaminated Material	
	· Description of cut to fill or cut to stockpile activities including locations; · Notification to HCCDC of suspected contaminated or otherwise hazardous material encountered and description of handling, current location, further assessment required; and · Summary of any handling of previously notified material including update on current location. All notifications are also to be tracked through a notifications register to record final disposal location. **Monthly Progress Reporting** is to include details of the implementation environmental management requirements including: · Update on any environmental risks and opportunities, and significant environmental impacts associated with the work; · Progress against environmental objectives, targets and measures of performance; and · Management actions, including environmental controls, training, inspections and testing. Specifically, the environmental monthly reporting is to include such items as: · Characterisation, site management and fate of contaminated material, collated materials tracking information; · Quality assurance on placed material; · non-compliances and corrective actions; · environmental monitoring requirements; and · monthly logs and photographs and other records of the progressive compilation of information that will be integrated into the Validation Report on completion. A **Validation Report** is required to satisfy Condition 4h of the Surrender Notice which requires that there is written confirmation the cap was established in accordance with relevant specifications.
Actions	The Contractor's CEMP is to include specific procedure for monitoring, management and documentation of materials management suitable for implementation to achieve the intent of the Materials Management Plan and Surrender Notice under the Contractors specific construction methodology.
Responsibilities	The Contractor is to ensure that appropriate resources and processes are in place and that appropriate records are kept to allow validation that materials have been managed in accordance with the Surrender Notice.
Timeframe	Duration of site activities where works may encounter potentially contaminated fill materials.

Appendix D. Flora and Fauna Management Plan

Flora and Fauna	
Objective	To comply with contractual and legislative requirements and ensure that native fauna and flora are protected from construction activities.
Targets	No death or injury to fauna including the Green and Golden Bell Frog No unapproved destruction of flora
Legal, Contractual & Other Requirements	*Environmental Protection and Biodiversity Conservation Act 1999* *Threatened Species Conservation Act 1995 (repealed)* *Biodiversity Conservation Act 2016 (Transitional Arrangements).*
Site specific planning / approval conditions / licence conditions	**State Documents** NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063) Golders (2011), KIWEF Closure Works, Green and Golden Bell Frog Management Plan (Ref: 117623029-001-R-Rev0) Jacobs (2018) Addendum Review of Environmental Factors, KIWEF Area 2 Closure Works **Commonwealth Documents** Ramboll (2018), EPBC Referral, Preliminary Documentation Package – KIWEF Area 2 Closure Works (Ref: 318000395)
General Flora and Fauna Mitigation Measures and Controls	General mitigation measures to be considered include: · Adequate run-off, erosion and sedimentation controls should be in place during construction, particularly in areas where run-off has the potential to impact on nearby waterways, surrounding native vegetation, EEC regrowth, and existing drainage line and dam areas. · Care should be taken that any noxious weeds occurring on the site are not further dispersed as a result of the Proposal. A follow up Weed Control Program may be necessary to control the encroachment of these species into surrounding areas. The landowner has a legal responsibility to control and suppress these species on their property under the *Noxious Weeds Act 1995*. The Weed Control Program should be remove weeds by physical means and avoid the use of herbicides. · Stockpiling of soil that may contain seeds of exotic species shall be stockpiled away from adjacent vegetation or drainage lines where they could be spread during rainfall events. · Placement of soil stockpiles away from vegetated areas. · Utilising existing disturbed corridors such as cleared areas, roads, tracks and existing easements, where possible for set up of equipment, stockpile areas and site facilities.

Flora and Fauna	
	· Noxious weeds to be managed in accordance with the expectations under the *Biosecurity Act 2018*. It is recommended that the plants be removed by physical removal, as herbicides may impact GGBFs and their habitat. · Open excavations and storage areas to be inspected regularly for the presence of fauna species. · Plant and equipment brought on to site must be cleaned and free of deleterious material, mud and other material that may harbour weed seeds · Proposed hours of construction are to be maintained to restrict noise and light impacts on nocturnal fauna. · Utilise an onsite ecologist during construction to re-locate any native fauna which may be displaced. · Avoid rubbish and other waste build up to deter feral animals. · Habitat features such as woody debris that may be utilised by fauna within the construction area would be retained and set-aside during the construction period for reinstatement at completion of works. · Any water required for dust suppression will be drawn from ponds established for the purpose. No water for dust suppression will be drawn from existing ponds on the site. The establishment of dedicated dust suppression ponds will be undertaken to prevent the potential spread of Plague Minnow into ponds currently free of this species. The location and procedure for those dedicated dust suppression ponds will be communicated during the site induction and training. · No night works are permitted without additional assessment of potential noise and light impacts. · Lighting of site compounds, if required for safety and security, will avoid light spill outside of the construction works footprint and will be undertaken in accordance with *Australian Standard 4282—1997 Control of the obtrusive effects of outdoor lighting.*
GGBF Management	GGBF impact avoidance is to be based on the following: · Establishment and use of Chytrid Hygiene procedures such that the Chytrid fungus is not brought to site or transferred between areas of the site; · Appropriate levels of GGBF pre-clearance/disturbance surveys and relocation to ensure to the extent possible that direct disturbance areas are free of GGBF on commencement of works in each area; · Establishment of GGBF exclusion fencing such that the risk of GGBF re-entering surveyed areas is prevented; · Establishment of clear boundaries of works areas such that unnecessary disturbance is avoided, particularly adjacent to existing ponds; · Establishment of appropriate erosions and sediment controls to prevent sedimentation and pollution of waters; · Implementation of GGBF risk consideration to all decision making such that unintended consequences to GGBF can be avoided. This includes in considering suitability of imported materials from a Chytrid risk and nutrient perspective and use of chemicals including flocculants, herbicides and pesticides; and · Rehabilitation using species preferred by GGBF (refer to rehabilitation management plan).

Flora and Fauna	
Chytrid Fungus hygiene protocol	A Chytrid Hygiene procedure in accordance with the NSW Threatened Species Management Information Circular No.6 – Service Hygiene Protocol for the Control of Disease in Frogs (April (2008) or most recent revision of that document, must be implemented on the Closure Works site during all works and any other activities undertaken as part of the action. This procedure is to include: · Dedicated disinfection bays established at site entry and all vehicles required to enter via this bay; · All disinfection processes will be monitored and controlled at the Closure Works entry point; · The location of these disinfection bays, and the obligations of disinfection, will be communicated during the site induction and training; · Cleaning and disinfection of workers boots upon entry and exit from the site; · Procedures will be implemented to inspect mobile plant entering the Project site during construction activities to control soil and/or organic matter and to disinfect tyres and wheels of vehicles entering the Project site; and · Vehicles arriving at site muddy will be sent away for more intensive cleaning prior to disinfection.
Chytrid Fungus Risk Assessment Process	The contractor is to demonstrate that suitable risk assessment has been undertaken by an appropriately qualified and experienced ecologist on all imported capping and revegetation materials to demonstrate that it contains a low risk of containing Chytrid. Risk assessment should consider as a minimum: · Material not sourced from known, suspected or likely amphibian habitat areas; · Material unlikely to have had contact with amphibians and no amphibians present in material; and · Material are not to be stored in, or come in contact with material sourced from, areas of known, suspected or likely amphibian habitat prior to transport.
Pre-clearance survey design and clearance methodology.	The Contractor will be responsible for developing a pre-clearance survey and clearing methodology suitable for implementation with the contractors specific construction methods that minimises potential harm to GGBF species. The survey methodology should give consideration to the following factors: · Level of effort warranted in different areas and habitats; · Seasonal factors on GGBF use of habitat; and · Need for night time surveys. · Survey effort required is likely to include: o Targeted active searches of potential GGBF habitat located within the disturbance footprint; o Conducted to minimise disruption of breeding activities: relocated tadpoles or metamorphs; · Be conducted in accordance with hygiene protocol;

Flora and Fauna	
	· Habitat resources including all wet areas as well as rocks, logs, tussock forming vegetation, and other cover will be searched during diurnal visual inspections. · A nocturnal habitat search including visual search, spotlighting and call playback may be conducted to assess nocturnal use (breeding/calling) in the habitat supported in disturbance area, if the surveys are conducted during core breeding season (spring/summer); · Any GGBF observed within the disturbance footprint will be relocated in accordance with relocation procedure provided in the GGBF Management Plan prior to commencement of disturbance; and · The survey methodology implemented should allow the qualified and experienced ecologist to confirm that the risk of GGBF mortality has been reduced to the extent reasonable and feasible for the applicable habitat type/area. The clearing methodology should include the following: · Consideration of most appropriate time to install frog exclusion fences; · Presence of an appropriately qualified and experienced ecologists during clearing; · Gradual degradation of higher risk habitat areas progressing from areas furthest away from pond towards areas of refuge; · Relocation of cleared vegetation to areas away from immediate works that allow remaining amphibians to escape; and · Ability to open amphibian fences during clearing at key times to allow fauna to escape.
Amphibian Relocation	If any frog specimens thought to be a GGBF are observed and are within project disturbance area the following relocation procedure will be implemented: · Observer to notify Site supervisor who in turn is to notify the HCCDC, a suitably qualified ecologist, and the Contractor's supervisor of the frog's location immediately; · Contractor supervisor to halt work in the immediate vicinity to prevent accidental interaction with the frog; · The ecologist or HCCDC's environmental representative will determine whether the frog is likely to be harmed by works or is likely to migrate to an area that it could be harmed; · If likely to be harmed by works the GGBF will be captured by the ecologist or suitably trained frog handler following GGBF handling and Hygiene procedures; · A one frog per bag policy will be observed with disinfection of all equipment undertaken immediately following any contact with frogs of any description; · If healthy the frog will be held in a cool, dark, moist place until nightfall before being released to a suitable location in the immediate vicinity of capture but outside the disturbance footprint;

Flora and Fauna	
	· GGBF showing Chytrid symptoms and deemed unlikely to survive transportation will be euthanized and preserved prior to dispatch to a designated sick or dead frog recipient in accordance with Appendix 2 of the National Parks and Wildlife Service's Hygiene protocol for the control of disease in frogs (NPWS, 2008); · If deemed likely to survive transportation GGBF will be placed in a damp cloth bag or partially inflated plastic bag with leaf litter; · Dead frogs will be preserved in accordance with the approved GGBF management plan including cutting open stomach and preserving in 10 times the volume of the specimen of 65% ethonol or 10% buffered formalin · The designated sick or dead frog recipient will be contacted prior to transport to confirm appropriate procedures; · Containers used for storing frogs will be labelled with date, location and species if known; and · A standardised collection form must be completed and a copy sent with the specimen.
Actions	The contractors CEMP is required to establish the actual pre-clearance and clearance methodology, exclusion fence designs and Chytrid Risk assessment and documentation proposed.
Responsibilities	Contractor's Ecologist is responsible for ensuring risks to Fauna is minimised to the extent reasonable and feasible. Contractor's Project Manager is responsible for allowing sufficient time within program to conduct pre-clearance and clearance in a manner that maximises survival of GGBF and other fauna following the advice of the Ecologist. Contractor is responsible for notifying the Principal of any sick or dead GGBF. All personnel are responsible for ensuring that the clearing limits are addressed and native flora and fauna species are protected. All site personnel to undertake toolbox talks in relation to the reporting process for injury/ death to fauna or clearing of flora occurring beyond the required limits for construction.
Timeframe	Duration of the works.
Monitoring & Reporting	Daily visually monitoring by site supervisors for obvious signs of fauna and the functioning of controls including fences and Chytrid hygiene stations. Weekly inspections to be documented on a Weekly Environmental Inspection Checklist. Outcomes of pre-clearance surveys are to be documented and provided to the HCCDC. Observed sick or dead GGBF are to be notified to the Principal immediately.

Appendix E. Revegetation Management Plan

Revegetation Management Plan	
Objective	To comply with State and Commonwealth approvals requirements and related conditions. To provide a post construction environment that is revegetated to stabilise the capping surface; and planted with species known to be favoured by GGBF.
Targets	The capped surface is stabilised and vegetated within 12 months of construction completion. Provide a revegetated capped surface that includes species of flora known to be favoured by GGBF.
Key Documents	**State Documents** NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063) Golders (2011), KIWEF Closure Works, Green and Golden Bell Frog Management Plan (Ref: 117623029-001-R-Rev0) GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy (Ref: 22/14371/85882 R4) Jacobs (2018) Addendum Review of Environmental Factors, KIWEF Area 2 Closure Works **Commonwealth Documents** Ramboll (2018), EPBC Referral, Preliminary Documentation Package – KIWEF Area 2 Closure Works (Ref: 318000395)
Mitigation Measures and Controls	General mitigation measures to be considered include: · Care should be taken that any noxious weeds occurring on the site are not further dispersed as a result of the Proposal. A follow up Weed Control Program may be necessary to control the encroachment of these species into surrounding areas. The landowner has a legal responsibility to control and suppress these species on their property under the *Noxious Weeds Act 1995*. The Weed Control Program should be remove weeds by physical means and avoid the use of herbicides · Stockpiling of soil that may contain seeds of exotic species shall be stockpiled away from adjacent vegetation or drainage lines where they could be spread during rainfall events. · Placement of soil stockpiles away from vegetated areas. · Utilising existing disturbed corridors such as cleared areas, roads, tracks and existing easements, where possible for set up of equipment, stockpile areas and site facilities · Bitou Bush and Crofton Weed would be managed by following the Local Noxious Weed Control Plans (NCC 2006). It is recommended that the plants be removed by physical removal, as herbicides may impact GGBFs and their habitat.

Revegetation Management Plan	
	· Plant and equipment brought on to site must be cleaned and free of deleterious material, mud and other material that may harbour weed seeds · Works associated with the closure of the KIWEF must only occur within the closure works area (project footprint); and must be restricted to the extent required to satisfy the Surrender Notice requirements. · All disturbed surfaces will be revegetated within 1 month of final land forming and in compliance with the landscaping plans. · Any capping materials that are imported from outside the KIWEF facility must be sourced from an area that is assessed as having a low risk of containing Chytrid Fungus. The Chytrid Assessment Process will follow the below procedure: · The contractor is to demonstrate that suitable risk assessment has been undertaken by an appropriately qualified and experienced ecologist on all imported capping and revegetation materials to demonstrate that it contains a low risk of containing chytrid. Risk assessment should consider as a minimum: o Material not sourced from known, suspected or likely amphibian habitat areas; o Material unlikely to have had contact with amphibians and no amphibians present in material; and o Material stored in a dry location prior to transport. · Topsoil to be used for surface layers must be sourced from within KIWEF to the extent possible and will otherwise be assessed as low in nutrients and having a low risk of containing Chytrid Fungus to be protective of adjacent MNES habitat. · Upon completion of works, the works area will be rehabilitated with vegetation species known to be favoured by GGBF. · Open stormwater infrastructure across the KWIEF site will be planted with species known to be favoured by GGBF. This revegetation and rehabilitation strategy will include a 2m wide buffer on either side of the stormwater drains. The intention is to provide movement corridors for GGBF across the site. · Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF. · Habitat features such as woody debris that may be utilised by fauna within the construction area would be retained and set-aside during the construction period for reinstatement at completion of works. · Prior to the Construction Completion dates the Contractor is required to seed the vegetation layer above the capping layer and reseed areas where sparse vegetation coverage is achieved by the end of the care and maintenance period.
Species Mix	<u>Aquatic vegetation:</u> · Selection of reeds that provide good habitat cover such as Typha, Bolboshoenus, Phragmites, and Juncus; · A mixed community is preferable to single species stands;

Revegetation Management Plan	
	· GGBF prefer wetlands with sections of open water. Water depth should be deep enough to prevent Typha spreading across the entire pond area; the reeds should be mainly at the edge of ponds; Substrate at edges should be suitable for reed growth (i.e. not too many pebbles, sandbags, etc.); · Areas of low blanketing vegetation are also desirable for GGBF breeding, for example, Paspalum grass and Shoenoplectus rush; · Establishing aquatic plants with planting after Closure Works: will maximise structural suitability of wetland to immigrating GGBF as soon as construction is completed. Terrestrial vegetation: · Stabilise new works with sterile millet (or other suitable cover crop); · Retain seed bank in fill taken from site (to be reused); · Avoid large tree species (as roots may potentially compromise the cap); Allow terrestrial species to re-colonise Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF.
Performance Criteria	Establish adequate vegetation coverage across the closure area. Where vegetation regrowth is sparse (ie less than 50% growth) in areas of greater than $10m^2$, the performance criteria will be considered to have failed and contingency measures are required. No deep-rooted vegetation (ie large shrubs or trees) on top of capped surface
Contingency Measures	Where Vegetation Coverage has been identified to be insufficient, the area will be reseeded. Where deep-rooted vegetation is identified on top of capped surface. The vegetation will be removed (mechanically where possible).
Responsibilities	The Contractor is responsible for undertaking the work, monitoring and maintenance of all elements of the revegetation management plan, until the completion of the construction maintenance period (indicatively 3 months post construction completion). The State (or its agent) is responsible for the monitoring and maintenance of all elements of the revegetation management plan and any rectification works, following the completion of the construction maintenance period.
Timeframe	For the duration of the construction works; and the construction maintenance period.
Monitoring & Reporting	Vegetation establishment will be visually monitored monthly during the construction works and construction maintenance period to identify any areas where vegetation is failing to establish. Should vegetation not establish within the construction maintenance period then targeted seeding and/or planting would be undertaken.

Appendix F. Water Quality Management Plan

<table>
<tr><th colspan="2">Water Quality Management Plan</th></tr>
<tr><td>Objective</td><td>To comply with State and Federal approval requirements.
To prevent water discharges from construction works area to the extent possible.
To manage water discharged to avoid impact to receiving waters.</td></tr>
<tr><td>Targets</td><td>No sediment or water quality impacts to the surrounding environment and waterways from the construction works.</td></tr>
<tr><td>Key Documents</td><td>State Documents

NSW EPA (2010), Approval of the Surrender of a Licence – Licence 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063).
GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy (Ref: 22/14371/85882 R4)
Commonwealth Documents

Ramboll (2018), EPBC Referral, Preliminary Documentation Package – KIWEF Area 2 Closure Works (Ref: 318000395)</td></tr>
<tr><td>Controls</td><td>Erosion and sediment control will be designed, installed and managed as follows:
Progressive erosion and sediment control plans (ESCPs) will be developed by the Contractor and implemented prior to the commencement of topsoil stripping and earthworks.
The for construction design for permanent sediment basins is to be in accordance with the environmental protection standards for sensitive environments based on Managing Urban Stormwater - Soils and Construction, (Landcom, 2004), as well as documents from other States and internationally (such as “International Erosion Control Association – Australasia”).
The Contractor is required to install the permanent sediment basins as per the for construction design and any necessary temporary erosion and sediment control measures in advance of bulk-earthworks reporting to each basin.
Alternative arrangements proposed by the Contractor are also required to be in accordance with these standards.
Erosion and sediment control structures are to be regularly inspected and maintained, particularly in advance of and following significant rainfall events.
Any water discharges are required to be managed to avoid pollution of waters having regard to the sensitivity of the receiving environment. In particular, any flocculants are to be demonstrated as being both effective and safe for amphibians prior to use.
Top soil/mulch stockpiles to be not greater than 2.0m in height. All stockpiles will be located clear of watercourses and drainage works.
Wastewater management facilities shall only be provided through proprietary storage and pump out systems.
All disturbed surfaces will be revegetated as soon as possible.</td></tr>
</table>

Water Quality Management Plan	
	· All temporary ESC works will be removed immediately prior to final completion and all surfaces will be returned to pre-existing condition. · Provision of shaker grids or rumble strip at site egress points. · if contaminated materials are encountered, they are to be managed in accordance with Materials Management Plan, and as a minimum isolated and covered to avoid runoff.
Performance Criteria	Discharge quality must comply with Performance Criteria: · TSS: < 50mg/Lt (~Turbidity 30NTU). · pH: Between 6.5 and 8.5. · Otherwise able to be demonstrated not to have caused pollution of waters.
Contingency Measures	If Water Quality performance criteria is not suitable for discharge, other management measures must be implemented prior to discharge. These may include such things as: · the trapped sediment laden water may be treated with flocculants at a rate demonstrated in advance to be effective on the local material properties and using substances safe for amphibians; · Dosing with appropriate buffers to neutralise water; · Other mitigation measures deemed appropriate which may include a purpose constructed soak-away where HCCDC advices a suitable location such that contamination in fill is not likely to be mobilised.
Responsibilities	The Contractor is responsible for undertaking the work, monitoring and maintenance of all elements of the water quality management plan until the completion of the construction maintenance period (indicatively 3 months post construction completion). The State (or its agent) is responsible for the monitoring described under the KIWEF Annual Water Monitoring and the KIWEF Continuous Data Logging.
Timeframe	Construction Water Quality and Erosion Sediment Controls will be maintained and monitored throughout the duration of site works.
Monitoring and Reporting	Daily visual monitoring by site supervisors. Documented post rainfall checks of sediment basin water level and water quality and erosion and sediment control functioning. Weekly documented inspections. Maintenance activities for ESCPs shall be documented. Sediment basin discharge or dewatering water quality sampling and analysis suitable to demonstrate pollution of water has/will not occur. All water quality data including quantity, quality and dates of water release will be maintained within the project records.

Appendix G. Traffic Management

Traffic Management	
Objective	To ensure that additional traffic from construction activities does not cause an environmental nuisance.
Targets	No valid complaints resulting from congestion from construction traffic Comply with traffic management standards
Legal, Contractual and Other Requirements	*Protection of the Environment Operations Act 1997* *Roads Act 1993* RTA Traffic Control at Worksites Roads (General) Regulation 2000 *Local Government Act 1993*
Site specific planning / approval conditions / licence conditions	Not applicable.
Controls (means and resources)	The Contractor is required to develop a Traffic Management Plan detailing the route to the site, times of activity, types of machinery, signage, traffic control measures, once the source of any imported materials has been identified. The following traffic management control measures to be implemented are to be detailed in Construction Traffic Management Procedures (CTMP): · Traffic will be required to adhere to routes and speed limits designated by the Contractor, in consultation with the HCCDC, ARTC, NCIG and RMS and the RMS Contractor for the Tourle Street / Cormorant Road upgrade works (if ongoing); · Worksite speed limits will be determined for areas of the site based on road type, road condition and adjacent work activity; · Normal road rules apply unless specifically stated otherwise; · Barrier systems may be used at the discretion of the Contractor to define the designated routes; · All project personnel will be required to undertake the site induction that will specify appropriate traffic practices on site; · Site staff with responsibilities for control of construction activities will perform site inspections aimed at maintaining traffic at determined worksite speed limits; · Following site surface stabilisation/ rehabilitation works to control erosion, foot and vehicular traffic will be avoided on recently stabilised areas wherever practical; · Water spraying (where appropriate) will be used to minimise the generation of dust from roadway surfaces; · An inspection system will be established by the Contractor to assess effectiveness of traffic control measures. The assessments will determine if any modification is required to practices on site or the CTMP; and · An incident management procedure for emergencies relating to traffic management for the project works.

Traffic Management	
Actions	Contractor to incorporate the above traffic management measures into Contractor’s Traffic Management Plans.
Responsibilities	The Contractor is responsible for ensuring traffic management plans are developed, approved and implemented.
Timeframe	Duration of site works.
Monitoring and Reporting	Daily inspection, checks and regular maintenance to be completed for traffic control measures.

Appendix H. Air Quality Management

Dust and Air Quality	
Objective	To ensure that dust and other air emissions from construction activities do not cause impacts on sensitive receivers and equipment.
Targets	No visible dust (or offensive odours) leaving site and reaching: · Identified or potential GGBF habitat, particularly water bodies and fringing vegetation; and · Cormorant Road or neighbouring coal loader operations.
Legal, Contractual and Other Requirements	Contract specification Review of Environmental Factors Kooragang Island Waste Emplacement Facility Area 2 Closure Works (ERM 2016) *Protection of the Environment Operations Act 1997* *Protection of the Environment Operations (Clean Air) Regulation 2002*
Site specific planning / approval conditions / licence conditions	All activities associated with the closure, capping, rehabilitation and post-closure maintenance and monitoring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.
Controls (means and resources)	Mitigation measures include amending the nature of work in the event that construction works do not meet the above Objective. Operation of all facilities and equipment on the site will be performed so as to minimise reduce the emission of dust, odour and other air impurities including: · Use of water sprays to reduce dust emission from trafficable areas, work areas, stockpiles and other exposed areas but not to draw water from existing ponds as per the flora and fauna management plan; · Where necessary, stabilisation of long term stockpiles; · Reduce the number and extent of disturbed areas at a given time during the remediation activity on site; · Control of haul loading vehicles, whereby the load will not exceed the height of the haul boards and tailboards on the vehicles; · The vehicle speed shall be restricted along the haul roads on site to minimise dust generation and potential spilling of hauled material; · Cleaning/maintenance of the access and haul roads where they interface with public roads to prevent sediment tracking; · Loads of soil or contaminated material entering and leaving site will be covered. Internal material transport will also require a cover if material is likely to or observed to be generating dust; · Any excavated material likely to generate odours will be covered; · Maintenance and servicing of plant and vehicles to minimise reduce emission of air pollutants; · Observations of prevailing (and forecast) weather conditions, to program site activities in order to minimise air quality issues;

Dust and Air Quality	
	· Modify work practices during dry and windy conditions; · Progressively stabilise and/or revegetate as areas of works as completed; · Provide shaker grids or rumble strip at site egress points and where aggregate is used, minimum size is 150mm; · Remove mud from haul vehicles prior to entering public roads; · Remove spilt mud by construction equipment or vehicles on public roads; and · Provide awareness training in the need to minimise dust during site inductions and toolbox talks.
Actions	Contractor to implement reasonable and feasible measures from the above to achieve air quality goal.
Responsibilities	Contractor
Timeframe	Duration of site works. Water tankers and other measures available at the commencement of earthworks. Spilt mud and sediment to be removed from public roads as soon as practicable, and at least prior to the end of each shift.
Monitoring and Reporting	Daily observations of dust generation, mud tracking, vehicle emissions, site generated odours and weather conditions (wind direction and strength). Weekly inspect to record functioning of air quality controls.

Appendix I. Noise Management

<table>
<tr><th colspan="2">Noise and Vibration</th></tr>
<tr><td>Objective</td><td>To ensure that noise and vibration from construction activities does not cause environmental nuisance or unnecessarily disturb fauna.</td></tr>
<tr><td>Targets</td><td>No valid noise / vibration complaints resulting from construction works.
No unreasonable noise or vibration.
No noise and vibration impacts on external receptors.</td></tr>
<tr><td>Legal, Contractual and Other Requirements</td><td>Works are to be undertaken in accordance with the Interim Construction Noise Guidelines with works to be restricted to:
· 7 am to 6 pm Monday – Friday
· 8 am to 1 pm Saturdays
No work outside of these hours without HCCDC’s approval (except for emergency situations).
Protection of the Environment Operations Act 1997
Protection of the Environment Operations (Noise Control) Regulation 2000</td></tr>
<tr><td>Site specific planning / approval conditions / licence conditions</td><td>All activities associated with the closure, capping, rehabilitation and post-closure maintenance and monitoring at the premises must be carried out in a competent manner. This includes:
· The processing, handling, movement and storage of materials and substances used at the premises; and
· The treatment, storage, processing, reprocessing, transport and disposal of any waste generated by the activity.
All plant and equipment installed at the premises or used in connection with the closure, capping, rehabilitation and post-closure maintenance and monitoring activities at the premises must be:
· Maintained in a proper and efficient condition; and
· Operated in a proper and efficient manner.</td></tr>
</table>

Noise and Vibration	
Controls (means and resources)	No work will be undertaken outside of the agreed hours without prior approval (except in an emergency situation). Delivery operations or other noise generating activities at compound and storage areas will take place during the designated construction hours nominated above, unless specifically required by Police or RTA requirements. Reasonable and feasible mitigation measures to be considered as required include: · Avoiding where practical the use of noisy plant simultaneously close together or adjacent to sensitive receptors; · All plant will be maintained in accordance with the manufacturer's requirements; · Stationary noise generating equipment to be orientated away from sensitive areas; · Undertaking loading and unloading activities away from sensitive areas and during designated construction hours; · Selection of the most appropriate plant and equipment to minimise noise generation and include where necessary screening and enclosures; · Regular checks are to be undertaken to ensure all equipment and vehicles are in good working order and are operated correctly; and · Awareness training and information will be provided to project personnel in relation to the vibration requirements on the project and the need to minimise vibration when in close proximity to operational areas (rail corridor).
Responsibilities	Contractor
Timeframe	Duration of site works.
Monitoring and Reporting	Vehicle inspections to be recorded on daily vehicle pre-start checks.

Appendix J. Heritage management

Heritage Management Archaeology and Heritage	
Objective	To ensure that undiscovered heritage and archaeological items are protected from construction activities.
Targets	Unknown or undocumented heritage sites are not knowingly destroyed, defaced or damaged. Identify and protect any new artefacts or heritage sites before any harm can take place.
Legal, Contractual & Other Requirements	*Heritage Act 1977* *National Parks and Wildlife Act 1974*
Controls (means & resources)	No known heritage items or areas have been identified within the project site or surrounds. As such, heritage mitigation measures are limited to restricting access beyond the project boundary and the implementation of the following 'chance find' protocol: · In the event that potential Aboriginal and Historic heritage items are discovered, STOP ALL WORK in the vicinity of the find and immediately notify the relevant Construction Supervisor and Environmental Manager; · Contact HCCDC to notify of the find as soon as they receive notification; · In the event of uncovering remains that are potentially human, the NSW Police are also to be contacted immediately; · Record the details and take non-intrusive photos of the find and relay information to HCCDC; · HCCDC will contact a qualified archaeologist to get advice regarding the nature and potential significance of the find; · If the qualified archaeologist advises that the find is not a potential heritage item, work will recommence in consultation with HCCDC; · If the qualified archaeologist advises that the find is a potential heritage item HCCDC will contact and notify the relevant authority; and · Work is not to recommence in the area of the identified find until clearance is received from HCCDC.
Responsibilities	All persons are responsible for reporting items of potential cultural or heritage value. Contractor's representative will ensure the implementation of the above chance finds protocol in the event that items of potential cultural or heritage value are uncovered.
Timeframe	Duration of site works
Monitoring & Reporting	Ongoing visual observations for previously unidentified items. Reporting of any chance finds in accordance with the above protocol.

Appendix B – Green and Golden Bell Frog Management Plan (Golder Associates, 2011)

19 April 2011

GREEN AND GOLDEN BELL FROG MANAGEMENT PLAN

Kooragang Island Waste Emplacement Facility Closure Works

Submitted to:
Hunter Development Corporation
Suite B, Level 5
PricewaterhouseCoopers Centre
26 Honeysuckle Drive
Newcastle, New South Wales 2300

Report Number. 117623029-001-R-Rev0

REPORT

Golder Associates

Executive Summary

The Kooragang Island Waste Emplacement Facility (KIWEF) is located on land owned by the New South Wales (NSW) State Property Authority, which is managed under delegated-authority by the Newcastle Port Corporation (NPC).

The KIWEF contains various wastes from the former BHP steelworks at Mayfield. Hunter Development Corporation (HDC) is in the process of closing the KIWEF via implementing certain landfill closure works, which include land-forming of waste emplacement cells and construction of a capping layer over much of the KIWEF site.

Historically, HDC was the holder of an Environment Protection Licence (EPL) over the site for the former BHP Solid Waste facility (refer to Figure 1). That EPL has now been surrendered, subject to the implementation of landfill closure works required by the NSW Office of Environment and Heritage (OEH) (formerly the NSW Department of Environment, Climate Change and Water (DECCW)). HDC, as the Agents for the Crown, are undertaking those necessary landfill closure works, on lands administered by NPC, which encompass the KIWEF (Figure 1).

The KIWEF site supports known populations and habitat of the Green and Golden Bell Frog (*Litoria aurea*). A flora and fauna impact assessment (GHD, 2010a) of the proposed landfill closure works concluded that the works are "*designed to minimise the direct and indirect impacts on biodiversity of the locality, especially in relation to the Green and Gold Bell Frog... The Proposal also addresses the risks posed from the prior disposal of BHP waste on the site*" and is unlikely to result in "*long-term decrease in the size of a population, reduce the area of occupancy of species, fragment an existing population, adversely affect habitat critical to the survival of a species, disrupt the breeding cycle of a population, modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline, result in invasive species that are harmful to an endangered species becoming established in the endangered habitat, or interfere with the recovery of any threatened species*".

Overall, the flora and fauna impact assessment (GHD, 2010a) reported that the proposed capping strategy is unlikely to impact significantly on Green and Golden Bell Frogs, provided the works are managed through an appropriate environmental management plan.

In order to assist in minimising impacts of the landfill closure works, HDC engaged Golder Associates Pty Ltd (Golder) to develop this Green and Golden Bell Frog Management Plan (the GGBF Management Plan). HDC intend to incorporate this GGBF Management Plan into the detailed design documentation currently being developed for the landfill closure works. An Action Plan has been developed by Golder in conjunction with this GBBF Management Plan and is reported to HDC separately (Golder, 2011).

The Green and Golden Bell Frog is listed as 'endangered' under the NSW *Threatened Species Conservation Act 1995*, and 'vulnerable' under the federal *Environmental Protection and Biodiversity Conservation Act 1999*. Historically, this species was widespread across much of the Hunter Valley; however, it is now believed to be restricted to four key populations, including a large population on Kooragang Island (including the KIWEF site).

The Green and Golden Bell Frog is a relatively large species and is usually green, most often with irregular large gold spots and/or stripes. The Green and Golden Bell Frog can be regarded as somewhat of a habitat generalist, dispersing widely and maturing early. It is known to inhabit marshes, dams and stream sides and appears to prefer those water bodies where Bulrushes (*Typha* spp.) or Spikerushes (*Eleocharis* spp.) grow (NPWS, 1999). Green and Golden Bell Frogs are also known to inhabit highly disturbed sites (NPWS, 1999), such as the KIWEF site. The Green and Golden Bell Frog is known to travel significant distances across often seemingly inhospitable habitat. Distances of up to 1.5 km day/night are not unknown, particularly associated with significant rain events.

Frog Chytrid Fungus (FCF) has been identified as a key threatening process, at both the state and national level, for the Green and Golden Bell Frog (DSEWPC, 2009). FCF is widespread on Kooragang Island and Hexham Swamp, the other key Green and Golden Bell Frog population in the Newcastle area (DECC, 2007).

Section 3 of this document details the management procedures to be implemented, including identification and delineation of disturbance areas, pre-work surveys, identification of relocation areas, relocation procedures and rehabilitation of disturbed habitat, environmental induction training and site hygiene management for Chytrid fungus.

Section 4 of this document outlines the proposed monitoring programme for Green and Golden Bell Frogs at the KIWEF site. The monitoring programme includes annual review of publicly available baseline and ongoing data from other surveys including frog populations (such as that being undertaken by NCIG across the KIWEF site). An Annual Environmental Monitoring Report (AEMR) discussing the results of analysis of monitoring data will be presented to OEH.

Section 5 of this document identifies specific management and mitigation measures for disturbed areas and triggers for the development of response criteria in the unlikely event that the landfill closure works have an impact on the Green and Golden Bell Frogs. If the results of the monitoring programme indicate a decline in Green and Golden Bell Frog numbers across the site, which cannot be attributed to natural population fluctuations and variability, and is potentially a direct result of the landfill closure works, specific response criteria will be developed by HDC in consultation with the OEH.

Section 6 of this document outlines proposed review and reporting actions. HDC will report to OEH annually for 5 years following completion of the landfill closure works, unless analysis shows that Green and Golden Bell Frog populations are being impacted, then further reporting will be undertaken until a time agreed with OEH.

In accordance with the *Approval of Surrender of Licence Number 6437*, the Director-General will be notified of any incident with actual or potential significant off-site impacts on people or the biophysical environment, as soon as practicable after the occurrence of the incident. The Director-General will be provided with written details of the incident within seven days of the date on which the incident occurred.

The AEMR will be distributed to relevant government agencies and stakeholders, and copies provided to other interested parties, if requested.

In accordance with the *Approval of Surrender of Licence Number 6437*, this Management Plan will be made available on the HDC website.

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FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 BACKGROUND

The Kooragang Island Waste Emplacement Facility (KIWEF) is located on land owned by the New South Wales (NSW) State Property Authority, which is managed under delegated-authority by the Newcastle Port Corporation (NPC).

The KIWEF contains various wastes from the former BHP steelworks at Mayfield. Hunter Development Corporation (HDC) is in the process of closing the KIWEF via implementing certain landfill closure works, which include land-forming of waste emplacement cells and construction of a capping layer over much of the KIWEF site.

Historically, HDC was the holder of an Environment Protection Licence (EPL) over the site for the former BHP Solid Waste facility (refer to Figure 1). That EPL has now been surrendered, subject to the implementation of landfill closure works required by the NSW Office of Environment and Heritage (OEH) (formerly the NSW Department of Environment, Climate Change and Water (DECCW)). HDC, as the Agents for the Crown, are undertaking those necessary landfill closure works, on lands administered by NPC, which encompass the KIWEF (Figure 1).

The KIWEF site supports known populations and habitat of the Green and Golden Bell Frog (*Litoria aurea*). A flora and fauna impact assessment (GHD, 2010a) of the proposed landfill closure works concluded that the works are "*designed to minimise the direct and indirect impacts on biodiversity of the locality, especially in relation to the Green and Gold Bell Frog... The Proposal also addresses the risks posed from the prior disposal of BHP waste on the site*" and is unlikely to result in "*long-term decrease in the size of a population, reduce the area of occupancy of species, fragment an existing population, adversely affect habitat critical to the survival of a species, disrupt the breeding cycle of a population, modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline, result in invasive species that are harmful to an endangered species becoming established in the endangered habitat, or interfere with the recovery of any threatened species*".

Overall, the flora and fauna impact assessment (GHD, 2010a) reported that the proposed capping strategy is unlikely to impact significantly on Green and Golden Bell Frogs, provided the works are managed through an appropriate environmental management plan.

In order to assist in minimising impacts of the landfill closure works, HDC engaged Golder Associates Pty Ltd (Golder) to develop this Green and Golden Bell Frog management plan (the GGBF Management Plan) to support the landfill closure works. HDC intend to incorporate this GGBF Management Plan into the detailed design documentation currently being developed by HDC for the landfill closure works.

This GGBF Management Plan has been prepared in accordance with HDC's Request for Tender No. 141 ("Green & Golden Bell Frog Management Plan and Action Plan for K26/32 Ponds: KIWEF"), dated February 2011, and Golder's responding proposal, dated 28 February 2011 as accepted via a letter from HDC emailed to Golder on 16 March 2011. This Management Plan has been prepared via review of documentation provided by HDC to Golder on 22 March 2011, a visual site visit by Golder personnel and written commentary from HDC.

An Action Plan for the K26/K32 Ponds has been developed by Golder in conjunction with this GBBF Management Plan and is reported to HDC in a separate document (Golder, 2011).

1.2 A SUMMARY OF WORKS COMPLETED TO DATE

A range of studies have been completed by others in relation to the Green and Golden Bell Frogs on the KIWEF site since its hand over to the Crown in 2002. The most recent relevant studies are listed in the following. It is noted that other previous studies are summarised in these works, and, therefore, are not identified here.

- Revised Capping Strategy, Flora and Fauna Impact Assessment, Rev 3 (GHD, 2010a).
- March 2011 Green and Golden Bell Frog (Litoria aurea) Survey at the Kooragang Island Waste Emplacement Facility (Umwelt, 2011).
- Revised Final Landform and Capping Strategy, Rev 4, (GHD, 2010b).

The key findings of those reports, as relevant to the ongoing management of Green and Golden Bell Frogs on the KIWEF site, are presented below.

1.2.1 Flora and Fauna Impact Assessment

The flora and fauna impact assessment of the revised capping strategy was undertaken as part of the EPL surrender, which the then DECCW required to identify any impacts resulting from the implementation of the final capping strategy on Green and Golden Bell Frogs (and other threatened species). The assessment was also required to identify associated mitigation measures for those species and their habitats.

Key Findings

The key findings of the flora and fauna impact assessment (GHD, 2010a) comprised the following:

- The assessment identified areas of known and potential Green and Golden Bell Frog Habitat (as indicated on Figure 1), and determined the presence, relative abundance and distribution of Green and Golden Bell Frogs on the KIWEF site, and the adjacent Ash Island. A summary of the locations and numbers of Green and Golden Bell Frogs recorded on the KIWEF site is presented in Figure 1. During the assessment (that is February and March 2009), 59 Green and Golden Bell Frogs were recorded from the KIWEF and surrounding area; 38 individuals were recorded on the KIWEF site.
- Two important factors to note, as identified in the report, are:
  - The Green and Golden Bell Frog's ongoing survival on Kooragang Island, and the KIWEF site, may be related to the protection that the brackish wetland habitat provides from the Chytrid fungus (Stockwell, pers. comm., in GHD, 2010a).
  - The terrestrial habitats and ephemeral water bodies supported on the KIWEF site and the larger Kooragang Island may provide important movement corridor refuges for Green and Golden Bell Frogs (Hamer *et al.*, 2008, in GHD, 2010a).
- Potential changes to water quality, especially salinity, may adversely affect the Green and Golden Bell Frogs on the KIWEF site.
- The *in situ* contaminated materials present across the KIWEF site will be addressed by the capping strategy. There is, therefore, the potential for water quality in, and adjacent to, the capped location to remain similar or improve.
- The capping strategy was designed to minimise changes to hydrology. As noted, however, the construction of the NCIG rail loop has impacted on the known Green and Golden Bell Frog habitat supported in the K26 and K32 cells, and potentially already altered the hydrology of these ponds.
- Where the proposed capping strategy would impact on streamside vegetation and banks, and, hence, potential Green and Golden Bell Frog habitat, that vegetation would be reinstated immediately following capping works to a state as close as possible to the original.
- Plague Minnow (*Gambusia holbrooki*), a known predator of Green and Golden Bell Frog tadpoles, was recorded in ponds across the KIWEF site.
- The assessment considered that the capping strategy would result in minimal fragmentation or isolation of currently interconnecting areas of Green and Golden Bell Frog habitat. The capping strategy would

leave areas of appropriate habitat in areas within the KIWEF site and the adjacent Hunter Estuary National Park.

- That vegetation that may be cleared or capped is considered unlikely to constitute key foraging habitat for Green and Golden Bell Frogs.
- The potential cumulative impacts on Green and Golden Bell frogs and their habitat across the local area from other proposals, is unknown; particularly impacts on potential movement between populations north and south. Furthermore, inference is made that competition for resources, required by the species, may have potentially increased because of the translocation of individuals into suitable areas on the KIWEF site from areas impacted by other proposals. However, the proposed "*capping strategy aims to avoid increasing these pressures while dealing with the potentially harmful pollutants on site*" and "*is unlikely to add to these previous impacts or add to cumulative adverse impacts on threatened species at the KIWEF site*".
- Overall, the assessment reports that the proposed capping strategy is unlikely to impact significantly on Green and Golden Bell Frogs, provided the works are managed through an appropriate environmental management plan. Those assessments of significance were undertaken in accordance with the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW *Environmental Planning and Assessment Act 1979* (EPA Act).

Mitigation Measures

The following mitigation measures were recommended in the flora and fauna impact assessment:

- A 30 m buffer zone is proposed around fresh and brackish water wetlands, ponds, and identified areas of Green and Golden Bell Frog habitat.
- If it is identified that works will occur in Green and Golden Bell Frog habitat (such as the fringing habitat near Deep Pond), one week prior to those works commencing, a pre-clearance survey is required to be conducted by a qualified ecologist. In the event that any Green and Golden Bell Frogs are identified, they will be relocated (using appropriate amphibian hygiene protocols).
- Once works are complete, the restoration and rehabilitation of that habitat should be undertaken.
- Control of noxious weeds on the site should be undertaken limiting the use of herbicides, which may be detrimental to Green and Golden Bell Frogs.
- Maintenance of the current hydrological and water chemistry regimes; in particular, low levels of salinity in the brackish wetlands, which may protect amphibian species from the Chytrid fungus. The maintenance of runoff volumes into these areas may help conserve appropriate salinity levels.
- Similarly, general erosion and sediment control should be implemented to limit the transport of other contaminants across the KIWEF site.
- Capping and grading activities should be conducted outside of the Green and Golden Bell Frog's core breeding period (that is, September to March). If works need to be undertaken during this time, they should be limited to areas outside of recognised breeding habitat. For the purposes of this GGBF Management Plan, breeding habitat is defined as areas within or immediately adjacent to emergent, aquatic macrophytes.
- Standing water should not be transferred between waterbodies, to prevent the spread and establishment of the Plague Minnow.
- Suitable hygiene protocols must be developed and adhered to for all plant and personnel entering the KIWEF site to avoid the spread of Chytrid fungus.

- Compensatory habitat for the Green and Golden Bell Frog may be considered as part of the capping strategy. For example, the capping works may facilitate rehabilitation of suitable Green and Golden Bell Frog habitat. However, HDC has indicated that it is not intending to create artificial habitat, interfere with existing habitat, nor are seeking to modify frog population numbers or habitat.

- Ongoing, long-term monitoring of the Green and Golden Bell Frog population across the entire KIWEF site, and adjacent areas, such as the NCIG facility, should be undertaken seasonally. This data will help identify if any adverse impacts have affected the Green and Golden Bell Frog population and habitat across Kooragang Island.

1.2.2 March 2011 Survey

The March 2011 survey of GGBF (Umwelt, 2011) targeted the rail loop area, including K26 and K32 Ponds (as well as K24 and K31 Ponds). Overall, this survey was suitable for its purpose. However, the following comments are made in relation to the survey scope and its findings. Those comments were used to assist in the development of the Action Plan for the K26/K32 Ponds (Golder, 2011).

- No detailed surface water quality data have been collected and analysed for the standing water in the Ponds.

- It is known that some contaminants are detrimental to frog embryos and development, as well as known to lead to malformations in frogs for example, Abbasi and Soni, 1984; Anon., 1999, Arrieta *et al.*, 2004, Guillermo *et al.*, 2000; Marquis *et al.*, 2006; Rice *et al.*, 2002; Stabenau *et al.*, 2006; Wang and Jia, 2008). Some surface water chemistry data are available (see NCIG, 2008, in GHD, 2010b) that indicate values exceeding ANZECC trigger values for aquatic ecosystems; however, these are limited. In the absence of detailed water chemistry data, there is no baseline to compare for the long-term monitoring of the water quality, correlated with the frog populations. This represents a significant data gap.

- Data on the periodicity of the standing water in the cells has not been collected. Such data would assist in the understanding of the impacts of changes in local hydrology, such as may have occurred during construction of the NCIG rail loop.

- The mere presence of calling males may not be a useful indicator of successful breeding in the ponds. This, to some extent, has been alluded to in both the GHD (2010) and the Umwelt (2011) studies in that no tadpoles were recorded in the cells during either of those studies.

- The presence of juveniles may be a valid indicator of a sustainable population as this species is known to emigrate over large distances. Therefore, it would be useful to confirm that there has been effective breeding over one or more seasons, with tadpoles that survive to adulthood.

- The baseline comparison that the Umwelt (2011) report makes with the GHD (2010) results, in particular, that “There is no substantial change in the numbers recorded from 2009 to 2011.” (page 8) needs to be further qualified. A stable number of frogs each year over a relatively short time frame could result from a variety of factors (such as low mortality or in-migration) and is not necessarily confirmation of sustainable breeding.

To meet HDC’s requirements regarding management of contamination and frog habitat at the Ponds it is recommended that these data gaps are addressed by HDC.

1.2.3 Capping Strategy

The objectives of the capping strategy were to “*reduce risks to the environment associated with migration of contaminated groundwater and to prevent the risk of biological harm associated with contaminated soil and groundwater*” (GHD, 2010b). This objective had the associated objectives of preserving and maintaining habitat for shorebirds and other threatened species, and endangered ecological communities.

The strategy assessed the KIWEF based on sub-areas, with each sub-area assessed for the requirement for capping, and the effects that capping may have on the ecology. The locations of those sub-areas are presented on Figure 1. In terms of impacts to ecology, in particular the ecology of the Green and Golden Bell Frog, the following sub-areas were important:

- K1 – This sub-area presents a low risk to the surrounding environment from contamination. Capping of this area would have a significant impact on the ecology of the area.
- K2 – This sub-area presents a low to moderate risk to the surrounding environment from contamination. Capping of this area could impact on Green and Golden Bell Frog habitat.
- K3 – This sub-area presents a low to moderate risk to the surrounding environment from contamination. Capping of the fringing areas of this sub-area may have an impact on Green and Golden Bell Frog habitat. Therefore, capping is suggested only up to within 30 m of that habitat, with the exception of the area located near K3/1W.
- K4 (deep pond) – Contamination in this sub-area presents a low risk to the environment. However, filling and capping of this sub-area will have a significant impact on Green and Golden Bell Frog habitat, and the overall ecology of the area.
- K6 – This sub-area presents a low risk from contamination. However, capping of this sub-area will have a significant impact on the ecology of the area.
- K7 – The sub-area presents a low to moderate risk to the environment from contamination. Capping of the edges of the site will significantly impact on Green and Golden Bell Frog habitat.
- K26/K32 cells – These cells present a high risk to the environment. However, they also support Green and Golden Bell Frog habitat. Capping is not recommended, but rather a monitoring and risk assessment be completed. Details of recommended actions for the K26/K32 Ponds are presented in an Action Plan (Golder, 2011).

Based on the above assessment, a capping strategy was developed that minimised the impacts to Green and Golden Bell Frog habitat. A brief summary of the other sub-areas, suggested for capping, is provided below.

- K5 (excluding pond 5) – This sub-area presents a low to moderate risk to the environment from contamination. There is no significant Green and Golden Bell Frog habitat in this area; therefore, capping is an option.
- Pond 5 – Migration of contaminants from this sub-area may impact the estuarine aquifer. This sub-area does not support significant Green and Golden Bell Frog habitat. Therefore, capping is an option.
- K10 (excluding K26/K32) – The sub-area presents a low to moderate risk to the environment from contamination. The BOS area presents a moderate risk to the environment. Capping is suggested for this area.

1.3 Other Relevant Management Plans and Guidelines

This GGBF Management Plan should be read and in conjunction with the following management plans and guidelines, which are relevant to the Green and Golden Bell Frog population on Kooragang Island and the KIWEF:

- *Coal Export Terminal Green and Golden Bell Frog Management Plan* (Newcastle Coal Infrastructure Group (NCIG) (Document No. GGBFMP-R01-E.DOC, 2007)) (the NCIG management plan)
- *Draft Management Plan for the Green and Golden Bell Frog Key Population in the Lower Hunter* (Department of Environment and Climate Change (DECC) (NSW) 2007) (the Lower Hunter management plan)
- *Significant impact guidelines for the vulnerable Green and Golden Bell Frog (*Litoria aurea*)* (Department of Sustainability, Environment, Water, Populations and Communities (DSEWPC), Nationally threatened species and ecological communities; Background paper to the EPBC Act policy statement 3.19, 2009)
- *Best practice guidelines: Green and Golden Bell Frog habitat* (DECC, 2008)
- *Protecting and restoring Green and Golden Bell Frog habitat* (DECC, 2008)
- *Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*).* (DECC, 2005)
- *Threatened Species Management Information Circular No.6, Hygiene Protocol for the Control of Disease in Frogs* (NPWS, 2001) (the hygiene protocol) (Appendix A).

1.4 Project Approval

This GGBF Management Plan has been developed in order to partly address the KIWEF site's *Approval of Surrender of Licence Number 6437*, dated 8 December 2010, Condition 5.b), which requires the following:

b) The licensee shall prepare and submit a Green and Golden Bell Frog Management Plan to the EPA for approval by 13 April 2011. The Plan shall encompass the entire premises occupied by the licensee and include, but not be limited to:

i) Management measures to be undertaken to minimise the spread of the amphibian Chytrid fungus including:

> *(i) the training of project personnel in site hygiene management; and*
>
> *(ii) site hygiene procedures for project personal, mobile plant and equipment, in accordance with the NPWS Hygiene Protocol for the Control of Disease in Frogs 2001; and*

ii) Measures to maintain, restore and enhance Green and Golden Bell Frog habitat, including movement corridors across the site.

Additionally, obligations exist under the DSEWPC's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as to the protection of this nationally threatened species. These obligations are detailed in the EPBC Act policy statement 3.19 (see above for reference), as well as the significant impact criteria set out in the NSW *Threatened Species Conservation Act 1995* (TSC Act).

1.5 Objectives of this Plan

In relation to Green and Golden Bell Frogs on the KIWEF site, one of the overall aims of the KIWEF landfill closure works is to manage those works in a manner that does not impact threatened species and their habitat, and to restore small areas of temporary disturbance to their original (or better) condition. To that end, the objectives of this GGBF Management Plan are:

1) To maintain the existing Green and Golden Bell Frog populations supported on the KIWEF site.

2) To reduce the spread of the amphibian Chytrid fungus (*Batrachochytrium dendrobatidis*).

3) To protect the existing Green and Golden Bell Frog habitat on the KIWEF site.

4) To increase connectivity between the existing areas of Green and Golden Bell Frog habitat on the KIWEF site.

5) To restore Green and Golden Bell Frog habitat that may be disturbed during the landfill closure works to a condition as-good or better than prior to the works.

Hence, this GGBF Management Plan aims to assist HDC in the implementation of appropriate environmental management measures during the KIWEF closure works.

1.6 Scope and Use of this Plan

The scope of this GGBF Management Plan covers that area known as the KIWEF (Figure 1), before, during and after landfill closure works.

This GGBF Management Plan has been prepared in accordance with the relevant state guidelines as identified in Section 1.3.

This GGBF Management Plan will be reviewed and updated by those responsible for undertaking the detailed design and associated documentation to ensure that it is current at the time that the landfill closure works are tendered. Once tendered, the Contractor will incorporate the revised GGBF Management Plan into their Environmental Management Plans (EMP). Where there is any conflict between the provisions of this GGBF Management Plan and Contractors' obligations under their respective contracts, including the various statutory requirements (that is, licences, permits, project approval conditions and relevant laws), the contract and statutory requirements are to take precedence. In the case of any real or perceived ambiguity between elements of this GGBF Management Plan and the above statutory requirements, the Contractor shall first gain clarification from HDC, prior to implementing that element of this GGBF Management Plan over which the ambiguity is identified.

It is intended that this GGBF Management Plan should complement those studies identified in Section 1.2. To that end, this management plan should be supplemented by publicly available monitoring results collected by others for projects on Kooragang Island. For example, it is understood that the NCIG plan requires monitoring to occur on an annual basis until 2020, as outlined in the EPBC Act Particular Matter conditions for that project. The NCIG monitoring data will be useful input into management of Green and Golden Bell Frogs on the KIWEF site.

1.7 Structure of this Plan

The structure of this GGBF Management Plan is provided below. This structure has been adopted to address the requirements as specified in the HDC brief (document number HDC141), and be in accordance with required guidelines.

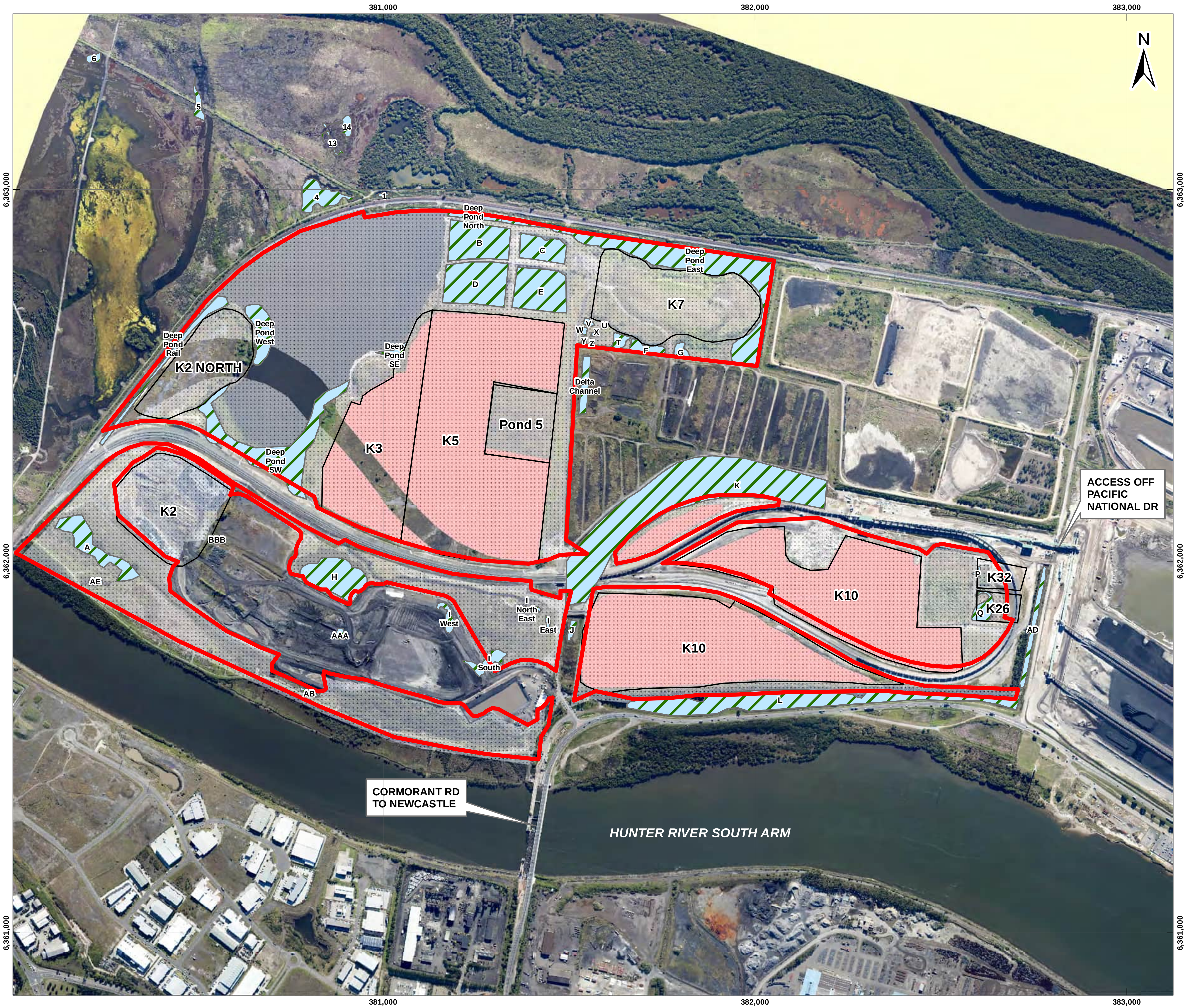
- Section 2: Provides a profile of the Green and Golden Bell Frog, including its key identifying features in the field, similar species on the KIWEF site, general ecology relevant to the KIWEF site, its conservation status and distribution on the KIWEF site.

- Section 3: Details the management procedures to be implemented, including identification and delineation of disturbance areas, pre-work surveys, identification of relocation areas, relocation procedures and rehabilitation of disturbed habitat, environmental induction training and site hygiene management for Chytrid fungus.

- Section 4: Outlines the monitoring programme for the KIWEF site.

- Section 5: Response criteria and mitigation measures, including comparison with previous data collected at the site, and procedures to be followed if a decline in the Green and Golden Bell Frog population is detected.

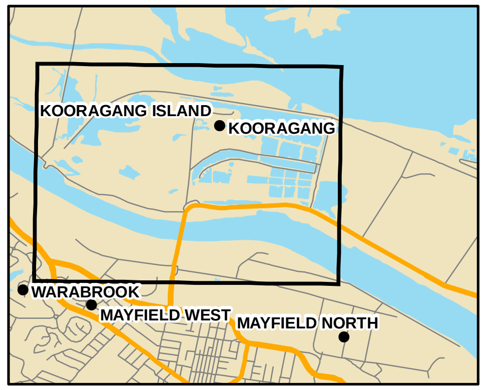
- Section 6: Lists the reporting and review requirements of this management plan.
- Section 7: Lists references cited in this Green and Golden Bell Frog Management Plan and other supporting information.



GREEN AND GOLDEN BELL FROG MANAGEMENT PLAN

HUNTER DEVELOPMENT CORPORATION

SITE LOCATION



LEGEND

- Kooragang Island Waste Emplacement Facility License Area
- Known and Potential Habitat Areas (GHD, 2010)
- Capping Extent Landfill Closure Works
- HDC Closure Area 2010

NOTES

Imagery provided by The Hunter Development Corporation 16/03/2011
Data digitised from Land & Property Management Authority Request for Tender - RFT No. HDC141, February 2011 Appendix A - Site and Access Map

0 40 80 160 240 320 400 metres

SCALE (at A3) 1:10,000

Coordinate System: GDA 1994 MGA Zone 56

PROJECT: 117623029
DATE: 18/04/2011
DRAWN: AJW
CHECKED: TC

FIGURE 1

2.0 SPECIES PROFILE – GREEN AND GOLDEN BELL FROG (*LITORIA AUREA*)

2.1 Conservation Status

2.1.1 Listing

The Green and Golden Bell Frog's conservation status is listed as follows:

- **Endangered** under the NSW *Threatened Species Conservation Act 1995*
- **Vulnerable** under the federal *Environmental Protection and Biodiversity Conservation Act 1999*.

2.1.2 Known Populations

The Green and Golden Bell Frog is estimated to have disappeared from 90% of its former range within NSW over the last 30 years (Pyke and White, 1996; DECC, 2007), although populations in Victoria are believed to be secure (Gillespie, 1996).

There are about 45 known populations of Green and Golden Bell Frog within NSW (DECC, 2007). Of these, only a few occur in conservation reserves; Kooragang Island Nature Reserve supports the closest protected population to the KIWEF site (DECC, 2007). Historically, this species was widespread across much of the Hunter Valley; however, it is now believed to be restricted to four key populations:

- a large population on Kooragang Island (including the KIWEF site)
- small, isolated populations at Sandgate on the margins of Hexham Swamp
- a meta-population in the Gillieston Heights/East Maitland, Ravensdale areas (also including Wentworth Swamp)
- a meta-population in the Ravensworth/Liddell/Bayswater area.

2.1.3 Management and Recovery Plans

To "ensure that the Lower Hunter population is successfully managed and monitored such that the species continues to persist in the Lower Hunter and that 'measures' of the two populations' viability are maintained or improved over time", the following key documents are important:

- *Draft Management Plan for the Green and Golden Bell Frog Key Population in the Lower Hunter* (Department of Environment and Climate Change (DECC) (NSW) 2007) (the Lower Hunter management plan)
- *Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*)*(DECC, 2005).

2.2 Key Distinguishing Features

The following provides some key diagnostic features that are important for quick and easy field-identification of this species.

2.2.1 Adult Frogs

- Relatively large, muscular species with robust body form and smooth skin compared to other species known to inhabit the KIWEF site (Barker *et al.*, 1995).
- The background colouration is usually green, most often with irregular large spots and/or stripes of gold (Barker *et al.*, 1995), refer to Figure 2. It should be noted that adults can vary considerably in pattern; however, the background colouration will always be green.

- Males vary in size from 60 to 70 mm (snout to vent length (SVL)); females vary from 65 to 110 m SVL (Tyler and Knight, 2009). Typically, most individuals being in the range of 60 to 80 mm SVL (DEC, 2005).
- A white or cream stripe extends from above the nostril, over the eye and ear (tympanum) and continues as a fold down the side (Robinson, 1998). There is usually a darker stripe below the white stripe, and another pale stripe from below the eye, extending to the base of the forearm (Robinson, 1998).
- The groin area, and behind the thighs, is usually pale blue or bluish-green, particularly in breeding males (Tyler and Knight, 2009). Mature males may also have a yellowish darkening of the throat area (DEC, 2005).
- The tympanum is usually brown (Tyler and Knight, 2009).
- The belly is usually creamish-white (DEC, 2005); the lower sides of the body are adorned with raised glandular, creamish-coloured spots of irregular size.
- The eye has a horizontally elliptical pupil and a golden yellow iris. The toes are three-quarters to nearly fully webbed (Robinson, 1998).

Figure 2: Adult Green and Golden Bell Frog (Litoria aurea)
(Source: A. White (2007), as in the NCIG plan)

2.2.2 Tadpoles

- Relatively large, reaching 65 to 100 mm at limb bud development stage (DEC, 2005). May be confused with other large-bodied tadpoles of species in the KIWEF site; for example, Peron's Tree Frog (*Litoria peronii*).
- Deep bodied and possess long tails with a high fin that extends almost half way along the body (refer to Figure 3).
- Although not typically used in field identification given the need for a microscope, the mouthparts consist of two upper and three lower labial rows (Anstis, 2002).

Figure 3: Tadpole Green and Golden Bell Frog (Litoria aurea)
(Source: A. White (2007), as in the NCIG plan)

2.2.3 Similar Species within the KIWEF Area

The Green and Golden Bell Frog should not be confused with any other species in the KIWEF area, given its very distinctive features and large size, wart-free skin, expanded finger and toe pads, and lack of spotting or marbling on the hind side of the thigh (Robinson, 1998).

Nevertheless, to the untrained eye, metamorphosing individuals may be confused with the adults and metamorphs of the following species that are known to occur on the KIWEF site:

- Eastern Dwarf Tree Frog (*Litoria fallax*)

  This species is also green, but lacks any of the golden markings on the back and presents with a plain, single colour.

- Peron's Tree Frog (*Litoria peronii*)

  Adults have bright yellow with black mottling on armpits, groin, and backs of thighs. The back texture is rough, and often is covered with faint, emerald spots, giving its other common name, the Emerald-spotted Treefrog.

- Broad-palmed Rocket Frog (*Litoria latopalmata*)

This species ranges from light to dark brown on its back, sometimes with darker blotches. The backs of the thighs are yellow and dark brown.

- Spotted Marsh Frog (*Limnodynastes tasmaniensis*)

  Adults usually have large regularly-shaped olive green blotches on the back and sometimes have a yellow, red, or orange mid-dorsal stripe. The background colouration is not green.

2.3 Aspects of Ecology Important for Management

2.3.1 Preferred Habitat

The Green and Golden Bell Frog can be regarded as somewhat of a habitat generalist, dispersing widely and maturing early. It is known to inhabit marshes, dams and stream sides and appears to prefer those water bodies where Bulrushes (*Typha* spp.) or Spikerushes (*Eleocharis* spp.) grow (NPWS, 1999). In the Lower Hunter region, such plant species as Salt Marsh Rush (*Juncus kraussi*), Coast Club Rush (*Schoenoplectus subulatus*), and Salt Couch (*Sporobolus virginicus*) are indicators of habitat suitability for Green and Golden Bell Frogs (DECC, 2007). Such habitat is typically unshaded, free of Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites (NPWS, 1999).

Green and Golden Bell Frogs are also known to inhabit highly disturbed sites (NPWS, 1999), such as the KIWEF site.

Typically, Green and Golden Bell Frogs will require habitat for breeding, foraging, shelter, movement and over wintering. All such habitat types occur across the KIWEF site, and have been incorporated under the banner of known and potential Green and Golden Bell Frog habitat by GHD (2010a). These habitat areas are indicated on Figure 1.

2.3.2 Habits

The Green and Golden Bell Frog is frequently active during the day, although it is known to forage at night on insects, as well as other frogs (Cogger, 2000; Barker *et al*., 1995; NPWS, 1999). Tadpoles are known to feed on algae and other vegetative matter (NPWS, 1999; Anstis, 2002).

The Green and Golden Bell Frog exhibits strong migration tendencies, and is known to travel significant distances across often seemingly inhospitable habitat (DECC, 2007). Distances of up to 1.5 km in a single day/night are not unknown (Wellington, 1998; Pyke and White, 2001; DECC, 2007). It should be noted that such movements most often occurred during or immediately after significant rain events.

2.3.3 Breeding

The Green and Golden Bell Frog usually breeds in summer when conditions are warm and wet, typically after rain (Cogger, 2000; Barker, *et al*., 1995). The core breeding period for this species is generally accepted to be between September and February (DECC, 2007), provided sufficient rainfall occurs during this time.

Males call while floating in water and females produce a floating raft of eggs, which gradually settle to the bottom (NPWS, 1999).

Tadpoles take around six weeks to develop depending on environmental conditions (for example, temperature) (Pyke and White, 1996; NPWS, 1999).

Adult male Green and Golden Bell Frogs may only live for around two years in a hostile environment but, typically, life expectancy is likely to vary markedly according to the quality of the habitat (Goldingay and Newell, 2005).

2.3.4 Threats

Frog Chytrid Fungus (FCF) has been identified as a key threatening process, at both the state and national level, for the Green and Golden Bell Frog (DSEWPC, 2009). FCF is widespread on Kooragang Island and Hexham Swamp, the other key Green and Golden Bell Frog population in the Newcastle area (DECC, 2007).

Recent evidence suggests that occasional exposure to saline influences and/or certain contaminants may be attenuating the effects of the FCF (DECC, 2007). Such saline and polluted conditions occur on the KIWEF site. Hypotheses supporting this scenario are presently being tested by M. Stockwell and M. Mahoney from the University of Newcastle (NCIG, 2007).

3.0 MANAGEMENT PROCEDURES

3.1 Identification and Delineation of Disturbance Areas

Known and potential Green and Golden Bell Frog habitat is located across the KIWEF site and surrounds. GHD (2010a) identified and mapped that habitat (as identified in Figure 5.5 of their report), which is presented in Figure 1 of this GGBF Management Plan. Prior to capping works commencing, this habitat will be clearly identified on the ground (with appropriate signage), and the locations of it communicated to personnel undertaking works on the site. This communication will be undertaken as part of the site induction (refer to section 3.3), and will include obligations of personnel to maintain and protect that habitat.

Ponds P and Q (that is, cells K26 and K32) will be subject to a separate Action Plan (Golder, 2011) due to their significance as habitat and the presence of contaminated soil and groundwater.

3.2 Identification of Areas of Disturbance to Habitat

As part of the capping strategy, a small proportion of the known and potential Green and Golden Bell Frog habitat may be disturbed. This habitat area comprises the fringing habitat adjacent to Deep Pond, that is the area located near K3/1W and the BOS area (Figure 1).

The frogs will be relocated within the KIWEF during the capping works.

3.3 Environment Induction and Training

All HDC personnel, contractors and sub-contractors will undergo environmental induction and training before commencing work on-site. As it pertains to the Green and Golden Bell Frog, information addressed during this training will include (NCIG, 2007):

- Green and Golden Bell Frog profile and identification (Section 2).
- Identification of Green and Golden Bell Frog habitat areas. Project personnel will be prohibited from entering Green and Golden Bell Frog habitat areas located outside defined works areas.
- Site hygiene management in accordance with the Hygiene Protocol (Section 3.4).
- Procedures to be followed in the event Green and Golden Bell Frogs are found (Section 3.6).

3.4 Site Hygiene Management

The proposed hygiene management protocol described below largely follows that prepared by NCIG (2007), which has been accepted by OEH.

FCF (refer to section 2.3.4) has the potential to adversely affect Green and Golden Bell Frogs. It is known to occur on Kooragang Island, and potentially on the KIWEF site. Infection occurs through waterborne zoospores released from an infected amphibian in water (NPWS, 2001) and the fungus infects both frogs and tadpoles (Berger *et al.*, 1999). Therefore, the spread of FCF can occur via the movement of water around the site and/or soil attached to equipment (both plant and personal protective equipment).

Typical clinical signs of frogs infected with FCF (after Berger *et al.*, 1999) include:

- lethargy
- loss of appetite
- skin discoloration
- presence of excessive sloughed skin
- sitting unprotected during the day with hind legs held loosely to the body.

3.4.1 Hygiene Training

To reduce the likelihood of spreading FCF, all HDC employees and contractors involved in activities in areas of known habitat for the Green and Golden Bell Frog (and other amphibian species) will be trained in site hygiene management in accordance with the hygiene protocol (Appendix A). This will be part of the environmental induction and training (Section 3.3).

3.4.2 Inspection and Disinfection of Mobile Plant

Any mobile plant entering and leaving the KIWEF site during the closure and capping activities will be routinely disinfected at a designated wash bay.

Similarly, personal protective equipment (PPE) of HDC employees and contractors entering and leaving the site will be disinfected as a matter of routine, following the methods outlined in the Hygiene Protocol (Appendix A).

Inspection and disinfection of mobile plant, and affected PPE, will be undertaken at a designated, concrete-bunded disinfection area at the entrance of the KIWEF site. The location of this area, and the disinfection procedure, will be incorporated into the site induction and training programme (refer to Section 3.3).

3.5 Pre-works Surveys for Disturbance Areas

Pre-works surveys will include targeted active searches of potential Green and Golden Bell Frog habitat located within proposed disturbance areas. These surveys will be undertaken by a suitably qualified and licensed ecologist.

The pre-works surveys (and, if applicable, relocation activities) will be conducted to minimise disruption to breeding activities and the need to relocate tadpoles or metamorphs, where practicable. All these activities will be conducted in accordance with the relevant measures outlined in the hygiene protocol (Section 3.4).

Habitat resources typically associated with the lifecycle components of the Green and Golden Bell Frog (for example, ponded areas, rocks, logs, tussock forming vegetation and other cover) will be searched during a diurnal visual inspection.

Following the diurnal habitat searches, a nocturnal habitat search may be conducted to assess nocturnal usage (that is, breeding/calling) in the habitat supported in the disturbance area, if the surveys are conducted during the core breeding season. The nocturnal habitat searches may include:

- searching of habitat features, which were searched during the day
- spotlighting
- call play-back.

In the event that any Green and Golden Bell Frogs are observed during the diurnal or nocturnal searches, the relocation procedures outlined in Section 3.6 will be initiated prior to the commencement of disturbance works. In some cases a frog-proof fence may be used to protect the frogs in-situ or to exclude frogs from the surveyed area.

The results of the pre-works surveys will be recorded and reported in the Annual Environmental Management Report (AEMR) (Section 6).

3.6 Green and Golden Bell Frog Relocation Procedures

The proposed relocation procedure described below largely follows that proposed by NCIG (2007), which has been accepted by OEH.

3.6.1 Relocation Procedure during Pre-works Surveys

In the event a Green and Golden Bell Frog is identified within the disturbance areas during pre-works surveys, the following relocation procedure will be initiated:

a) The ecologist undertaking the pre-clearance survey will capture the frog.

b) If the frog appears to be healthy:

   a. A suitable release location in the immediate vicinity of the disturbance area, yet outside of potential areas of disturbance, will be identified by the ecologist.

   b. The frog will be released into the relocation area. Any frog to be relocated will be held in a cool, dark, moist place until nightfall. Where practicable, relocation will be timed to coincide with periods of recent rainfall to optimise chances of survival of the frog.

c) If the frog appears to be sick, or is dead:

   a. the procedures outlined in Section 3.6.3 will be followed.

Relocation of Green and Golden Bell Frogs during pre-works surveys will be conducted in accordance with the relevant measures outlined in the hygiene protocol (Section 3.4).

Details of Green and Golden Bell Frogs that are relocated (that is, lifecycle stage and sex of individual [if possible], location where found and location of release) conducted during pre-works surveys will be recorded and reported in the AEMR (Section 6).

3.6.2 Relocation Procedure Outside of Pre-works Surveys

In the event a frog is observed within the KIWEF site outside of the designated pre-works surveys (for example, within an area already disturbed), and is thought to be a Green and Golden Bell Frog, the following relocation procedure will be initiated if the frog is likely to be harmed by the capping works:

a) The observer will notify the HDC's Environmental Representative, or suitably-qualified ecologist, of the frog's location.

b) The Environmental Representative, or suitably-qualified ecologist, will determine whether the frog is likely to be harmed by works.

c) If the frog is likely to be harmed by works, a suitably-qualified ecologist, will capture the frog.

d) If the frog appears to be healthy:

   a. A suitable release location (that is, one of the potential relocation areas identified on Figure 1) will be identified by the ecologist.

   b. The frog will be released into the relocation area. Any frog to be relocated will be held in a cool, dark, moist place until nightfall. Where practicable, relocation will be timed to coincide with periods of recent rainfall to optimise chances of survival of the frog.

e) If the frog appears to be sick, or is dead:

   a. the procedures outlined in Section 3.6.3 will be followed.

Relocation of Green and Golden Bell Frogs outside pre-works surveys will be conducted in accordance with the relevant measures outlined in the hygiene protocol (Section 3.4).

Details of Green and Golden Bell Frogs that are relocated (that is, lifecycle stage and sex of individual [if possible], location where found and location of release) during pre-work surveys will be recorded and reported in the AEMR (Section 6).

3.6.3 Procedures for Handling Sick or Dead Green and Golden Bell Frogs

Table 1 presents the range of symptoms that may be exhibited by sick or dying frogs, while Table 2 provides diagnostic behaviour tests, which can be used to determine if a frog is sick (for example, infected with FCF) (after NCIG, 2007).

Table 1: Symptoms of sick and dying frogs

Appearance	Behaviour
■ Darker or blotchy upper (dorsal) surface ■ Swollen hind limbs ■ Very thin or emaciated ■ Reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes ■ Skin lesions (sores, lumps) ■ Infected eyes ■ Obvious asymmetric appearance	■ Lethargic limb movements, especially hind limbs ■ Abnormal behaviour (e.g. a nocturnal burrowing frog sitting in the open during the day and making no vigorous attempt to escape when approached) ■ Little or no movement when touched

Source: after NPWS (2001)

Table 2: Diagnostic behaviour tests – sick frogs will fail one or more of the following tests

Test	Healthy	Sick
■ Gently touch with finger	■ Frog will blink.	■ Frog will not blink.
■ Turn frog on its back	■ Frog will flip back over.	■ Frog will remain on its back.
■ Hold frog gently by its mouth	■ Frog will use its forelimbs to try to remove grip	■ No response from frog

Source: after NPWS (2001)

In the event that a Green and Golden Bell Frog appears to be sick, or is dead, the following procedures will be followed (after NPWS, 2001):

- Disposable gloves will be worn when handling all frogs, as well as sick or dead frogs.
- To prevent cross-contamination, new gloves and a clean plastic bag will be used for each frog specimen.
- Frogs exhibiting one or more of the symptoms for sick frogs listed in Table 1 or 2, and considered unlikely to survive transportation will be euthanised[1].
- Sick frogs likely to survive transportation will be placed into either a moistened cloth bag with some damp leaf litter, or into a partially-inflated, clean plastic bag with damp leaf litter. All frogs will be kept separate during transportation.
- Dead frogs will be kept cool and preserved as soon as possible. The belly of the frog will be cut open and the specimen placed in preservative (approximately 10 times the volume of the specimen). Specimens will be preserved in either 65% ethanol or 10% buffered formalin.
- The recipient of the sick or dead frog will be contacted to confirm the appropriate procedure prior to transport[2].

[1] Terminally ill frogs will be placed into a container with the bottom covered with 3% chloral hydrate (NPWS, 2001).

- Containers will be labelled with the following details: date, location and species (if known).
- Standardised collection form will be filled out and a copy sent with the specimen (in Appendix A).
- Individual containers will be used for each specimen.

Details of sick or dead Green and Golden Bell Frogs found at the KIWEF site will be recorded and reported in the AEMR (Section 6).

[2] A list of potential sick and dead frog recipients is provided in Attachment 4 (NPWS, 2001), including Associate Professor Michael Mahony of the School of Biological Sciences, University of Newcastle.

4.0 GREEN AND GOLDEN BELL FROG MONITORING PROGRAMME

Baseline monitoring of the Green and Golden Bell Frog has been undertaken by GHD (2010 and Umwelt (2011).

NCIG has also implemented a monitoring programme that collects data that includes the Green and Golden Bell Frog populations on the KIWEF site.

The NCIG monitoring will be conducted annually until 2020 and then three-yearly till 2030. On the basis that the NCIG monitoring programme continues to be implemented, HDC do not propose to undertake any further monitoring, other than that specified in the Action Plan for the K26/K32 Ponds (Golder, 2011).

HDC propose to annually review the NCIG data to ensure that it meets HDC's requirements. The overall objective of HDC's review of the Green and Golden Bell Frog monitoring programme is to monitor the dynamics of the Green and Golden Bell Frog populations supported within known and potential habitat areas within the KIWEF site. The intention of the review programme will be to ascertain if the landfill closure works have an effect on the population.

Monitoring parameters that will be used for comparison will include, yet not be limited to:

a) Green and Golden Bell Frog presence/absence, distribution, habitat utilisation, behaviour and abnormalities.

b) observations of other frog species distribution, relative abundance and abnormalities.

c) habitat condition.

d) date

e) time of day

f) rainfall (mm)

g) site location (GPS co-ordinates and map location)

h) survey method utilised

i) sampling effort

j) habitats surveyed

k) weather conditions (including temperature)

l) number of observers

m) photographs taken

HDC will report to OEH annually for 5 years following the completion of the landfill closure works, unless analysis shows that Green and Golden Bell Frog populations are being impacted, then further reporting will be undertaken until a date agreed with OEH.

Monitoring and research to understand better the extent and dynamics of Green and Golden Bell Frog populations is a proposed action of the Draft Recovery Plan (DECC, 2005). This action has been adopted as a strategy to achieve the objectives of the Lower Hunter Management Plan. The results of this monitoring programme would contribute to this action/strategy.

The results of the monitoring programme will be recorded and reported in the AEMR (Section 6).

5.0 RESPONSE CRITERIA AND SPECIFIC MITIGATION AND MANAGEMENT MEASURES

The following proposed mitigation measures have been developed based on a review of information provided by GHD (2010a) and a review of site conditions.

5.1 Management of All Disturbance Areas

The following mitigation measures will be implemented to manage areas proposed for disturbance.

- The boundaries of all Green and Golden Bell Frog habitat will be clearly identified on the ground.
- Appropriate erosion and sediment control structures will be installed at least 30 metres upslope of all such habitat areas. These erosion and sediment control structures will be regularly inspected and maintained, particularly after significant rainfall events.
- All plant entering and leaving the KIWEF site will be, as a matter of routine, disinfected via a wash bay. The location and procedures involved at this wash bay will form part of the site induction and training (see Section 3.3). Records will be kept.
- Similarly, all HDC employees and contractors involved in activities in areas of known habitat for the Green and Golden Bell Frog (and other amphibian species) will be trained in site hygiene management in accordance with the hygiene protocol (Appendix A). This will be part of the environmental induction and training (Section 3.3). Records will be kept.
- All PPE in contact with soil, particularly boots, of HDC employees and contractors entering and leaving the site will be disinfected as a matter of routine, following the methods outlined in the Hygiene Protocol (Appendix A).
- All disinfection processes will be monitored and controlled at the KIWEF site's entry and exit point. The location of these disinfection bays, and the obligations of disinfection, will be communicated during the site induction and training (Section 3.3).
- All water required for dust suppression will be drawn from ponds established for the purpose. No water for dust suppression will be drawn from current ponds on the site. The establishment of dedicated dust suppression ponds will be undertaken to prevent the potential spread of Plague Minnow into ponds currently free of this species. The location and procedure for those dedicated dust suppression ponds will be communicated during the site induction and training (Section 3.3).
- Stormwater diversion measures, if required, will be put in place to maintain the current hydrological regime for the site.
- If practicable, the capping and grading activities will be scheduled to occur outside of the core Green and Golden Bell Frog breeding period (that is, September to March), especially in areas adjacent to known and potential breeding habitat.

5.2 Specific Management Measures for Disturbed Areas

The following mitigation measures will be implemented to manage areas proposed for disturbance. It should be noted that these measures do not negate the need for the measures outlined in Section 5.1.

- The disturbance area will be clearly delineated on the site plan and on the ground. The boundaries of the area and its location will be made known to all personnel involved during the site induction (refer to Section 3.3).
- One week prior to works commencing in the disturbance area, a pre-works survey will be conducted by a qualified ecologist (refer to Section 3.5 for a suggested survey protocol).

- In the event that any Green and Golden Bell Frogs are identified in the area, they will be relocated (using appropriate amphibian hygiene protocols) to known and suitable Green and Golden Bell Frog habitat areas immediately adjacent to the disturbance footprint (refer to Section 3.6 for appropriate relocation procedures).
- The works will be scheduled to occur outside of the core breeding period for Green and Golden Bell Frogs, that is, September to March.
- An on-site, suitably-qualified ecologist will be available during all clearing and capping works undertaken in the habitat areas to be disturbed. This person will be available to relocate Green and Golden Bell Frogs that may be found in the disturbance footprint during capping activities.
- In an attempt to limit the potential for Green and Golden Bell Frogs to enter the disturbance footprint, and if practicable, a frog-proof barrier will be erected around the disturbance footprint.
- Appropriate erosion and sediment control measures will be put in place around the disturbance area, prior to any works commencing, to prevent sediment from moving into adjacent habitat.
- Once works are complete, the restoration and rehabilitation of that habitat will be undertaken in accordance with a rehabilitation and revegetation plan.

5.3 Measures to Enhance Restore and Maintain Habitat

It is noted that the proposed capping works have been designed to minimise impacts on Green and Golden Bell Frog Habitat and will impact upon only two small areas.

It is anticipated that the mitigation measures presented in Sections 5.1 and 5.2 will assist in the management of the Green and Golden Bell Frogs, and their habitat on the KIWEF site, during and immediately following the landfill closure work, and the associated activities. In addition to those, the following mitigation measures have been developed to assist, where practicable, in the enhancement, restoration and maintenance of Green and Golden Bell Frog habitat following the completion of the landfill closure works.

- The capping strategy has been designed to limit and ultimately reduce the exposure of potential Green and Golden Bell Frog habitat, and the wider ecosystems of Kooragang Island, to soil and groundwater contaminants.
- As part of the rehabilitation and revegetation plan for the KIWEF site, open stormwater infrastructure across the KIWEF site may be planted with species known to be favoured by Green and Golden Bell Frogs. This revegetation and rehabilitation strategy will include a 2 metre wide buffer on either side of the stormwater drains. The intention of these areas is to provide movement corridors for Green and Golden Bell Frogs across the site.
- The capped areas will ideally be designed to shed water to table drains, which, in a similar manner to other stormwater infrastructure, will be vegetated with species known to be favourable to Green and Golden Bell Frogs.
- Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF.
- The drainage culverts in the NCIG rail loop may provide additional areas that can be rehabilitated to facilitate the migration and dispersal of the Green and Golden Bell Frog (Connell Hatch, 2008, in GHD, 2010b).

5.4 Response Criteria

5.4.1 General Site Environmental Management

As part of the overall environmental management plan for the site, during the landfill closure works, the HDC's environmental representative will conduct weekly inspections of all the management measures identified in Sections 5.1, 5.2 and 5.3. The results of these inspections will be recorded and a summary provided in the AEMR.

Should non-conformances be identified, HDC's environmental representative will contact the Site Foreman within 24 hours and request a remediation action. The Site Foreman will have 48 hours to correct the non-conformance.

5.4.2 Population Monitoring

If the results of the monitoring programme indicate a decline in Green and Golden Bell Frog numbers across the site, which cannot be attributed to natural population fluctuations and variability, and is potentially a direct result of the landfill closure works, specific response criteria will be developed by HDC, in consultation with the OEH. The aim of these response criteria will be to determine whether declining populations (if evident from the monitoring programme [Section 4]) are directly attributable to the capping project.

6.0 REPORTING AND REVIEW

In accordance with the *Approval of Surrender of Licence Number 6437*, the Director-General will be notified of any incident with actual or potential significant off-site impacts on people or the biophysical environment, as soon as practicable after the occurrence of the incident. The Director-General will be provided with written details of the incident within seven days of the date on which the incident occurred.

HDC will prepare an Annual Environmental Management Report (AEMR) that:

a) Reviews the performance of the capping project against this management plan.

b) Provides an overview of environmental management actions and summarises monitoring results over the 12 month reporting period.

c) Continues on an annual basis for a minimum of five years following completion of the Landfill Closure Works.

d) Will be phased out on presentation of adequate information to establish that the Landfill Closure Works have had no measurable impacts to Green and Golden Bell Frog populations on the KIWEF site. In the unlikely event that changes in the Green and Golden Bell Frog population are observed, which appear to be attributable to the Landfill Closure Works, extended review will be undertaken. This may involve a more detailed monitoring and investigation programme to address the potential cause of the decline in those areas. The programme will aim to identify direct evidence indicating that the Landfill Closure Works contributed to the decline. The details of that programme will be developed through discussion with OEH.

The AEMR will be distributed to relevant government agencies and stakeholders, and copies provided to other interested parties, if requested.

In accordance with the *Approval of Surrender of Licence Number 6437*, this management plan will be made available on the HDC website.

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Report Signature Page

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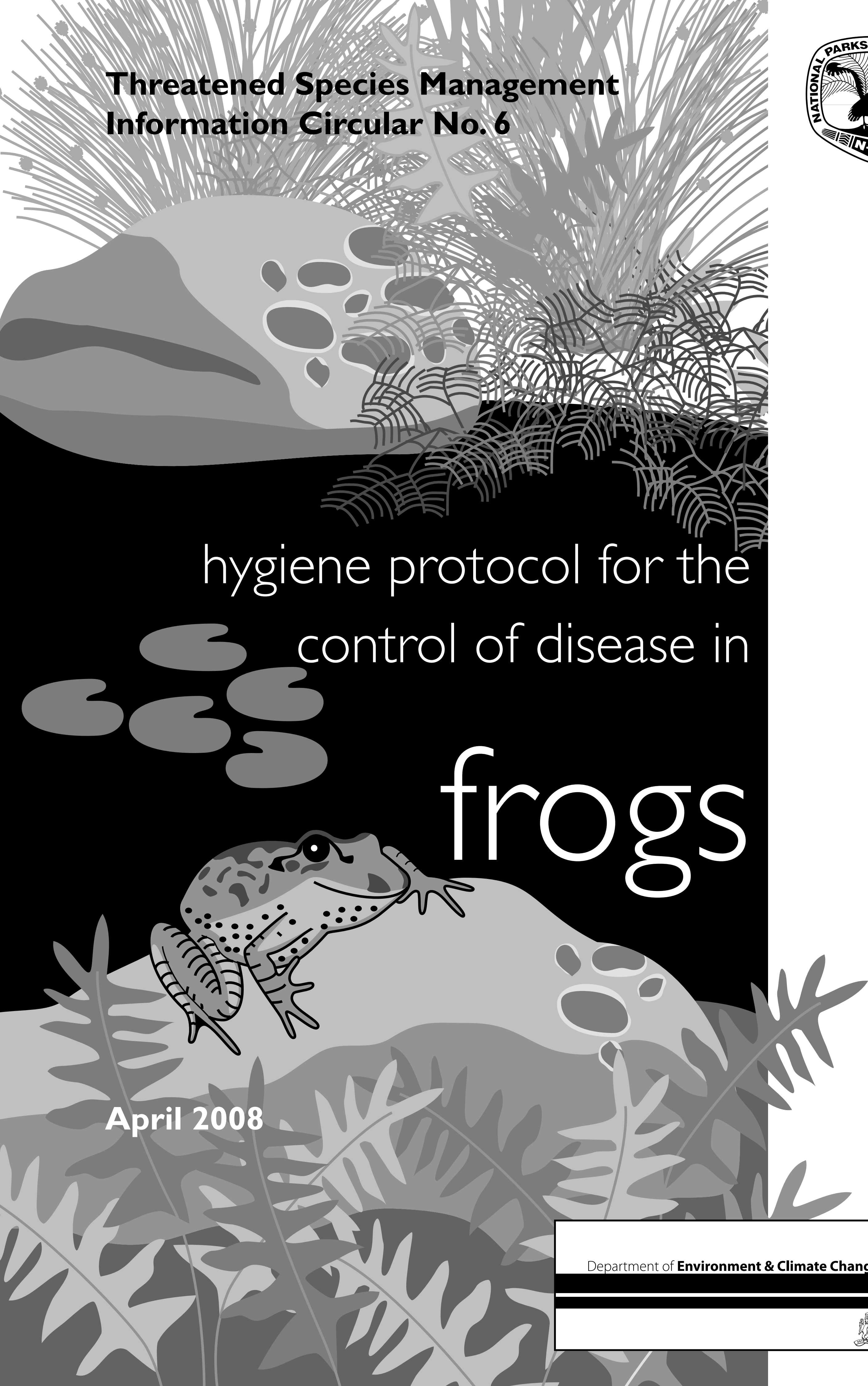
APPENDIX A

Hygiene Protocol for the Control of Disease in Frogs

Threatened Species Management
Information Circular No. 6



hygiene protocol for the control of disease in frogs

April 2008

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This hygiene protocol is an adaptation of the Declining Amphibian Population Task Force (DAPTF) Fieldwork Code of Practice and the recommendations of Speare et al. (1999) and has drawn on recommendations from earlier guidelines prepared by Environment ACT.

Foundation for National Parks and Wildlife funded the printing of this protocol.

hygiene protocol for the control of disease in frogs

1 introduction

This information circular outlines measures to:

- Prevent or reduce disease causing pathogens being transferred within and between wild populations of frogs.
- Ensure captive frogs are not infected prior to release.
- Deal safely with unintentionally transported frogs.
- Assist with the proper identification and management of sick and dead frogs in the wild.

1.1 Who should read this document?

This protocol is intended for use by all researchers, wildlife consultants, fauna surveyors and students undertaking frog field-work. In addition, the protocol should be read by Department of Environment and Climate Change (DECC) personnel, frog keepers, wildlife rescue and carer organisations, herpetological/frog interest groups/ societies, fauna park/zoo operators/workers and other individuals who regularly deal with or are likely to encounter frogs.

This protocol outlines the expectations of the DECC regarding precautionary procedures to be employed when working with frog populations. The intention is to promote implementation of hygiene procedures by all individuals working with frogs. New licences and licence renewals will be conditional upon incorporation of the protocol. The DECC recognises that some variation from the protocol may be appropriate for particular research and frog handling activities. Such variation proposals should accompany any licence application or renewal to the DECC.

1.2 Background

1.2.1 Amphibian Chytrid Fungus

The apparent decline of frogs, including extinctions of species and local populations, has attracted increased international and national concern. Many potential causes for frog declines have been proposed (eg see Pechmann et al., 1991; Ferrero and Bergin, 1993; Pechmann and Wilbur, 1994; Pounds and Crump, 1994; Pounds et al., 1997). However, the patterns of decline at many locations suggest that epidemic disease maybe the cause (Richards et al., 1993; Laurance et al., 1996; Alford and Richards, 1997). Recent research has implicated a water-borne fungal pathogen *Batrachochytrium dendrobatidis* as the likely specific causative agent in many of these declines both in Australia and elsewhere (Berger et al., 1998; 1999). This agent is commonly known as the amphibian or frog chytrid fungus and is responsible for the disease Chytridiomycosis (Berger et al., 1999).

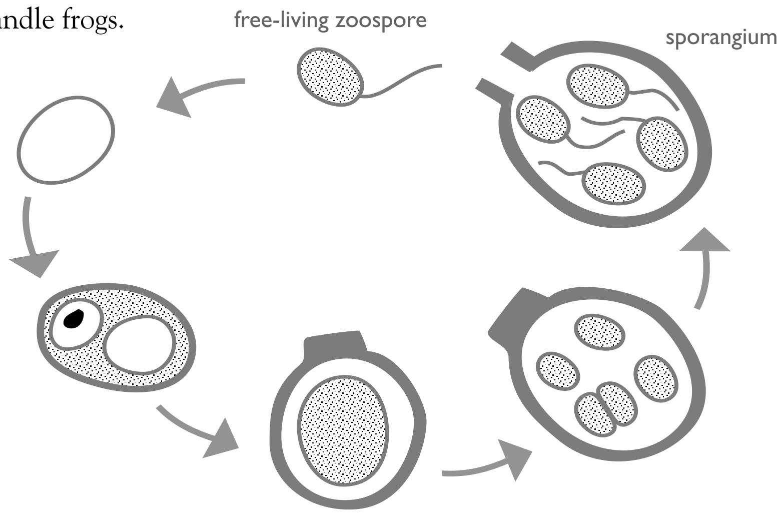
B. dendrobatidis is a form of fungus belonging to the phylum Chytridiomycota. Most species within this phylum occur as free-living saprophytic fungi in water and soil and have been found in almost every type of environment including deserts, artic tundra and rainforest and are considered important primary biodegraders (Powell 1993). *B. dendrobatidis* is a unique parasitic form of Chytridiomycete fungi, in that it invades the skin of amphibians, including tadpoles, often causing sporadic deaths with up to 100% mortality in some populations. Chytridiomycosis has been detected in over 40 species of native amphibian in Australia (Mahony and Workman 2000). However, it is not currently known whether the fungus is endemic or exotic to Australia.

The infective stage of *B. dendrobatidis* is the zoospore and transmission requires water (Berger et al.,1999). Zoospores released from an infected amphibian can potentially infect other amphibians in the same water. More research is needed on the dynamics of infection in the wild. *B. dendrobatidis* is known to be susceptible to seasonal temperature changes, dehydration, salinity, water pH, light, nutrition and dissolved oxygen (Berger et al., 1999).

1.3 Objectives

The objectives of the hygiene protocol are to:

- Recommend best-practice procedures for DECC personnel, researchers, consultants and other frog enthusiasts or individuals who handle frogs.
- Suggest workable strategies for those regularly working in the field with frogs or conducting fieldwork activities in wetlands and other aquatic environments where there is the potential for spreading pathogens such as the frog chytrid fungus.
- Provide background information and guidance to people who provide advice or supervise frog related activities.
- Provide standard licence conditions for workers engaged in frog related activities.
- Inform Animal Care and Ethics Committees (ACEC) for their consideration when granting research approvals.



Life cycle of frog chytrid fungus from infective free-living zoospore stage to sporangium (adapted from L. Berger).

2 site hygiene management

A checklist of risk management procedures and recommended standard hygiene kit is provided in Appendix 1. Please note Footnote 1 on page 4.

Individuals studying frogs often travel and collect samples of frogs from multiple sites. Some frog populations can be particularly sensitive to the introduction of infectious pathogens such as the frog chytrid fungus. Also, the arrangement of populations in the landscape may make frogs particularly vulnerable to transmission of infectious pathogens. Therefore, it is important that frog workers recognise the boundaries between sites and undertake measures which reduce the likelihood of spreading infection.

Where critically endangered species or populations of particular risk are known to occur, this protocol should be applied over very short distances ie a single site may need to be subdivided and treated as separate sites.

When planning to survey multiple sites, always start at a site where frog chytrid fungus is not known to be present before entering other infected areas.

2.1 Defining a site

Defining the boundary of a site maybe problematic. In some places, the boundary between sites will be obvious but in others, less so. Undertaking work at a number of sites or conducting routine monitoring at a series of sites within walking distance creates obvious difficulties with boundary definitions. It is likely that defining the boundary between sites will differ among localities. It may be that a natural or constructed feature forms a logical indicator of a site boundary eg a road/track, a large body of water such as a river or the sea, a marked habitat change or a catchment boundary.

As a guiding principle, each individual waterbody should be considered a separate site.

When working along a river or stream or around a wetland or a series of interconnecting ponds it is reasonable, in most instances, to treat such examples as a single site for the purposes of this protocol. Such a case would occur in areas where frogs are known to have free interchange between ponds.

Where a stream consists of a series of distinctive tributaries or sub-catchments or where there is an obvious break or division then they should be treated as separate sites, particularly if there is no known interchange of frogs between sites.

2.2 On-site hygiene

When travelling from site to site it is recommended that the following hygiene precautions be undertaken to minimise the transfer of disease from footwear, equipment and/or vehicles.

Footwear

Footwear must be thoroughly cleaned and disinfected at the commencement of fieldwork and between each sampling site.

This can be achieved by initially scraping boots clear of mud and standing the soles in a disinfecting solution. The remainder of the boot should be rinsed or sprayed with a disinfecting solution that contains *benzalkonium chloride* as the active ingredient. Disinfecting solutions should be prevented from entering any water bodies.

Rubber boots such as 'gum boots' or 'Wellingtons' are recommended because of the ease with which they can be cleaned and disinfected.

Several changes of footwear bagged between sites might be a practical alternative to cleaning.

Equipment

Equipment such as nets, balances, callipers, bags, scalpels, headlamps, torches, wetsuits and waders etc that are used at one site must be cleaned and disinfected before re-use at another site.

Disposable items should be used where possible. Non-disposable equipment should be used only once during a particular field exercise and disinfected later or disinfected at the site between uses using procedures outlined in 2.4 below.

Vehicles

Where necessary, vehicle tyres should be sprayed/flushed with a disinfecting solution in high-risk areas.

Transmission of disease from vehicles is unlikely to be a problem. However, if a vehicle is used to traverse a known frog site, which could result in mud and water being transferred to other bodies of water or frog sites, then wheels and tyres should undergo cleaning and disinfection. This should be carried out at a safe distance from water bodies, so that the disinfecting solution can infiltrate soil rather than run-off into a nearby water body.

Spraying with ‘toilet duck’ (active ingredient *benzalkonium chloride*) is recommended to disinfect car wheels and tyres.

Cleaning of footwear before getting back into the car will prevent the transfer of pathogens from/to vehicle floor and control pedals.

2.3 Handling of frogs in the field

The spread of pathogenic organisms, such as the frog chytrid fungus, may occur as a result of handling frogs.

Frogs should only be handled when necessary.

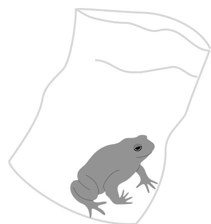
Where handling of frogs is necessary the risk of pathogen transfer should be minimised as follows:

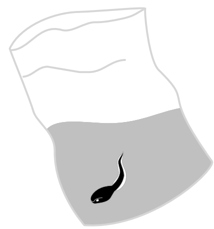
- Hands should be either cleaned and disinfected between samples or a new pair of disposable gloves used for each sample[1]. This may be achieved by commencing with a work area that has a dish containing a disinfecting solution and paper towels.
- A ‘one bag – one frog’ approach to frog handling should be used especially where several people are working together with one person processing frogs and others doing the collecting. Bags should not be reused.
- A ‘one bag – one sample’ approach to tadpole sampling should be used. Bags should not be reused.

Researchers who use toe clipping or Passive Integrated Transponder (PIT) tagging are likely to increase the risk of transmitting disease between frogs due to the possibility of directly introducing pathogens into the frogs’ system. This can be minimised by using:

- Disposable sterile instruments
- Instruments disinfected previously and used once
- Instruments disinfected in between each frog

Disinfecting solutions containing *benzalkonium chloride* are readily available from local supermarkets. Some brands include Toilet Duck, Sanpic, New Clenz and Pine Clean.





[1] As a principle, this protocol assumes that not all frogs in an infected pond will be contaminated by the frog chytrid fungus. The infective load of a body of water may not be high enough to cause cross contamination of individual frogs in the same pond. Therefore care should be taken to use separate gloves and bags and clean hands for each sample, to avoid transmission of high infective loads between individuals.

Open wounds from toe clipping and PIT tagging should be sealed with a cyanoacrylate compound such as *Vetbond©* to reduce the likelihood of entry of pathogens. The DECC ACEC further recommends the application of topical anaesthetic *Xylocaine©* cream and *Betadine©* disinfectant (1% solution) before and after any surgical procedure. This should then be followed by the wound sealant.

All used disinfecting solutions, gloves and other disposable items should be stored in a sharps or other waste container and disposed or sterilised appropriately at the completion of fieldwork. Disinfecting solutions must not come into contact with frogs or be permitted to contaminate any water bodies

2.4 Disinfection Methods

Disinfecting agents for hands and equipment must be effective against bacteria and both the vegetative and spore stages of fungi. The following agents are recommended:

- Chloramine and Chlorhexidine based products such as *Halamid©*, *Halasept©* or *Hexifoam©* are effective against both bacteria and fungi. These products are suitable for use on hands, footwear, instruments and other equipment. The manufacturers instructions should be followed when preparing these solutions.
- Bleach and alcohol (ethanol or methanol), diluted to appropriate concentrations can be effective against bacteria and fungi. However, these substances may be less practical because of their corrosive and hazardous nature.

  When using methanol either:

  - immerse in 70% methanol for 30 minutes or
  - dip in 100% methanol then flame for 10 seconds or boil in water for 10 minutes

Fresh bleach (5% concentration) may be also effective against other frog pathogens such as Rana Virus.

Some equipment not easily disinfected in these ways can be effectively cleaned using medical standard 70% isopropyl alcohol wipes – *Isowipes©*.

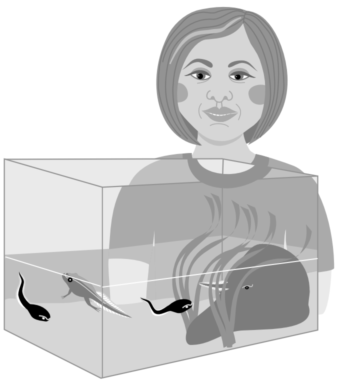
3 captive frog hygiene management

3.1 Housing frogs and tadpoles

Frogs and tadpoles should only be removed from a site when absolutely necessary.

When it is necessary for frogs or tadpoles to be collected and held for a period of time, the following measures should be undertaken:

- Animals obtained at different sites should be kept isolated from each other and from other captive animals.
- Aquaria set up to hold frogs should not share water, equipment or any filtration system. Splashes of water from adjacent enclosures or drops of water on nets may transfer pathogens between enclosures.
- Prior to housing frogs or tadpoles, ensure that tanks, aquaria and any associated equipment are disinfected.
- Tanks and equipment should be cleaned, disinfected and dried immediately after frogs/tadpoles are removed.



Careful maintenance of your enclosures will ensure a safe and hygienic environment for captive frogs and tadpoles.

When contemplating a release of captive bred tadpoles for conservation purposes a Translocation Proposal should be submitted to the DECC and pathological screening for disease should be undertaken (see also DECC Translocation Policy). Tadpoles can be tested by randomly removing 10 individuals at 6 weeks and again at 2 weeks before anticipated release. Testing could be undertaken by the pathology section at Taronga Zoo, Newcastle University, CSIRO Australian Animal Health Laboratories at Geelong and James Cook University at Townsville. Such an arrangement would need to be negotiated by contacting one of these institutions well before the anticipated release date. (see Appendix 2 for contact details)

DECC have licenced NSW Schools to allow students and/or teachers to remove tadpoles for classroom life cycle studies. They are authorised to remove individuals from only one location, each school also requires endorsement from Department of Education and Training Animal Care and Ethics Committee and comply with this protocol.

Tadpoles collected for these purposes are to be obtained from the local area of the school and are not to be obtained from DECC Reserves. As soon as tadpoles have transformed, froglets must be returned to the exact point of capture. Tadpoles from different locations are not to be mixed.

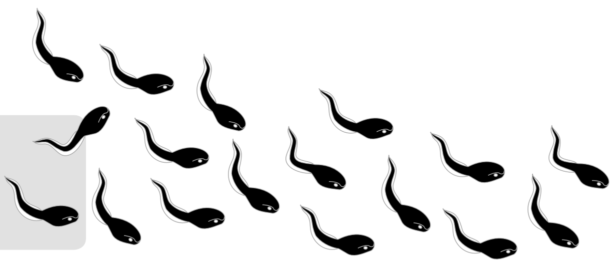
Antifungal cleansing treatments to clear tadpoles of the frog chytrid fungus are currently being trialed. In the future, such a treatment may be an added procedure required prior to froglet releases.

Detailed information on safely maintaining frogs in captivity is provided in Voigt (2001).

3.2 Tadpole treatment

In most instances:

Release to the wild of tadpoles held or bred in captivity should be avoided.



3.3 Frog treatment

The rigour with which frogs must be treated to ensure pathogens are not introduced to native populations means that any proposal for the removal of adult frogs (particularly threatened species) from wild populations should be given careful consideration.

When it is essential for frogs to be removed from the wild, the following should apply.

Individuals to be released should be quarantined for a period of 2 months and monitored for any signs of illness or disease.

Frogs must not be released if any evidence of illness or infection is detected. If illness is suspected, further advice must be sought from a designated frog recipient (Appendix 2) as soon as possible to determine the nature of the problem. Chytridiomycosis can be diagnosed in live frogs by microscopical examination of preserved toe clips or from shedding skin samples. Research is still in progress on the development of a simple technique for the detection of Chytridiomycosis and a treatment for infected frogs.

Current methods which may be used include:

- A technique for the treatment of potentially infected frogs is to place the frogs individually in a 1mg/L benzalkonium chloride solution for 1 hour on days 1, 3, 5, 9, 11 and 13 of the treatment period. Frogs are then isolated/quarantined for two months. This and other possible treatments are documented in Berger and Speare (1998)
- *Betadine*© and *Bactone*© treatments have also been used on adult frogs with some success (M. Mahony, Newcastle University pers. comm.)
- *Itraconazole*© is an expensive drug which has been used successfully (Lee Berger CSIRO Australian Animal Health Laboratory pers. comm.). Information on this method is available on the Website http://www.jcu.edu.au/school/PHTM/frogs/adms/attach6.pdf.

Frogs undergoing treatment should be housed individually and kept separate from non-infected individuals.

3.4 Displaced frogs

Displaced frogs are those native frog species and introduced Cane Toads (Bufo marinus) which have been unintentionally transported around the country with fresh produce, transported produce and landscaping supplies. Procedures to be undertaken when encountering introduced/displaced native frog species (as well as Cane Toads) are as follows.

3.4.1 Banana box frogs

'Banana Box' frog is the term used to describe several native frog species (usually Litoria gracilenta, L. infrafrenata, L. bicolor and L. caerulea) commonly transported in fruit and vegetable shipments and landscaping supplies. In the past, well meaning individuals have attempted to return these frogs to their place of origin but this is usually impossible to do accurately. There is risk of spread of disease if these frogs are transferred from place to place.

It is strongly recommended that:

Displaced Banana Box frogs should be treated as if they are infected and should not to be freighted anywhere for release to the wild unless specifically approved by DECC.

When encountering a displaced frog:

- Contact a licensed wildlife carer organisation to collect the animal. The frog should then undergo a quarantine period of 2 months along with an approved disinfection treatment.
- Post-quarantine, the frog (if one of the species identified above) may be transferred to a licensed frog keeper. All other species require the permission from DECC Wildlife Licensing and Management Unit (WLMU) prior to transfer. Licensed carer groups are to record and receipt frogs obtained and disposed of in this way.
- Licensed Frog Keepers are to list these frogs in their annual licence returns to DECC.

Frogs held by licensed frog keepers are not to be released to the wild except with specific DECC approval.

Displaced frogs may be made available to recognised institutions for research projects, display purposes or perhaps offered to the Australian Museum as scientific specimens once approval has been provided by the DECC WLMU.

Frogs are often unintentionally transported with fresh produce and landscaping supplies. They are collectively known as 'banana box' or displaced frogs.

3.4.2 Cane toads

Cane toads are known carriers of the Frog chytrid fungus and should not be knowingly transported or released to the wild.

If a cane toad is discovered outside of its normal range, it should be humanely euthanased in accordance with the recommended NSW Animal Welfare Advisory Council procedure (see Appendix 3). Care should be taken to avoid euthanasia of native species due to mistaken identity.

An NPWS information brochure titled 'Cane Toads in NSW' provides further information on cane toads and assistance with identification of some of the commonly misidentified native species. This information is also available on the DECC website.

3.4.3 Local frog species

Frogs encountered on roads, around dwellings and gardens or in swimming pools should not be considered as displaced frogs.

Frogs encountered in these situations should be assisted off roads, away from dwellings, or out of swimming pools preferably to the nearest area of vegetation or suitable habitat.

Incidences of frogs spawning or tadpoles appearing in swimming pools should be referred to a wildlife carer/rescue organisation for assistance (see Appendix 4).

Contact the Frogwatch Helpline if you are unsure whether a frog is a local species or displaced.

4 sick or dead frogs

Unless an obvious cause of illness or death is evident (eg predation or road mortality): Sick or dead frogs encountered in the wild should be collected and disposed of in accordance with the procedures described in section 4.2 below.

4.1 Symptoms of sick and dying frogs

Sick and dying frogs exhibit a range of symptoms characteristic of chytrid infection. Symptoms may be expressed in the external appearance or behaviour of the animal. A summary of these symptoms are described below. More detailed information can be found in Berger et al., (1999) or at the James Cook University Amphibian Disease website at: http://www/jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm.

Appearance (one or more symptoms)

- darker or blotchy upper (dorsal) surface
- reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes
- swollen hind limbs
- very thin or emaciated
- skin lesions (sores, lumps)
- infected eyes
- obvious asymmetric appearance

Behaviour (one or more symptoms)

- lethargic limb movements, especially hind limbs
- abnormal behaviour (eg a nocturnal, burrowing or arboreal frog sitting in the open during the day and making no vigorous attempt to escape when approached)
- little or no movement when touched

Great barred frog (*Mixophyes fasciolatus*) with severe Chytrid infection — note lethargic attitude and sloughing skin. Photo: L. Berger

Diagnostic behaviour tests

Sick frogs will fail one or more of the following tests:

test	healthy	sick
Gently touch with finger	Frog will blink	Frog will not blink above the eye
Turn frog on its back	Frog will flip back over	Frog will remain on its back
Hold frog gently by its mouth	Frog will use its forelimbs to try to remove grip	No response from frog

4.2 What to do with sick or dead frogs

A procedure for the preparation and transport of a sick or dead frog is given below[2]. Adherence to this procedure will ensure the animal is maintained in a suitable condition for pathological examination and assist the DECC and researchers to determine the extent of the disease and the number of species affected.

- Disposable gloves should be worn when handling sick or dead frogs. Avoid handling food and touching your mouth or eyes as this could transfer pathogens and toxic skin secretions from some frog species.
- New gloves and a clean plastic bag should be used for each frog specimen to prevent cross-contamination. When gloves are unavailable, use an implement to transfer the frog to a container rather than using bare hands.
- If the frog is dead, keep the specimen cool and preserve as soon as possible (as frogs decompose quickly after death making examination difficult). Specimens can be fixed/preserved in 70% ethanol or 10% buffered formalin.

Cut open the belly and place the frog in about 10 times its own volume of preservative. Alternatively, specimens can be frozen (although this makes tissues unsuitable for some tests). If numerous frogs are collected, some should be preserved and some should be frozen. Portions of a dead frog can be sent for analysis eg a preserved foot, leg or a portion of abdominal skin.

- The container should be labelled showing at least the species, date and location. A standardised collection form is provided in Appendix 5.
- If the frog is alive but unlikely to survive transportation (death appears imminent), euthanase the frog (see Appendix 3) and place the specimen in a freezer. Once frozen, the specimen is ready for shipment to the address provided below.
- If the frog is alive and likely to survive transportation, place the frog into either a moistened cloth bag with some damp leaf litter or into a plastic bag with damp leaf litter and partially inflated before sealing. Remember to keep all frogs separated during transportation.
- Preserved samples can be sent in jars or wrapped in wet cloth, sealed in bags and placed inside a padded box.
- Send frozen samples in an esky with dry ice (available from BOC/CIG Gas outlets).
- Place live or frozen specimens into a small styrafoam esky (available from K-Mart/Big W for approximately $2.50).
- Seal esky with packaging tape and address to one of the laboratories listed in Appendix 4.
- Send the package by courier.

Further information on sick and dying frogs is available on the Amphibian Disease Home Page at http://www.jcu.edu.au/dept/PHTM/frogs/ampidis.htm — in particular refer to *'What to do with dead or ill frogs'*.

[2] The measures described below are standard procedures and may vary slightly depending on the distance and time required to reach the intended recipient. Contact the intended recipient of the sick or dead frog prior to sending to confirm the appropriate procedure.

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appendix 1

hygiene protocol checklist and field kit

The following checklist and field kit are designed to assist with minimising the risk of transferring pathogens between frogs.

Have you considered the following questions before handling frogs in the field:

- Has your proposed field trip been sufficiently well planned to consider hygiene issues?
- Have you taken into account boundaries between sites (particularly where endangered species or populations at risk are known to occur)?
- Have footwear disinfection procedures been considered and a strategy adopted?
- Have you planned the equipment you will be using and developed a disinfection strategy?
- Are you are planning to visit sites where vehicle disinfection will be needed (consider both vehicle wheels/tyres and control pedals) and if so, do you have a plan to deal with vehicle disinfection?
- Have handling procedures been planned to minimise the risk of frog to frog pathogen transmission?
- Do you have a planned disinfection procedure to deal with equipment, apparel and direct contact with frogs?

If you answered NO to any of these questions please re-read the relevant section of the DECC Hygiene Protocol for the Control of Disease in Frogs and apply a suitable strategy.

Field hygiene kit

When planning to survey frogs in the field a portable field hygiene kit should be assembled to assist with implementing this protocol. Recommended contents of a field hygiene kit would include:

- Small styrofoam eski
- Disposable gloves
- Disinfectant spray bottle (atomiser spray) and/or wash bottle
- Disinfecting solutions
- Wash bottle
- Scraper or scrubbing brush
- Small bucket
- Plastic bags large and small
- Container for waste disposal
- Materials for dealing with sick and dead frogs (see section 4.2)

appendix 2

Always contact the relevant specialist prior to sending a sick or dead frog. In some cases, only wild frogs will be assessed for disease. Analysis may also attract a small fee per sample.

designated sick and dead frog recipients

Contact one of the following specialists to arrange receipt and analyse sick and dead frogs. Make contact prior to dispatching package:

Karrie Rose
Australian Registry if Wildlife Health
Taronga Conservation Society, Australia
PO Box 20
MOSMAN NSW 2088

Phone: 02 9978 4749
Fax: 02 9978 4516
Krose@zoo.nsw.gov.au

Diana Mendez or
Rick Speare
School of Public Health,
Tropical Medicine and
Rehabilitation Sciences
James Cook University
Douglas Campus
TOWNSVILLE QLD 4811

Phone: 07 4796 1735
Fax: 07 4796 1767
Diana.Mendez@jcu.edu.au
Richard.Speare@jcu.edu.au

Michael Mahony
School of Biological Sciences
University of Newcastle
CALLAGHAN NSW 2308

Phone: 02 4921 6014
Fax: 02 4921 6923
bimjm@cc.newcastle.edu.au

For information on frog keeping licences and approvals to move some species of displaced frog contact:

Co-ordinator, Wildlife Licensing
Wildlife Licensing and Management Unit
DECC
PO Box 1967
Hurstville NSW 1481
Ph 02 9585 6481
Fax 02 9585 6401
wildlife.licensing@environment.nsw.gov.au

For information on the possible identity of displaced frogs contact:

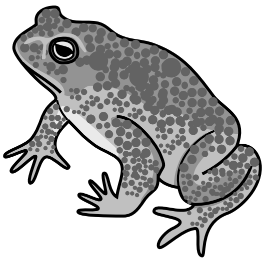
Frog and Tadpole Society (FATS)
Frogwatch Helpline

Ph: 0419 249 728

appendix 3

NSW Animal Welfare Advisory Council methodology

The NSW Animal Welfare Advisory Council procedure for humanely euthanasing cane toads or terminally ill frogs is stated as follows:



- Using gloves, or some other implement, place cane toad or terminally ill frog into a plastic bag.
- Cool in the refrigerator to 4°C.
- Crush cranium with a swift blow using a blunt instrument.

Note: Before killing any frog presumed to be a cane toad, ensure that it has been correctly identified and if outside the normal range for cane toads in NSW (north coast) that local DECC regional office is informed.

appendix 4

licensed wildlife carer and rescue organisations

Following is a list of wildlife rehabilitation groups licensed by Department of Environment and Climate Change (NSW):

Northern NSW

Australian Seabird Rescue
For Australian Wildlife Needing Aid (FAWNA)
Friends of the Koala
Friends of Waterways (Gunnedah)
Great Lakes Wildlife Rescue
Koala Preservation Society of NSW
Northern Rivers Wildlife Carers
Northern Tablelands Wildlife Carers
Tweed Valley Wildlife Carers
Seaworld Australia
WIRES branches in Northern NSW

Southern NSW

Looking After Our Kosciuszko Orphans (LAOKO)
Native Animal Network Association
Native Animal Rescue Group
Wildcare Queanbeyan
WIRES branches in Southern NSW

Sydney, Hunter and Illawarra

Hunter Koala Preservation Society
Ku-ring-gai Bat Colony Committee
Kangaroo Protection Co-operative
Native Animal Trust Fund
Organisation for the Rescue and Research of Cetaceans (ORRCA)
Sydney Metropolitan Wildlife Services
Wildlife Aid
Wildlife Animal Rescue and Care (Wildlife ARC)
Waterfall Springs Wildlife Park
Oceanworld
Wildlife Care Centre, John Moroney Correctional Centre
Koalas in Care
WIRES branches around Sydney, Hunter and Illawarra

Western NSW

Rescue and Rehabilitation of Australian Native Animals (RRANA)
RSPCA Australian Capital Territory Inc.
Wildlife Carers Network (Central West)
WIRES branches in Western NSW
Cudgegong Wildlife Carers

[4] Note: some of these organisations may not care for frogs.

appendix 5 — sick or dead frog collection form

Sender details:

name: address: postcode:

phone: (w) (h) fax: email:

Collector details: (where different to sender)

name: address: postcode:

phone: (w) (h) fax: email:

Specimen details:

record no: no. of specimens: species name: date collected:
day/month/year

time collected: sex: status at time of collection: date sent:
male/female healthy(H)/ sick(S)/ dead(D) day/month/year

location: map grid reference:
(easting) (northing)

reason for collection:

Batch details for multiple species collection:

species	no.	locality	(AMG)	date	sex	status (H/S/D)

habitat type: vegetation type: micro habitat:
eg creek, swamp, forest eg rainforest, sedgeland eg creek bank, under log, amongst emergent vegetation, on ground in the open

unusual behaviour of sick frogs:
eg lethargic, convulsions, sitting in the open during the day, showing little or no movement when touched.

dead frogs appearance:
eg thin, reddening of skin on belly and/or toes, red spots, sore, lumps or discolouration on skin

deformed frogs: dead/sick tadpoles:
eg limb(s) missing, abnormal shape or length eg numbers/behaviour

unusual appearance of egg masses: recent use of agricultural chemicals in area:
eg grey or white eggs eg pesticides, herbicides, fertilisers

other potential causes of sickness/mortality/comments/additional information:

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

General inquiries: PO Box A290 South Sydney 1232
Phone: 9995 5000 or 1300 361967
Fax: 02 9995 5999 **Web site:** www.environment.nsw.gov.au

Department of **Environment & Climate Change** NSW

APPENDIX B

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LIMITATIONS

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Appendix C – Kooragang Island Wide GGBF Survey Program, 2021/22 Report – Graphical Summary (University of Newcastle, 2022)

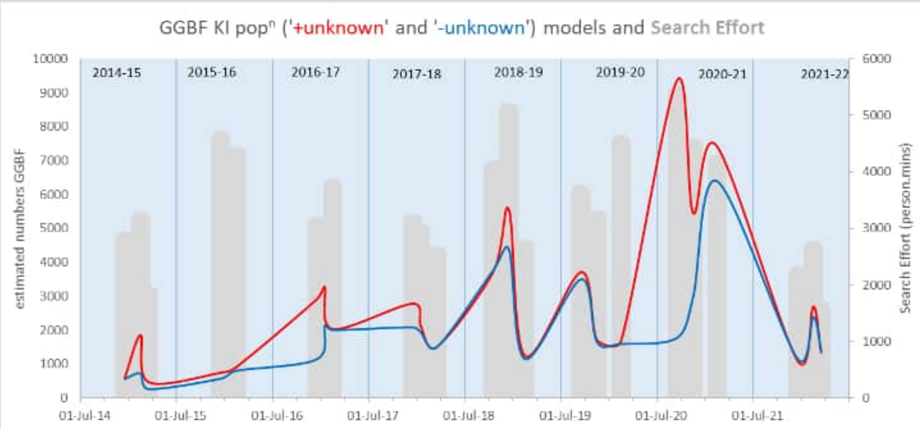
Green and Golden Bell Frog population trends across multiple seasons

1. Population size: A key question for the Island-Wide Survey (IWS) program is; what is the population of green and golden bell frogs (GGBF, *Litoria aurea*) on Kooragang Island?

The charts below show two different estimates of the population for **the wetlands in the Island Wide Survey program**. The red line is likely and overestimate, and the blue line is likely an underestimate.

Note that this estimate relates only to the surveyed wetlands, and is thus an underestimate of the population across the whole of Kooragang (+Ash) island.

(For more information on the difference between the lines, see **Section 3** – the short version is that the difference relates to breeding events and the 'space' in-between the lines shows the presence of many small juvenile frogs that were spawned some months earlier. More on this in **Section 4**.)



The main take home points from this chart:

- There is a weak relationship between Search Effort (grey columns) and population estimate. In short, the more time we spend looking for frogs, the more we find. More on this in the main report.
- Even so, there seems to be a regular seasonal pattern with a peak in summer (most obvious for the three seasons from 2016-17 to 2018-19).
- The overall population was fairly consistent (between 1,000 and 3,000) from 2016-17 to 2018-19.
- Drought-breaking rain in Feb 2020 saw a mass breeding event (shown by the large peak in the red line) and a consequent increase in the adult population (the smaller but still significant peak in the blue line). Although search effort was high in 2020-21, the population estimate is not just a result of this additional effort.
- Since 2021, the population numbers have decreased back to the levels that were typical from 2016-19.

2. How do we make the population estimate for Kooragang GGBF? This involves a few different types of data and calculations:

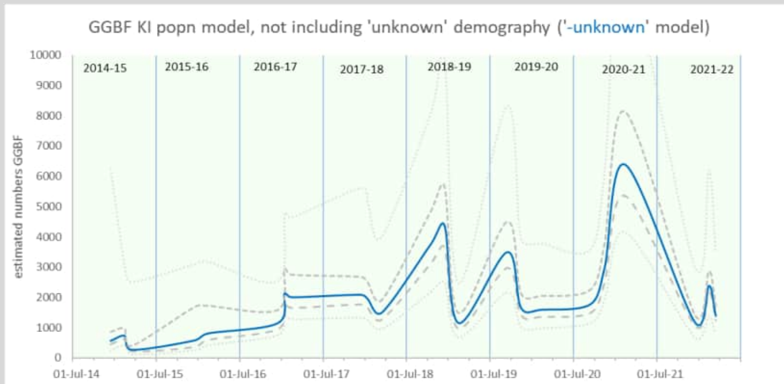
i. We survey 60-90 wetlands across the island several times per season (at least twice, usually three times) using standardised Visual Encounter Surveys (VES), counting all frogs seen.

ii. During VES surveys, we don't see every frog that is actually present, so how to account for the ones we don't see? Intensive surveys at 2 or 3 specific wetlands are used to calculate the actual number of frogs at those wetlands, using an approach called 'Capture-Mark-Recapture' (CMR).

iii. For those CMR ponds, we use the VES count and calculated subpopulation size to work out a 'detection ratio'. This tells us how many frogs are actually present for each frog seen in a VES. The ratio is typically between 6 and 9 frogs present for each one seen.

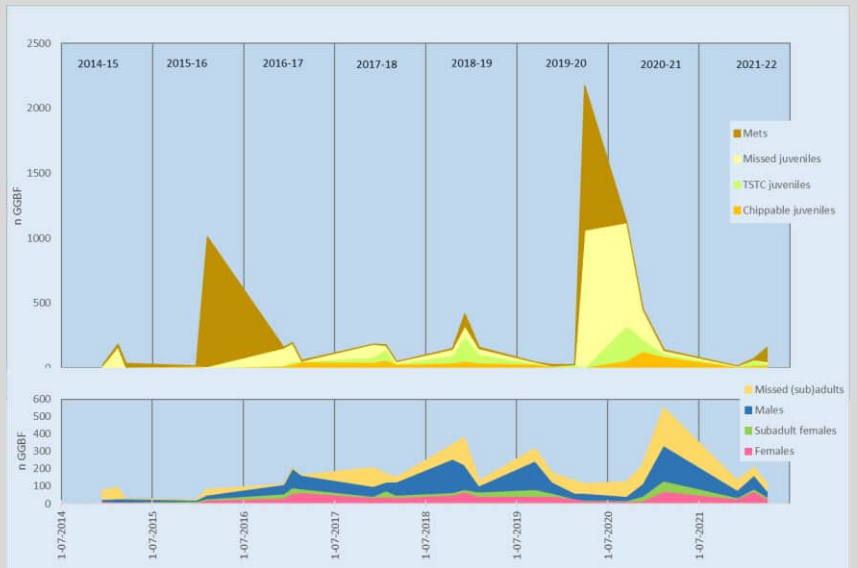
2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
8.3	8.3	9.3	8.4	7.3	8.3	7.7	8.8

iv. Applying that detection ratio to the VES counts across the whole island provides an estimate of the population across the surveyed sites.



4. Breeding events: Because the difference between the two models is caused by how we deal with small juveniles that we didn't catch, the places where the lines are very different should be telling us something about times where there are a lot of small juveniles in the system, i.e. immediately following mass breeding events.

We can confirm this by looking at the demographic breakdown of the frogs detected during VES. The upper chart shows the number of juvenile size classes detected, and the lower one the age-sex classes for larger animals.



Two massive breeding events are clearly shown by very large numbers of mets; the first in 2015-16, and the second in 2019-20. Neither of the population models include mets, so they don't cause the difference between them. But the 'missed juveniles' category is included in the +unknown model and omitted from the -unknown one, so the large number of 'missed juveniles' immediately following the breeding events is a major cause of the difference between the two population models.

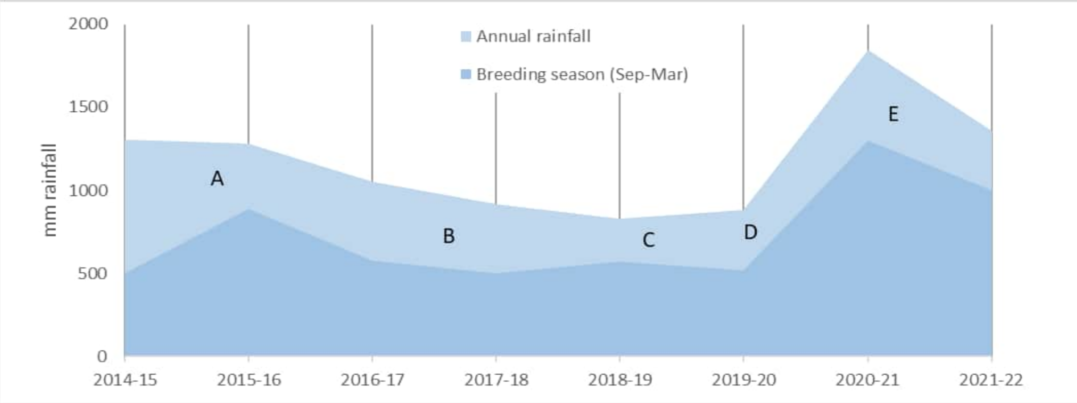
What were the factors that caused these breeding events? The short answer is climatic variation – see the next sections for an exploration of these.

3. One problem with the model we used for estimating population size is how to account for frogs that were seen but not captured. Because the CMR component of the model explicitly only considers frogs larger than 40 mm SVL (snout-vent length), it can't be applied to counts that include frogs smaller than 40 mm. But if we don't catch the frog, we can't measure it. But we did detect those frogs in VES, so we can't pretend they weren't there.

The two versions of the model described in Section 1 show two ways of dealing with this problem: the blue line is where all animals that were not captured are excluded from the calculations unless they were recorded as being adults. ('-unkown' model). The red line is the model that include animals that were seen but not captured unless they were recorded as definitely being smaller than 40 mm ('+unknown' model).

Environmental Factors, Breeding Events, & Constructed Habitats

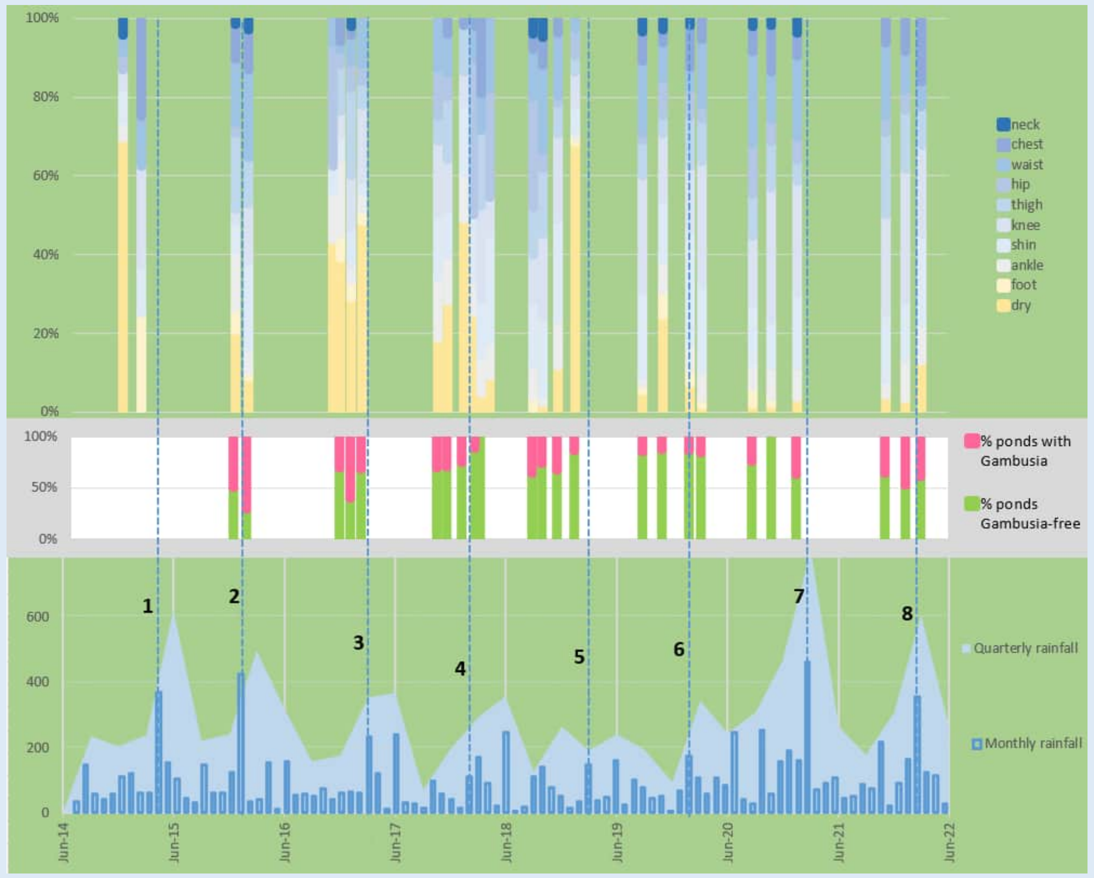
5. The **climatic pattern** over the last 8 seasons has seen some extremes:



A. A moderately wet year in 2014-15 was followed by an extremely wet summer breeding season in 2015-16.
B. This was followed by a series of drier summers, with low rainfall during the breeding season
C. culminating in a severe drought in 2019.
D. Drought breaking rain in February-March 2020
E. was followed by a prolonged *La Nina* and very wet conditions for the last two seasons.

6. Climatic context helps us to understand the GGBF population dynamics over these last 8 seasons, especially the two large breeding events.

The top chart shows wetland hydrology as the percentage of surveyed wetlands of different depths (measured against body regions of a standard frog ecologist, and reflecting the deepest water encountered during a survey - not necessarily the deepest water in the wetland). Tan colours indicate dried out wetlands, light to mid blue is shallow to moderate depths, and darker blues indicate deep water present.



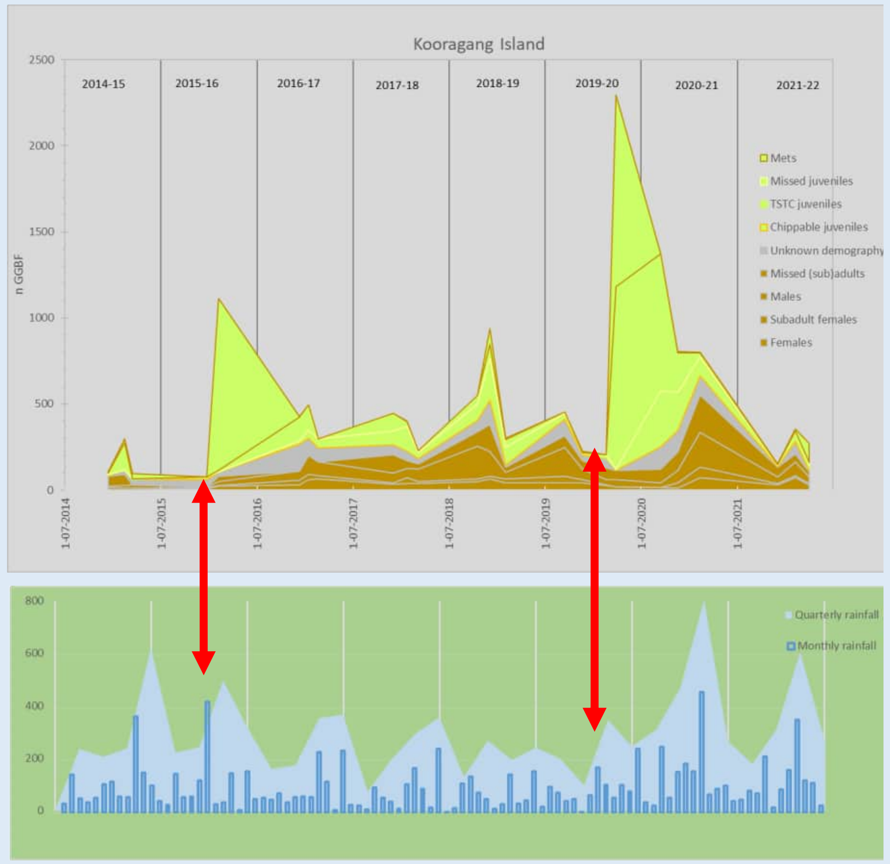
Gambusia infestation rates are shown as the percentage of surveyed wetlands in each round where *Gambusia* is present (dark pink) vs those where *Gambusia* is absent (green).

Rainfall data is shown as monthly (dark blue bars) and quarterly (light blue area) plots. Significant rainfall events are highlighted as numbered vertical dashed blue lines (see **Section 7**).

7. The notable events labelled in **Section 6**:

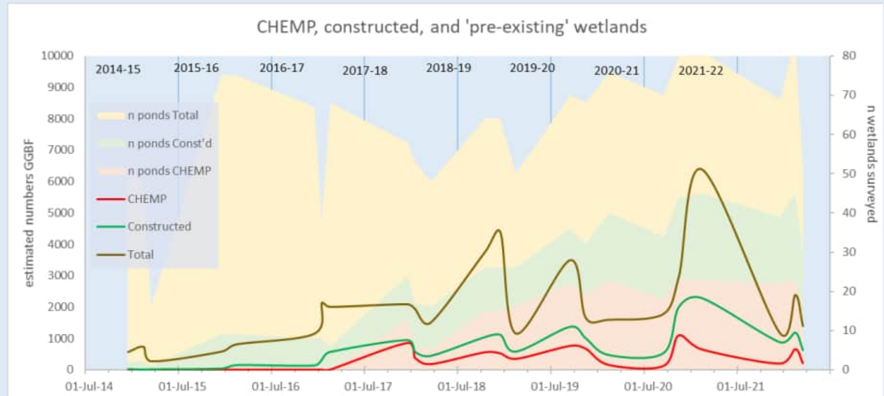
1. April 2015: a large event that caused widespread flooding in the lower Hunter, but which occurred after the main GGBF breeding season.
2. January 2016: includes the greatest single day of rainfall in this dataset (225 mm on 6th Jan, 2016), this mid-summer event resulted in a very large GGBF breeding event. In combination with the April 2015 event, the severe flooding across Kooragang also resulted in widespread dispersal of *Gambusia* across the island.
3. March 2017: Following a dry summer where nearly half of all wetlands dried out, ex-tropical cyclone Debbie moved down the east coast and recharged the wetlands across the island. Moderate late-season GGBF breeding was observed.
4. March 2018: Following another dry summer (with ~50% of wetlands dry by end-Feb), rain in early autumn gain resulted in late season breeding. The rain event was large enough to recharge wetlands without connecting them; *Gambusia* were removed from many wetlands as they dried, and remained absent when they refilled.
5. March 2019: A third consecutive dry summer resulted in nearly 70% of wetlands drying out by the end of February, and included a grass fire across Kooragang that caused extensive damage. Moderate rainfall in March was not enough to connect wetlands, and levels of *Gambusia* infestation continued to decrease.
6. Feb-March 2020: Low winter and spring rainfall was followed by severe drought, resulting in catastrophic bushfires along the East Coast. The survey data shown here does not fully reflect the extent of dry conditions by Jan-Feb 2020 (as there was no survey round in that time); separate observations show that most wetlands were dry by early February. Significant rain in later February to early March caused widespread flooding and resulted in a massive GGBF breeding event; it also connected many wetlands, allowing *Gambusia* to disperse from refugia.
7. March 2021: Following 4 years of dry to drought years, La Nina conditions caused a remarkably wet season with very few wetlands drying out over the summer. Heavy flooding rain in March continued to connect wetlands, allowing further spread of *Gambusia* through the system.
8. March 2022: A second consecutive La Nina year caused heavy rainfall throughout the season and allowed the continued spread of *Gambusia*. With ~50% of surveyed wetlands containing *Gambusia*, infestation rates are similar to those seen in 2015-16.

8. The two major **breeding events** from 2016 and 2020 were stimulated by the rainfall events listed at #2 and #6 in **Section 7**.



The upper chart shows the VES counts across the 8 seasons for each of the demographic categories, with juvenile classes in green and adult/subadult in brown. The peaks in 2016 and 2020 highlight the breeding events.

9. Constructed habitats: the number and extent of these have increased steadily since 2015, principally with the addition of CHEMP and HCCDC ponds.

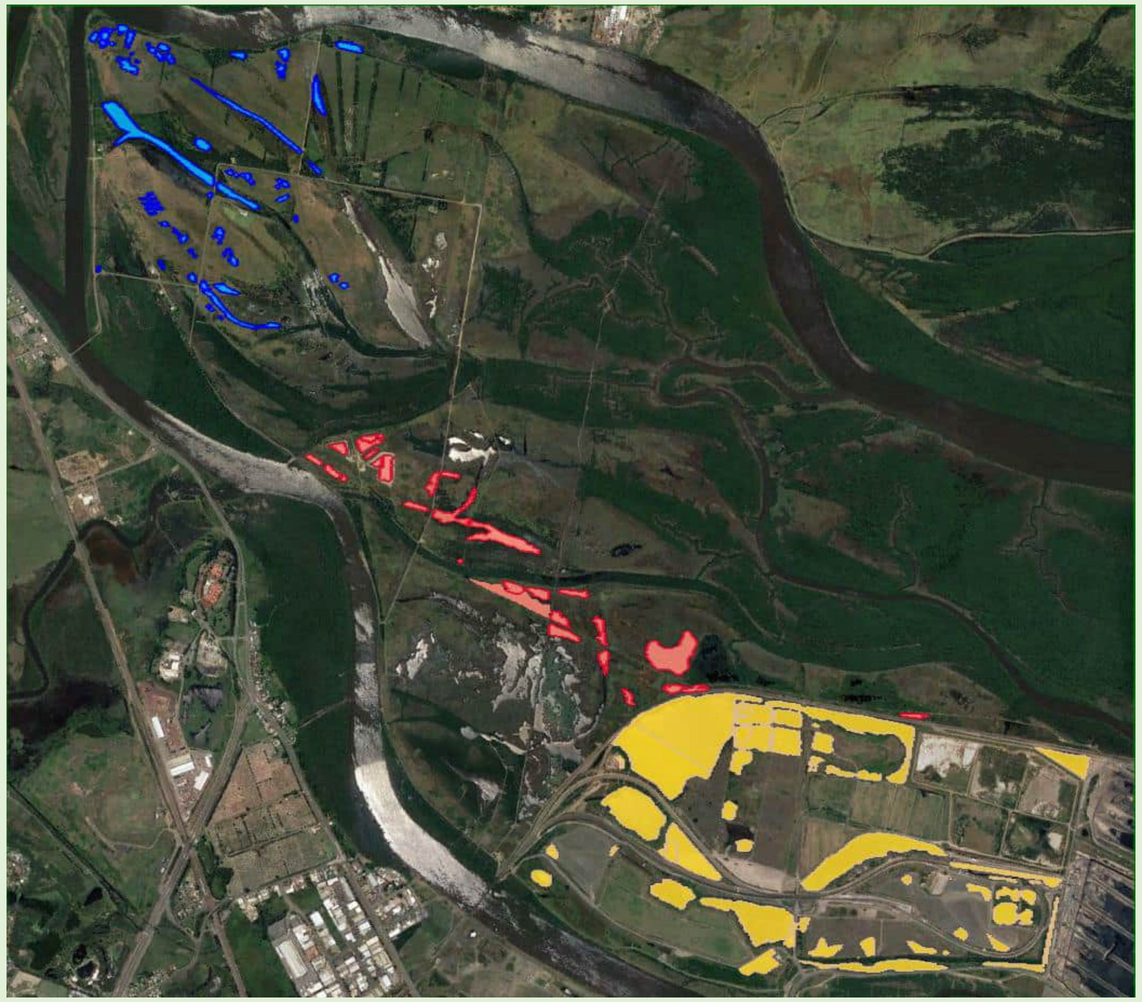


The number of CHEMP, 'other constructed wetlands', and 'all wetlands' surveyed each season are shown as shaded areas. The lines show the estimate populations (using the '-unknown' model from Section 1) for the CHEMP wetlands (red), the 'other constructed' wetlands (green), and all wetlands (brown). Data is stacked (e.g. the number of GGBF in the 'other constructed' wetlands at a particular time is the difference between the green and the red lines)

Between them, the constructed wetlands are now home to a significant portion of the GGBF population on Kooragang.

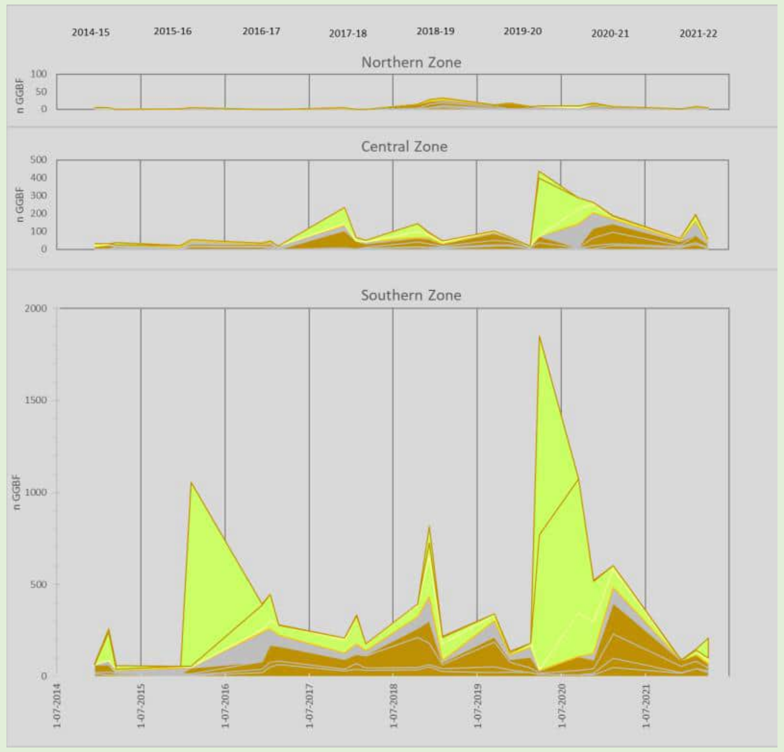
Spatial variation across Kooragang

10. Analysing Kooragang Wetlands by **'Zones'**



At the first level of looking at spatial differences in the GGBF population across Kooragang, we group wetlands into three zones: Northern (blue – also known as 'Ash Island'); Central (red), and Southern (gold). The Southern Zone is also known as the 'Industrial' zone and is located on the KIWEF.

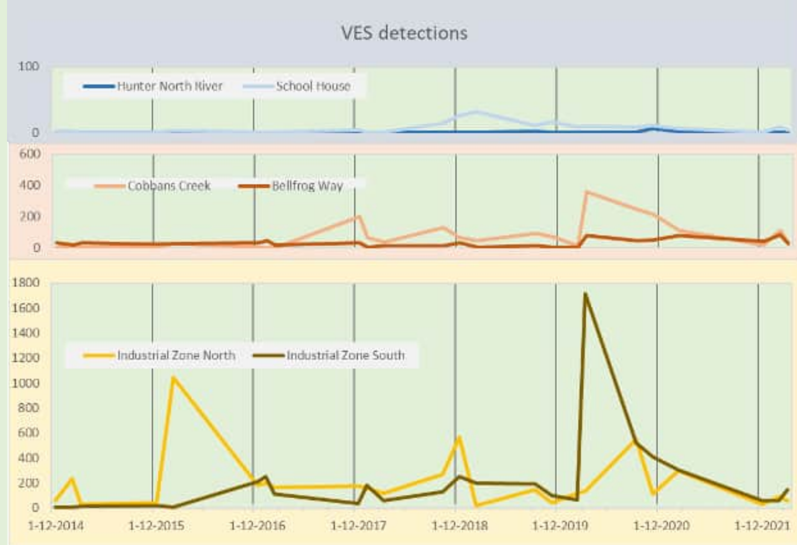
12. GGBF populations by Zone: these charts show VES detections for the three zones, with juvenile demographic classes shaded in green and adults/subadults in brown.



The majority of GGBF detected are in the Southern Zone (KIWEF). Although this is skewed by two very large breeding events, even the numbers of adults in the Southern Zone are consistently higher than in the Central Zone.

Numbers in the Northern Zone are very low, especially for juveniles. Although the reasons for these low levels are not clear, this is an urgent priority for GGBF management on Kooragang.

13. GGBF populations by 'Regions': each Zone can be divided into a pair of regions – essentially a northern and a southern region for each zone.



- GGBF are almost completely absent from the northern part ('Hunter River North) of the Northern Zone.
- In the Central Zone, Cobban's Creek (the location of most of the BHP CHEMP) often has many more GGBF than Bellfrog Way
- The northern and southern parts of the Southern Zone now have approximately equal numbers of GGBF.

The strategy to increase the GGBF population in the southern part of the Southern Zone (KIWEF) seems to have been successful. Likewise, the BHP CHEMP has been successful, but the population along Bellfrog Way is potentially a concern.

In the Northern Zone, GGBF numbers increased in School House region between 2017 and 2019, but have since declined. This might be linked to the release of captive bred juveniles in 2016-17, and perhaps suggests a potential management strategy.

11. Wetland **water quality** across the three zones:

Year	2016	2017-18				2018-19				2019-20				2020-21			2021-22		
Round	2	0	1	2	3	0	1	2	3	1	2	3	4	1	2	3	1	2	3
Zones	**Water temp**																		
Northern	28.6	21.7	25.2	24.6	23.3	14.8	20.3	24.1	25.1	19.1	23.2	26.0		19.1	23.9	24.4	21.3	25.7	21.7
Central	28.5	23.9	25.3	24.7	23.0	20.4	23.2	25.9	26.7	20.5	23.8	26.7	21.3	18.3	25.9	24.0	22.3	24.4	23.6
Southern	27.6	19.5	22.0	26.3	23.8	15.6	20.5	22.9	24.2	17.7	21.7	25.3	21.0	17.5	24.5	24.2	22.6	24.5	22.8
	pH																		
Northern	8.6	6.9	7.3	7.5	7.5	7.1	7.4	6.7	5.9	6.7	6.8	6.5		4.5	7.7	7.0	6.8	6.9	6.8
Central	6.5	6.7	7.6	6.5	7.0	7.2	7.2	7.0	6.9			6.3	6.9	5.8	7.2	7.5	7.3	7.7	7.6
Southern	8.0	8.3	7.7	7.4	8.0	5.5	8.0	8.2	7.6	7.5	7.8	7.4	7.8	7.3	8.7	8.2	8.3	8.4	8.1
	Salinity																		
Northern	5.1	7.0	10.5	15.7	5.0	2.5	1.9	4.6	0.9	1.0		2.2		4.6	2.6	1.2	0.4	1.4	0.3
Central	7.2	12.4	6.2	33.5	11.8	10.1	7.1	15.6	3.3	6.8	4.4	7.1	7.2	9.3	11.5	10.1	1.9	5.6	2.3
Southern	5.5	3.0	0.9	1.2	2.7		0.3			1.4	1.5	0.9	1.0	1.0	0.7	0.5	0.4	0.5	0.4

Water temperature shows seasonal variation (note the lower temps in the first round of each season), but little difference between zones. pH is generally more alkaline in the Southern Zone, and lowest in the Northern.

Salinity (shown here in ppt) is important for GGBF because moderately saline water inhibits chytrid fungus. Levels > 10 ppt are less suitable for GGBF. The levels are highest in the Central Zone, and are highest in dry years.

14. Breeding by Zone: indicators of breeding include calling, the presence of tadpoles and metamorphlings ('mets'), and the presence of very small ('Xsmall; <35mm SVL) and small (<40mm SVL) juvenile frogs. Data for Calling and Tadpoles is presence/absence for individual wetlands, whilst data for Mets, Xsmall, and Small are counts of individual animals.

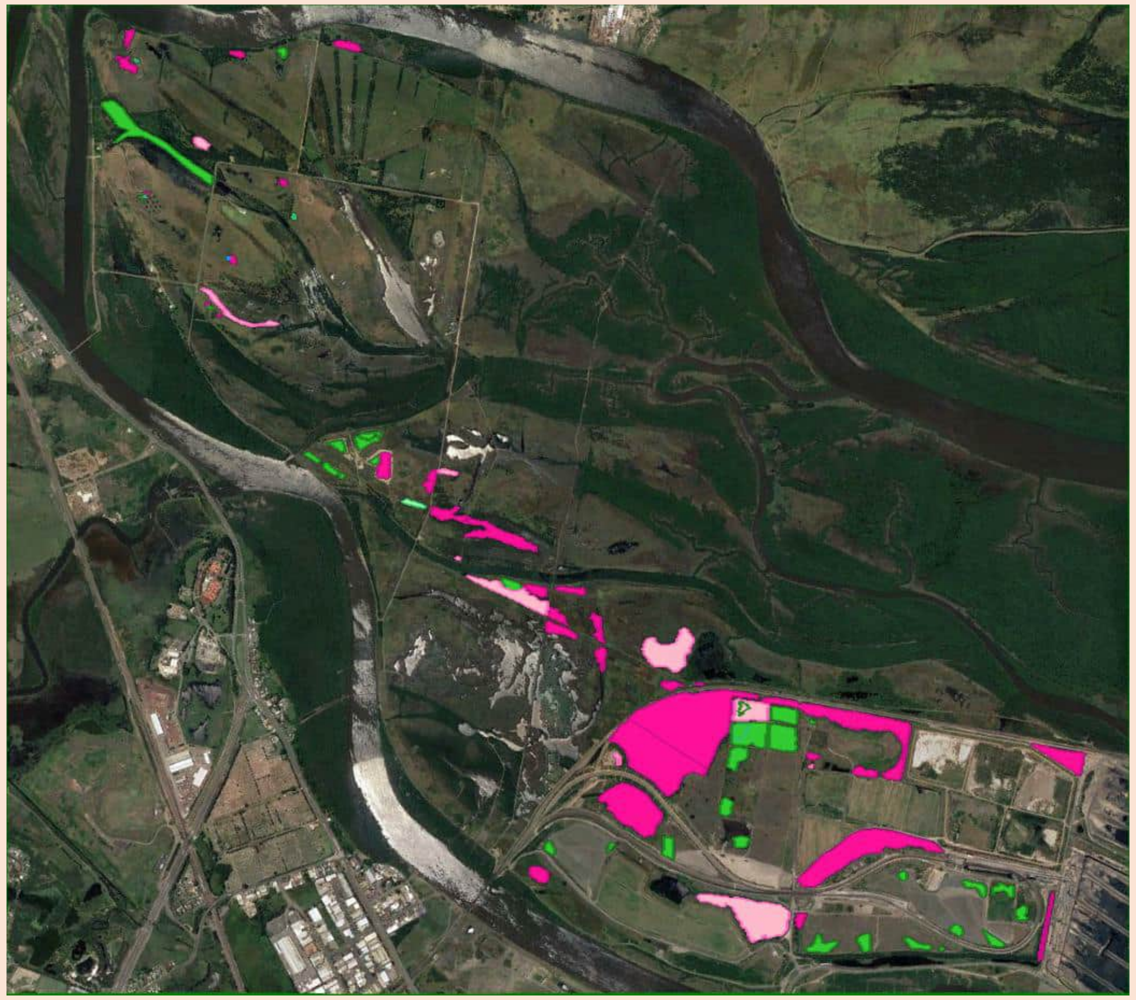
Year	2014-15			2015-16		2016-17				2017-18						2017-18				2019-20						2020-21			2021-22									
Round	1	2	3	1	2	0	1	2	3	0	1	2	3	3.1	4	0	1	2	3	1	1.9	2	3	4	4.1	1	2	3	0.1	0.2	1	1.1	1.2	2	2.1	3	3.1	3.2
	Calling																																					
Northern	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	3	2	0	0	0	1	1	0	0	1	5	0	0	0	2	0	0	0	0	0	0	0
Central	4	0	0	0	2	0	0	0	1	0	2	0	2	1	0	1	2	2	0	3	0	1	1	2	0	1	6	1	2	0	11	0	2	8	0	0	0	0
Southern	2	0	0	9	3	0	8	3	0	5	9	3	7	8	0	6	22	20	1	7	7	1	13	0	0	8	5	5	10	5	14	2	1	6	2	0	0	0
	Tadpoles																																					
Northern	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central	0	0	0	0	1	0	0	0	7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0
Southern	0	1	0	0	5	0	0	0	1	0	2	2	10	12	5	1	4	16	0	11	0	3	0	0	12	0	0	1	0	0	0	0	2	4	4	3	0	0
	Mets																																					
Northern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Central	2	0	6	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2	2	0	0	0	0	37	0	0	0	3	0	0	1	0	3	8	8	14	0	0
Southern	0	1	0	0	1001	0	16	4	1	0	0	5	0	0	12	0	1	120	8	0	0	9	0	1078	0	0	7	1	0	1	5	1	3	7	0	113	0	0
	Xsmall Juvs																																					
Northern	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Central	11	1	0	1	17	1	5	0	0	0	1	0	0	0	0	23	6	10	6	0	0	0	0	0	0	38	2	1	1	2	1	0	1	15	0	8	0	0
Southern	1	2	3	3	1	0	20	42	20	1	56	71	3	1	0	9	44	336	43	2	0	6	8	935	3878	250	91	8	0	0	1	1	0	13	1	30	4	1
	Small juvs																																					
Northern	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central	3	4	0	2	11	2	4	1	0	0	0	0	1	0	0	6	7	3	0	1	0	0	0	1	0	38	9	28	1	0	3	0	4	38	3	3	0	0
Southern	0	10	1	3	8	1	14	27	37	1	65	36	9	2	0	0	46	22	24	4	1	0	0	7	0	72	89	35	0	0	0	0	0	15	1	12	2	3

Consistent with the VES data, breeding indicators have been consistently low in the Northern Zone, better in the Central Zone, and high in the Southern Zone. A key question for research is identifying the factors that contribute to successful breeding – more on these in the main report.

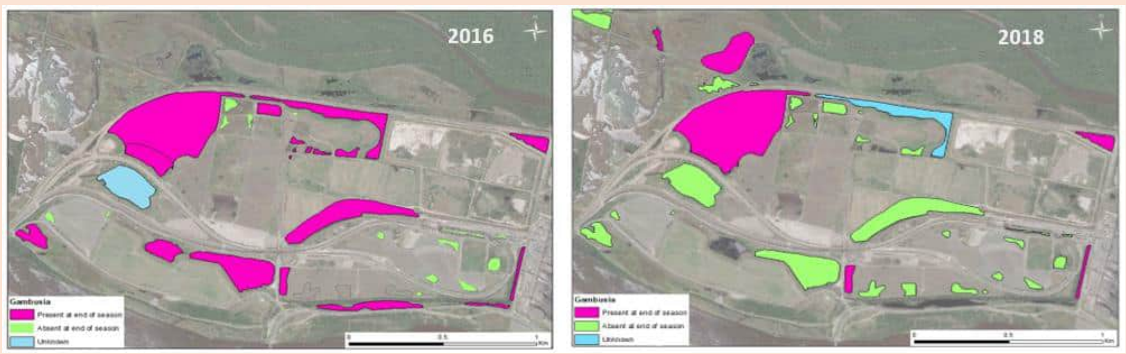
The 2021-22 season

15. *Gambusia*: these invasive pest fish have an important impact on GGBF as they predate eggs and tadpoles. The infestation status of wetlands at the end of the 2021-22 season is shown as

- Green = *Gambusia* absent
- Light pink = *Gambusia* appeared in the wetland during the season
- Dark pink = *Gambusia* was present through the season



Gambusia infestation rates are currently at their highest levels since the very wet summer of 2015-16 (see **Section 5** for the temporal variation in infestation rates on Kooragang). The maps below show the distribution in the Southern Zone at the end of that summer, compared with the situation after two seasons with relatively dry summers.



The lowest levels of infestation were in 2019-20, but two years of *La Nina* have provided wet conditions that allow *Gambusia* to re-disperse across many of the lower-lying wetlands. The majority of wetlands that are currently *Gambusia*-free are constructed.

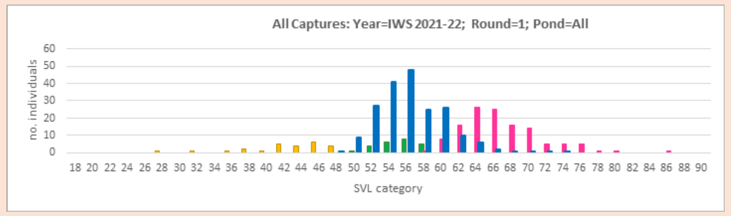
The increased rates of *Gambusia* infestation since 2020 are likely to be having a negative effect on GGBF breeding in the last two seasons.

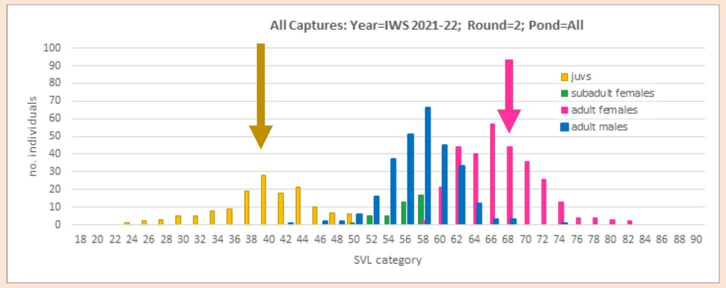
16. Breeding (by Region): Using the same breeding indicators outlined in **Section 14**, and the regional breakdown shown in **Section 13**:

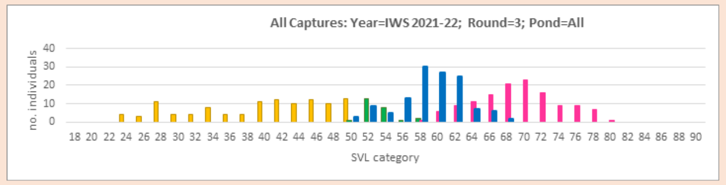
Round	0.1	0.2	1	1.1	1.2	2	2.1	3	3.1	3.2
Avg. date of round	18-10-2021	12-11-2021	2-12-2021	28-12-2021	16-01-2022	7-02-2022	5-03-2022	31-03-2022	28-04-2022	29-05-2022
Calling										
Hunter North River	0	0	0	0	0	0	0	0	0	0
School House	0	0	2	0	0	0	0	0	0	0
Cobbans Creek	1	0	4	0	2	5	0	0	0	0
Bellfrog Way	1	0	7	0	0	3	0	0	0	0
Industrial Zone North	0	0	5	0	0	3	0	0	0	0
Industrial Zone South	10	5	9	2	1	3	2	0	0	0
Tadpoles										
Hunter North River	0	0	0	0	0	0	0	0	0	0
School House	0	0	0	0	0	0	0	0	0	0
Cobbans Creek	0	0	0	0	0	1	0	2	0	0
Bellfrog Way	0	0	0	0	0	1	0	0	0	0
Industrial Zone North	0	0	0	0	0	3	0	1	0	0
Industrial Zone South	0	0	0	0	2	1	4	2	0	0
Mets										
Hunter North River	0	0	0	0	0	0	0	0	0	0
School House	0	0	0	0	0	0	0	0	0	0
Cobbans Creek	0	0	1	0	3	7	0	0	0	0
Bellfrog Way	0	0	0	0	0	1	8	14	0	0
Industrial Zone North	0	0	0	0	0	6	0	12	0	0
Industrial Zone South	0	1	5	1	3	1	0	101	0	0
Xsmall Juvs										
Hunter North River	0	0	0	0	0	0	0	0	0	0
School House	0	0	0	0	0	0	0	0	0	0
Cobbans Creek	1	1	0	0	1	6	0	1	0	0
Bellfrog Way	0	1	1	0	0	9	0	7	0	0
Industrial Zone North	0	0	0	0	0	10	0	10	0	0
Industrial Zone South	0	0	1	1	0	3	1	20	4	1
Small juvs										
Hunter North River	0	0	0	0	0	0	0	0	0	0
School House	0	0	0	0	0	0	0	0	0	0
Cobbans Creek	0	0	3	0	4	31	3	1	0	0
Bellfrog Way	1	0	0	0	0	7	0	2	0	0
Industrial Zone North	0	0	0	0	0	7	0	7	0	0
Industrial Zone South	0	0	0	0	0	8	1	5	2	3
Rainfall										
mm in prev. month	85	138	214	37	43	144	285	354	153	110

- Calling was most prevalent early in the season and continued to early March.
- Rainfall was consistent in Spring and early Summer, low during mid-Summer, and then very heavy in February and March.
- Data for Mets and Juveniles suggests that breeding occurred at low levels through the early part of the season, with a small breeding 'event' late in the season following the late summer rainfall.

17. Demography: frequency distribution plots are useful for identifying cohorts of young animals. They also show how many larger (=older) females are present – these females are very important for successful breeding.

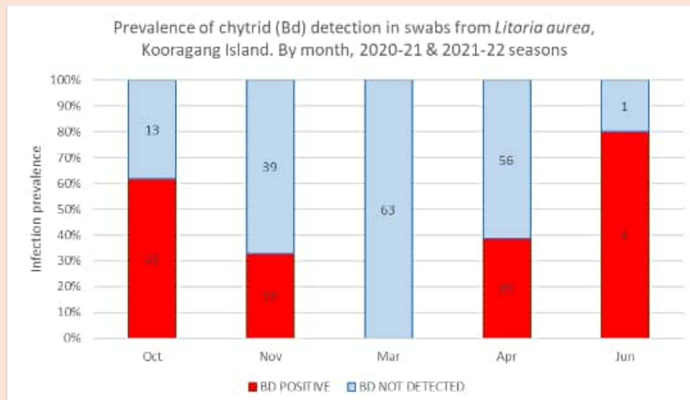






- Low number of juveniles early in the season indicate a lack of significant breeding late in the previous season.
- A cohort of medium-sized juveniles in Round 2 indicate a moderate breeding event early in the 2021-22 season (gold arrow)
- Whilst there are good numbers of adult females present, they are generally small in size (pink arrow). These animals were likely recruited in Feb-March 2020, and have not yet reached optimal size for breeding. If they have survived the 2022 winter then they can be important for potential breeding in the coming season.

18. Chytrid: For various reasons (including, most recently, availability of swabs during COViD), chytrid infection rates are difficult to monitor. Samples from the 2020-21 and 2021-22 seasons demonstrate the baseline pattern of seasonal variation, with higher rates during Winter and Spring.



We would like to know the infection rates in different parts of the island, or in constructed vs 'natural' wetlands, but this requires a higher sampling intensity.

Appendix D – KIWEF Datalogger Download Monitoring – October 2021 (Robert Carr & Associates, January 2022)

RCA ref 11766E-411/0
Client ref HDC291

19 January 2022

Hunter and Central Coast Development Corporation
Level 5, 26 Honeysuckle Drive
NEWCASTLE NSW 2300

Attention Grant Moylan
CC Mike Bardsley

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Noise & Vibration
Occupational Hygiene

KIWEF DATALOGGER DOWNLOAD MONITORING
FACTUAL REPORT – OCTOBER 2021

RCA Australia (RCA) has been engaged by Hunter and Central Coast Development Corporation (HCCDC) to undertake Datalogger Monitoring at Kooragang Island Waste Emplacement Facility (KIWEF), Newcastle NSW.

Dataloggers were collected and downloaded by RCA personnel on 25 October 2021 from locations shown on **Drawing 1**, **Attachment A**. It is noted that this was earlier than the scheduled November 2021 due to pending personnel changes within RCA and was approved by HCCDC prior to scheduling works.

A total of eleven (11) loggers, and the barometric logger, were downloaded. Field readings were collected from SWDP4 however there was no logger to download.

A summary of relevant information, including well and water physical characteristics, data logger condition and programming, and any other relevant observations were recorded by RCA during the monitoring round and are summarised in **Attachment B**.

Graphical charts of the barometric corrected water level (mAHD), electrical conductivity (EC) data, rainfall (BOM data for Nobbys Head) and EC chytrid protection threshold levels (as advised by HCCDC) were produced by RCA and are presented in **Attachment C**.

RCA notes that survey data for well locations K114 and B-02L as well as for Deep Pond B were not supplied. For data presentation purposes RCA have assigned a nominated RL of 3.0m AHD for each of these locations.

A summary of EC chytrid protection threshold levels (as advised by HCCDC) are detailed in **Table 1**.

Table 1 *Salinity Thresholds (as advised by HCCDC)*

No Chytrid Protection	Chytrid Protection Threshold[1]	GGBF Tadpole Health Threshold[2]	GGBF Adult Health Threshold[3]
0-1,650 µS/cm	1,650 µS/cm	2,900 µS/cm	4,100 µS/cm

1. EC levels below the Threshold present an increased risk of mortality resulting from Chytrid Fungus.
2. EC levels above the Threshold indicate conditions unsuitable for GGBF tadpole survival.
3. EC levels above the Threshold indicate conditions unsuitable for GGBF adult habitat.

A copy of all electronic data files including Solinst XLE program files, Microsoft Excel CSV data files, barometric corrected data files, and Microsoft Excel Worksheets showing calculations and graphs have been supplied to HCCDC electronically.

Yours faithfully
RCA AUSTRALIA

FJBrooker

Fiona Brooker
Manager of Environmental Services (BEng(Env))

Attachments

Drawing
Summary Data Table
Water Level Charts

LEGEND

● Approximate data logger unit location

Aerial image taken from Nearmap, 15 December 2021
(used in accordance with commercial licence)

0 100 200 300 400
metres

N

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

DATA LOGGERS
KOORAGANG ISLAND WASTE
EMPLACEMENT FACILITY

CLIENT	Hunter & Central Coast Development Corporation			RCA Ref	11766e-411/0
DRAWN BY	FB	SCALE	1 : 8000 (A3)	DRAWING No 1	REV 0
APPROVED BY	FB	DATE	19/01/2022	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

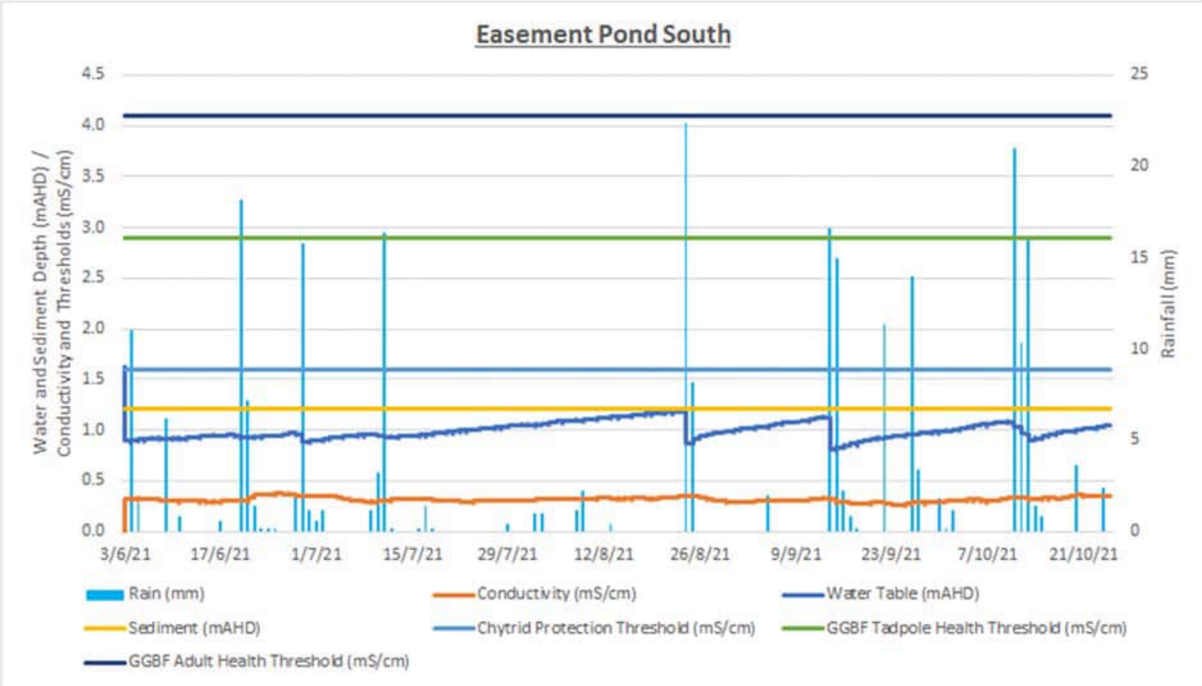
RCA summary of data logger information for KIWEF - October 2021

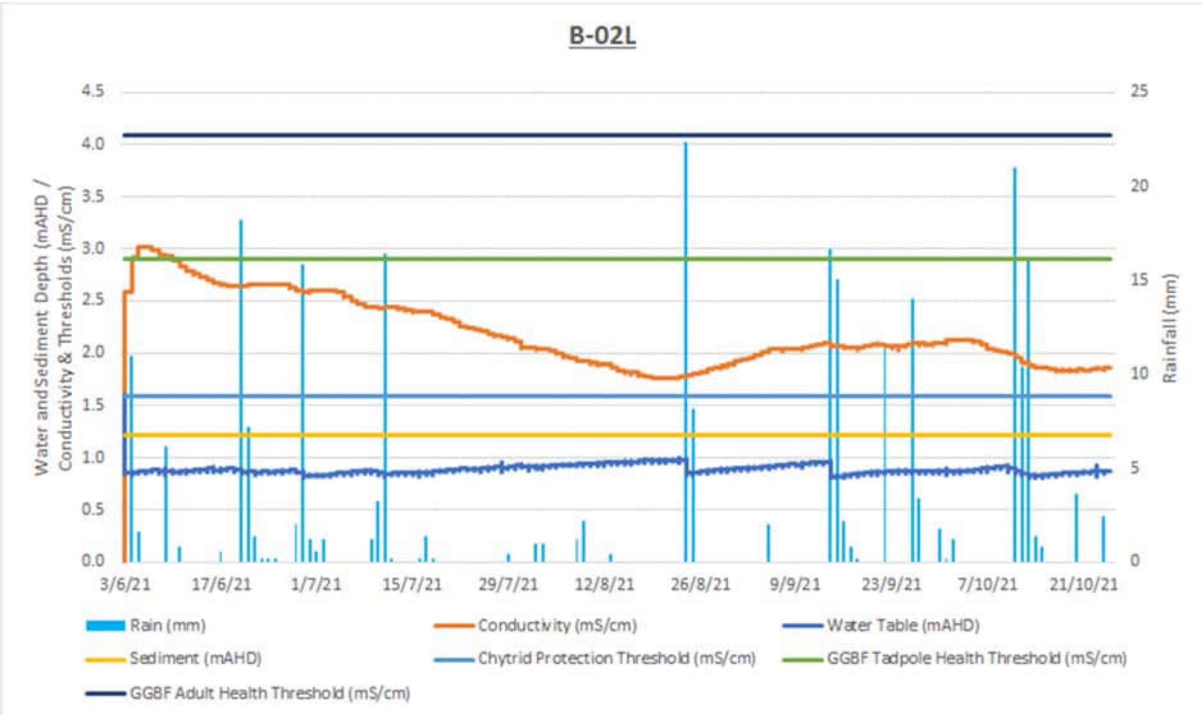
Logger Name/ Location	Logger Serial Number	Model	GPS (UTS/UPM)	Date of Retrieval	Date of Deployment	Battery	Condition	*Surveyed T.O.P (mAHD)	Top of Pipe to Water Level (m)	Water to Sediment (m)	Top of Pipe to Data Logger Tip (m)	Water level above logger	Measurement from data logger			Logger set to take new readings from	Logger Interval (mins)	Estimated Memory Capacity	Data Presented and Graphed	Notes
													* Water level above logger	Date of last reading	Logger Offest (m)					
SWDP-103	1072536	Solinst Levelogger 3001 LT F30/M10	0381402, 6361958	25/10/2021	25/10/2021	100%	Good	2.901	**1.10**	**0.62**	**1.90**	**0.80**	0.574	Unknown	-9.55m	25/10/2021	20	7.4 months	Yes	--
Easement Pond South	131068163	Solinst Levelogger 3001 LTC F30/M10	0381614, 6361855	25/10/2021	25/10/2021	97%	Good	2.957	1.10	0.65	1.62	0.52	0.472	6/03/2021	None	25/10/2021	20	7.4 months	Yes	--
SWDP4	1072543	Solinst Levelogger 3001 LTC F30/M10	0381778, 6362349	25/10/2021	25/10/2021	100%	Good	2.463	0.97	0.80	1.63	0.66	0.347	Unknown	None	25/10/2021	20	7.4 months	No	No logger within well (none available to replace faulty logger in June 2021)
SWSMEC-K2	121071565	Solinst Levelogger 3001 LTC F30/M10	0380330, 6362216	25/10/2021	25/10/2021	100%	Good	2.032	0.96	0.55	1.35	0.39	0.359	Unknown	None	25/10/2021	20	7.4 months	Yes	--
B-02L	121071574	Solinst Levelogger 3001 LTC F30/M10	0382825, 6361856	25/10/2021	25/10/2021	98%	Good	--	1.1	0.68	1.62	0.52	0.746	25/10/2021	None	25/10/2021	20	7.4 months	Yes	--
Deep Pond B	1076043	Solinst Levelogger 3001 LTC F30/M10	0380871, 6362461	25/10/2021	25/10/2021	98%	Good	--	**0.91**	**0.42**	**1.34**	**0.43**	--	3/06/2021	None	25/10/2021	20	7.4 months	Yes	--
K114	1068452	Solinst Levelogger 3001 LTC F30/M10	0382129, 6362224	25/10/2021	25/10/2021	99%	Good	--	1.11	0.48	1.56	0.45	--	Unknown	None	25/10/2021	20	7.4 months	Yes	--
Deep Pond A	1071594	Solinst Levelogger 3001 LTC F30/M10	0381238, 6362908	25/10/2021	25/10/2021	100%	Good	1.799	0.36	0.58	0.89	0.53	0.005	3/06/2021	None	25/10/2021	20	7.4 months	Yes	--
SW K7	1076842	Solinst Levelogger 3001 LTC F30/M10	0381670, 6362757	25/10/2021	25/10/2021	100%	Good	2.901	0.65	0.80	1.26	0.61	0.679	4/06/2021	None	25/10/2021	20	7.4 months	Yes	--
SW Pond 11	121071570	Solinst Levelogger 3001 LTC F30/M10	0381482, 6363035	25/10/2021	25/10/2021	98%	Good	2.106	0.63	0.88	1.30	0.67	0.363	6/03/2021	None	25/10/2021	20	7.4 months	Yes	--
Railway Pond	1071610	Solinst Levelogger 3001 LTC F30/M10	0381625, 6363051	25/10/2021	25/10/2021	98%	Good	2.053	0.60	0.57	0.97	0.37	-0.004	3/06/2021	None	25/10/2021	20	7.4 months	Yes	--
SW K7B	121071572	Solinst Levelogger 3001 LTC F30/M10	0381772, 6362754	25/10/2021	25/10/2021	99%	Good	2.318	0.27	0.84	0.90	0.63	0.545	3/06/2021	None	25/10/2021	20	7.4 months	Yes	--

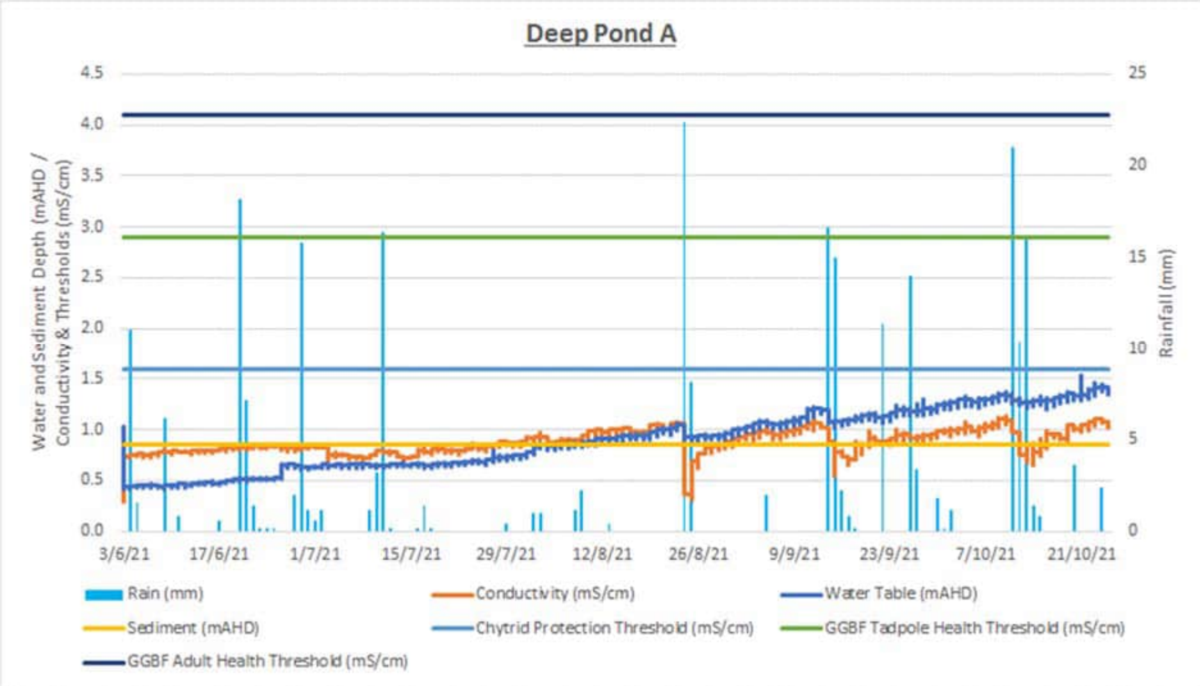
Bold values are considerd to indicate a potential error with field measurements

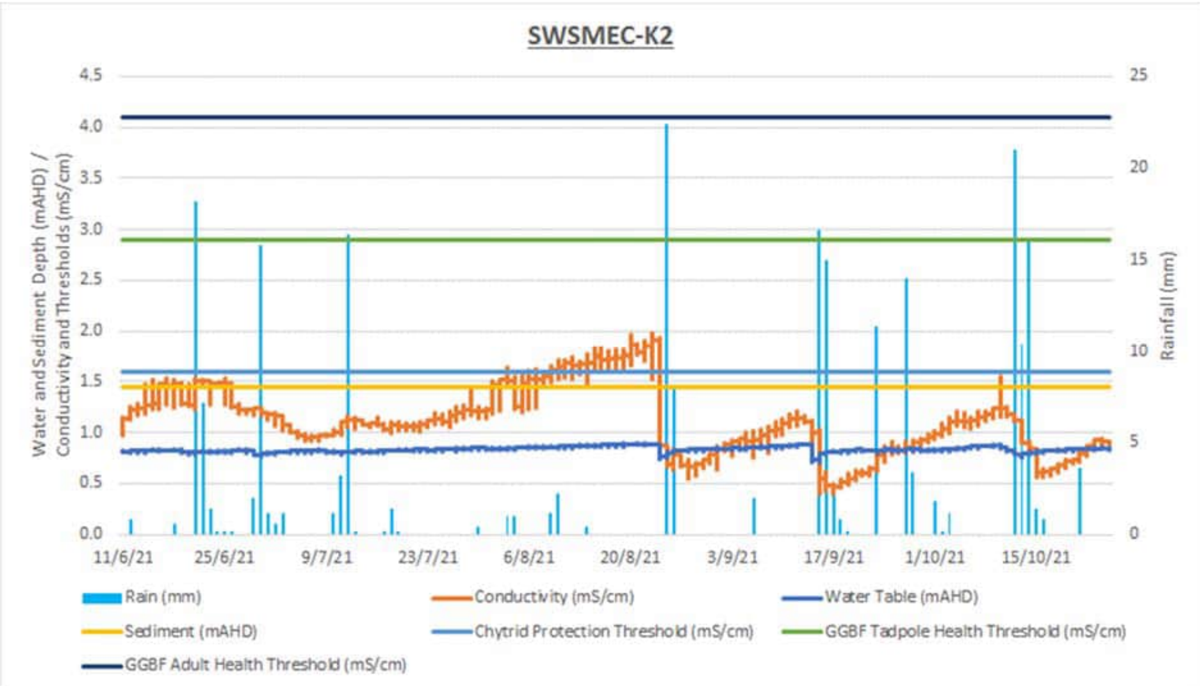
* Surveyed AHD proved by Daly Smith

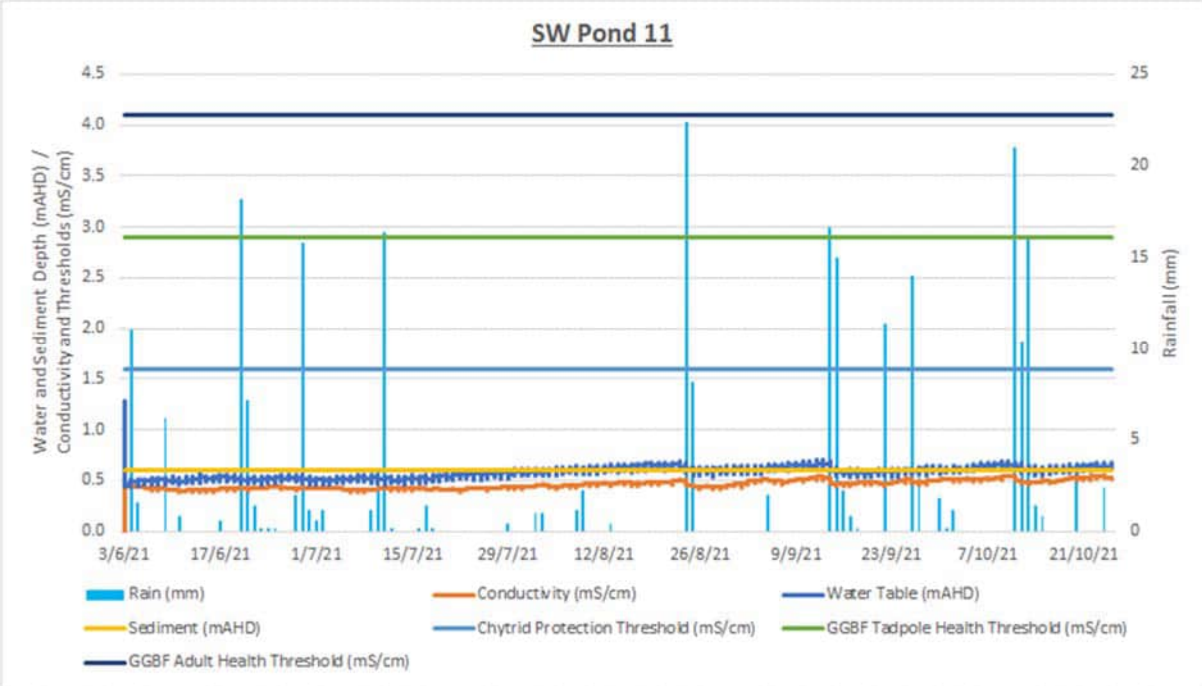
Site Barologger (SWDP-103)	12059754	Solinst Barolgger 3001 LT/M15	0381402, 6361958	25/10/2021	25/10/2021	100%	Good	--								25/10/2021	20	7.4 months	--	--

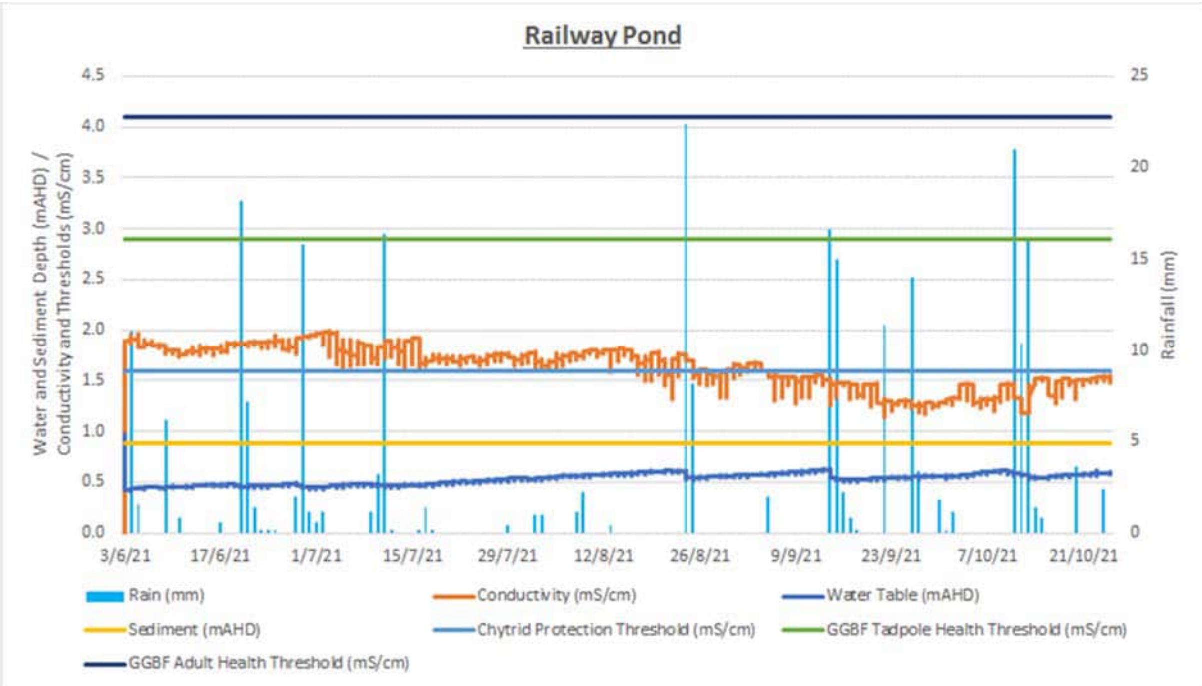

Easement Pond South
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Water and Sediment Depth (mAHD) / Conductivity and Thresholds (mS/cm)
25
20
15
10
5
0
Rainfall (mm)
3/6/21
17/6/21
1/7/21
15/7/21
29/7/21
12/8/21
26/8/21
9/9/21
23/9/21
7/10/21
21/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

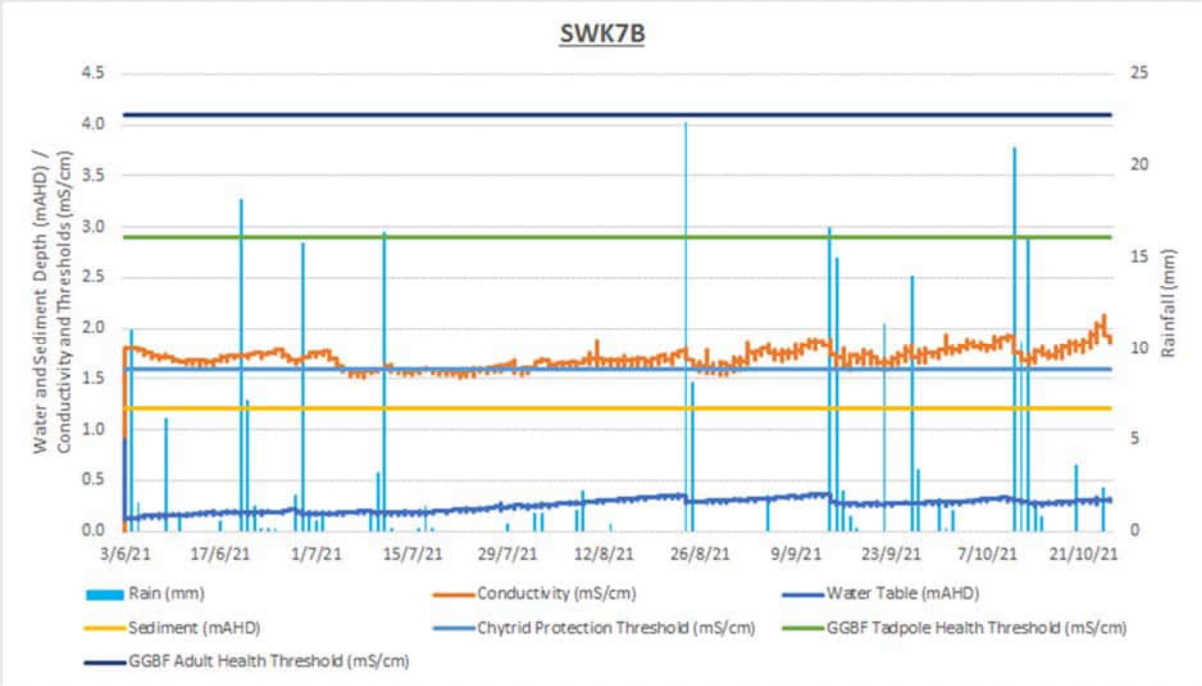

B-02L
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Water and Sediment Depth (mAHD / Conductivity & Thresholds (mS/cm)
25
20
15
10
5
0
Rainfall (mm)
3/6/21
17/6/21
1/7/21
15/7/21
29/7/21
12/8/21
26/8/21
9/9/21
23/9/21
7/10/21
21/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

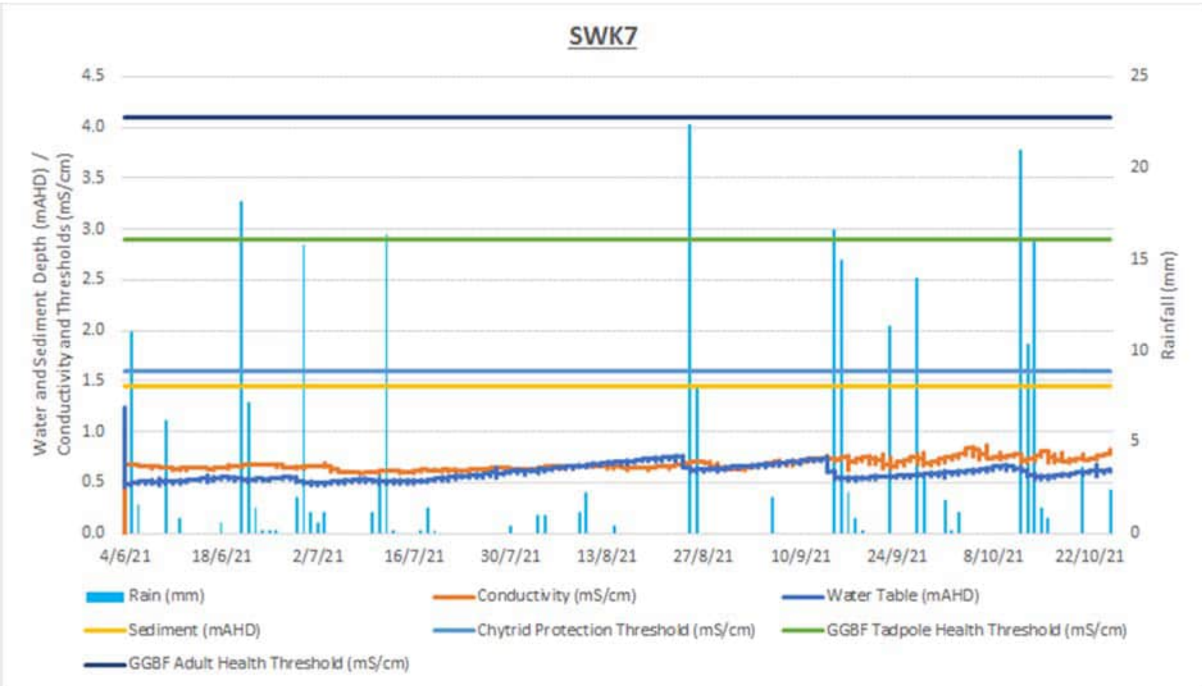

Deep Pond A
Water and Sediment Depth (mAHD) / Conductivity & Thresholds (mS/cm)
Rainfall (mm)
3/6/21
17/6/21
1/7/21
15/7/21
29/7/21
12/8/21
26/8/21
9/9/21
23/9/21
7/10/21
21/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

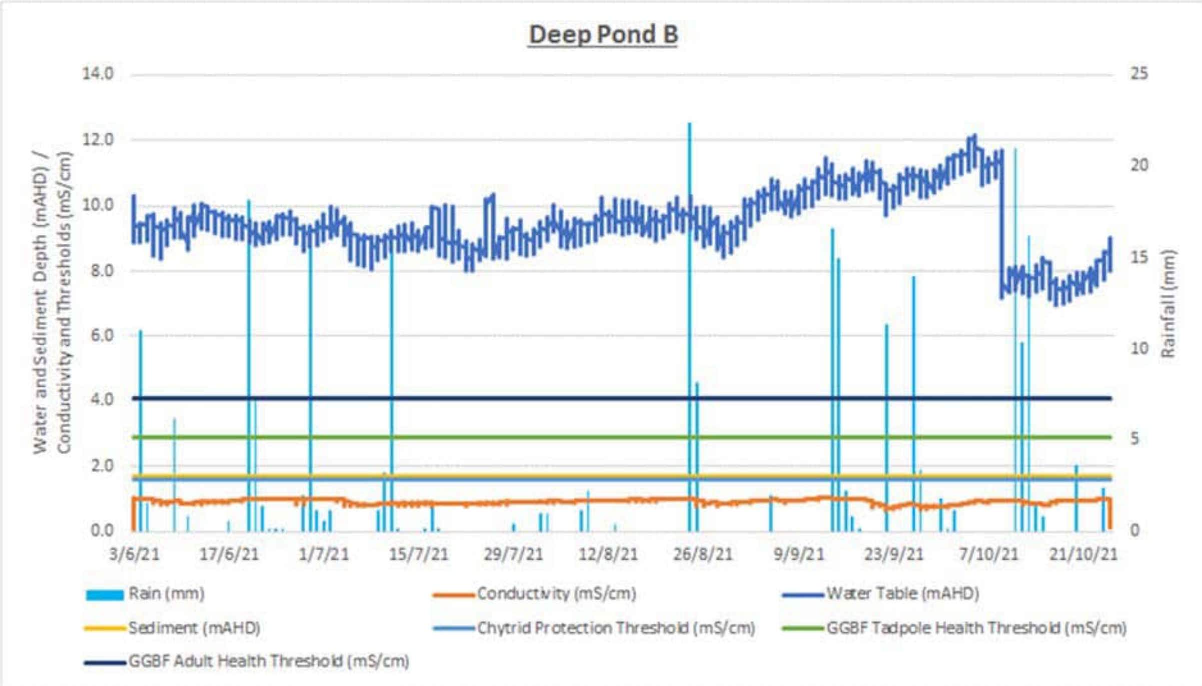

SWSMEC-K2
Water and Sediment Depth (mAHD) / Conductivity and Thresholds (mS/cm)
Rainfall (mm)
11/6/21
25/6/21
9/7/21
23/7/21
6/8/21
20/8/21
3/9/21
17/9/21
1/10/21
15/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)


SW Pond 11
Water and Sediment Depth (mAHD) / Conductivity and Thresholds (mS/cm)
Rainfall (mm)
3/6/21
17/6/21
1/7/21
15/7/21
29/7/21
12/8/21
26/8/21
9/9/21
23/9/21
7/10/21
21/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

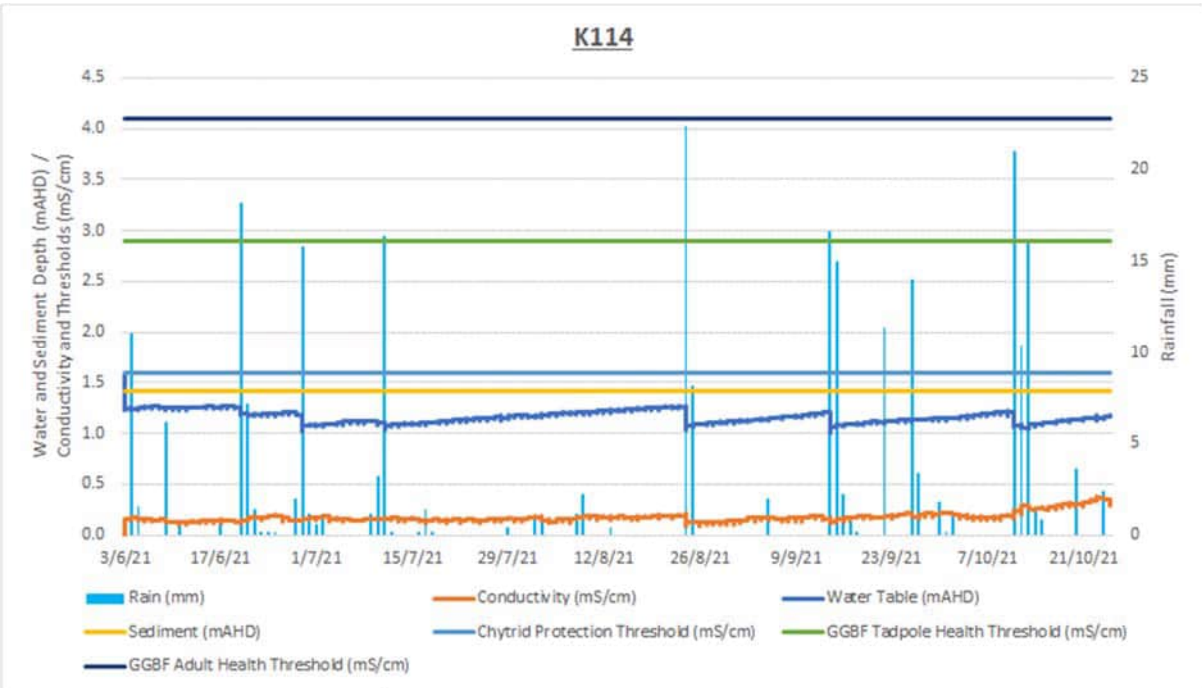

Railway Pond
Water and Sediment Depth (mAHD) / Conductivity and Thresholds (mS/cm)
Rainfall (mm)
3/6/21
17/6/21
1/7/21
15/7/21
29/7/21
12/8/21
26/8/21
9/9/21
23/9/21
7/10/21
21/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

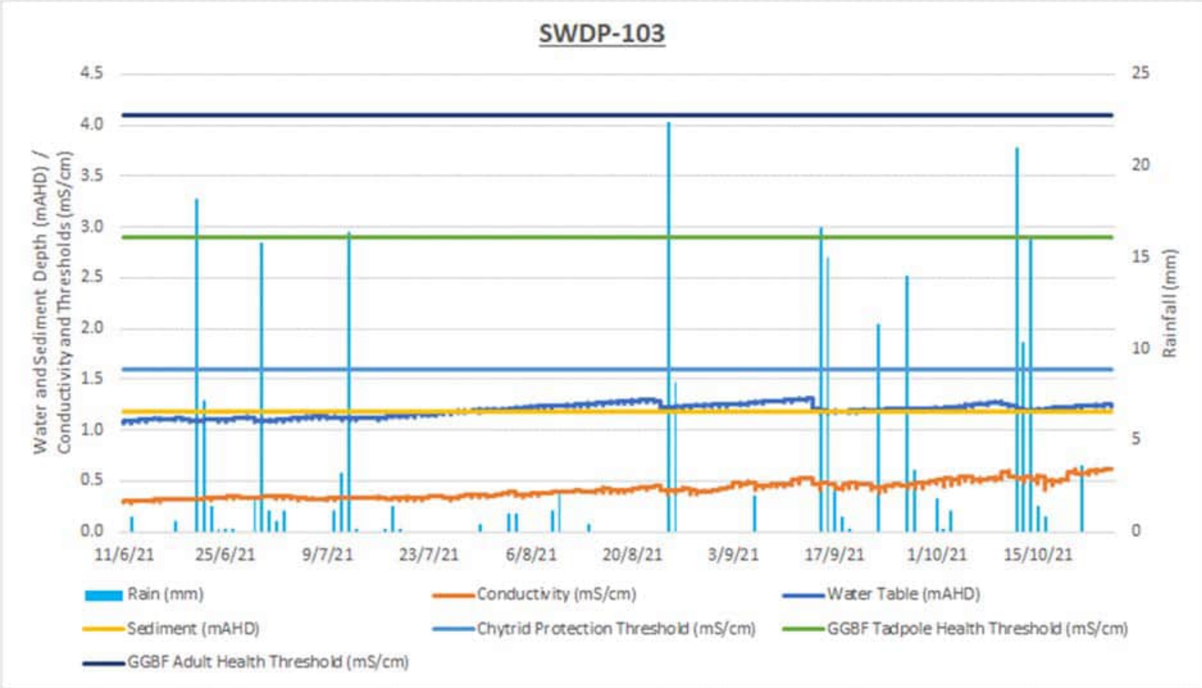

SWK7B
Water and Sediment Depth (mAHD) / Conductivity and Thresholds (mS/cm)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25
20
15
10
5
0
3/6/21
17/6/21
1/7/21
15/7/21
29/7/21
12/8/21
26/8/21
9/9/21
23/9/21
7/10/21
21/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)


SWK7
Water and Sediment Depth (mAHD) / Conductivity and Thresholds (mS/cm)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25
20
15
10
5
0
4/6/21
18/6/21
2/7/21
16/7/21
30/7/21
13/8/21
27/8/21
10/9/21
24/9/21
8/10/21
22/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)



It is noted that the drop in the reason for the water level drop in mid October 2021 is considered to indicate a potential error or related to some movement of the logger which RCA is not aware of/




SWDP-103
Water and Sediment Depth (mAHD) / Conductivity and Thresholds (mS/cm)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25
20
15
10
5
0
11/6/21
25/6/21
9/7/21
23/7/21
6/8/21
20/8/21
3/9/21
17/9/21
1/10/21
15/10/21
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

Hunter & Central Coast Development Corporation

Appendix E – KIWEF Datalogger Download Monitoring – June 2022 (Robert Carr & Associates, August 2022)

RCA
AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Noise & Vibration
Occupational Hygiene

RCA ref 11766f-401/0
Client ref HDC291

23 August 2022

Hunter and Central Coast Development Corporation
Level 5, 26 Honeysuckle Drive
NEWCASTLE NSW 2300

Attention: Grant Moylan
CC: Mike Bardsley

KIWEF DATALOGGER DOWNLOAD MONITORING
FACTUAL REPORT – ROUND 12 (JUNE 2022)

RCA Australia (RCA) has been engaged by Hunter and Central Coast Development Corporation (HCCDC) to undertake Datalogger Monitoring at Kooragang Island Waste Emplacement Facility (KIWEF), Newcastle NSW.

Dataloggers were collected and downloaded by RCA personnel on 9 and 16 June 2022 from locations shown on **Drawing 1**, **Attachment A**. It is noted that this was later than scheduled due to inclement weather and organising site access however was approved by HCCDC prior to scheduling works. In the quarter prior to sampling, 445mm of rain had been recorded at the Newcastle Nobby's BOM station.

Six (6) loggers and the barometric logger were able to be collected from the field. Due to the recent inclement weather, five (5) locations were not accessible due to the water levels of the ponds. Inaccessible locations were Easement Pond South, Deep Pond A and B, and SW K7 and K7B: the pipe at SW K7B was not found and due to approximately only 0.3m of pipe being above water, it is considered that this may be below the current level of the pond.

A total of three (3) loggers and the barometric logger, were downloaded: the loggers in Railway Pond, SW Pond 11 and K114 were unresponsive and have been sent back to the manufacturers for data retrieval. Spare loggers were installed at Railway Pond and SW Pond 11; however none were left to place at K114.

A summary of relevant information, including well and water physical characteristics, data logger condition and programming, and any other relevant observations were recorded by RCA during the monitoring round are summarised in **Attachment B**.

Graphical charts of the barometric corrected water level (mAHD), electrical conductivity (EC) data, rainfall (BOM data for Nobbys Head) and EC chytrid protection threshold levels (as advised by HCCDC) were produced by RCA and are presented in **Attachment C**.

RCA notes that survey data for well locations K114 and B-02L as well as for Deep Pond B were not supplied. For data presentation purposes RCA have assigned a nominated RL of 3.0m AHD for each of these locations.

A summary of EC chytrid protection threshold levels (as advised by HCCDC) are detailed in **Table 1**.

Table 1 *Salinity Thresholds (as advised by HCCDC)*

No Chytrid Protection	Chytrid Protection Threshold[1]	GGBF Tadpole Health Threshold[2]	GGBF Adult Health Threshold[3]
0-1,650 µS/cm	1,650 µS/cm	2,900 µS/cm	4,100 µS/cm

1. EC levels below the Threshold present an increased risk of mortality resulting from Chytrid Fungus.
2. EC levels above the Threshold indicate conditions unsuitable for GGBF tadpole survival.
3. EC levels above the Threshold indicate conditions unsuitable for GGBF adult habitat.

It is noted that data for K5_N6, extracted in December 2020, has been recovered by manufacturers, and the graph is included in **Attachment C**.

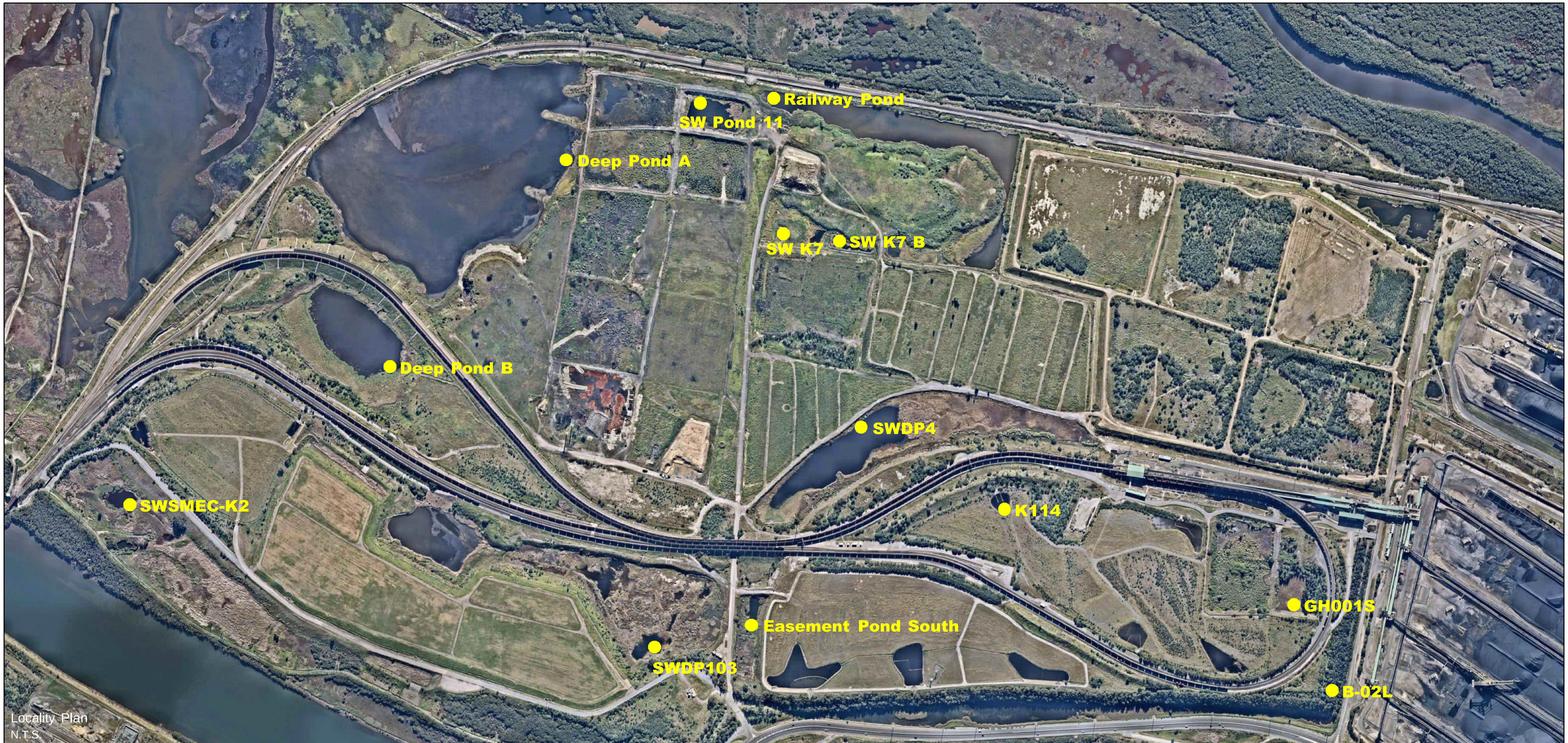
A copy of all electronic data files including Solinst XLE program files, Microsoft Excel CSV data files, barometric corrected data files, and Microsoft Excel Worksheets showing calculations and graphs have been supplied to HCCDC electronically.

Yours faithfully
RCA AUSTRALIA

Adeleh Khoshzaban
Environmental Engineer

Attachments

Drawing
Summary Data Table
Water Level Charts



Locality Plan
N.T.S.

LEGEND

Approximate data logger unit location

Aerial image taken from Nearmap, June 11 2019
(used in accordance with commercial licence)

0 100 200 300 400
metres

N

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

DATA LOGGERS
KOORAGANG ISLAND WASTE
EMPLACEMENT FACILITY

CLIENT Hunter & Central Coast Development Corporation				RCA Ref	11766f-401/0
DRAWN BY	AK	SCALE	1 : 8000 (A3)	DRAWING No 1	REV 0
APPROVED BY	FB	DATE	23/08/2022	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

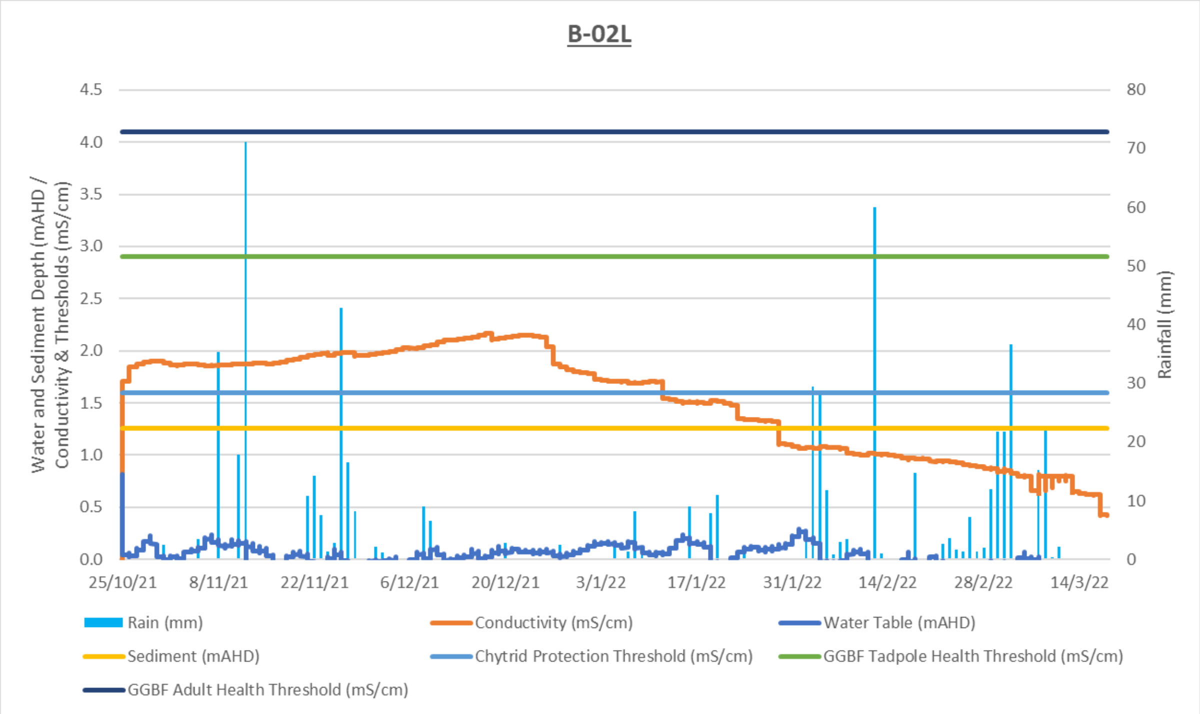
RCA summary of data logger information for KIWEF - June 2022

Logger Name/ Location	Logger Serial Number	Model	GPS (UTS/UPM)	Date of Retrieval	Date of Deployment	Battery	Condition	*Surveyed T.O.P (mAHD)	Top of Pipe to Water Level (m)	Water to Sediment (m)	Top of Pipe to Data Logger Tip (m)	Water level above logger	Measurement from data logger			Logger set to take new readings from	Logger Interval (mins)	Estimated Memory Capacity	Data Presented and Graphed	Notes
													* Water level above logger	Date of last reading	Logger Offest (m)					
SWDP-103	1072536	Solinst Levelogger 3001 LT F30/M10	0381402, 6361958	9/06/2022	9/6/222	100%	Good	2.901	**0.63**	**1.13**	**1.05**	**0.42**	0.574	Unknown	-9.55m	9/06/2022	20	7.4 months	Yes	--
Easement Pond South	131068163	Solinst Levelogger 3001 LTC F30/M10	0381614, 6361855	Inaccessible															No	--
SWDP4	1072543	Solinst Levelogger 3001 LTC F30/M10	0381778, 6362349	No logger - did not access									0.347	Unknown	None	N/A	20	7.4 months	No	No logger within well (none available to replace faulty logger in June 2021)
SWSMEC-K2	121071565	Solinst Levelogger 3001 LTC F30/M10	0380330, 6362216	9/06/2022	9/06/2022	100%	Good	2.032	0.87	0.77	1.32	0.45	0.359	Unknown	None	9/06/2022	20	7.4 months	Yes	--
B-02L	121071574	Solinst Levelogger 3001 LTC F30/M10	0382825, 6361856	16/06/2022	16/06/2022	98%	Good	--	1.00	0.74	1.65	0.65	0.746	25/10/2021	None	16/06/2022	20	7.4 months	Yes	--
Deep Pond B	1076043	Solinst Levelogger 3001 LTC F30/M10	0380871, 6362461	Inaccessible															Yes	--
K114	1068452	Solinst Levelogger 3001 LTC F30/M10	0382129, 6362224	25/10/2021	25/10/2021	99%	Good	--	1.10	0.43	1.49	0.39	--	Unknown	None	N/A	20	7.4 months	Yes	--
Deep Pond A	1071594	Solinst Levelogger 3001 LTC F30/M10	0381238, 6362908	Inaccessible															Yes	--
SW K7	1076842	Solinst Levelogger 3001 LTC F30/M10	0381670, 6362757	Inaccessible															Yes	--
SW Pond 11	121071570	Solinst Levelogger 3001 LTC F30/M10	0381482, 6363035	9/06/2022	9/06/2022	100%	Good	2.106	0.34	1.12	0.95	0.61	0.363	6/03/2021	None	9/06/2022	20	7.4 months	Yes	--
Railway Pond	1071610	Solinst Levelogger 3001 LTC F30/M10	0381625, 6363051	9/06/2022	9/06/2022	100%	Good	2.053	0.31	0.88	0.68	0.38	-0.004	3/06/2021	None	9/06/2022	20	7.4 months	Yes	--
SW K7B	121071572	Solinst Levelogger 3001 LTC F30/M10	0381772, 6362754	Inaccessible															Yes	--

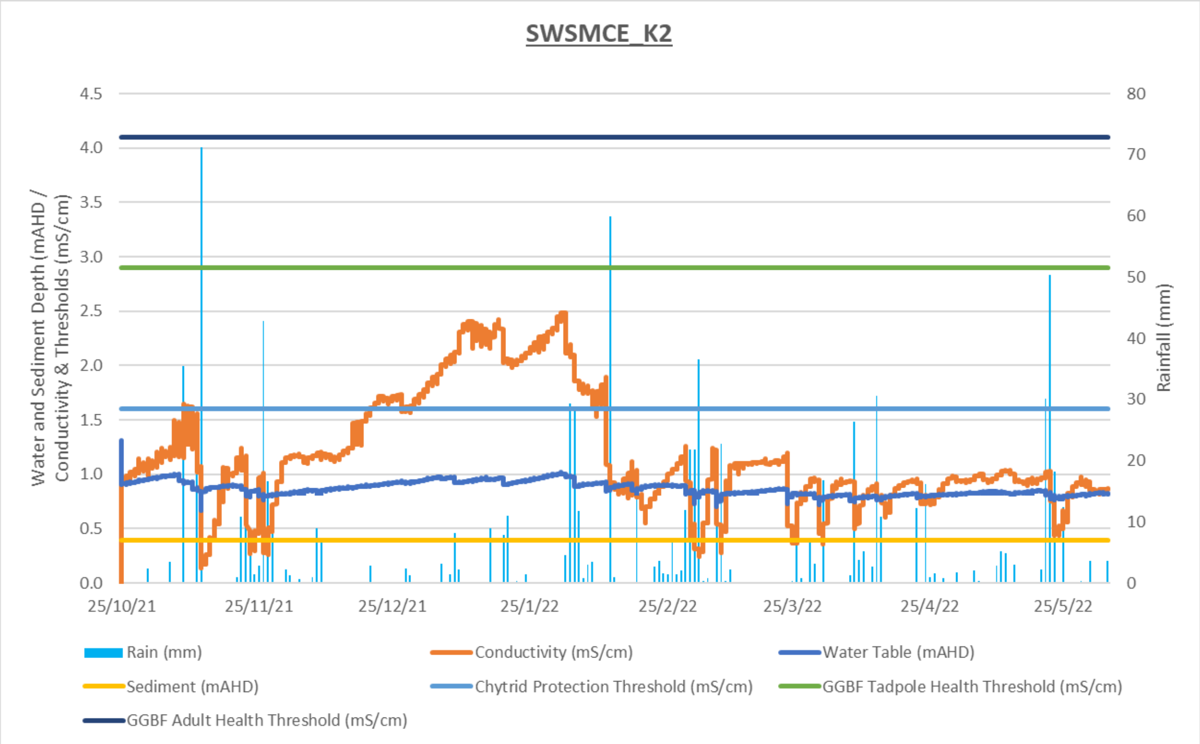
Bold values are considerd to indicate a potential error with field measurements

* Surveyed AHD proved by Daly Smith

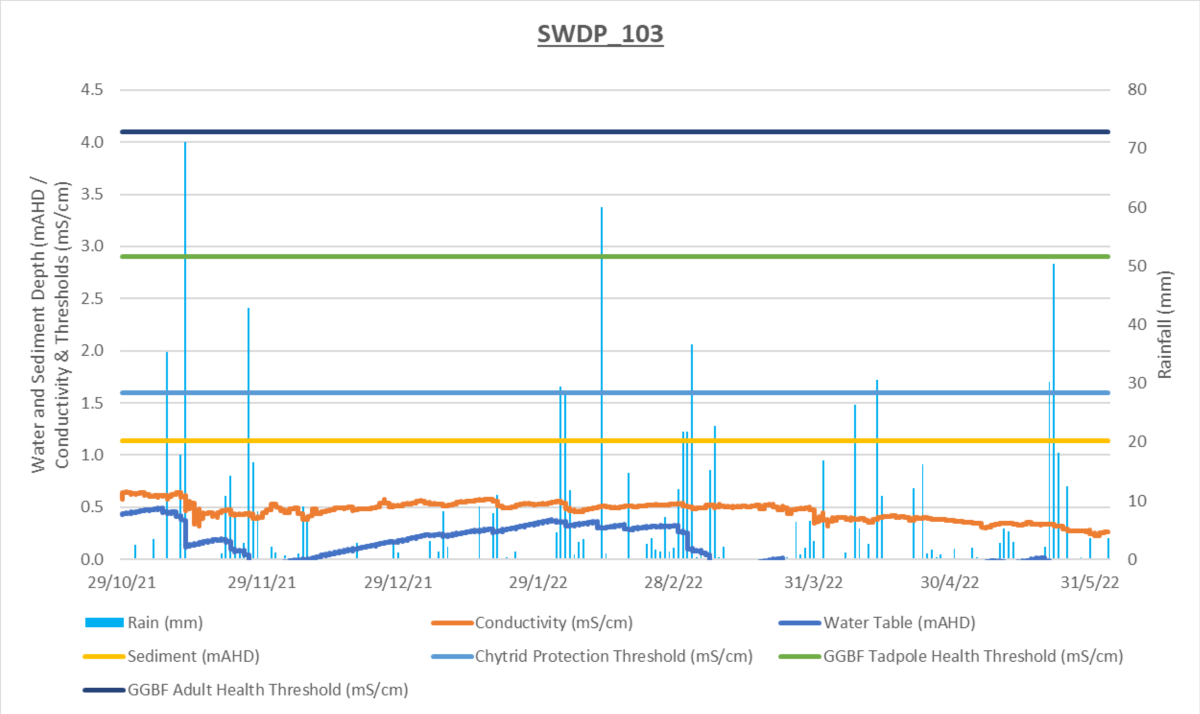
Site Barologger (SWDP-103)	12059754	Solinst Barolgger 3001 LT/M15	0381402, 6361958	9/06/2022	9/06/2022	100%	Good	--								9/06/2022	20	7.4 months	--	--



B-02L
Water and Sediment Depth (mAHD) / Conductivity & Thresholds (mS/cm)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
80
70
60
50
40
30
20
10
0
25/10/21
8/11/21
22/11/21
6/12/21
20/12/21
3/1/22
17/1/22
31/1/22
14/2/22
28/2/22
14/3/22
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

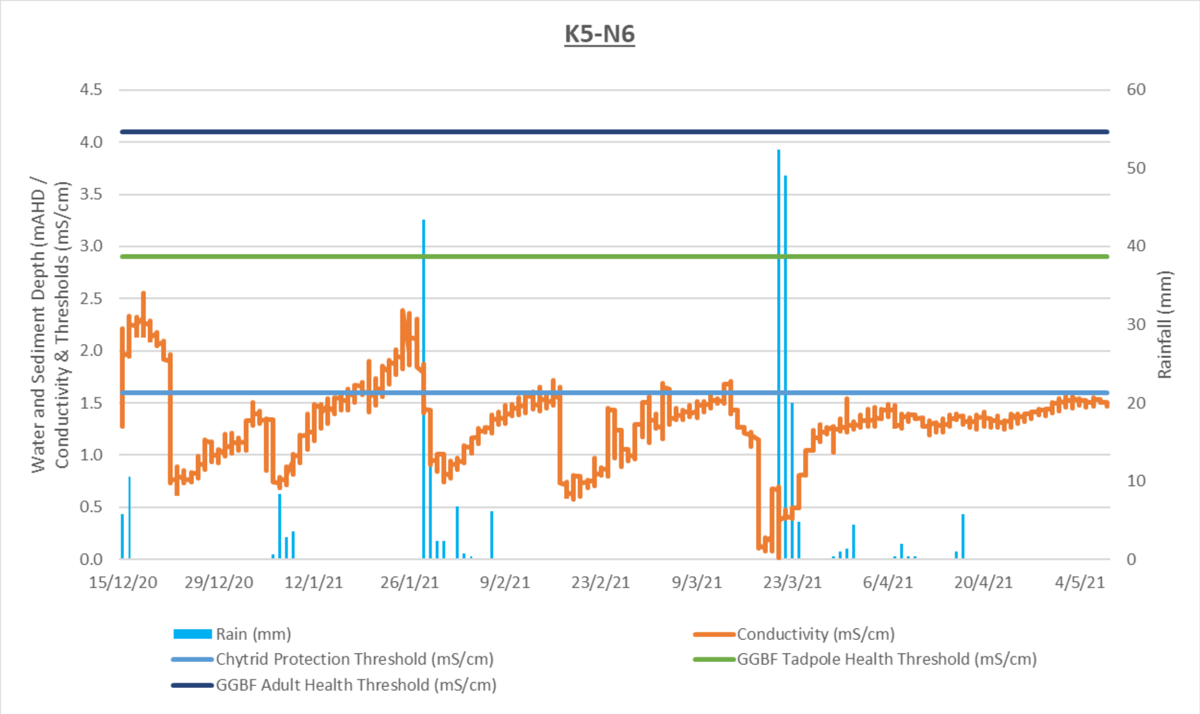


SWSMCE_K2
Water and Sediment Depth (mAHD) / Conductivity & Thresholds (mS/cm)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
80
70
60
50
40
30
20
10
0
25/10/21
25/11/21
25/12/21
25/1/22
25/2/22
25/3/22
25/4/22
25/5/22
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)


SWDP_103
Water and Sediment Depth (mAHD / Conductivity & Thresholds (mS/cm)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
80
70
60
50
40
30
20
10
0
29/10/21
29/11/21
29/12/21
29/1/22
28/2/22
31/3/22
30/4/22
31/5/22
Rain (mm)
Conductivity (mS/cm)
Water Table (mAHD)
Sediment (mAHD)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

December 2020 download – Recovered Data

(K5_6N)



K5-N6
Water and Sediment Depth (mAHD / Conductivity & Thresholds (mS/cm)
Rainfall (mm)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
60
50
40
30
20
10
0
15/12/20
29/12/20
12/1/21
26/1/21
9/2/21
23/2/21
9/3/21
23/3/21
6/4/21
20/4/21
4/5/21
Rain (mm)
Conductivity (mS/cm)
Chytrid Protection Threshold (mS/cm)
GGBF Tadpole Health Threshold (mS/cm)
GGBF Adult Health Threshold (mS/cm)

Hunter & Central Coast Development Corporation

Appendix F – KIWEF Annual Groundwater & Surface Water Monitoring 2022 (Hazmat Services, June 2022)

Ground and Surface Water Monitoring, Kooragang Island Waste Emplacement Facility

Annual Monitoring 2022

N4656_GME_RPT01_R0_200622

June 2022

OHS | WASTE | ENVIRONMENT

Ground and Surface Water Monitoring, Kooragang Island Waste Emplacement Facility

Annual Monitoring 2022

N4656_GME_RPT01_R0_200622

June 2022

PREPARED FOR

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DISCLAIMER

APPROVED COMPANY ISO 45001 Occupational Health & Safety Management Systems — QMS Certification Services
APPROVED COMPANY ISO 14001 Environmental Management Systems — QMS Certification Services
APPROVED COMPANY ISO 9001 Quality Management Systems — QMS Certification Services

Hazmat Services Pty Ltd operates under a Health, Safety, Environment and Quality Management System which has been certified by QMS Certification Services to comply with the requirements of ISO 45001:2018 Occupational Health & Safety Management Systems, ISO 14001:2015 Environmental Management Systems and ISO 9001:2015 Quality Management Systems.
Accreditation No S1410994MA.

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ABBREVIATIONS

ANZECC	Australian and New Zealand Environment Conservation Council
ANZECC/ ARMCANZ	Australian and New Zealand Environment Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure
BoM	Bureau of Meteorology
COC	Chain of Custody
DO	Dissolved Oxygen
DQO	Data Quality Objective
EC	Electric Conductivity
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
HCCDC	Hunter and Central Coast Development Corporation
KIWEF	Kooragang Island Waste Emplacement Facility
LOR	Limit of Reporting
NATA	National Association of Testing Authorities
OEH	NSW Office of Environment and Heritage
PID	Photo-ionisation Detector
QA/QC	Quality Assurance/Quality Control
RCA	RCA Australia
RPD	Relative Percentage Difference
SWL	Standing Water Level
VOC	Volatile Organic Compounds

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1 INTRODUCTION

Hazmat Services Pty Ltd ("**Hazmat**") was commissioned by Hunter & Central Coast Development Corporation ("**HCCDC**") to undertake ground and surface water monitoring for an additional year at the former Kooragang Island Waste Emplacement Facility ("**KIWEF**") located off Cormorant Drive, Kooragang Island NSW (the "**Site**"). The Site comprises several lots which are legally identified as Part Lot 7, Lot 10, Lot 11 and Part Lot 14 of DP11194525. The location of the Site is shown on **Figure 3** in **Appendix A**.

The former landfill was operated by BHP under Environmental Protection Licence ("**EPL**") EPL6437 between 1997 and 2003 (Protection of the Environment Operations Act ("**PoEO**") licensing did not exist prior to 1997, and the landfill was regulated under State Pollution Control Commission and other environmental protection regulations). Under the EPL, BHP was required to undertake a range of ground and surface water monitoring. Since the closure of the steelworks and landfill, HCCDC is responsible for the ongoing monitoring of the Site on behalf of the state government, which is now the owner of the Site. The conditions for the ongoing monitoring are set out in the *Approval of the Surrender of a Licence Notice* (No 1111840; the "**Notice**") issued by the NSW Environment Protection Authority ("**EPA**"). The monitoring described in this report satisfies the routine regulatory requirements under Section 5 Environmental Monitoring Part c) Groundwater and Surface Water Monitoring Program, within the Notice.

1.1 Project Objectives

The objective of the surface and groundwater monitoring was to satisfy the conditions of the Notice by assessing the water quality and reporting the results to HCCDC in form of an annual report.

1.2 Scope of Works

The monitoring includes 50 established groundwater wells and five (5) surface water monitoring locations as prescribed by HCCDC in the tender documents (Env1899, KIWEF Water Monitoring (2018-2020) Variation 3 – 2022 Extension); the "**Brief**"). The groundwater wells and surface water locations are shown on the sample location map as **Figure 2** in **Appendix A**.

Groundwater and surface water monitoring was undertaken in accordance with the requirements specified in the Services Brief. The following scope of work was undertaken:

- Review of previous monitoring data;
- Follow previously developed and implemented Data Quality Objectives ("**DQO**") for the investigation of groundwater;
- Prepare a site-specific health, safety and environmental plan and safe work method statement prior to commencing the works;
- Undertake fieldwork in accordance with Hazmat's standard field and quality assurance/control procedures and in consideration of relevant industry guidelines;
- Sampling and analysis for the range of specified parameters at 42 of the 50 groundwater wells and five (5) surface water monitoring locations conducted in June and July 2022, as follows;
  - Ammonia;
  - Phenols;
  - Cyanide (Total, Weak Acid Dissociable and Free);
  - Hexavalent chromium;
  - Molybdenum;
  - Lead; and
  - Total PAHs.

- Collect quality control samples in accordance with the frequency specified in the Brief and in accordance with the relevant Australian Standards; and
- Review analytical results and prepare a report detailing the methodology and outcomes of the monitoring program including conclusions regarding the Site's contamination status.

2 SITE INFORMATION

2.1 Site Identification

The Site comprises of Part Lot 7, Lot 10, Lot 11 and Part Lot 14 of DP11194525. A site map showing the study area is attached as **Figure 3** in **Appendix A**.

2.2 Site Description

KIWEF is approximately 197 ha in area on the western portion of Kooragang Island. The site has been filled with waste materials relating to the operation of the former BHP Steel Works from the late 1960's until 2001.

The former landfill was operated by BHP under EPL6437 between 1997 and 2003 (PoEO licensing did not exist prior to 1997, and the landfill was regulated under State Pollution Control Commission and other environmental protection regulations). In 2003 the landfill was transferred to the State under an s58 License transfer, which was subsequently monitored under the EPL by the State until it was surrendered under s80 N1111840 in December 2010.

2.3 Site History

Prior to ownership by BHP, the KIWEF site was originally a series of low-lying wetlands. Over time these wetlands have been filled by mostly inert materials arising from the operations of the former BHP steel works. The site received BHP waste from the late 1960's to 2001. Currently the site comprises filled and partially filled waste emplacement cells, recent construction activity on the adjacent NCIG lease lands and various ponds and surrounding wetlands. Since closure of the landfill in 2010 the State is progressing a sequence of works to provide a suitable final landform, cap and drainage system to the site consistent with PoEO requirements. The first stages of capping have been completed and further works are being progressed in accordance with regulatory requirements.

2.4 Previous Monitoring

Prior to the Surrender of the Licence in 2010, HCCDC conducted an extensive review of the monitoring programme which was then documented in the report *KIWEF Groundwater and Surface Water Rationalisation Report* (GHD, 2010). The recommendations of the report formed the basis for the annual ongoing post-licence monitoring set out in the Notice.

Analytical results from previous monitoring events were provided by HCCDC and form part of this report as an electronic attachment. It is therefore assumed that all results are of good quality and obtained using standard industry practice.

The last round of monitoring was conducted by Hazmat in 2021. Hazmat sampled a total of 42 of the 50 groundwater monitoring wells and five (5) surface water bodies. A number of wells (8) were unable to be sampled due to either being destroyed, insufficient groundwater, or inaccessibility to the sample sites.

3 ASSESSMENT CRITERIA

3.1 KIWEF Annual Surface and Groundwater Monitoring Criteria

The laboratory analysis conducted as part of the 2022 KIWEF annual monitoring is as per the sample analysis requirements outlined in the Notice. Groundwater and surface water concentrations were compared to Groundwater Investigation Levels ("**GIL**") published in the ASC NEPM. The GIL are similar to a set of trigger values published by the Australian and New Zealand Environment Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand ("**ANZECC/ARMCANZ**") *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000). The ANZECC (2000) trigger values were also adopted in the NSW EPA *Guidelines for the Assessment and Management of Groundwater, 2007* (NSW EPA 2007).

Assessment values are established by accounting for the protection of environmental values. These values are defined in ANZECC (2000) as:

> *"…particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare safety or health which require protection from the effects of pollution, waste discharges and deposits."*

The following values will be considered when applying assessment criteria:

- Relevant aquatic ecosystems; and
- Relevant human uses (such as, potable water, agricultural water, industrial water, aquaculture and farming for human consumption, recreational, visual amenity).

The ANZECC (2000) guideline provides three grades of guideline trigger values (i.e. high, moderate or low reliability trigger values) in Section 3.4.2.3 (procedures for deriving trigger values for toxicants). The grade depends on the data available and hence the confidence or reliability of the final figures. Only high and moderate reliability trigger values are reported in Table 3.4.1 of ANZECC (2000). The GIL were adopted for a 95 % protection of aquatic species. Because of the tidal nature of the Hunter River, considered to be the receiving body, the marine values were used. These trigger values are in line with values adopted during previous monitoring. In addition, current results were compared to previous results in order to detect any trends or natural attenuation of contaminants. The adopted monitoring criteria were applied to groundwater and surface water as a screening level and are listed in **Table 1.** It is noted that the terms 'trigger value' and 'GIL' are used interchangeably in this report.

Table 1: Adopted Monitoring Criteria for Groundwater and Surface Water (µg/l)

Analyte	ASC NEPM GIL for Marine Waters	ANZECC (2000) Slightly – Moderately Disturbed Systems Trigger Values
Inorganics		
Chromium VI	4.4	4.4
Lead	4.4	4.4
Molybdenum	-	23*
Ammonia	910	910
Cyanide	4	4
Organics		
Naphthalene	50	70
Benzo(a)pyrene	-	-
Phenols	400	400

**- ANZECC 2000 low reliability value*

3.2 Absence of Specific Criteria

In the absence of specific criteria, any analytes reported above the laboratory limit of reporting ("**LOR**") will be reviewed and professional judgement will be applied to assess the detrimental effects. The laboratory LOR will be at or below the adopted assessment criteria where practicable. Where specific criteria are not available, the standard laboratory test, and therefore LOR, will be used. As there are no published criteria for Total PAHs, Hazmat has adopted the laboratory LOR as the assessment criteria for Total PAHs.

4 FIELDWORK METHODOLOGY

Sampling for the annual monitoring event was conducted between the 20th of June and 6th of July 2022 and included the collection of groundwater samples from 42 groundwater monitoring wells and five (5) surface water locations. Sample locations are shown in **Figure 2** in **Appendix A**.

During the monitoring event, the majority of the wells and surface water bodies were easily located and accessed. The wells that were not sampled for the 2022 monitoring period are listed in the **Table 2** below.

Table 2: List of Monitoring Wells Not Sampled – 2022 Monitoring Event

Well ID	Issue	Recommended Action
K12/9	Well was inaccessible due to flooding in the area and could not be sampled.	Retry next event if undertaken.
K12/9E	Well was inaccessible due to flooding in the area and could not be sampled.	Retry next event if undertaken
K12/1E	Well was inaccessible due to well cap being stuck and could not be sampled.	Retry next event if undertaken
K12/6	Well was damaged during Ash Island fires in 2019.	Discussion required with EPA to confirm whether continued monitoring at location is required and if well should also be replaced.
E61/S	Well was dry and could not be sampled.	Retry next event if undertaken.
K7/2N	Well was dry and could not be sampled.	Retry next event if undertaken.
GHD01N	Well obstruction. Well was blocked with tubing and could not be sampled.	Discussion required with EPA to confirm whether continued monitoring at location is required and if well should also be replaced.
GHD01S	Well obstruction. Well was blocked with tubing and could not be sampled	Discussion required with EPA to confirm whether continued monitoring at location is required and if well should also be replaced.

In order to rectify the above issues, it is recommended that the EPA be consulted to determine if ongoing monitoring of these locations is required and therefore, whether they can be taken out of the next monitoring round (if to be undertaken) or that they must be repaired or replaced.

As a result of the above, 42 groundwater samples and five surface water samples were collected.

4.1 Fieldwork Guidelines

The collection of samples was undertaken in general accordance with Hazmat's Standard Operating Procedures and the following Australian Standards ("**AS**") and guidance documents:

- NEPC (2013) ASC NEPM Schedule B(2) Guideline on Data Collection, Sample Design and Reporting, 2013; and
- Australian Standard (AS/NZS 5667.11:1998) Water quality—Sampling Part 11: Guidance on sampling of groundwater.

4.2 Surface Water Sampling

A total of five (5) surface water samples were collected, one from each surface water location. Surface water samples were collected directly from the surface water body using a sampling arm attached to a laboratory supplied unpreserved bottle so as to avoid disturbing sediments. The unpreserved bottles were submerged just below the water surface and disposable nitrile gloves were worn for all sampling. The following water quality parameters were taken using a YSI water quality meter:

- Dissolved oxygen ("**DO**");
- Redox;
- Temperature;
- pH; and
- Electrical Conductivity ("**EC**").

The samples were then decanted into laboratory supplied and preserved bottles suitable for the chosen analytes. The water quality parameters are included in the Results Summary in **Table B** in **Appendix D.**

The calibration certificate for the water quality meter is attached in **Appendix G**.

4.3 Groundwater Sampling

A total of 42 groundwater monitoring wells were sampled. Prior to sampling, concentrations of Volatile Organic Compounds ("**VOCs**") in the wells were determined using a calibrated MiniRAE 3000 Photoionisation Detector ("**PID**"). Standing Water Levels ("**SWL**") were measured from a fixed top-of-casing mark point prior to sampling. Wells were sampled using one of the following sampling methods:

- Low flow micropurge pump – wells were purged until the field parameter readings were stabilised and measured with a YSI water quality meter as per the low flow sampling protocol; and
- Disposable hand bailers – a minimum of three well volumes were removed and purging was continued until field parameters stabilised and measured by a YSI water quality meter to ensure a representative sample was collected.

These methods were chosen for the Site due to the requirement for high integrity samples. The low flow pump was the preferred sample collection method due to the potential presence of volatile compounds. The hand bailer was only used for monitoring wells where the low flow pump did not fit inside casings and for wells which exhibited elevated sediment levels, causing blockage of the low flow pump.

At each sampling location, the following field parameters were monitored with a YSI water quality meter:

- Dissolved oxygen ("**DO**");
- Redox;
- Temperature;
- pH; and
- Electrical Conductivity ("**EC**").

The field parameters were considered stable when the pH was within 0.1 pH units of the preceding measurement and DO was within 10%. Field record sheets are attached in **Appendix F**. The calibration certificates for the interface probe, water quality meter and micropurge kit are attached in **Appendix G.**

Samples which were analysed for heavy metals and hexavalent chromium were field filtered with disposable 45 micron filters before being placed into the sample bottle.

4.4 Sample Analysis

Laboratory analysis was conducted in accordance with the standard test methods outlined in Schedule B (3) of the NEPM (2013) for waters. The selected laboratories are National Association of Testing Authorities ("**NATA**") accredited for the analyses performed. The water samples were analysed for a suite of analytes which included:

- Ammonia;
- Phenols;
- Cyanide (Total, Weak Acid Dissociable and Free);
- Hexavalent chromium;
- Molybdenum;
- Lead; and
- Total PAHs.

Hazmat notes that, for some samples, only some of the above analytes were tested, in accordance with the Brief.

4.5 Sample Handling and Transport

Groundwater and surface water samples were placed in laboratory supplied containers suitable for the chosen analytes. Samples were placed directly into a chilled esky following collection and transported to an accredited laboratory under chain of custody ("**CoC**") protocols within appropriate holding times. A copy of the CoC documentation is provided in **Appendix E**.

Envirolab was used as the primary laboratory for the project and ALS as the secondary laboratory. Both laboratories are National Association of Testing Authorities ("**NATA**") accredited for the performed analysis.

4.6 Decontamination

The decontamination of sampling equipment was performed to minimise risks to health and safety, and to reduce the potential for cross-contamination between samples. For each sample, a new set of disposable nitrile gloves was used. The samples were placed into laboratory supplied sample bottles. Between each groundwater sample, the low flow pump was decontaminated. This process included a scrubbing brush and a solution of Decon 90 and tap water followed by a rinse in deionised water.

Decontamination of the sampling equipment was not required for surface water as samples were collected directly from the surface water body into the required analytical bottles. A new set of appropriately preserved sample bottles was used to collect each surface water sample.

4.7 Quality Assurance/Quality Control

Analytical data validation is the process of assessing whether the data is in compliance with method requirements and project specifications. The primary objective of this process is to ensure that data of known quality are reported, and to identify if data can be used to fulfil the overall project objectives.

The data validation guidelines adopted are based upon the following data validation guidance documents published by the United States Environmental Protection Agency (USEPA):

- USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 540-R-10-011, dated January 2010);

- USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA 540/R-99/008, dated June 2008); and
- National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM 2013).

The process involves the checking of analytical procedure compliance and the assessment of the accuracy and precision of analytical data from a range of quality control measurements generated from both field sampling and analytical programs. Specific elements that have been checked and assessed for this project include:

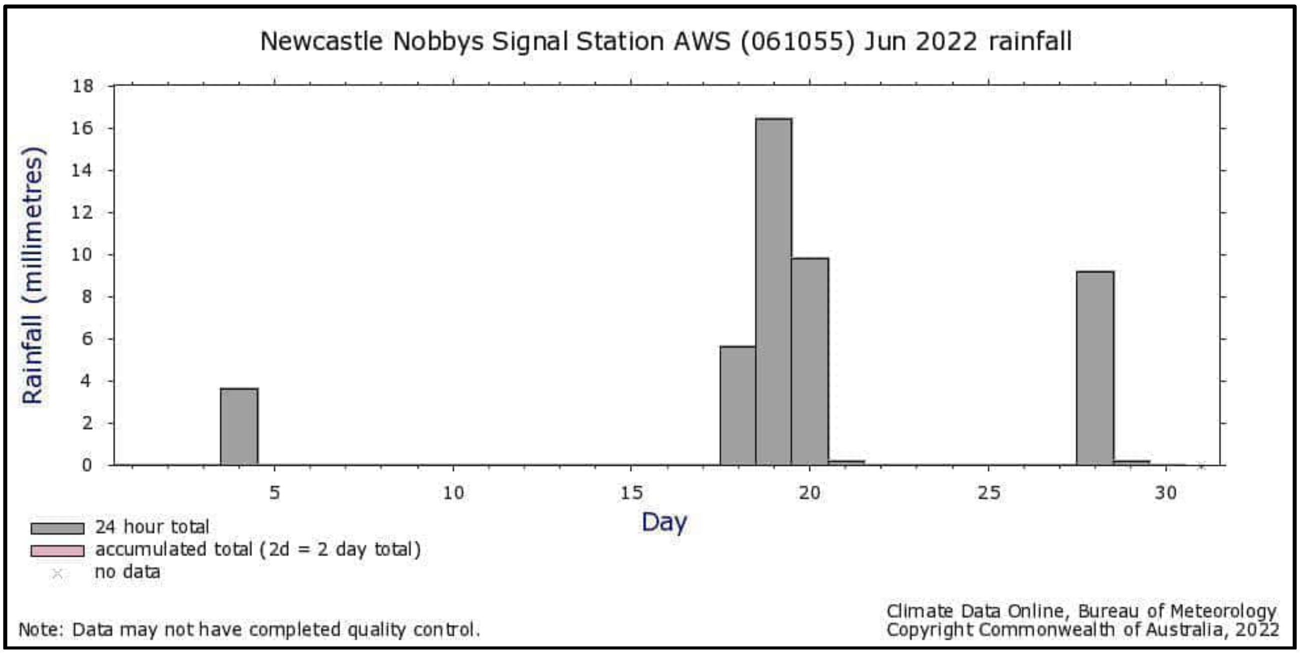
- preservation and storage of samples upon collection and during transport to the laboratory;
- holding times;
- use of appropriate analytical procedures;
- required Limit of Reporting ("**LOR**");
- frequency of conducting quality control measurements;
- laboratory blanks;
- field duplicates;
- rinsate blanks;
- laboratory duplicates;
- matrix spike/matrix spike duplicates (MS/MSDs);
- surrogates (or System Monitoring Compounds); and
- the occurrence of apparently unusual or anomalous results, e.g. laboratory results that appear to be inconsistent with field observations or measurements.

The description of sampling, analysis and data quality objectives and validation methods that were followed for this project are located in the quality assurance and quality control section presented in **Appendix C**. The outcomes are also summarised in **Table 3.**

4.8 Meteorological Conditions

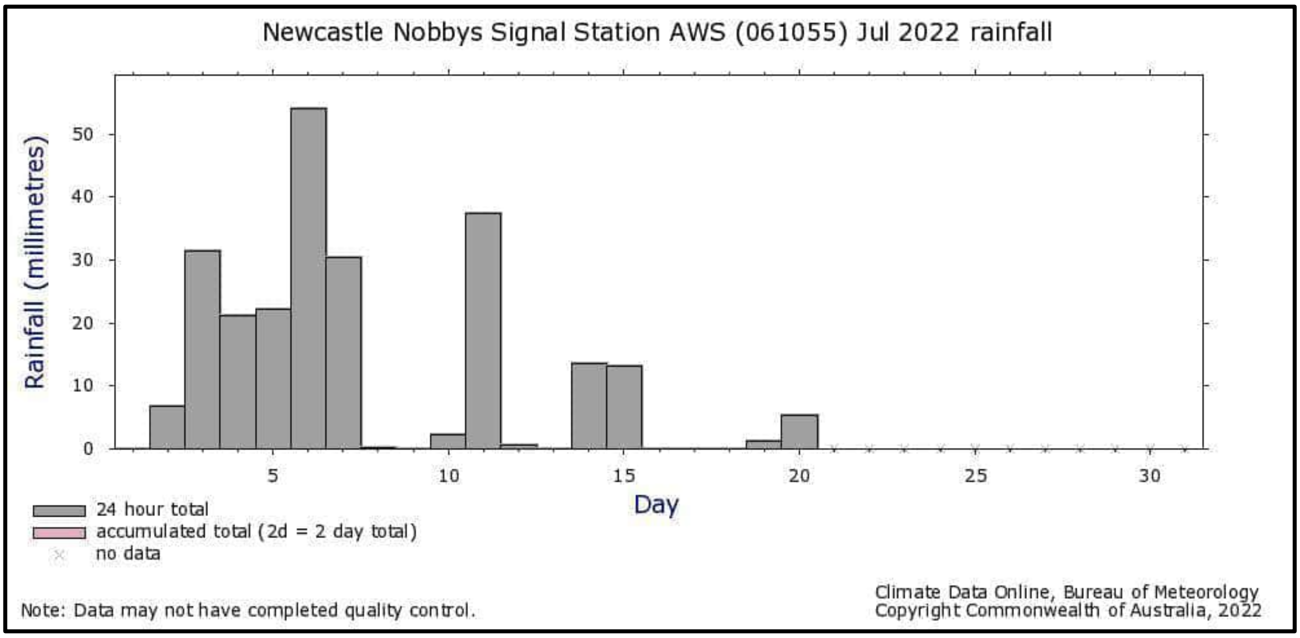
Meteorological conditions for June and July 2022 were sourced from the Bureau of Meteorology's ("**BoM**") Newcastle Nobbys signal station (Station 061055). The rainfall data for June and July 2022 are shown in **Figure 1** and **Figure 2** below. There were 7 rain events in the month of June with the highest amount of rainfall being 16.4mm. June was generally a dry month with below average overall rainfall observed.

Up until the end of monitoring, the month of July had 5 rain events with the highest amount of rainfall being 54.0mm. July was a very wet month with above average rainfall observed.



(Source: BoM, 2022)

Figure 1: June 2022 Rainfall Data



(Source: BoM, 2022)

Figure 2: July 2022 Rainfall Data

5 SUMMARY OF RESULTS

5.1 PID Screening

Prior to sampling of all groundwater wells, concentrations of VOCs were determined using a calibrated PID. All sampled wells reported VOC concentrations below 5 ppm.

Reported VOC concentrations for all wells sampled are presented in **Table A** in **Appendix D**. The calibration certificate for the PID is attached in **Appendix G**.

5.2 Field Water Quality Parameters

Reported field water quality parameters for all wells sampled are presented in **Table A** in **Appendix D.**

A summary of the field water quality parameters observed are as follows:

- Electrical conductivity readings ranged from 3.9 µs/cm to 47,123 µs/cm;
- pH readings ranged from 5.26 to 10.93;
- Dissolved oxygen readings ranged from 0.33 to 11.23 mg/L;
- Redox readings ranged from -380.9 mV to 458.9 mV; and
- Temperature ranged from 13.8^{0}C to 22.9^{0}C.

5.3 Groundwater

Groundwater analytical results are presented in **Table B** in **Appendix D.** A discussion on the longer-term trends of these results and what the results mean is presented in **Section 6**.

The following observations are made:

- The reported concentrations of ammonia exceeded the adopted ANZECC Criteria in 23 wells. The following wells were above the ANZECC Criteria: K12/7E, NCIG2, K5/5S, K9/2E, K9/3N, K11/1S, K11/3W, K12/4N, K11/2W, K9/4W, K12/10, K7/1, K8/5E, K7/4N, BHe29S, E61D, K8/5W, K7/2S, K9/4E, K10/2NN, K11/3E, 344B and BH21S. The highest concentration of ammonia was observed at well K12/4N which reported a concentration of 48 mg/L, which is 52 times above the ANZECC Criteria. K12/4N is located outside the KIWEF footprint and is approximately 800 m northwest of the KIWEF boundary within the deep estuarine aquifer.
- The samples analysed for total phenols were detected below the ANZECC Criteria.
- Samples analysed for total cyanide exceeded the ANZECC Criteria in 9 samples. The following wells were above the guideline: K5/6S, K11/3W, K5/6N, K7/1, K8/5E, 344A, K7/4N, K8/5W and BH21S. The highest concentration was observed at well BH21S which reported a concentration of 0.21mg/L which is 52 times above the ANZECC Criteria. The wells that reported a detectable total cyanide concentration also reported Weak Acid Dissociable ("**WAD**") and free cyanide concentrations equal to or below the LOR.
- The reported concentrations of hexavalent chromium were below the LOR for all samples.
- Samples analysed for dissolved molybdenum exceeded ANZECC Criteria in six samples; K7/1, K10/2, K8/5E, K7/4N, K8/5W and BH21S. The highest concentration was observed at well BH21S which reported a concentration of 540µg/L (0.54mg/L) which is more than 15 times above the ANZECC Criteria.

- Samples analysed for dissolved lead were detected below the ANZECC Criteria.
- Samples analysed for naphthalene detected concentrations below the ANZECC Criteria with the exception of well BH21S which reported a concentration of 210 µg/L which 3 times above the ANZECC Criteria.
- The samples also reported concentrations of total PAHs below the LOR with the exception of wells K12/7E, K7/1, K8/5E, K8/5W, K7/2S, K11/1, K10/2NN and BH21S. BH21S reported the highest concentration of 240µg/L which is more than 400 times above the LOR.
- Samples analysed for benzo(a)pyrene detected concentrations below the LOR, with the exception of sample BH21S, which recorded a concentration of 0.6µg/L.

5.4 Surface Water

Surface water analytical results are shown in **Table B** in **Appendix D.** The following observations are made:

- The samples reported ammonia concentrations below the ANZECC Criteria.
- The samples reported a total phenol concentration below the LOR and adopted ANZECC Criteria.
- The results for free, WAD and total cyanide were reported below the LOR and respective ANZECC Criteria.
- The samples reported total molybdenum concentrations below the adopted ANZECC Criteria with the exception of KS2/1, which reported concentrations of 27µg/L (0.027mg/L which is approximately one and half times above the ANZECC Criteria.
- The samples reported total lead concentrations below the adopted ANZECC Criteria.
- The samples analysed for total PAH including naphthalene and benzo(a)pyrene reported concentrations below the LOR and adopted ANZECC Criteria.

5.5 Quality of Analytical Data

The outcome of the data quality assessment is summarised in **Table 3.** On the basis of the analytical data validation procedure employed, the overall quality of the groundwater and surface water analytical data produced is considered to be of an acceptable standard for interpretive use. Details of the methodology and outcome of the quality assurance and quality control for the project is outlined in **Appendix C.**

Table 3: Data Quality

Requirement	Required Frequency	Compliance	Comments
Field Duplicates (intra-laboratory duplicates)	5% (primary lab) or 1 per batch	Yes	Three duplicate samples were collected for 47 primary samples (42 groundwater and 5 surface water). Intra-laboratory duplicate samples were collected by splitting each sample into the primary and duplicate sample containers.

Requirement	Required Frequency	Compliance	Comments
Check Duplicates (inter-laboratory duplicates	5% (secondary lab) or 1 per batch	Yes	Three duplicate samples were collected for 47 primary samples (42 groundwater and 5 surface water). Inter-laboratory duplicate samples were collected by splitting each sample into the primary and duplicate sample containers.
Rinsate sample	One per day	Yes	11 rinsate samples were collected, one for each day, from the sampling equipment. The results were reported below LOR for the analytes tested.
Laboratory Duplicates	10 % (primary lab) or 1 per batch	Yes	The laboratory duplicates meet the required frequency.
Laboratory Spikes	5 % (primary lab) or 1 per batch	Yes	The laboratory spikes meet the required frequency.
Laboratory Control Samples	5 % or 1 per batch	Yes	It is noted that the Brief requires 10 % while the ASC NEPM requires 5 %.
RPDs	-	Yes	The majority of calculated RPDs fall within the acceptable range of <50 %, the exception being samples with concentrations of <10 times the LOR which can show a higher RPD. Where concentrations of either sample is <LOR or <10 times the LOR, then no limit applies. Appendix C provides details on individual RPDs.
Sampling equipment properly decontaminated	Each sample	Yes	Disposable equipment used where possible. The pump, interface probe and water quality meter were decontaminated between sampling locations.
Sample Preservation	All samples	Yes	Samples were properly preserved. Samples were compliant with required storage temperature.
Samples delivered to laboratory within sample holding times.	All samples	Yes	Confirmed from COCs and laboratory reports.
Equipment Calibration	Once per event	Yes	Refer to **Appendix G.**
Analytical procedures	All procedures	Yes	All procedures are NATA accredited.
SOP and competent field personnel	Always	Yes	Sampling procedures follow industry standards, and field staff are competent in sampling methods and QA/QC protocols.

6 DISCUSSION

6.1 KIWEF Annual Monitoring

Analytical results for groundwater and surface water show that, with the exception of ammonia, total cyanide, dissolved molybdenum, phenols, dissolved lead, and naphthalene, the majority of wells did not report concentrations above the ANZECC Criteria. Results that exceed the adopted monitoring criteria were compared to historical data dating back to 1999. These are discussed in **Sections 6.1.1** to **6.1.4**. The results summary presented in **Table B** of **Appendix D** indicates for each sample whether it was collected from surface water or from a bore constructed in fill, shallow estuarine or deep estuarine. Historical data are provided in **Appendix H**.

6.1.1 Fill Bores

Three of the ten wells in fill material (K7/1, K8/5E, and K7/4N) reported ammonia concentrations above the ANZECC Criteria. Total cyanide was also detected at a concentration above the ANZECC Criteria in wells K7/1, K8/5E, 344A, and K7/4N. Concentrations of WAD and free cyanide were also detected below the LOR indicating that the cyanide present is not bio-available. Molybdenum was detected above the ANZECC Criteria in four wells (K7/1, K10/2, K8/5E, and K7/4N). Lead was detected below the ANZECC Criteria in all wells.

A comparison to historical data for the wells where contaminants were recorded above the adopted ANZECC Criteria indicated the following:

- Ammonia concentrations were lower than the historical maximum concentrations;
- Total cyanide concentrations were lower than the historical maximum concentrations;
- Molybdenum concentrations were lower than the historical maximum concentrations; and
- Lead concentrations were also lower than the historical maximum concentrations.

Ongoing monitoring is recommended to observe the potential fluctuations in PAH, total cyanide, ammonia, and molybdenum concentrations within the fill bores, with particular attention to sample location K7/1.

6.1.2 Shallow Estuarine Bores

A total of 20 bores were monitored in the shallow estuarine aquifer. Reported concentrations for ammonia were above the ANZECC Criteria in 9 samples. Total cyanide concentrations exceeded the adopted ANZECC Criteria in two samples. Concentrations of WAD and free cyanide were also detected below the LOR indicating that the cyanide present is not bio-available. Molybdenum concentrations exceeded the adopted ANZECC Criteria in two samples, and lead concentrations were below the adopted ANZECC Criteria. Naphthalene concentrations exceeded the adopted ANZECC Criteria in one sample and total PAH's were recorded above the adopted laboratory LOR Criteria in five samples.

A comparison to historical data for the wells where contaminants were recorded above the adopted ANZECC Criteria indicated the following:

- Concentrations with ammonia were consistent compared to the historical maximum concentrations;
- Total cyanide was either consistent with, or lower than, the historical maximum concentrations;
- Molybdenum was either consistent with, or lower than, the historical maximum concentrations; and
- The high naphthalene result recorded in well BH21S is lower than the historical maximum concentrations.

Ongoing monitoring is recommended to observe the potential fluctuations in PAH, total cyanide, ammonia, lead and molybdenum concentrations within the shallow estuarine bores. While fluctuating lead concentrations have historically been recorded in the sample locations, the individual concentrations recorded have remained historically low, and may be representative of background conditions. Nevertheless, ongoing monitoring is recommended.

6.1.3 Deep Estuarine Bores

A total of 12 bores were monitored in the deep estuarine aquifer. Reported concentrations for ammonia were above the ANZECC Criteria in 11 samples. Total cyanide was recorded above the adopted ANZECC Criteria in sample K5/6S and K11/3W. Total PAH's was recorded above the adopted laboratory LOR Criteria in one sample K12/7E.

A comparison to historical data for the wells where contaminants were recorded above the adopted ANZECC Criteria indicated the following:

- Concentrations of ammonia were either consistent with or lower than the historical maximum concentrations. The highest concentrations were detected within the deep estuarine aquifers;
- Total cyanide was lower than the historical maximum concentrations; and
- Total PAH's were lower than the historical maximum concentrations.

Ongoing monitoring in line with the Notice is recommended to observe the potential fluctuations in ammonia, phenol, cyanide, naphthalene and total PAH concentrations within the deep estuarine bores. While fluctuating phenol and total PAH concentrations have historically been recorded in the sample locations, consistent low or elevated results have been recorded at individual sample locations. Ongoing monitoring is therefore recommended to assess if these trends remain consistent.

6.1.4 Surface Water

All five surface water locations were sampled and the majority of reported concentrations for all analytes were below the LOR and/or the ANZECC Criteria with the exception of sample location KS2/1 which recorded molybdenum concentrations above the ANZECC Criteria. The levels were lower than or consistent with the historical averages for molybdenum.

Compared with historical data, surface water quality is in line with previous results and concentrations appear generally lower than previously observed.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The following conclusions are made based on the reported data:

- Ammonia concentrations, although there were numerous exceedances of the adopted ANZECC Criteria, are generally lower than the historical observations. The highest concentration was detected within background location K12/4N and the concentrations were lower than the historical maximum concentrations at this location.
- Total cyanide concentrations in groundwater, although some exceedances of the adopted ANZECC Criteria exist, are generally at levels consistent with historical observations. Concentrations of WAD and free cyanide were also detected below the LOR indicating that the cyanide present is not bio-available.
- Concentrations for heavy metals (Pb, Mo, Cr VI), although some exceedances of the adopted ANZECC Criteria exist, are generally at levels consistent with historical observations.
- Concentrations for phenol are at levels below or consistent with historical observations.
- Concentrations of PAH are below the LOR in the majority of samples. However, a few samples exceed the adopted laboratory LOR Criteria. The PAH concentrations observed during the 2022 monitoring event are generally consistent or lower than those detected in previous recent results.
- The surface water quality observed in this round of monitoring is generally consistent with historical data and meets most of the adopted ANZECC Criteria.
- The current contaminant concentrations at the KIWEF have been detected at levels generally consistent with historical concentrations (collected since 1999).
- The contaminant concentrations detected at boundary monitoring points, or lack thereof, indicate that offsite migration of contaminants was not occurring.

7.2 Recommendations

The following recommendations are made based on the reported data:

- HCCDC to conduct discussion with EPA in regard to the installation or replacement monitoring wells for lost or damaged wells identified during the most recent monitoring round;
- HCCDC to undertake consultations with the EPA in regard to rationalising the monitoring network as there has been a reduction in contaminant concentrations in some of the locations on site;
- Ongoing groundwater and surface water monitoring in accordance with Surrender notice and; and
- Ongoing vegetation clearing and maintenance prior to next round of monitoring.

8 LIMITATIONS

Hazmat prepared this report for the purpose set out in **Section 1** and as agreed to by the Client. Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current to the date of this document. Any other party should satisfy themselves that the scope of work conducted and reported herein meets their specific needs. Hazmat cannot be held liable for third party reliance on this document, as Hazmat is not aware of the specific needs of the third party.

From a technical perspective, the subsurface environment at any site may present substantial uncertainty. It is a heterogeneous, complex environment, in which small subsurface features or changes in geologic conditions can have substantial impacts on water and chemical movement. Uncertainties may also affect source characterisation assessment of chemical fate and transport in the environment, assessment of exposure risks and health effects, and remedial action performance.

Hazmat professional opinions are based upon its professional judgement, experience, and training. These opinions are also based upon data derived from testing and analysis described in this document. Hazmat has limited its investigation to the scope agreed upon with its client. Hazmat believes that its options are reasonably supported by the testing and analysis that have been done, and that those opinions have been developed according to the professional standard of care for the environment consulting profession in this area at this time. That standard of care may change and new methods and practices of exploration, testing, analysis and remediation may develop in the future, which might produce different results. Hazmat professional opinions contained in this document are subject to modification if additional information is obtained, through further investigation, observations, or validation testing and analysis during remedial activities.

Finally, Hazmat does not make any other warranty, expressed or implied, as to the professional advice contained in this report.

9 REFERENCES

- Australian and New Zealand Environment Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ) (2000) The Australian and New Zealand Guidelines for Fresh and Marine Water Quality;
- Australian Standard (AS/NZS 5667.11:1998) Water quality—Sampling Part 11: Guidance on sampling of groundwater;
- Australian Standard (AS4482.1-2005) Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 1: Non-volatile and semi-volatile compounds;
- Australian Standard (AS4482.2-1999) Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile substances;
- National Health and Medical Research Council (NHMRC) (2011) Australian Drinking Water Guidelines 6;
- NEPC (2013) ASC NEPM Schedule B(2) Guideline on Data Collection, Sample Design and Reporting, 2013;
- NSW EPA (2007) Guidelines for the Assessment and Management of Groundwater, 2007;
- NSW EPA (1995), Contaminated Sites: Sampling Design Guidelines, (NSW EPA, 1995);
- NSW EPA Environmental Protection License No. 6437; and
- RCA Australia (2014) KIWEF Groundwater and Surface Water Rationalisation Report.

APPENDIX A
Study Area and Sampling Locations

Hunter Development Corporation

Former Kooragang Island Waste Emplacement Facility Aerial Photograph April 2013

HAZMAT SERVICES

OHS | WASTE | ENVIRONMENT

Title: Former KIWEF Study Area	
Figure: 3	Project No: N4656
Date: 01/06/2022	Revision: 0

Page Size A4

HAZMAT SERVICES

OHS | WASTE | ENVIRONMENT

Title: KIWEF Groundwater & Surface Water Monitoring Locations 2022	
Figure: 4	Project No: N4656
Date: 01/06/2022	Revision: 0

Page Size A4

APPENDIX B
EPL Surrender Notice

Section 80(1) of the Protection of the Environment Operations Act 1997

Approval of the Surrender of a Licence

Licence - 6437

Department of Environment, Climate Change and Water NSW

HUNTER DEVELOPMENT CORPORATION ,

ABN 94 688 782 063,

PO BOX 813,

NEWCASTLE NSW 2300

Attention: Mr. Michael Bardsley

Notice Number 1111840

File Number LIC07/20

Date 08-Dec-2010

APPROVAL OF THE SURRENDER OF LICENCE NO. 6437

BACKGROUND

A. The following licensee(s):

HUNTER DEVELOPMENT CORPORATION

94 688 782 063

applied to the Environment Protection Authority ("EPA") to surrender Environment Protection Licence No. 6437 ("the licence") issued under the *Protection of the Environment Operations Act 1997* ("the Act"). The licence authorises the carrying out of Scheduled Activity - Premises Based at KOORAGANG ISLAND, CORMORANT DRIVE, KOORAGANG, NSW.

B. The EPA received the application on 13-Jan-2010.

C. The following documents were supplied in support of the application:

a. Hunter Development Corporation – Report on KIWEF – Revised Final Landform and Capping Strategy – August 2009 – Revision 2, prepared by GHD;

b. Hunter Development Corporation – Revised Capping Strategy – Flora and Fauna Impact Assessment – January 2010 – Revision 3, prepared by GHD; and

c. Hunter Development Corporation – KI Groundwater and Surface Water Monitoring – Trend Analysis Report – January 2010 – Revision 1, prepared by GHD.

APPROVAL OF THE SURRENDER OF A LICENCE

1. The surrender of the licence is approved.

PART A GENERAL CONDITIONS

2. The approval of the surrender is subject to the following conditions:

   a) The licensee must provide the EPA with an Annual Return in relation to compliance with the conditions of the licence during the period beginning on the last licence anniversary date and ending on the date that the surrender of the licence takes effect as set out in point 5 below.

   b) The Annual Return must be supplied to the EPA within 60 days of the date from which this notice operates (see note at the end of this notice).

   c) The content and form of the Annual Return must be in accordance with the applicable reporting conditions in the licence before it was surrendered.

   d) The Annual Return must be signed in accordance with the applicable reporting conditions in the licence before it was surrendered.

3. This surrender notice applies to the following land on Kooragang Island as defined by Lot and DP numbers:

   Part Lot 7, Lot 10, Lot 11 and Part Lot 14 of DP1119752,

   and shown on map titled '*Plan of Subdivision of Lot 122 DP874949, Lot 2 DP581473, Lot 6 DP1015754 and Lots 71 and 74 in DP1119950'* date of survey 2 November 2007, Surveyors Reference HW43.01.03.00 and registered on 29 November 2007, attached to this notice.

   Note: Part Lot 14 DP1119752 refers to that area identified as Lot 14 DP 1119752 excluding land labelled as '*Extra Land Area 2*', '*Extra Land Area 4* and '*Extra Land Area 5'* shown on map titled '*Plan of Extra Land Showing Coordinates Kooragang* dated 08/06/10, attached to this notice.

PART B SITE SPECIFIC CONDITIONS

4. Final Capping

   a) The licensee shall implement the final landform and capping strategy as detailed in the document titled *Hunter Development Corporation – Report on KIWEF – Revised Final Landform and Capping Strategy – August 2009 – Revision 2, prepared by GHD,* ('the Landform and Capping Strategy') by **28 March 2013**.

   b) Three months prior to the commencement of final capping of Pond 5 (defined in Figure 4 - Areas of Contamination Hotspots – 20 May 2009, provided in the Landform and Capping Strategy) the licensee shall provide a report to the EPA, that confirms the geotechnical stability of the geosynthetic liner to withstand the additional weight of a coal washery reject capping layer as described in the Landform and Capping Strategy.

   c) The licensee shall update the Materials Management Plan provided in the Landform and Capping Strategy and provide the updated Materials Management Plan for approval to the EPA by **30 November 2011**. The updated Materials Management Plan must provide and commit to specific engineered and/or management measures to be adopted for contingency purposes if/when unknown contaminated material is encountered during the cut and fill component of the Landform and Capping Strategy.

   d) The licensee shall implement, maintain and operate erosion and sedimentation controls during the final capping process to ensure that there is no sedimentation of waterways.

   e) All activities associated with the closure, capping, rehabilitation and post-closure maintenance and monitoring at the premises must be carried out in a competent manner. This includes:

      i) The processing, handling, movement and storage of materials and substances used at the premises; and

ii) The treatment, storage, processing, reprocessing, transport and disposal of any waste generated by the activity.

f) All plant and equipment installed at the premises or used in connection with the closure, capping, rehabilitation and post-closure maintenance and monitoring activities at the premises must be:

i) maintained in a proper and efficient condition; and

ii) operated in a proper and efficient manner.

g) All activities associated with the closure, capping, rehabilitation and post-closure maintenance and monitoring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.

h) Within three months of completion of the installation of the final cap, the licensee must provide the EPA with a written Validation Report that includes:

i) Advice that the final cap has been installed;

ii) Advice from a suitably qualified and experienced person as to whether or not the cap was installed in accordance with Chapter 7 of the Landform and Capping Strategy and relevant conditions of this Notice, or future variations to this Notice;

iii) Provision of the results of all relevant test results to validate that the permeability of the final capping layer is less than or equal to $K = 1 \times 10^{-7}$m/s. Permeability testing must be taken of the sealing layer material at a rate of not less than 1 per 2000T (or 1250m3);

iv) Provision of information that establishes the thickness of the installed sealing and revegetation layers in the format of either:

(i) As constructed drawings, including cross sections, of the surfaces of the coal washery reject layer; and

(ii) The results of surveys undertaken for each capping layer by a registered surveyor.

i) The Validation Report must be prepared by a suitably qualified person who had suitable involvement in overseeing the cap's installation.

j) At the completion of the final cap, the licensee shall undertake inspections of the cap, on a six (6) monthly basis, to detect and remediate areas where the cap has eroded, degraded or slumped.

k) The licensee shall provide the EPA with a written statement of the results of the inspection required by condition 4(j) on an annual basis. The statement must describe the condition of the cap and any actions taken to remediate the cap as a result of the inspection. The first statement must be provided to the EPA by **30 September 2013** with subsequent reports provided 12 monthly following the provision of the first report.

5. Environmental Monitoring

a) The licensee shall prepare and submit a K26/32 Groundwater and Green and Golden Bell Frog Monitoring Program to the EPA for approval by **13 April 2011.** The Monitoring program shall:

i) Document known risks associated with the contaminant hotspot located in the area known as K26/32 (defined in Figure 4 - Areas of Contamination Hotspots – 20 May 2009, provided in the Capping Strategy);

ii) Be designed to assess the:

(i) risk of contaminant mobilisation; and

(ii) ongoing viability of the Green and Golden Bell Frog population in the K26/32 area; and

iii) Identify triggers for Green and Golden Bell Frog management intervention and/or actions required to address contaminant mobilisation.

b) The licensee shall prepare and submit a **Green and Golden Bell Frog Management Plan** to the EPA for approval by **13 April 2011.** The Plan shall encompass the entire premises occupied by the licensee and include, but not be limited to:

i) Management measures to be undertaken to minimise the spread of the amphibian *Chytrid* fungus including:

(i) the training of project personnel in site hygiene management; and

(ii) site hygiene procedures for project personal, mobile plant and equipment, in accordance with the NPWS Hygiene Protocol for the Control of Disease in Frogs 2001; and

ii) Measures to maintain, restore and enhance Green and Golden Bell Frog habitat, including movement corridors across the site.

c) The licensee shall undertake the groundwater monitoring program as outlined in Table 1, 2 and 3 of this notice. Monitoring locations are those groundwater bores identified in both the fill and natural aquifers as shown on the map titled '*Figure 2 - Rationalised Groundwater and Surface Water Monitoring Program*', dated 28 SEP 2010 and attached to this notice.

Table 1 – Deep Estuarine Wells being K5/5S, K5/6S, K7/2N, K9/2E, K9/3N, K9/4W, K11/1S, K11/2W, K11/3W, K12/1E, K12/3N, K12/4N, K12/7E, K12/9E and K12/10

Pollutant	Units of Measure	Frequency	Sampling Method
Ammonia	mg/L	Every 12 months	Grab sample
Phenols[1]	mg/L	Every 12 months	Grab sample
Cyanide (Total, WAD and free)	mg/L	Every 12 months	Grab sample
Chromium (hexavalent)	mg/L	Every 12 months	Grab sample
Molybdenum (dissolved)[2]	mg/L	Every 12 months	Grab sample
Lead (dissolved)[3]	mg/L	Every 12 months	Grab sample
Total PAHs	mg/L	Every 12 months	Grab sample
Conductivity	mg/L	Every 12 months	Grab sample
pH	pH	Every 12 months	Grab sample

[1] Not required to be analysed at wells K5/5S, K9/2E, K9/4W

[2] Not required to be analysed at wells K5/5S, K5/6S, K7/2N, K9/4W

[3] Not required to be analysed at wells K5/5S, K5/6S, K7/2N, K9/2E, K9/4W

Table 2 – Shallow Estuarine Wells being K3/1W, K5/6NN, K7/2S, K7/4S, K8/5W, K9/2W, K9/3S, K9/4E, K10/2NN, K11/1, K11/2E, K11/3E, K12/1W, K12/3W, K12/6, K12/7, K12/9, K12/10E, BHe29s, GHD02, E61D, 336B, 334B

Pollutant	Units of Measure	Frequency	Sampling Method
Ammonia	mg/L	Every 12 months	Grab sample
Phenols[4]	mg/L	Every 12 months	Grab sample
Cyanide (Total, WAD and free)	mg/L	Every 12 months	Grab sample
Chromium (hexavalent)	mg/L	Every 12 months	Grab sample
Molybdenum (dissolved)[5]	mg/L	Every 12 months	Grab sample
Lead (dissolved)[6]	mg/L	Every 12 months	Grab sample
Total PAHs	mg/L	Every 12 months	Grab sample
Conductivity	mg/L	Every 12 months	Grab sample
pH	pH	Every 12 months	Grab sample

Table 3 – Fill Wells being K5/4, K5/5N, K5/6N, K7/4N, K8/5E, K10/2, K10/2N, K7/1, GHD01, E61S, 336A, 344A

Pollutant	Units of Measure	Frequency	Sampling Method
Ammonia	mg/L	Every 12 months	Grab sample
Phenols[7]	mg/L	Every 12 months	Grab sample
Cyanide (Total[8], WAD and free)	mg/L	Every 12 months	Grab sample
Chromium (hexavalent)	mg/L	Every 12 months	Grab sample
Molybdenum (dissolved)[9]	mg/L	Every 12 months	Grab sample
Lead (dissolved)[10]	mg/L	Every 12 months	Grab sample
Total PAHs	mg/L	Every 12 months	Grab sample
Conductivity	mg/L	Every 12 months	Grab sample
pH	pH	Every 12 months	Grab sample

[4] Not required to be analysed at wells K7/4S, K8/3W, K9/2W, K9/4E, K10/2NN

[5] Not required to be analysed at wells K5/6NN, K7/2S, K9/4E

[6] Not required to be analysed at wells K5/6NN, K7/2S, K9/4E, K7/4S, K9/2W, K9/4E

[7] Not required to be analysed at wells K5/4, K5/5N, K7/4N, K8/5E, K10/2, K10/2N

[8] Not required to be analysed at wells K5/5N, K10/2, K10/2N

[9] Not required to be analysed at wells K5/4, K5/5N, K5/6N

[10] Not required to be analysed at wells K5/4, K5/5N, K5/6N, K7/4N

d) The licensee shall undertake the surface water monitoring program as outlined in Table 4 of this notice. Monitoring locations are those surface water monitoring locations as shown on the map titled '*Figure 2 - Rationalised Groundwater and Surface Water Monitoring Program*', dated 28 SEP 2010 and attached to this notice.

Table 4– Surface Water Monitoring at Locations KS2/1, KS1/3, K10/1, KS7/1, KS12/6

Pollutant	Units of Measure	Frequency	Sampling Method
Ammonia	mg/L	Every 12 months	Grab sample
Phenols	mg/L	Every 12 months	Grab sample
Cyanide (Total, WAD and free)	mg/L	Every 12 months	Grab sample
Chromium (hexavalent)	mg/L	Every 12 months	Grab sample
Molybdenum (dissolved)	mg/L	Every 12 months	Grab sample
Lead (dissolved)	mg/L	Every 12 months	Grab sample
Total PAHs	mg/L	Every 12 months	Grab sample
Conductivity	mg/L	Every 12 months	Grab sample
pH	pH	Every 12 months	Grab sample

e) The licensee shall provide the EPA with a written report of the results of the monitoring required by condition 5(c) and 5(d) on an annual basis. The report must be in a tabular and graphical format and the first report must be provided by **30 June 2011** with subsequent reports provided 12 monthly after the provision of the first report.

6. Except as provided by section 84(2) of the Act, the approval of the surrender of the licence by this notice operates from the date of this notice.

. . . .

Mr Grahame Clarke

Regional Manager

North East - Hunter

(by Delegation)

INFORMATION ABOUT THIS NOTICE

- On the date that the surrender of your licence takes effect the current licence fee period comes to an end. However, the surrender of your licence does not affect your liability to pay fees owing to the EPA for that licence fee period or for any earlier licence fee period.
- If you have not already paid the administrative fee for the licence fee period which has just come to an end on the surrender of your licence you must still do so. The administrative fee for a licence fee period

must be paid no later than 60 days after the beginning of that licence fee period (clause 36(1) of the *Protection of the Environment Operations (General) Regulation 2009*).

- Any load-based fees payable in relation to the licence fee period ending on the surrender of the licence must be paid no later than 90 days after the surrender of the licence takes effect (clause 37(1) of the *Protection of the Environment Operations (General) Regulation 2009*).
- Details provided in this notice will be available on the EPA's Public Register in accordance with section 308 of the Act.
- The reporting period on your Annual Return must be filled in to reflect the appropriate dates beginning on the last licence anniversary date and ending on the date that the surrender of the licence takes effect.
- The completed Annual Return must be sent by Registered Post no later than 60 days from the end of the reporting period to:

  Regulatory and Compliance Support Unit

  Department of Environment, Climate Change and Water

  PO Box A290

  SYDNEY SOUTH NSW 1232

- This notice is issued under section 80(1) of the Act.

Appeals against this decision

- You can appeal to the Land and Environment Court against this decision. The deadline for lodging the appeal is 21 days after you were given notice of this decision.

When this notice begins to operate

- The surrender of the licence specified in this notice begins to operate immediately from the date of this notice, unless another date is specified in this notice.
- If an appeal is made against this decision to approve the surrender of the licence and the Land and Environment Court directs that the decision is stayed the decision does not operate until the stay ceases to have effect or the Land and Environment Court confirms the decision or the appeal is withdrawn (whichever occurs first).

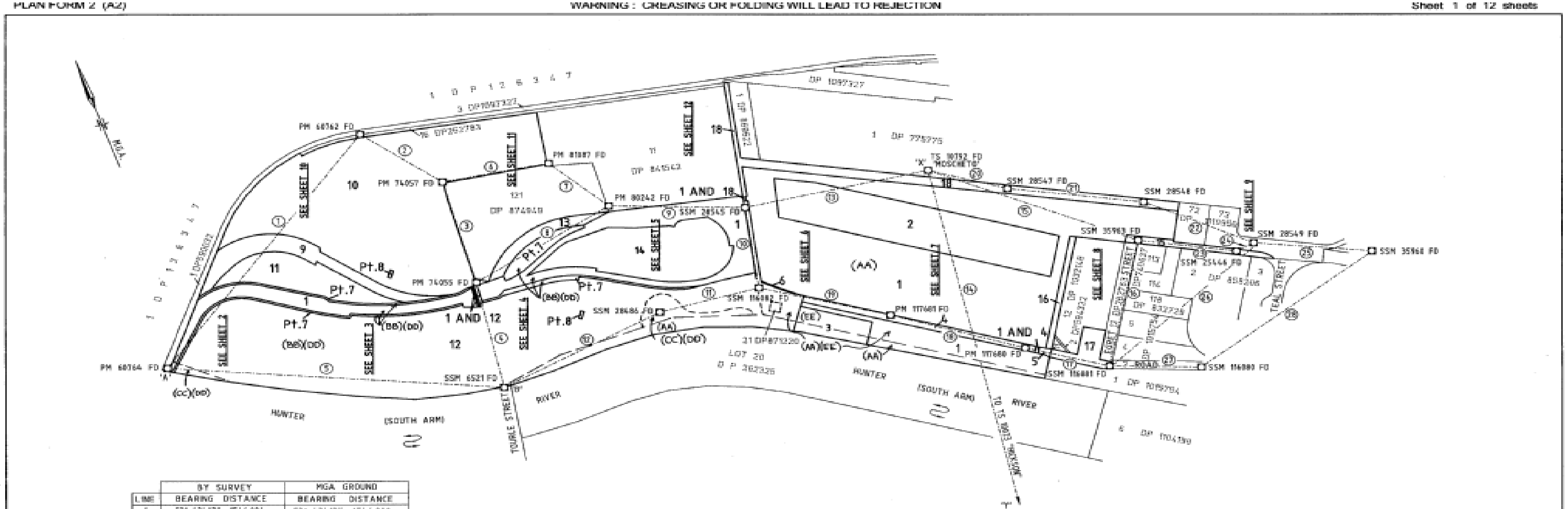
Section 80(1) of the Protection of the Environment Operations Act 1997

Approval of the Surrender of a Licence

Department of
Environment, Climate Change and Water NSW

Licence - 6437

PLAN FORM 2 (A2) WARNING : CREASING OR FOLDING WILL LEAD TO REJECTION Sheet 1 of 12 sheets



LINE	BY SURVEY BEARING	BY SURVEY DISTANCE	MGA GROUND BEARING	MGA GROUND DISTANCE
1	53° 43' 03"	1546.924	53° 43' 13"	1546.980
2	143° 34' 12"	456.165	143° 34' 15"	456.191
3	3° 07' 56"	566.855	–	
4	6° 29' 57"	584.4	6° 30' 09"	584.385
5	292° 50' 06"	1541.581	292° 50' 16"	1541.607
6	97° 10' 20"	495.740	97° 10' 22"	495.726
7	148° 42' 45"	361.69	148° 43' 16"	361.651
8	74° 39' 15"	736.945	74° 39' 17"	736.919
9	109° 40' 10"	632.785	109° 40' 16"	632.821
10	190° 33' 57"	440.101	–	
11	92° 48' 58"	478.56	–	
12	259° 19' 23"	828.934	–	
13	95° 28' 20"	873.08	95° 28' 26"	873.05
14	185° 44' 53"	–	185° 44' 53"	–
15	130° 07' 05"	1046.772	130° 07' 06"	1046.756
16	29° 52' 03"	696.695	–	
17	302° 53' 40"	404.18	–	
18	304° 52' 42"	650.675	304° 52' 50"	650.655
19	122° 29' 20"	628.545	122° 29' 18"	628.535
20	303° 54' 50"	301.983	–	
21	295° 31' 10"	636.96	–	
22	312° 15' 30"	555.96	–	
23	296° 21' 25"	459.96	–	
24	259° 30'	92.93	–	
25	113° 32' 50"	550.38	–	
26	63° 50' 49"	946.65	–	
27	109° 46' 07"	425.395	–	
28	258° 19'	1013.16	–	

(AA) LAND EXCLUDES MINERALS – T447400
(BB) LAND EXCLUDES MINERALS VIDE S.141 PUBLIC WORKS ACT 1912
(CC) LAND EXCLUDES MINERALS – SEE CROWN GRANT
(DD) COVENANT – R363374
(EE) BENEFITED BY EASEMENT FOR SERVICES VARIABLE WIDTH – DP869622

SURVEYING REGULATION 2006, CLAUSE 35(1)(B) AND CLAUSE 61(2)

MARK	M.G.A. CO-ORDINATES EASTING	M.G.A. CO-ORDINATES NORTHING	ZONE	CLASS	ORDER	R.L.	CLASS	ORDER	METHOD	ORIGIN
PM 25446	384,981	6,361,217	56	U	U					
PM 60762	381,354.815	6,363,128.872	56	A	1					
PM 60764	380,108.093	6,362,213.745	56	B	2					
PM 74055	381,594.68	6,362,196.04	56	D	4	4.13	LB	L2	CLOSED LOOP LEVEL RUN	FOUND
PM 74057	381,625.65	6,362,761.91	56	D	4					
PM 80242	382,305.16	6,362,391.01	56	D	4					
PM 81087	382,117.43	6,362,780.02	56	D	4					
PM 117680	383,883.829	6,361,035.912	56	C	U	3.91	D	4	FROM SCIMS	SCIMS
PM 117681	383,350.793	6,361,407.916	56	C	U					
SSM 6521	381,528.515	6,361,615.551	56	B	2	3.780	LB	L2	FROM SCIMS	SCIMS
SSM 28486	382,362	6,361,769	56	U	U					
SSM 28545	382,900.91	6,362,178.04	56	D	4	2.850	LB	L2	CLOSED LOOP LEVEL RUN	FOUND
SSM 28547	384,087	6,361,882	56	U	U					
SSM 28548	384,661	6,361,607	56	U	U					
SSM 28549	385,033	6,361,234	56	U	U					
SSM 35960	385,577.111	6,361,013.698	56	B	2					
SSM 35963	384,570.057	6,361,420.439	56	A	1					
SSM 116080	384,650	6,360,654	56	U	U					
SSM 116081	384,196	6,360,821	56	U	U					
SSM 116082	382,820.149	6,361,745.439	56	C	U					
TS 10823	382,888.057	6,353,335.460	56	B	2					
TS 10792	383,769.775	6,362,094.777	56	B	2					
COMBINED SCALE FACTOR: 0.999765										
SOURCED BY SCIMS: 14th May 2007										

ALL R.L.'s ARE BASED ON A.H.D. DATUM

Surveyor: PAUL JOHN STIVANO Date of Survey: 2nd NOVEMBER 2007 Surveyor's Reference: HW43.01.03.06	PLAN OF SUBDIVISION OF LOT 122 DP874949, LOT 2 DP581473 LOT 6 DP1015754 AND LOTS 71 AND 74 IN DP1119950	LGA: NEWCASTLE Locality: KOORAGANG ISLAND Subdivision No: SUC002 Lengths are in metres. Reduction Ratio 1 : 12500	Registered 29.11.2007	DP1119752

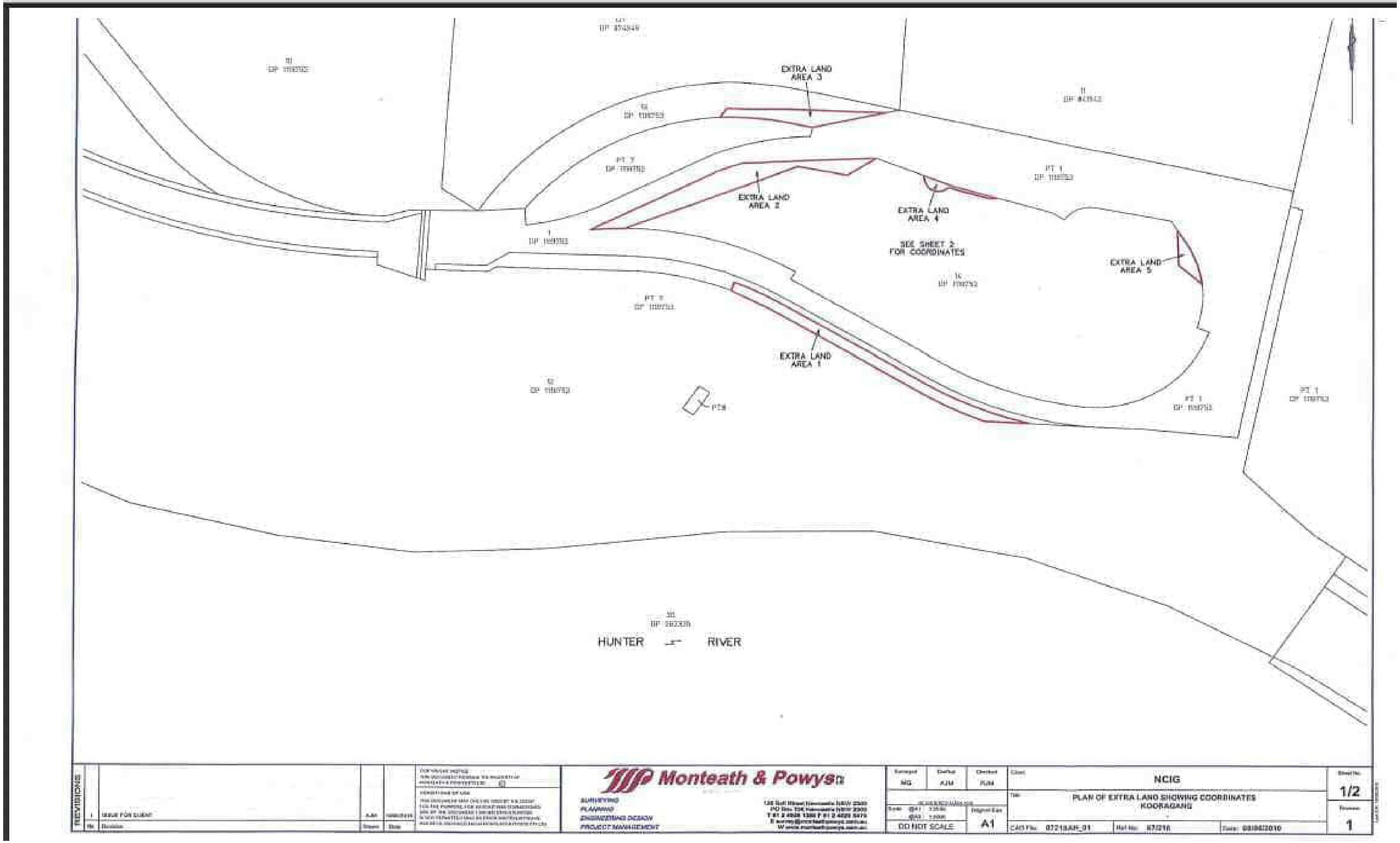
Req:R243117 /Doc:DP 1119752 P /Rev:03-Dec-2007 /Sts:SC.OK /Prt:10-Dec-2008 16:21 /Pgs:ALL /Seq:1 of 14
Ref:lee-ann /Src:T

Section 80(1) of the Protection of the Environment Operations Act 1997

Approval of the Surrender of a Licence

Licence - 6437

Department of
Environment, Climate Change and Water NSW



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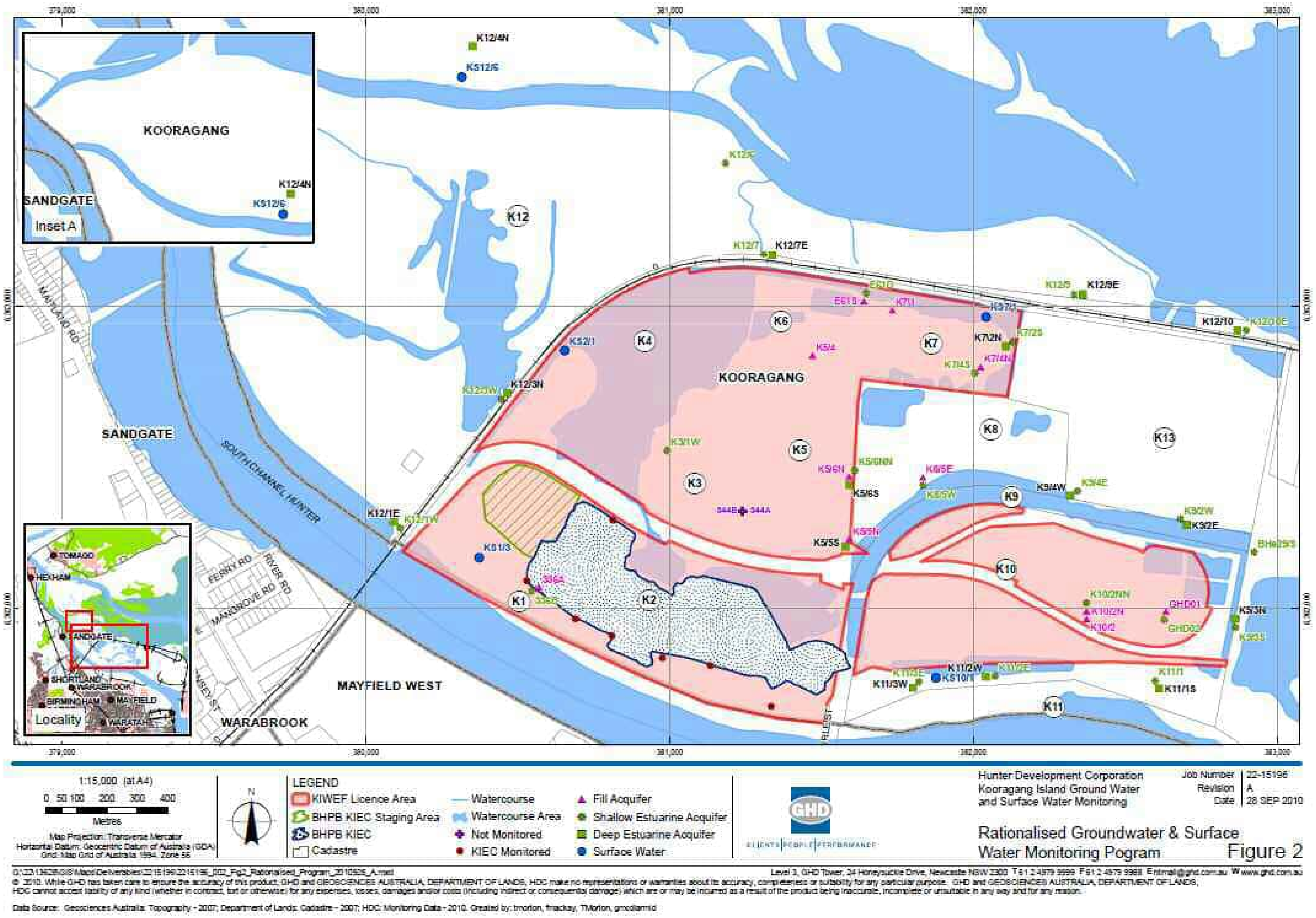


Notice to Vary a Surrender Condition

HUNTER DEVELOPMENT CORPORATION

ABN 94 688 782 063

PO BOX 813

NEWCASTLE NSW 2300

Attention: Mr Bob Hawes

Notice Number	1510956
File Number	«LicenceTrimNo»
Date	02-May-2013

VARIATION OF SURRENDER CONDITION

BACKGROUND

A. HUNTER DEVELOPMENT CORPORATION ("the licensee") is the holder of Environment Protection Licence No. 6437 ("the licence") issued under the *Protection of the Environment Operations Act 1997* ("the Act"). The licence authorised the carrying out of activities at «LocationAddress» ("the premises").

B. The licence was surrendered on **8 December 2010** by Surrender Notice number 1111840, subject to various conditions.

C. The conditions are being varied because the licensee has advised that it cannot complete the capping works required by the completion date of **28 March 2013**.

D. In a letter dated 4 February 2013, the licensee advised that it has been unable to meet the completion date referred to in paragraph B due to delays in the application to the Australian Government's Dept of Sustainability, Environment, Water, Populations and Communities relating to impacts on the threatened species, *Litorea aurea* (the Green and Golden Bell Frog).

E. The licensee has also advised would be in breach of Australian Government legislation if capping works were to commence at the premises without a determination from the Australian Government's Dept of Sustainability, Environment, Water, Populations and Communities.

VARIATION OF SURRENDER CONDITION

Notice to Vary a Surrender Condition

1. By this notice the EPA varies the condition/s of the Approval of the Surrender of licence «LinkedLicenceNo» in the following ways:

- **Amends Condition 3** to read:

  3(a) This surrender notice applies to the following land on Kooragang Island as defined by Lot and DP numbers:

  Part Lot 7, Lot 10 and Lot 11 and Part Lot 14 of DP1119752,

  and shown on the map titled '*Plan of Subdivision of Lot 122 DP874949, Lot 2 DP581473, Lot 6 DP1015754 and Lots 71 and 74 in DP1119950'* date of survey 2 November 2007, Surveyors Reference HW43.01.03.00 and registered on 29 November 2007, attached to Surrender Notice #1111840.

  Note: Part Lot 14 DP1119752 refers to that area identified as Lot 14 DP1119752 excluding land labelled as '*Extra Land Area 2', Extra Land Area 4'* and '*Extra Land Area 5'* shown on map titled '*Plan of Extra Land Showing Coordinates Kooragang'*, dated 08/06/10, attached to Surrender Notice #1111840.

  3(b) The land defined in Condition 3(a) is divided into three Areas being:

  Area 1: Polygon ID3 and Polygon ID4 - Closure Works by HDC (K2 and K10 North);

  Area 2: Polygon ID1 and Polygon ID2 - Closure Works by PWCS (North of Rail Line);

  Area 3: Polygon ID 5 - Closure Works by PWCS (with Part Funding of State) (K10 South);

  as defined by the coordinates attached to the maps titled '*Former Kooragang Island Waste Emplacement Facility Plan of Works - Western Section* ' and '*Former Kooragang Island Waste Emplacement Facility Plan of Works - Eastern Section*' both submitted to the EPA on 15 April 2013 and attached to this Variation of Surrender Condition Notice (#1510956) .

- **Amends Condition 4(a)** to read:

  By **30 June 2017,** the licensee shall complete implementation of the final landform and capping strategy as detailed in the documents titled:

  Hunter Development Corporation - Report on KIWEF - Revised Final Landform and Capping Strategy - August 2009 - Revision 2, prepared by GHD, ("the Landform and Capping Strategy");

  '*Green and Golden Bell Frog Management Plan – Kooragang Island Waste Emplacement Facility Closure Works*' dated 19 April 2011 and prepared by Golder Associates;

  K26/32 and K24/31 Ponds Action Plan– Kooragang Island Waste Emplacement Facility' dated 31 May 2011 and prepared by Golder Associates and

  '*Materials Management Plan - Kooragang Island Waste Emplacement Facility*' dated November 2012 prepared by RCA Australia.

- **Removes Condition 4(b)** as the existing bentonite based geosynthetic clay liner installed over Pond 5 is consistent with the performance objectives of the agreed capping strategy as specified in the Landform and Capping Strategy referred to in Condition 4(a).

- **Replaces Condition 4(b)** with the following new condition.

4(b) The capping and closure works as defined in Condition 4(a) are to be carried out in a staged manner in accordance with the following timeframes:

Area 1: - Capping and Closure works to be completed by **31 December 2014**

Area 2: - Capping and Closure works to be completed by **30 June 2017**

Area 3: - Capping and Closure works to be completed by **30 June 2017**

- **Removes Conditions 4(c)** as the Materials Management Plan has been updated in accordance with Condition 4(c). The updated Materials Management Plan is now referred to in Condition 4(a).
- **Replaces Condition 4(c)** with the following new condition.

4(c) Capping and Closure works, as defined in Condition 4(a), in Areas 2 and 3 may occur in synergy with the construction of the proposed Terminal 4 ('T4') project. If, by 28 February 2014, the T4 project does not obtain development consent necessary to commence construction of the T4 project, the licensee is required by this notice to complete Capping and Closure works in Areas 2 and 3, as defined in Condition 4(a).

- **Replaces Condition 4(k)** with the following new condition.

4(k) The licensee shall provide the EPA with a written statement of the results of the inspection required by condition 4(j) on an annual basis. The statement must describe the condition of the cap and any actions taken to remediate the cap as a result of the inspection. The first statement must be provided to the EPA by **30 June 2015 for Area 1** and **31 December 2017 for Areas 2 and 3**, with subsequent reports provided 12 monthly following the provision of the first report.

- **Removes Condition 5(a) and 5(b)** as these reports have been submitted to, and reviewed by the EPA. The reports required by these conditions are now referred to in Condition 4(a).
- **Conditions 5(a) and 5(b)** are to read '**Not Applicable**'.
- Adds the following new condition at **Condition 5(f)**.

Condition 5(f) If any samples collected at the monitoring locations identified in Conditions 5(c) and 5(d) show an increase in pollutant concentration at the boundary of the lands to which this notice applies, Hunter Development Corporation must commence capping works within 2 months of receiving the data. Capping works are to commence, regardless of the progress of the T4 project, unless otherwise agreed in writing by the EPA.

- Apart from amendments as detailed in this Variation Notice, all other conditions are to remain as drafted on Surrender Notice #1111840 issued on 08 December 2010.

....

Rebecca Scrivener

Acting Unit Head

North - Hunter

Notice to Vary a Surrender Condition

(by Delegation)

INFORMATION ABOUT THIS NOTICE

- This notice is issued under section 81(3) of the Act.

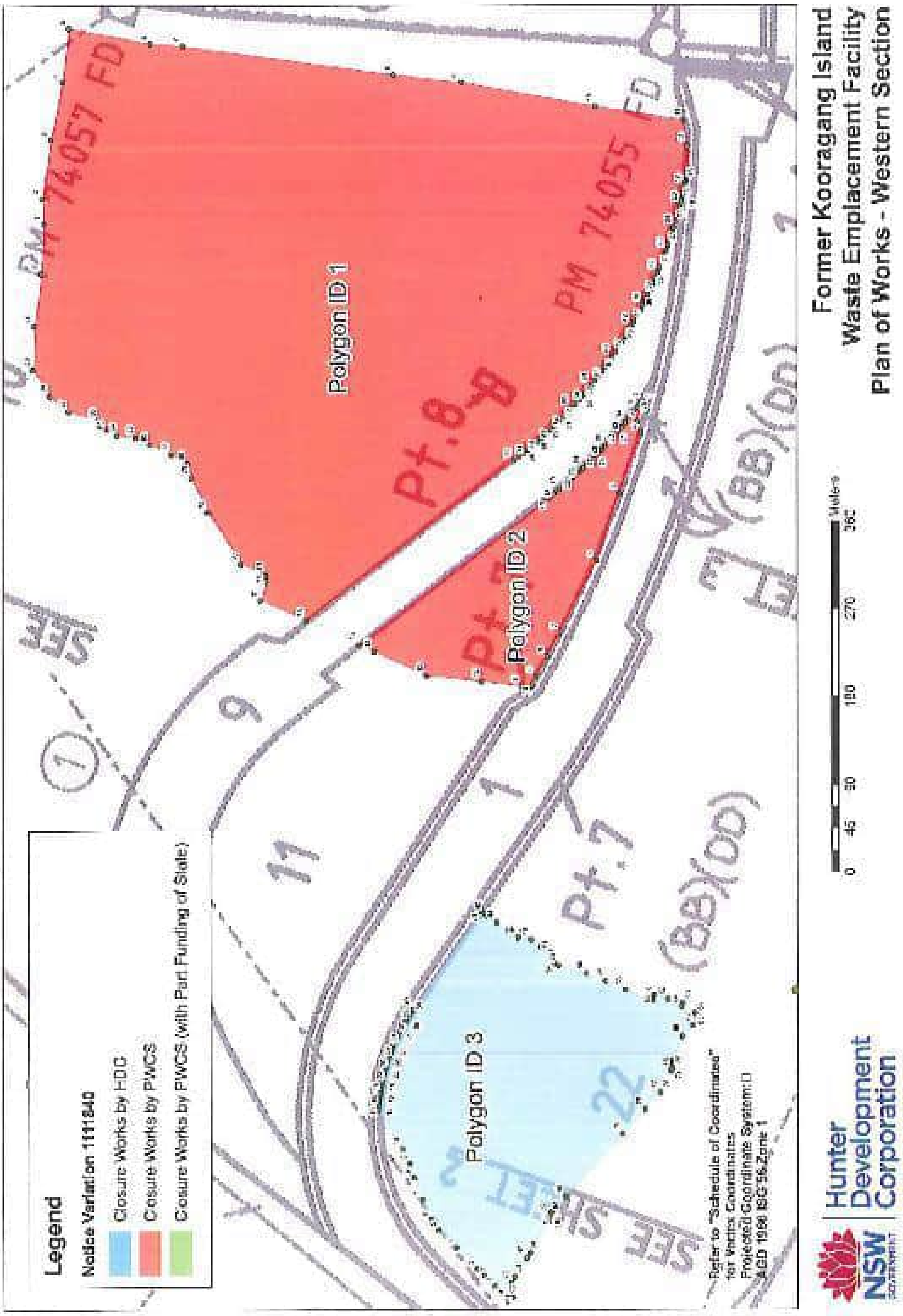
Appeals against this decision

- You can appeal to the Land and Environment Court against this decision. The deadline for lodging the appeal is 21 days after you were given notice of this decision.

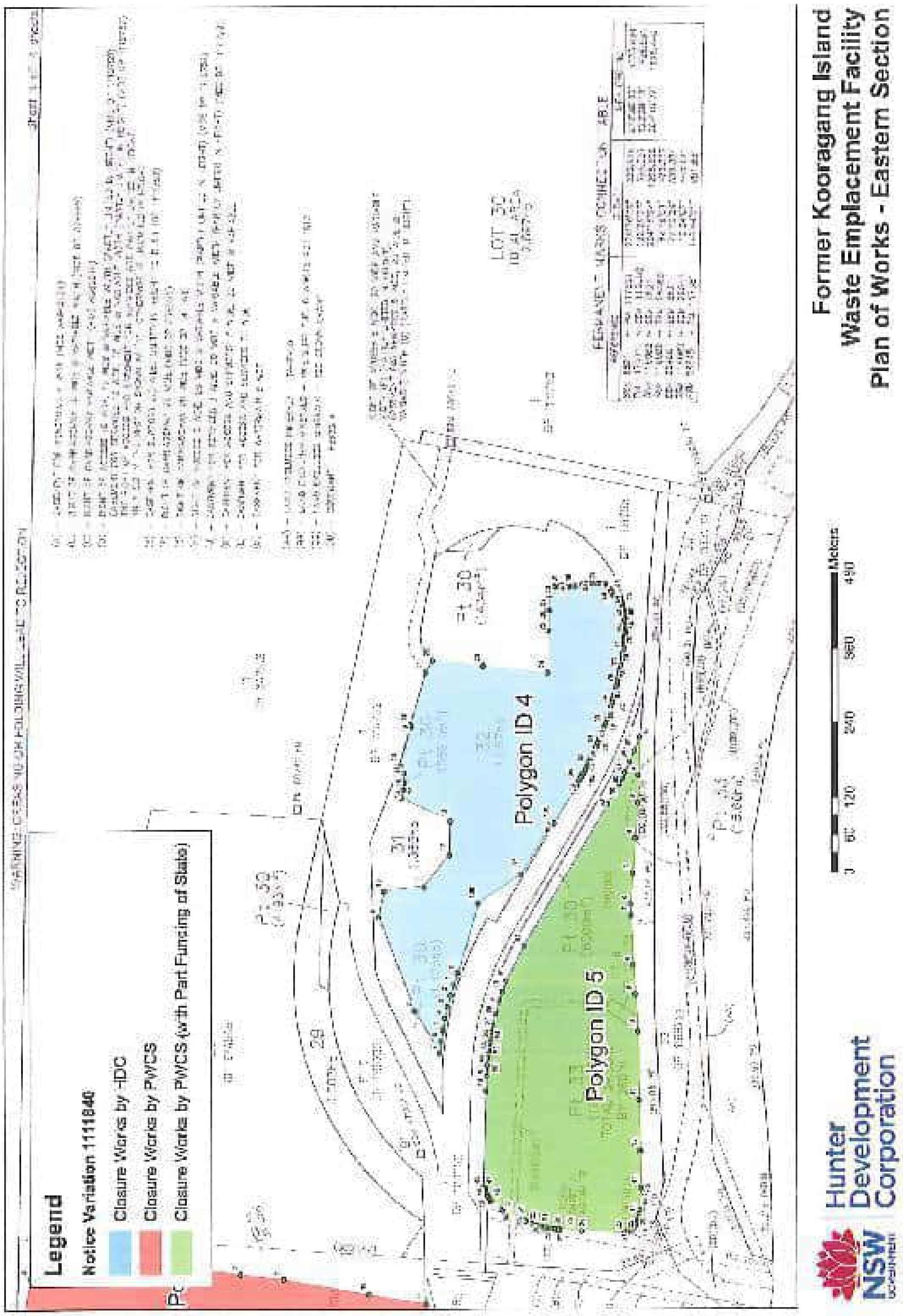
When this notice begins to operate

- The variations to the Approval of the Surrender of licence specified in this notice begin to operate immediately from the date of this notice, unless another date is specified in this notice.
- If an appeal is made against this decision to vary a condition of Approval of Surrender of licence and the Land and Environment Court directs that the decision is stayed the decision does not operate until the stay ceases to have effect or the Land and Environment Court confirms the decision or the appeal is withdrawn (whichever occurs first).

Notice to Vary a Surrender Condition



Notice to Vary a Surrender Condition



Notice to Vary a Surrender Condition

Schedule of Coordinates   Polygon ID 1   Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
0	368383.146	1361891.183
1	368434.849	1361888.268
2	368481.322	1361890.336
3	368521.712	1361881.236
4	368581.276	1361869.241
5	368636.288	1361862.623
6	368620.156	1361777.828
7	368617.675	1361743.910
8	368587.893	1361525.926
9	368580.034	1361455.609
10	368555.216	1361317.042
11	368540.325	1361224.389
12	368513.850	1361220.252
13	368489.277	1361220.252
14	368483.815	1361221.215
15	368477.733	1361222.387
16	368471.007	1361223.598
17	368465.816	1361224.907
18	368459.584	1361226.295
19	368457.833	1361226.721
20	368453.589	1361227.760
21	368447.574	1361229.303
22	368441.600	1361230.823
23	368435.847	1361232.620
24	368429.716	1361234.394
25	368423.809	1361236.245
26	368417.926	1361238.172
27	368412.069	1361240.174
28	368406.238	1361242.252
29	368400.434	1361244.406
30	368394.658	1361246.634
31	368388.912	1361248.930
32	368383.196	1361251.313
33	368377.512	1361253.763
34	368371.859	1361256.287
35	368366.240	1361258.883
36	368360.654	1361261.552
37	368355.104	1361264.293
38	368349.589	1361267.105
39	368344.111	1361269.988
40	368338.671	1361272.942
41	368333.270	1361275.966
42	368327.908	1361279.059
43	368322.586	1361282.222
44	368317.306	1361285.453
45	368312.068	1361288.752
46	368306.873	1361292.118
47	368301.722	1361295.551
48	368296.616	1361299.051
49	368291.556	1361302.616
50	368286.542	1361306.246
51	368281.575	1361309.941
52	368276.656	1361313.700
53	368271.787	1361317.522
54	368266.967	1361321.406

Notice to Vary a Surrender Condition

Schedule of Coordinates Polygon ID 1 Ref KIWLF Plan of Works

Reference No	X Coordinate	Y Coordinate
55	368262.196	1361325.353
56	368257.480	1361329.380
57	368252.815	1361333.429
58	368248.202	1361337.557
59	368243.643	1361341.745
60	368239.139	1361345.991
61	368234.690	1361350.295
62	368230.296	1361354.656
63	368225.960	1361359.074
64	368221.681	1361363.547
65	368217.460	1361368.075
66	368213.298	1361372.656
67	368209.196	1361377.293
68	368205.154	1361381.982
69	368201.173	1361386.722
70	368197.253	1361391.513
71	368193.396	1361396.355
72	368189.601	1361401.240
73	368025.503	1361615.613
74	368046.883	1361662.038
75	368066.717	1361657.048
76	368072.921	1361657.461
77	368083.876	1361682.693
78	368137.034	1361717.438
79	368172.607	1361734.810
80	368187.084	1361738.533
81	368196.597	1361755.492
82	368206.525	1361777.414
83	368213.970	1361792.719
84	368216.452	1361812.087
85	368222.656	1361823.328
86	368231.756	1361831.600
87	368240.856	1361862.623
88	368256.988	1361882.063
89	368284.287	1361898.022
90	368329.373	1361897.781

Notice to Vary a Surrender Condition

Schedule of Coordinates | Polygon ID 2 | Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
0	368244.519	1361272.818
1	368249.694	1361268.855
2	368251.260	1361267.686
3	368230.516	1361272.370
4	368218.106	1361268.647
5	368166.809	1361291.397
6	368087.399	1361316.388
7	368013.358	1361353.028
8	367988.954	1361366.078
9	367969.100	1361378.260
10	367959.173	1361382.396
11	367957.932	1361392.737
12	367963.308	1361434.100
13	367969.100	1361491.595
14	367993.918	1361545.781
15	368001.181	1361561.838
16	368148.311	1361369.638
17	368152.304	1361364.487
18	368156.381	1361359.385
19	368160.479	1361354.334
20	368164.000	1361349.333
21	368168.901	1361344.385
22	368173.203	1361339.488
23	368177.504	1361334.645
24	368181.985	1361329.856
25	368186.464	1361325.121
26	368191.001	1361320.442
27	368195.595	1361315.819
28	368200.246	1361311.252
29	368204.952	1361306.743
30	368209.713	1361302.292
31	368214.528	1361297.900
32	368219.397	1361293.567
33	368224.319	1361289.295
34	368229.293	1361285.083
35	368234.318	1361280.932
36	368239.394	1361276.844

Notice to Vary a Surrender Condition

Schedule of Coordinates　　Polygon ID 3　　Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
0	367327.607	1361409.027
1	367339.093	1361420.906
2	367351.097	1361432.131
3	367357.821	1361439.778
4	367379.838	1361460.555
5	367397.839	1361478.578
6	367408.840	1361486.404
7	367429.670	1361495.504
8	367452.378	1361504.081
9	367486.699	1361508.611
10	367481.568	1361516.379
11	367521.137	1361541.103
12	367523.873	1361540.974
13	367527.653	1361540.091
14	367531.626	1361540.329
15	367536.592	1361539.868
16	367539.648	1361539.368
17	367543.492	1361538.768
18	367547.424	1361538.090
19	367551.342	1361537.333
20	367555.243	1361536.498
21	367559.128	1361535.585
22	367562.993	1361534.595
23	367566.837	1361533.528
24	367570.660	1361532.384
25	367574.458	1361531.163
26	367578.232	1361529.867
27	367581.979	1361528.496
28	367585.698	1361527.050
29	367589.387	1361525.530
30	367593.045	1361523.937
31	367596.670	1361522.271
32	367600.261	1361520.532
33	367603.817	1361518.722
34	367607.336	1361516.842
35	367610.817	1361514.891
36	367614.259	1361512.871
37	367617.657	1361510.783
38	367621.015	1361508.627
39	367624.330	1361506.404
40	367625.819	1361505.373
41	367726.725	1361434.862
42	367724.528	1361431.918
43	367721.379	1361427.443
44	367715.618	1361418.809
45	367707.627	1361407.507
46	367700.081	1361396.781
47	367706.887	1361391.972
48	367705.176	1361389.711
49	367697.638	1361383.073
50	367689.988	1361373.173
51	367684.475	1361362.935
52	367681.775	1361362.373
53	367676.600	1361361.608
54	367673.502	1361359.223

Page 4 of 9　　Variation to N1111040

Notice to Vary a Surrender Condition

Schedule of Coordinates | Polygon ID 3 | Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
55	367671.200	1361355.285
56	367662.734	1361320.129
57	367655.083	1361306.216
58	367646.463	1361285.412
59	367637.090	1361263.243
60	367636.553	1361256.811
61	367640.708	1361254.968
62	367636.533	1361240.941
63	367631.894	1361225.386
64	367628.558	1361226.444
65	367622.708	1361212.381
66	367619.783	1361211.593
67	367609.208	1361215.081
68	367597.620	1361225.881
69	367571.712	1361237.400
70	367569.806	1361236.598
71	367568.430	1361236.240
72	367567.438	1361236.124
73	367565.939	1361236.136
74	367564.948	1361236.269
75	367562.230	1361237.193
76	367540.288	1361248.378
77	367539.434	1361248.870
78	367522.546	1361261.482
79	367498.844	1361288.241
80	367432.224	1361347.976
81	367418.813	1361360.559
82	367416.797	1361362.224
83	367416.002	1361362.829
84	367415.150	1361363.362
85	367412.484	1361364.779
86	367374.257	1361384.419
87	367369.094	1361388.109
88	367349.471	1361400.724
89	367343.935	1361403.458
90	367338.623	1361403.377
91	367333.047	1361402.045
92	367329.641	1361401.775
93	367328.283	1361404.180

Notice to Vary a Surrender Condition

Schedule of Coordinates | Polygon ID 4 | Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
0	369074.361	1361173.135
1	369050.409	1361179.246
2	369030.262	1361184.721
3	369019.833	1361189.552
4	369001.445	1361193.734
5	368987.822	1361197.282
6	368984.086	1361200.131
7	368945.260	1361202.338
8	369012.847	1361242.483
9	369104.511	1361301.132
10	369206.242	1361291.838
11	369212.837	1361227.497
12	369264.644	1361186.345
13	369319.262	1361184.939
14	369366.162	1361263.823
15	369370.328	1361261.362
16	369381.489	1361259.466
17	369396.417	1361259.905
18	369408.213	1361266.640
19	369471.210	1361248.567
20	369474.518	1361240.461
21	369558.818	1361225.158
22	369577.563	1361213.312
23	369668.731	1361132.119
24	369658.063	1361027.395
25	369624.600	1361026.312
26	369657.304	1361025.778
27	369681.950	1361025.370
28	369693.478	1361016.761
29	369695.029	1361012.791
30	369694.792	1361008.487
31	369696.877	1361006.744
32	369697.486	1361003.654
33	369695.762	1360998.650
34	369695.870	1360993.580
35	369698.473	1360983.933
36	369699.252	1360972.000
37	369700.628	1360965.293
38	369701.517	1360950.501
39	369700.383	1360940.564
40	369701.652	1360938.268
41	369701.027	1360933.365
42	369697.719	1360930.878
43	369695.919	1360930.139
44	369690.835	1360925.850
45	369687.096	1360924.409
46	369685.961	1360923.700
47	369680.046	1360919.080
48	369676.665	1360912.986
49	369677.606	1360908.978
50	369676.647	1360908.688
51	369672.947	1360907.704
52	369669.227	1360906.786
53	369665.489	1360905.946
54	369661.734	1360905.184

Notice to Vary a Surrender Condition

Schedule of Coordinates | Polygon ID 4 | Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
55	369657.964	1360904.501
56	369654.181	1360903.898
57	369650.365	1360903.370
58	369646.580	1360902.923
59	369642.767	1360902.556
60	369638.940	1360902.267
61	369635.120	1360902.059
62	369631.291	1360901.930
63	369627.460	1360901.881
64	369623.629	1360901.912
65	369619.799	1360902.023
66	369615.972	1360902.213
67	369612.150	1360902.483
68	369608.338	1360902.833
69	369602.788	1360903.478
70	369596.016	1360904.374
71	369589.253	1360905.348
72	369582.503	1360906.402
73	369575.765	1360907.534
74	369569.041	1360908.745
75	369562.332	1360910.035
76	369555.638	1360911.403
77	369548.980	1360912.850
78	369542.300	1360914.374
79	369535.659	1360915.970
80	369529.036	1360917.650
81	369522.434	1360919.414
82	369515.852	1360921.240
83	369509.283	1360923.159
84	369502.756	1360925.147
85	369496.243	1360927.211
86	369489.755	1360929.351
87	369483.202	1360931.567
88	369476.855	1360933.858
89	369470.446	1360936.225
90	369464.065	1360938.668
91	369457.713	1360941.182
92	369451.390	1360943.772
93	369445.099	1360946.436
94	369438.839	1360949.173
95	369432.611	1360951.984
96	369426.417	1360954.866
97	369420.257	1360957.822
98	369414.132	1360960.849
99	369408.042	1360963.947
100	369401.990	1360967.117
101	369395.975	1360970.357
102	369389.998	1360973.667
103	369384.060	1360977.047
104	369378.161	1360980.497
105	369316.019	1361017.329
106	369317.910	1361020.660
107	369233.364	1361070.649
108	369186.887	1361140.382

Notice to Vary a Surrender Condition

Schedule of Coordinates   Polygon ID 5   Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
0	369453.130	1360879.065
1	369454.455	1360875.605
2	369383.221	1360881.067
3	369348.485	1360881.716
4	369281.598	1360885.917
5	369235.684	1360890.045
6	369186.216	1360893.772
7	369167.672	1360893.040
8	369086.888	1360889.672
9	369039.789	1360886.243
10	368979.195	1360881.632
11	368860.064	1360880.063
12	368786.705	1360878.490
13	368726.582	1360877.175
14	368691.027	1360879.555
15	368680.379	1360880.550
16	368675.736	1360881.305
17	368671.278	1360882.800
18	368667.111	1360885.096
19	368663.342	1360887.927
20	368660.063	1360891.312
21	368657.355	1360895.170
22	368655.285	1360899.404
23	368653.903	1360903.910
24	368657.750	1360972.563
25	368658.746	1361008.176
26	368660.020	1361011.653
27	368660.672	1361017.212
28	368661.370	1361023.166
29	368662.799	1361030.884
30	368664.477	1361037.850
31	368666.546	1361044.864
32	368669.363	1361052.857
33	368673.913	1361063.669
34	368678.851	1361074.242
35	368690.506	1361100.694
36	368692.827	1361105.412
37	368695.416	1361109.271
38	368697.751	1361112.298
39	368701.089	1361116.404
40	368705.714	1361119.915
41	368709.054	1361122.292
42	368712.406	1361124.272
43	368715.316	1361125.705
44	368718.818	1361127.069
45	368721.183	1361127.561
46	368725.114	1361129.018
47	368726.815	1361129.368
48	368726.081	1361132.890
49	368884.159	1361127.697
50	368907.320	1361126.930
51	368925.452	1361125.970
52	368937.512	1361124.930
53	368940.541	1361123.572
54	368981.530	1361121.896

Notice to Vary a Surrender Condition

Schedule of Coordinates   Polygon ID 5   Ref KIWEF Plan of Works

Reference No	X Coordinate	Y Coordinate
55	368967.506	1361120.940
56	368979.418	1361118.792
57	368991.271	1361116.327
58	369008.918	1361112.046
59	369029.404	1361106.178
60	369043.629	1361101.405
61	369062.000	1361094.521
62	369118.003	1361066.924
63	369346.408	1360930.546
64	369361.615	1360921.598
65	369379.158	1360911.998
66	369388.046	1360907.413
67	369397.008	1360902.978
68	369415.146	1360894.553
69	369432.740	1360887.149

Notice to Vary a Surrender Condition

Notice to Vary a Surrender Condition

HUNTER DEVELOPMENT CORPORATION

ABN 94 688 782 063

PO BOX 813

NEWCASTLE NSW 2300

Attention: Mr Mike Bardsley

Notice Number	1520063
File Number	DOC14/53448 -01
Date	17-Apr-2014

VARIATION OF SURRENDER CONDITION

BACKGROUND

A. HUNTER DEVELOPMENT CORPORATION ("the licensee") is the holder of Environment Protection Licence No. 6437 ("the licence") issued under the *Protection of the Environment Operations Act 1997* ("the Act"). The licence authorised the carrying out of activities at CORMORANT DRIVE, KOORAGANG, NSW, 2304.

B. The licence was surrendered on 8 December 2010 by Surrender Notice number 1111840, subject to various conditions. The surrender notice was varied under Variation of Surrender Condition - Notice # 1510956 on 2 May 2013.

C. The licensee has requested an extension to the date provided in Condition 4(c) which acknowledges that Capping and Closure works, as defined in Condition 4(a), in Areas 2 and 3 may occur in synergy with the construction of the proposed T4 coal terminal project.

D. This notice removes this trigger date.

E. The date for the completion of capping and closure works in Areas 2 and 3 remains unchanged and the EPA expects that works will be commenced within a suitable timeframe to ensure that they are completed by the existing due date of 30 June 2017 .

Notice to Vary a Surrender Condition

VARIATION OF SURRENDER CONDITION

1. By this notice the EPA varies the condition/s of the Approval of the Surrender of Licence 6437 (Surrender Notice #1111840) in the following ways:

   - Condition 4(c) varied to read:

     Capping and Closure works, as defined in Condition 4(a), in Areas 2 and 3 may occur in synergy with the construction of the proposed terminal 4 ('T4') project.

....

Rebecca Scrivener

Acting Unit Head

North - Hunter

(by Delegation)

INFORMATION ABOUT THIS NOTICE

- This notice is issued under section 81(3) of the Act.

Appeals against this decision

- You can appeal to the Land and Environment Court against this decision. The deadline for lodging the appeal is 21 days after you were given notice of this decision.

When this notice begins to operate

- The variations to the Approval of the Surrender of licence specified in this notice begin to operate immediately from the date of this notice, unless another date is specified in this notice.
- If an appeal is made against this decision to vary a condition of Approval of Surrender of licence and the Land and Environment Court directs that the decision is stayed the decision does not operate until the stay ceases to have effect or the Land and Environment Court confirms the decision or the appeal is withdrawn (whichever occurs first).

APPENDIX C
Quality Assurance /Quality Control Report

1 LABORATORY REPORTS

Primary results and QAQC results were reported in the Envirolab certificates of analysis 299973, 299478, 298541, 299656, 298855, and 299097, and ALS reports ES2221693, ES2223035 and ES2224044. The data quality assessment detailed below refers to the data provided in these laboratory reports.

2 DATA QUALITY INDICATORS

Data Quality Indicators ("**DQI**") are typically developed to provide goals for the quality of data required to sufficiently meet the site-specific objectives of environmental site assessments and validation assessments. Precision, sensitivity, accuracy, representativeness, comparability and completeness (PSARCC parameters) are all indicators of data quality. The DQIs used to assess the PSARCC parameters for this assessment are detailed in **Table A**. The DQIs in **Table A** are in accordance with the ASC NEPM and are adopted by NSW EPA (2006).

Table A: Data Quality Indicators

Data Quality Indicator	Data Quality Indicator Limits	Non-Conformance Action
Precision		
Field Duplicate RPDs (inter-laboratory and intra-laboratory).	Hazmat has developed the following DQIs for field duplicates: • Less than 10 times LOR: no limit • Greater than 10 times LOR: <50% RPD Collected at a frequency of 5% for intra-lab and 5% for inter-lab duplicates.	Assess sample matrix. Request lab confirmation and if necessary re-analysis.
Laboratory Duplicate RPDs	Laboratory specified limits (expected to be similar to field duplicate DQIs).	Request lab confirmation
Method Blanks	Not detected above LOR.	Request lab confirmation
Sensitivity		
Practical Quantitation Limit (PQL) or LOR	Typically, this is achieved when PQLs is at least 3 times lower than the adopted screening levels.	Request more sensitive analysis from lab.
Accuracy		
Laboratory Control Samples	The laboratory sets their own limits for organic and inorganic compounds which are generally between 70% and 130% recovery. Recovery limits for each analyte are specified in the laboratory reports in Appendix E.	Request Lab Confirmation
Single Control Spikes (organics)	Specified by the laboratory within the quality control report or the certificates of analysis.	Request Lab Confirmation
Matrix Spikes (MS)	DQI provided by laboratory and varies between laboratories and surrogates.	Request Lab Confirmation
MS Duplicates and Duplicate Control Spikes	DQI provided by laboratory and varies between laboratories and surrogates.	Request Lab Confirmation

Data Quality Indicator	Data Quality Indicator Limits	Non-Conformance Action
Surrogate Spikes	DQI provided by laboratory and varies between laboratories and surrogates.	Request Lab Confirmation
Representativeness		
Rinsates	Not detected above LOR	Reassess decontamination procedure during sample collection
	All fieldwork including decontamination procedures to be undertaken in accordance with industry best practice.	
	Samples analysed for the analytes requested on the COC.	Refer any non-conformances to lab request explanation
	Sample handling, storage and transport to be in accordance with ASC NEPM.	
	Samples to be extracted and analysed within appropriate holding times.	Refer any non-conformances to lab request explanation
	Samples to be transported under full chain of custody documentation. The laboratory to return a copy of the signed CoC acknowledging the receipt data and time and identity of samples included in the shipment.	
	Include laboratory certificates of analysis which detail any standard and non-standard methods used.	
Completeness		
	100% of results requested for analysis to be reported by analytical laboratory.	Request confirmation
	Total representative data set to be >95% complete after data validation procedures.	
Comparability		
	Samples to be collected by experienced professional staff.	
	Where possible, analysis to be undertaken at NATA accredited laboratories utilising NATA accredited methods.	
	Detailed sample logs to be completed for each sample location noting any observed variations between conditions and signs of potential contamination.	
	Transported under the same conditions and analysed by one laboratory using consistent methods for each analysis suite.	

Data Quality Indicator	Data Quality Indicator Limits	Non-Conformance Action
	Primary samples to be stored and handled.	
	DQIs to indicate acceptable Precision and Accuracy.	

3 PRECISION

The precision of a duplicate determination was measured as Relative Percentage Difference ("**RPD**"), calculated from the following equation:

$$RPD = \left[\frac{X1 - X2}{\left(\frac{X1 + X2}{2} \right)} \right] \times 100$$

where: X1 is the primary sample analyte value
X2 is the duplicate sample analyte value

3.1 Field Precision

Intra-laboratory field duplicates are taken and analysed as an indicator of the effect of the field sampling protocol on the precision of analytical results. These duplicates also provide an indication of the nature of the field samples in terms of their relative heterogeneity and media variance. Intra-laboratory duplicate samples are required to be collected at a rate of one per 20 samples (5%) in accordance with ASC NEPM and the Brief.

Inter-laboratory field duplicates are taken and analysed as an indicator of the precision between different laboratories, as well as field sampling protocol and the nature of the field sample heterogeneity. Inter-laboratory duplicate samples are also required to be collected at a rate of one per 20 samples (5%) in accordance with ASC NEPM and the Brief.

Three intra-laboratory duplicates and three inter-laboratory duplicates were submitted representing 42 primary samples. The frequency between intra-lab and inter-lab samples averages at 6.7% and 6.7% respectively which is within the DQI shown in **Table A** for intra-laboratory and inter-laboratory duplicates.

RPDs were only calculated were both the primary and the duplicate sample reported a result above LOR. The majority of calculated RPD were within stipulated limits. RPDs are shown in **Table B** below.

Table B: Summary of QA/QC Samples and RPDs

ANALYTES			Ammonia	Phenols	Free Cyanide	Weak Acid Disociable Cyanide	Total Cyanide	Cr VI - Dissolved	Mo - Dissolved	Pb - Dissolved	BTEX	TRH	Total PAHs	Naphthalene	Benzo(a)pyrene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L			µg/L	µg/L	µg/L
LOR			0.01	1	0.004	0.004	0.004	0.01	0.001	0.001			0.5	0.2	0.5
Sample ID	**Duplicate Type**	**Batch ID**													
KS7/1		298541	0.005	<50	<0.004	<0.004	<0.004	<0.005	0.023	<0.001	-	-	<0.1	<0.2	<0.1
QC1		298541	0.007	<50	<0.004	<0.004	<0.004	<0.005	<0.001	0.02	-	-	<0.1	<0.2	<0.1
RPD A	Intra-lab		33%	-	-	-	-	-	-	-	-	-	-	-	-
KS7/1		298541	0.007	<50	<0.004	<0.004	<0.004	<0.005	<0.001	0.02	-	-	<0.1	<0.2	<0.1
QC1A		ES2221693	<0.01	<1	<0.004	<0.004	<0.004	<0.01	0.019	<0.001	-	-	<0.5	<0.1	<0.5
RPD A	Inter-lab		-	-	-	-	-	-	-	-	-	-	-	-	-
K11/3W		299478	5.6	<50	<0.004	<0.004	0.009	<0.005	<0.001	<0.001	-	-	<0.1	<0.1	<0.1
QC2		299478	5.7	<50	<0.004	<0.004	0.008	<0.005	<0.001	<0.001	-	-	<0.1	<0.2	<0.1
RPD A	Intra-lab		2%	-	-	-	-	-	-	-	-	-	-	-	-
K11/3W		299478	5.6	<50	<0.004	<0.004	0.009	<0.005	<0.001	<0.001	-	-	<0.1	<0.1	<0.1
QC2A		ES2223035	6.07	<1	<0.004	<0.004	<0.004	<0.10	<0.001	<0.001	-	-	<0.5	<0.1	<0.5
RPD A	Inter-lab		8%	-	-	-	-	-	-	-	-	-	-	-	-
K11/1S		299973	6.6	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	-	-	<0.1	<0.2	<0.1
QC3		299973	6.6	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	-	-	<0.1	<0.2	<0.1
RPD A	Intra-lab		0%	-	-	-	-	-	-	-	-	-	-	-	-
K11/1S		299973	6.6	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	-	-	<0.1	<0.2	<0.1
QC3A		ES2224044	5.41	<1	<0.004	<0.004	<0.004	<0.01	<0.001	<0.001	-	-	<0.5	<1.0	<0.5
RPD A	Inter-lab		20%	-	-	-	-	-	-	-	-	-	-	-	-

3.2 Laboratory Precision

Precision is a measure of the variation in results from a laboratory method. The laboratory measures the precision of the analyses performed on a particular batch of samples using laboratory duplicates. Acceptable RPDs for parameters are specified by the testing laboratory.

Each RPD was in accordance with the stipulated DQIs.

3.3 Sensitivity

The LOR is at least 3 times below the adopted investigation limit for all analytes with the exception of hexavalent chromium. Hexavalent chromium was reported at concentrations below the LOR and is therefore considered to be close to the adopted guideline values. Overall, the data is considered sufficiently sensitive for interpretative use.

4 ACCURACY

Accuracy is a measure of the closeness of the analytical result obtained by a method to the 'true' value. The laboratory measures accuracy using matrix spikes, laboratory control samples, control spikes, method blanks and surrogate spikes.

4.1 Matrix Spikes

Matrix spikes are prepared by spiking a field sample with a known concentration of a recommended spiking compound in order to ascertain the effects of the specific sample matrix on the recovery of analytes.

Accuracy as indicated by matrix spikes is measured in terms of percentage recovery as defined by the following equation:

– $$\%R = \frac{SSR - SR}{SA} X\, 100$$

where: %R = percentage recovery of the spike

SSR = spiked sample result

SR = sample result (native)

SA = spike added

All matrix spike recoveries in all work orders were within stipulated limits.

4.2 Laboratory Control Spikes

Laboratory Control Spikes ("**LCS**") are prepared by spiking a clean matrix (i.e. a matrix with the target analytes below the LOR), with known quantities of an organic or inorganic compound. Laboratory control samples are analysed at a rate of one per analytical batch for analytes.

Accuracy as indicated by laboratory control samples is measured in terms of percentage recovery as defined by the following equation:

%R = LCSR/LCSC

where: %R = percentage recovery of the laboratory control sample
LCSR = laboratory control sample result
LCSC = laboratory control sample concentration

The quality control analyte specific acceptance criterion is three times the standard deviation of the historical mean for each analyte. The range for each analyte is specified in the certificate of analysis.

No LCS outliers occurred.

4.3 Method Blanks

Method blanks monitor the externally introduced contaminants, which potentially derive from glassware, cleaning reagents and digestion reagents during the analysis process. The laboratory blank is treated as a sample in the laboratory, going through the same sample preparation and analysis procedures as corresponding samples.

All method blank results were reported below the LOR.

4.4 Surrogate Spikes

Both primary and QAQC samples analysed for organic parameters are spiked prior to extraction with surrogate compounds that are representative of the target analysis, but are not commonly found in samples taken from the natural environment.

Accuracy as indicated by surrogate spikes is measured in terms of percentage recovery as defined by the following equation:

%R = SSR/Sa x 100

where: %R = percentage recovery of the spike
SSR = spiked sample result
SA = spike added

The DQIs used for the assessment are based on USEPA surrogate recovery limits. No surrogate spike outliers occurred.

5 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sample point or an environmental condition. Representativeness is a qualitative parameter, which is most concerned with the proper design and implementation of the sampling program.

5.1 Rinsate Samples

A total of 14 rinsate samples were collected and analysed for the primary sample analysis. Results are reported below the LOR for the majority of analytes. Analytical results are provided in **Table C** and in the certificates of analysis in **Appendix E**.

Table C: Rinsate Blank Analytical Results

QC sample	Batch No	Date	Analysis Results
Rinsate 01	298541	20/06/2022	All below laboratory LOR
Rinsate 02	298541	21/06/2022	All below laboratory LOR
Rinsate 03	298855	22/06/2022	All below laboratory LOR
Rinsate 04	298855	23/06/2022	All below laboratory LOR
Rinsate 05	299097	24/06/2022	All below laboratory LOR
Rinsate 06	299097	27/06/2022	All below laboratory LOR
Rinsate 07	299478	28/06/2022	All below laboratory LOR
Rinsate 08	299478	29/06/2022	All below laboratory LOR
Rinsate 09	299656	01/07/2022	All below laboratory LOR
Rinsate 10	299656	04/07/2022	All below laboratory LOR
Rinsate 11	299973	06/07/2022	All below laboratory LOR

5.2 General Parameters

Other general parameters were employed to ensure representativeness, including:

- The sampling and analysis program was developed by experienced professionals based on adequate site history and a thorough understanding of the sampling objective.
- Samples were placed in clean, preserved/unpreserved laboratory supplied containers suitable for the target analytes. Samples were stored, transported and handled at a temperature of less than 4 °C and in accordance with NEPM 2013.
- Samples were transported under full chain of custody documentation including the sampler, nature of the sample, collection date, analyses to be performed, sample preservation method and departure time from the site. The laboratory returned a copy of the signed chain of custody acknowledging the receipt data and time and identity of samples included in the shipment. The chain of custody documentation is included in each of site contamination assessment reports.
- All fieldwork was undertaken in general accordance with Hazmat's standard operating procedures.

6 COMPARABILITY

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions. Data comparability was maintained by undertaking the validation as follows:

- The samples were collected by Hazmat professional field personnel in general accordance with Hazmat's standard operation procedures;
- Primary samples were stored, handled and transported under the same conditions and analysed by the same laboratory using consistent methods; and
- DQIs indicated acceptable precision and accuracy.

7 COMPLETENESS

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The DQI for completeness is that valid data is generated for all critical samples and that, overall, the data is valid. This is considered to be the case for the data set presented in this assessment.

7.1 Laboratory Accreditation

Envirolab and ALS are NATA accredited for the requested analyses and conducted all the requested analyses in accordance with the guidelines outlined in NEPM (2013). Extraction and analysis methods and the LORs are provided in the certificates of analysis provided in **Appendix E**.

8 CONCLUSIONS

The majority of PSARCC parameters were within the specified DQIs and, overall, the data is considered to be of sufficient quality to meet the objectives of the investigation.

APPENDIX D
Results Table and Sample Log

Ground and Surface Water Monitoring, Kooragang Island Waste Emplacement Facility
Annual Monitoring 2022

Table A: Sample Log 2022

Sample ID	GPS Coordinates, Lat and Long	a. Depth to water (m from TOC)	b. Well Stickup (m)	Depth to Water (m BGS)	Depth of Well	RL to top of casing (mAHD)	Inferred Groundwater RL (mAHD)	Volume purged	pH	Conductivity (us/cm)	Dissolved Oxygen (mg/L)	Redox (mV)	Temperature (^{0}C)	VOC Concentration	Observations
K5/4	@-32.866196525,151.733088180556	4.81	0.61	4	5.6	5.6	1.6	2	6.73	3.9	6.7	77.2	20.9	0	Clear, no odour
K8/5E	@-32.8700999194444,151.736928847222	4.16	1.73	2.43	5.36	6.203	3.773	10	10.32	2688	1.05	-262.8	19.4	0	Clear, no odour
K10/2	@-32.8739240083333,151.742615269444	2.03	0.89	1.14	9.97	9.949	8.809	15	7.43	362.8	4.48	86.9	18.7	0	Brown,murky, organic odour
K10/2N	@-32.8739010138889,151.742616533333	6.26	0.87	5.39	10.09	10.15	4.76	3	8.21	21.8	5.12	-212.9	19.6	0	Clear, organic odour
K5/5N	@-32.871887975,151.734181980556	2.89	0.65	2.24	3.7	5.08	2.84	8.5	7.09	31	7.13	76.4	19.7	0	Brown, clear, no odour
K5/6N	@-32.86981455,151.734329236111	2.23	0.62	1.61	3.56	4.54	2.93	10	5.43	29.2	4.19	-178.9	18.5	0	Clear, organic odour
K7/4N	@-32.866774825,151.738804752778	4.95	0.26	4.69	8.99	6.99	2.3	15	6.79	34.9	6.7	-160.8	22.9	0	Clear, no odour
K10/2NN	@-32.8738900583333,151.742619713889	10.18	1.03	9.15	14.11	10.151	1.001	10	6.87	20649	2.88	-272.3	20.7	0	Brown, clear, organic odour
K7/2S	@-32.8659912833333,151.739893777778	6.44	0.66	5.78	11.4	7.569	1.789	1	6.74	3570	8.24	-34.2	20.9	0	Brown, murky,no odour
K8/5W	@-32.8701029638889,151.736928872222	4.85	1.79	3.06	8.05	6.251	3.191	5	8.21	1592	4.91	-84.6	16.8	0	Clear, no odour
K5/5S	@-32.8719091722222,151.734169858333	3.76	0.59	3.17	9.49	5.09	1.92	15	7.2	47	6.61	-166.2	20.6	0	Clear, organic odour
K5/6S	@-32.8698296694444,151.73432795	3.14	0.61	2.53	9.83	4.73	2.2	10	7.11	3170	2.05	-131	20	0	Clear, slightly cloudy
K5/6NN	@-32.8698023361111,151.734331180556	3.01	0.45	2.56	5.51	4.39	1.83	10	6.29	75.9	4.71	458.9	20.2	0	Clear, organic odour
K7/4S	@-32.8667824805556,151.738801986111	5.98	0.5	5.48	13.73	7.19	1.71	20	6.86	219.1	4.73	-70.4	21.5	0	Yellow, murky, no odour
K9/2E	@-32.8711932138889,151.745977766667	1.88	0.28	1.6	11.6	2.85	1.25	20	6.98	692.4	0.33	-124.6	19.5	0	Clear, no odour
K9/2W	@-32.8711919638889,151.745961819444	1.866	0.28	1.586	3.9	2.86	1.274	7.5	5.8	29.7	1.07	-125.6	18	0	Slightly murky, no odour
K9/4E	@-32.8704616777778,151.742101736111	1.55	0.25	1.3	5.25	3.13	1.83	10	6.89	296.7	0.54	-144.7	17.1	0	Grey,murky, no odour
K9/4W	@-32.870457775,151.742094986111	2.03	0.2	1.83	11.64	3.09	1.26	20	7.18	104.8	4.72	-88.3	18.1	0	Light yellow, relatively clear, no odour
K11/3E	@-32.8761161888889,151.736490888889	1.45	0.51	0.94	5.48	2.436	1.496	10	6.93	10.2	2.97	-199.3	18.3	0	Grey, murky,organic odour
K11/3W	@-32.876119975,151.736482647222	1.75	0.52	1.23	12.57	2.593	1.363	20	6.74	159.8	2.41	-119	19.6	0	Gold/dark yellow, no odour
K12/4N	@-32.8568868944444,151.721287152778	1.03	0.58	0.45	12.73	1.415	0.965	20	6.28	190.4	0.96	-47.2	17.4	0	Yellow, clear, no odour
K12/6	@-32.8604496388889,151.730110666667	**Well damaged during Ash Island Fire**													
K11/1	@-32.8762061194444,151.745137916667	1.31	0.75	0.56	3.57	2.938	2.378	10	5.82	148	2.99	-228.3	16.8	0	Brown, murky, organic odour
K11/1S	@-32.8762269555556,151.745147841667	2.8	0.77	2.03	8.92	3.707	1.677	15	7.82	392.2	1.94	-380.9	18.9	0	Brown, murky, organic odour
K11/2E	@-32.8757992194444,151.739075363889	1.42	0.72	0.7	5.49	2.272	1.572	8	7.12	24.3	7.01	-99.2	18.1	0	brown/orange, murky
K11/2W	@-32.8758008861111,151.739066211111	1.7	0.41	1.29	11.46	2.382	1.092	20	7.39	368.5	6.29	-255.6	18.7	0	Clear, organic odour
K9/3N	@-32.8741753777778,151.747846636111	2.75	0	2.75	10.2	3.83	1.08	10	6.27	75.2	5.35	-157.2	20.6	0	Clear, organic odour
K9/3S	@-32.8741838277778,151.747842611111	1.74	0	1.74	3.74	4.09	2.35	6	7.75	137.2	8.19	-144.2	18	0	Cloudy, organic odour
K12/1W	@-32.8710135361111,151.718306388889	0.99	0.29	0.7	3.73	1.8	1.1	5	6.86	39.8	5.82	217.7	16.3	0	Brown, murky, no odour
K12/1E	@-32.8710068805556,151.718298030556					1.81	1.81	**Well Inaccessible - Caps on too tight**							
K12/7	@-32.863187625,151.731627994444	0.72	0.2	0.52	4.31	1.816	1.296	10	7.33	11214	4.44	119.6	16.1	0	Clear, no odour
K12/7E	@-32.8631926916667,151.731713938889	1.29	0.35	0.94	12.1	1.76	0.82	10	7.08	402.5	1.7	-80.5	18.2	0	Light brown, organic
K12/9	@-32.864467975,151.741461905556					1.939	1.939	**Well inaccessible due to flooding**							
K12/9E	@-32.8644670416667,151.742649177778					2.45	2.45	**Well inaccessible due to flooding**							
K12/10	@-32.8656095555556,151.748294761111	0.85	0.7	0.15	19.3	2.134	1.984	30	6.87	43539	1.86	-106.8	17.9	0	Clear, organic odour
K12/10E	@-32.8656093083333,151.748347552778	1.17	0.47	0.7	4.42	1.818	1.118	8.5	6.95	47123	0.9	-277	16.7	0	Dark grey, sediments
E61D	@-32.8645866583333,151.734909161111	5.7	0.69	5.01	23.56	6.338	1.328	10	6.92	44047	1.77	122.4	20.6	0	Clear, organic odour
E61S	@-32.8645983305556,151.734904794444					6.571	6.571	**Well dry**							
336A	@-32.8728012583333,151.722970138889	5.4	0.8	4.6	6.8	6.72	2.12	10	7.23	15.1	4.99	-61.2	18.7	0	Yellow, clear, no odour
336B	@-32.8727923027778,151.722959380556	5.8	0.55	5.25	12.39	6.71	1.46	20	6.91	6288	2.01	-94.8	19	0	Gold/dark yellow, no odour
KS1/3	@-32.8716136194444,151.720904211111	Not Applicable - Surface Water Location							7.2	621	2.77	-6.3	13.8	0	Murky, black, organic odour
KS7/1	@-32.8651573555556,151.739212786111	Not Applicable - Surface Water Location							6.96	1894	7.82	222.9	14	0	Clear, no odour
KS12/6	@-32.8575162972222,151.721228333333	Not Applicable - Surface Water Location							7.31	46.7	11.23	14.4	14	0	Pale brown, clear, no odour
KS10/1	@-32.8759084805556,34.0080794222222	Not Applicable - Surface Water Location							7.23	801	1.6	46.4	14.6	0	Clear, no odour
K7/2N	@-32.8659912138889,151.739894025	6.24	0.66	5.58	8.95	7.569	1.989	**Well Dry**							
K7/1	@-32.8648820777778,151.73590725	4.53	0.57	3.96	6.66	6.376	2.416	9	7.35	12.6	6.03	-171.8	19.1	0	Grey, clear, organic odour
BHe29s	@-32.8727340305556,151.748208691667	2.5	0.73	1.77	3.4	3.417	1.647	15	7.91	938	1.69	-258.2	18.3	0	Cloudy, organic odour
GHD01N	@-32.8741675833333,151.745355408333	5.99	0.25	5.74	9.38	10.051	4.311	**Well Obstructed with Tubing**							
GHD01S	@-32.8741774972222,151.745352797222	8.95	0.27	8.68	19.95	10.109	1.429	**Well Obstructed with Tubing**							
KS2/1	@-32.8658496111111,151.730459036111	Not Applicable - Surface Water Location							8.57	994	8.63	136.5	14.6	0	Clear, no odour
NCIG/1	@-32.8654273361111,151.724129322222	1.39	0.73	0.66	6.75	0	-0.66	12	8.94	14.4	1.81	-227.8	18.9	0	Clear, organic odour
NCIG/2	@-32.8653673,151.724219438889	1.5	0.73	0.77	13	0	-0.77	15	7.04	477.3	2.24	-118.6	19.1	0	Clear, organic odour
BH21S	@-32.8701522416667,151.726858402778	5.2	0.3	4.9	6.48	7.33	2.43	10	10.93	1663	1.64	302.1	21	0	Brown, organic odour
344A		5.62	0.75	4.87	8.48			10	5.26	83.9	2.3	-167.8	20.9	0	Grey, strong odour
344B		8.25	0.77	7.48	12.26			10	6.49	36.8	0.82	-77.3	19.5	0	Dark grey, murky, no odour

Ground and Surface Water Monitoring, Kooragang Island Waste Emplacement Facility
Annual Monitoring 2022

Table B: Results Summary 2022

ANALYTES				pH	Conductivity	Ammonia	Phenols	Free Cyanide	Weak Acid Disociable Cyanide	Total Cyanide	Cr VI - Dissolved	Mo - Dissolved*	Pb - Dissolved*	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)&(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3-cd)pyrene	Dibenzo(ah)anthracene	Benzo(ghi)perylene	TotalPAH's
				pH units	µs/cm	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/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						0.01	1	0.004	0.004	0.004	0.01	0.001	0.001	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
ASC NEPM GIL for Marine Waters Criteria				-	-	0.91	400µg/L	-	-	0.004mg/L	0.0044mg/L	-	0.0044mg/L	50µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANZECC Criteria				-	-	0.91	400µg/L	-	-	0.004mg/L	0.0044mg/L	0.023 (L)	0.0044mg/L	70µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sample ID	Type of Bore	Batch ID	Date																										
K12/7E	deep	299478	29/06/2022	7.08	402.5	20	<50	<0.004	<0.004	<0.004	<0.005	0.002	<0.001	<0.2	<0.1	0.8	0.7	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	1.5
NCIG/2	deep	299478	29/06/2022	7.04	477.3	29	<50	<0.004	<0.004	<0.004	<0.005	0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K5/5S	deep	298855	22/06/2022	7.2	47	0.93	-	<0.004	<0.004	<0.004	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K5/6S	deep	298855	22/06/2022	7.11	3170	0.4	<50	<0.004	<0.004	0.005	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K9/2E	deep	299097	24/06/2022	6.98	692.4	3.7	-	<0.004	<0.004	<0.004	<0.005	0.002	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K9/3N	deep	298541	21/06/2022	6.27	75.2	2.8	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K11/1S	deep	299973	6/07/2022	7.82	392.2	6.6	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	0.1
K11/3W	deep	299478	28/06/2022	6.74	159.8	5.6	<50	<0.004	<0.004	0.009	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K12/4N	deep	299656	1/07/2022	6.28	190.2	48	<50	<0.004	<0.004	<0.004	<0.005	0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K11/2W	deep	298541	21/06/2022	7.39	368.5	4.9	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K9/4W	deep	299097	24/06/2022	7.13	104.8	1	-	<0.004	<0.004	<0.004	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K12/10	deep	299478	29/06/2022	6.87	43539	5.1	<50	<0.004	<0.004	<0.004	<0.005	0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K5/6N	fill	298855	22/06/2022	5.43	29.2	0.65	<50	<0.004	<0.004	0.011	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K7/1	fill	298855	23/06/2022	7.35	12.6	6.7	<50	<0.004	<0.004	0.038	<0.005	0.28	<0.001	3.8	<0.1	0.4	<0.1	<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	4.6
K10/2	fill	299656	1/07/2022	7.43	362.8	0.04	-	-	-	-	<0.005	0.034	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K8/5E	fill	299097	24/06/2022	10.32	2688	0.98	<50	<0.004	<0.004	0.038	<0.005	0.037	<0.001	2.1	<0.1	1.4	0.6	1.2	<0.1	0.5	1.3	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	7.1
344A	fill	299097	27/06/2022	5.26	83.9	0.37	<50	<0.004	<0.004	0.012	<0.005	0.002	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K5/5N	fill	298855	22/06/2022	7.09	31	0.01	<50	<0.004	<0.004	-	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K10/2N	fill	299656	1/07/2022	8.21	21.8	0.48	<50	<0.004	<0.004	-	<0.005	0.008	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
336A	fill	299478	28/06/2022	7.23	15.1	0.83	<50	<0.004	<0.004	<0.004	<0.005	0.002	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K5/4	fill	298855	24/06/2022	6.73	3.9	0.084	-	<0.004	<0.004	<0.004	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K7/4N	fill	298855	23/06/2022	6.79	34.9	11	<50	<0.004	0.004	0.18	<0.005	0.031	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K12/7	shallow	299656	1/07/2022	7.33	11214	0.25	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
NCIG/1	shallow	299478	29/06/2022	8.94	14.4	0.58	<50	<0.004	<0.004	<0.004	<0.005	0.009	<0.001	0.2	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
336B	shallow	299478	28/06/2022	6.91	6288	0.58	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K5/6NN	shallow	298855	22/06/2022	6.29	75.9	0.72	<50	<0.004	<0.004	0.004	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
BHe29S	shallow	298541	21/06/2022	7.91	938	1.3	<50	<0.004	<0.004	<0.004	<0.005	0.003	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
E61D	shallow	298855	22/06/2022	6.92	44047	3.1	<50	<0.004	<0.004	<0.004	<0.005	0.003	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K8/5W	shallow	299097	24/06/2022	8.21	1592	5.2	<50	<0.004	<0.004	0.064	<0.005	0.025	<0.001	<0.2	<0.1	0.9	0.6	0.7	<0.1	0.3	0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	2.8
K7/2S	shallow	298855	23/06/2022	6.74	3570	20	<50	<0.004	<0.004	<0.004	<0.005	-	-	1	<0.1	<0.1	<0.1	0.2	<0.1	0.3	0.3	0.2	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	2.3
K9/2W	shallow	299097	24/06/2022	5.8	27.9	0.67	-	<0.004	<0.004	<0.004	<0.005	0.018	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K9/4E	shallow	299097	24/06/2022	6.89	296.7	2.2	-	<0.004	<0.004	<0.004	<0.005	-	-	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K11/1	shallow	299973	6/07/2022	5.82	148	0.29	<50	<0.004	<0.004	<0.004	<0.005	0.005	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	0.19
K9/3S	shallow	298541	21/06/2022	7.75	137.2	0.5	<50	<0.004	<0.004	<0.004	<0.005	0.018	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K10/2NN	shallow	299656	1/07/2022	6.87	20649	7.6	-	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	8.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	8.3
K11/2E	shallow	298541	21/06/2022	7.12	24.3	0.18	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K12/10E	shallow	299478	29/06/2022	6.95	47123	1.2	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K12/1W	shallow	299656	1/07/2022	6.86	39.8	0.21	<50	<0.004	<0.004	<0.004	<0.005	0.003	0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
K11/3E	shallow	299478	28/06/2022	6.93	10.2	5.6	<50	<0.004	<0.004	<0.004	<0.005	0.004	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
344B	shallow	299097	27/06/2022	6.49	36.8	3	<50	<0.004	<0.004	0.004	<0.005	0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
BH21S	shallow	299097	27/06/2022	10.93	1663	7.5	<50	<0.004	<0.004	0.21	<0.005	0.54	<0.001	210	2.6	3.7	3	10	2.8	4.4	3.6	0.8	0.6	0.9	0.6	0.3	<0.1	0.4	240
K7/4S	shallow	298855	23/06/2022	6.86	219.1	0.63	<50	<0.004	<0.004	<0.004	<0.005	0.003	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
KS12/6	surface	299656	1/07/2022	7.31	46.7	0.056	<50	<0.004	<0.004	<0.004	0.01	0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
KS1/3	surface	298541	20/06/2022	7.2	621	0.082	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
KS2/1	surface	298541	20/06/2022	8.57	994	0.16	<50	<0.004	<0.004	<0.004	<0.005	0.027	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
KS7/1	surface	298541	20/06/2022	6.96	1894	<0.005	<50	<0.004	<0.004	<0.004	<0.005	0.023	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
KS10/1	surface	298541	20/06/2022	7.23	801	0.056	<50	<0.004	<0.004	<0.004	<0.005	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1

Exceed KIWEF trigger values

APPENDIX E
Laboratory Report Sheets and Chain of Custody

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CERTIFICATE OF ANALYSIS 298541

Client Details

Client	Hazmat Services
Attention	Florence Archer
Address	PO Box 118, Carrington, NSW, 2294

Sample Details

Your Reference	**N4656-KIWEF**
Number of Samples	12 Water
Date samples received	22/06/2022
Date completed instructions received	22/06/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	29/06/2022
Date of Issue	29/06/2022

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Results Approved By
Diego Bigolin, Inorganics Supervisor
Dragana Tomas, Senior Chemist
Giovanni Agosti, Group Technical Manager
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

PAHs in Water - Low Level						
Our Reference		298541-1	298541-2	298541-3	298541-4	298541-5
Your Reference	UNITS	KS7/1	KS2/1	KS1/3	KS10/1	QC1
Date Sampled		20/06/2022	20/06/2022	20/06/2022	20/06/2022	20/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Date analysed	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	93	88	87	69	97

PAHs in Water - Low Level						
Our Reference	UNITS	298541-6	298541-7	298541-8	298541-9	298541-10
Your Reference		Rinsate 1	Rinsate 2	K11/2W	K11/2E	K9/3N
Date Sampled		20/06/2022	21/06/2022	21/06/2022	21/06/2022	21/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Date analysed	-	27/06/2022	27/06/2022	23/06/2022	23/06/2022	25/06/2022
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	110	89	83	100	112

PAHs in Water - Low Level			
Our Reference		298541-11	298541-12
Your Reference	UNITS	K9/3S	BHe29s
Date Sampled		21/06/2022	21/06/2022
Type of sample		Water	Water
Date extracted	-	23/06/2022	23/06/2022
Date analysed	-	25/06/2022	25/06/2022
Naphthalene	µg/L	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	122	91

Total Phenolics in Water						
Our Reference		298541-1	298541-2	298541-3	298541-4	298541-5
Your Reference	UNITS	KS7/1	KS2/1	KS1/3	KS10/1	QC1
Date Sampled		20/06/2022	20/06/2022	20/06/2022	20/06/2022	20/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Date analysed	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Total Phenolics in Water						
Our Reference		298541-8	298541-9	298541-10	298541-11	298541-12
Your Reference	UNITS	K11/2W	K11/2E	K9/3N	K9/3S	BHe29s
Date Sampled		21/06/2022	21/06/2022	21/06/2022	21/06/2022	21/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Date analysed	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

HM in water - dissolved						
Our Reference		298541-1	298541-2	298541-3	298541-4	298541-5
Your Reference	UNITS	KS7/1	KS2/1	KS1/3	KS10/1	QC1
Date Sampled		20/06/2022	20/06/2022	20/06/2022	20/06/2022	20/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Date analysed	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Lead-Dissolved	μg/L	<1	<1	<1	<1	<1
Molybdenum-Dissolved	μg/L	23	27	<1	<1	20

HM in water - dissolved						
Our Reference		298541-6	298541-7	298541-8	298541-9	298541-10
Your Reference	UNITS	Rinsate 1	Rinsate 2	K11/2W	K11/2E	K9/3N
Date Sampled		20/06/2022	21/06/2022	21/06/2022	21/06/2022	21/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Date analysed	-	23/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Arsenic-Dissolved	μg/L	<1	<1	[NA]	[NA]	[NA]
Cadmium-Dissolved	μg/L	<0.1	<0.1	[NA]	[NA]	[NA]
Chromium-Dissolved	μg/L	<1	<1	[NA]	[NA]	[NA]
Copper-Dissolved	μg/L	<1	<1	[NA]	[NA]	[NA]
Lead-Dissolved	μg/L	<1	<1	<1	<1	<1
Mercury-Dissolved	μg/L	<0.05	<0.05	[NA]	[NA]	[NA]
Nickel-Dissolved	μg/L	<1	<1	[NA]	[NA]	[NA]
Zinc-Dissolved	μg/L	<1	<1	[NA]	[NA]	[NA]
Molybdenum-Dissolved	μg/L	<1	<1	<1	1	<1

HM in water - dissolved			
Our Reference		298541-11	298541-12
Your Reference	UNITS	K9/3S	BHe29s
Date Sampled		21/06/2022	21/06/2022
Type of sample		Water	Water
Date prepared	-	23/06/2022	23/06/2022
Date analysed	-	23/06/2022	23/06/2022
Lead-Dissolved	μg/L	<1	<1
Molybdenum-Dissolved	μg/L	18	3

Miscellaneous Inorganics						
Our Reference		298541-1	298541-2	298541-3	298541-4	298541-5
Your Reference	UNITS	KS7/1	KS2/1	KS1/3	KS10/1	QC1
Date Sampled		20/06/2022	20/06/2022	20/06/2022	20/06/2022	20/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	22/06/2022	22/06/2022	22/06/2022	22/06/2022	22/06/2022
Date analysed	-	22/06/2022	22/06/2022	22/06/2022	22/06/2022	22/06/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Ammonia as N in water	mg/L	<0.005	0.16	0.082	0.056	0.007
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005

Miscellaneous Inorganics						
Our Reference		298541-8	298541-9	298541-10	298541-11	298541-12
Your Reference	UNITS	K11/2W	K11/2E	K9/3N	K9/3S	BHe29s
Date Sampled		21/06/2022	21/06/2022	21/06/2022	21/06/2022	21/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	22/06/2022	22/06/2022	22/06/2022	22/06/2022	22/06/2022
Date analysed	-	22/06/2022	22/06/2022	22/06/2022	22/06/2022	22/06/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Ammonia as N in water	mg/L	4.9	0.18	2.8	0.50	1.3
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically. Waters samples are filtered on receipt prior to analysis.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date extracted	-			23/06/2022	[NT]	[NT]	[NT]	[NT]	23/06/2022	[NT]
Date analysed	-			23/06/2022	[NT]	[NT]	[NT]	[NT]	27/06/2022	[NT]
Naphthalene	µg/L	0.2	Org-022/025	<0.2	[NT]	[NT]	[NT]	[NT]	90	[NT]
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	85	[NT]
Fluorene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	86	[NT]
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	118	[NT]
Anthracene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Pyrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	107	[NT]
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	69	[NT]
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	82	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	<0.1	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	92	[NT]	[NT]	[NT]	[NT]	87	[NT]

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W4	[NT]
Date extracted	-			[NT]	[NT]	[NT]	[NT]	[NT]	23/06/2022	[NT]
Date analysed	-			[NT]	[NT]	[NT]	[NT]	[NT]	23/06/2022	[NT]
Naphthalene	µg/L	0.2	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	95	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	95	[NT]
Fluorene	µg/L	0.1	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	95	[NT]
Phenanthrene	µg/L	0.1	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	118	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	106	[NT]
Pyrene	µg/L	0.1	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	113	[NT]
Chrysene	µg/L	0.1	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	62	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: Total Phenolics in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	298541-2
Date extracted	-			23/06/2022	1	23/06/2022	23/06/2022		23/06/2022	23/06/2022
Date analysed	-			23/06/2022	1	23/06/2022	23/06/2022		23/06/2022	23/06/2022
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	1	<0.05	<0.05	0	104	99

QUALITY CONTROL: HM in water - dissolved					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	298541-2
Date prepared	-			23/06/2022	1	23/06/2022	23/06/2022		23/06/2022	23/06/2022
Date analysed	-			23/06/2022	1	23/06/2022	23/06/2022		23/06/2022	23/06/2022
Arsenic-Dissolved	µg/L	1	Metals-022	<1	6	<1	[NT]		107	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	6	<0.1	[NT]		106	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	6	<1	[NT]		107	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	6	<1	[NT]		108	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	107	104
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	6	<0.05	<0.05	0	100	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	6	<1	[NT]		105	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	6	<1	[NT]		105	[NT]
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	23	23	0	104	100

QUALITY CONTROL: HM in water - dissolved					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	6	23/06/2022	23/06/2022		[NT]	[NT]
Date analysed	-			[NT]	6	23/06/2022	23/06/2022		[NT]	[NT]
Lead-Dissolved	µg/L	1	Metals-022	[NT]	6	<1	[NT]		[NT]	[NT]
Molybdenum-Dissolved	µg/L	1	Metals-022	[NT]	6	<1	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	298541-2
Date prepared	-			22/06/2022	1	22/06/2022	22/06/2022		22/06/2022	22/06/2022
Date analysed	-			22/06/2022	1	22/06/2022	22/06/2022		22/06/2022	22/06/2022
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	100	98
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	103	102
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	97	97
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	<0.005	<0.005	0	114	106
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	<0.005	1	<0.005	<0.005	0	103	103

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	22/06/2022	22/06/2022		[NT]	[NT]
Date analysed	-			[NT]	11	22/06/2022	22/06/2022		[NT]	[NT]
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	[NT]	11	<0.004	[NT]		[NT]	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	11	<0.004	[NT]		[NT]	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	11	<0.004	[NT]		[NT]	[NT]
Ammonia as N in water	mg/L	0.005	Inorg-057	[NT]	11	0.50	0.50	0	[NT]	[NT]
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	[NT]	11	<0.005	<0.005	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

ENVIROLAB GROUP - National phone number 1300 42 43 44

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Perth Lab - MPL Laboratories
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Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
Ph 0406 350 706 / adelaide@envirolab.com.au

Client: Hazmat Services	**Client Project Name / Number / Site etc (ie report title):** N4656 - KIWEF
Contact Person: Florence Archer	
Project Mgr: Florence Archer	**PO No.:**
Sampler: FA/DH	**Envirolab Quote No. :** 16SY078
Address: Level 1 45C Fitzroy Street Carrington NSW 2294	**Date results required:** **Or choose:** standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 02 49611887 **Mob:** 0438246996	**Report format:** esdat / equis /
Email: florence.archer@hazmatservices.com.au	**Lab Comments:**

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ammonia	Phenols	Free Cyanide/Total cyanide/dissolved cyanide	Hexavalent Chromium	Molybdenum	Lead	PAH	Free Cyanide/Dissolved Cyanide	BTEX	Heavy Metals (standard 8 + molybdenum)						Comments: Provide as much information about the sample as you can
1	KS7/1		20/06/2022	Water	X	X	X	X	X	X	X									
2	KS2/1		20/06/2022	Water	X	X	X	X	X	X	X									
3	KS1/3		20/06/2022	Water	X	X	X	X	X	X	X									
4	KS10/1		20/06/2022	Water	X	X	X	X	X	X	X									
5	QC1		20/06/2022	Water	X	X	X	X	X	X	X									
6	Rinsate 1		20/06/2022	Water	X	X	X	X	X	X	X			X						
7	Rinsate 2		21/06/2022	Water	X	X	X	X	X	X	X			X						
8	K11/2W		21/06/2022	Water	X	X	X	X	X	X	X									
9	K11/2E		21/06/2022	Water	X	X	X	X	X	X	X									
10	K9/3N		21/06/2022	Water	X	X	X	X	X	X	X									
11	K9/3S		21/06/2022	Water	X	X	X	X	X	X	X									
12	BHe29s		21/06/2022	Water	X	X	X	X	X	X	X									

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 298541
Date Received: 22.6.2022
Time Received: 1030
Received by: TJHan
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken

Relinquished by (Company): Hazmat Services	**Received by (Company):** ELS SYD	*Lab use only:*
Print Name: Florence Archer	**Print Name:** TJHan	**Samples Received:** Cool or Ambient (circle one)
Date & Time: 21/06/2022	**Date & Time:** 22.6.22 1030	**Temperature Received at:** 12 (if applicable)
Signature: FArcher	**Signature:**	**Transported by:** Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 298855

Client Details

Client	Hazmat Services
Attention	Florence Archer
Address	PO Box 118, Carrington, NSW, 2294

Sample Details

Your Reference	**N4656-KIWEF**
Number of Samples	13 Water
Date samples received	24/06/2022
Date completed instructions received	24/06/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	01/07/2022
Date of Issue	01/07/2022

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By

Diego Bigolin, Inorganics Supervisor
Dragana Tomas, Senior Chemist
Giovanni Agosti, Group Technical Manager

Authorised By

Nancy Zhang, Laboratory Manager

PAHs in Water - Low Level						
Our Reference		298855-1	298855-2	298855-3	298855-4	298855-5
Your Reference	UNITS	E61D	K5/6NN	K5/6N	K5/6S	K5/5S
Date Sampled		22/06/2022	22/06/2022	22/06/2022	22/06/2022	22/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Date analysed	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	87	88	75	93	85

PAHs in Water - Low Level						
Our Reference		298855-6	298855-9	298855-10	298855-11	298855-12
Your Reference	UNITS	K5/5N	K7/1	K7/4N	K7/4S	K7/2S
Date Sampled		22/06/2022	23/06/2022	23/06/2022	23/06/2022	23/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Date analysed	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Naphthalene	µg/L	<0.2	3.8	<0.2	<0.2	1
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	0.4	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	0.2
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	0.2	<0.1	<0.1	0.3
Pyrene	µg/L	<0.1	0.2	<0.1	<0.1	0.3
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	0.2
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	0.3
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	4.6	<0.1	<0.1	2.3
Surrogate p-Terphenyl-d14	%	88	71	89	82	77

PAHs in Water - Low Level		
Our Reference		298855-13
Your Reference	UNITS	K5/4
Date Sampled		23/06/2022
Type of sample		Water
Date extracted	-	01/07/2022
Date analysed	-	01/07/2022
Naphthalene	µg/L	<0.2
Acenaphthylene	µg/L	<0.1
Acenaphthene	µg/L	<0.1
Fluorene	µg/L	<0.1
Phenanthrene	µg/L	<0.1
Anthracene	µg/L	<0.1
Fluoranthene	µg/L	<0.1
Pyrene	µg/L	<0.1
Benzo(a)anthracene	µg/L	<0.1
Chrysene	µg/L	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2
Benzo(a)pyrene	µg/L	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5
Total +ve PAH's	µg/L	<0.1
Surrogate p-Terphenyl-d14	%	83

Total Phenolics in Water						
Our Reference		298855-1	298855-2	298855-3	298855-4	298855-9
Your Reference	UNITS	E61D	K5/6NN	K5/6N	K5/6S	K7/1
Date Sampled		22/06/2022	22/06/2022	22/06/2022	22/06/2022	23/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Date analysed	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Total Phenolics in Water					
Our Reference		298855-10	298855-11	298855-12	298855-13
Your Reference	UNITS	K7/4N	K7/4S	K7/2S	K5/4
Date Sampled		23/06/2022	23/06/2022	23/06/2022	23/06/2022
Type of sample		Water	Water	Water	Water
Date extracted	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Date analysed	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05

HM in water - dissolved						
Our Reference		298855-1	298855-7	298855-8	298855-9	298855-10
Your Reference	UNITS	E61D	Rinsate 3	Rinsate 4	K7/1	K7/4N
Date Sampled		22/06/2022	22/06/2022	23/06/2022	23/06/2022	23/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Date analysed	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Arsenic-Dissolved	µg/L	[NA]	<1	<1	[NA]	[NA]
Cadmium-Dissolved	µg/L	[NA]	<0.1	<0.1	[NA]	[NA]
Chromium-Dissolved	µg/L	[NA]	<1	<1	[NA]	[NA]
Copper-Dissolved	µg/L	[NA]	<1	<1	[NA]	[NA]
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Mercury-Dissolved	µg/L	[NA]	<0.05	<0.05	[NA]	[NA]
Nickel-Dissolved	µg/L	[NA]	<1	<1	[NA]	[NA]
Zinc-Dissolved	µg/L	[NA]	<1	<1	[NA]	[NA]
Molybdenum-Dissolved	µg/L	3	<1	<1	280	31

HM in water - dissolved		
Our Reference		298855-11
Your Reference	UNITS	K7/4S
Date Sampled		23/06/2022
Type of sample		Water
Date prepared	-	28/06/2022
Date analysed	-	28/06/2022
Lead-Dissolved	µg/L	<1
Molybdenum-Dissolved	µg/L	3

Miscellaneous Inorganics						
Our Reference		298855-1	298855-2	298855-3	298855-4	298855-5
Your Reference	UNITS	E61D	K5/6NN	K5/6N	K5/6S	K5/5S
Date Sampled		22/06/2022	22/06/2022	22/06/2022	22/06/2022	22/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Date analysed	-	24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Total Cyanide	mg/L	<0.004	0.004	0.011	0.005	[NA]
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	[NA]
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	[NA]
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Ammonia as N in water	mg/L	3.1	0.72	0.65	0.40	0.93

Miscellaneous Inorganics						
Our Reference		298855-6	298855-7	298855-8	298855-9	298855-10
Your Reference	UNITS	K5/5N	Rinsate 3	Rinsate 4	K7/1	K7/4N
Date Sampled		22/06/2022	22/06/2022	23/06/2022	23/06/2022	23/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Date analysed	-	24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Total Cyanide	mg/L	0.006	[NA]	[NA]	0.038	0.18
Free Cyanide in Water	mg/L	<0.004	[NA]	[NA]	<0.004	<0.004
Weak Acid Dissociable Cyanide	mg/L	<0.004	[NA]	[NA]	<0.004	0.004
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	[NA]	[NA]	<0.005	<0.005
Ammonia as N in water	mg/L	0.01	[NA]	[NA]	6.7	11

Miscellaneous Inorganics				
Our Reference		298855-11	298855-12	298855-13
Your Reference	UNITS	K7/4S	K7/2S	K5/4
Date Sampled		23/06/2022	23/06/2022	23/06/2022
Type of sample		Water	Water	Water
Date prepared	-	24/06/2022	24/06/2022	24/06/2022
Date analysed	-	24/06/2022	24/06/2022	24/06/2022
Total Cyanide	mg/L	<0.004	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005
Ammonia as N in water	mg/L	0.63	20	0.084

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically. Waters samples are filtered on receipt prior to analysis.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	
Date extracted	-			01/07/2022	2	01/07/2022	01/07/2022		01/07/2022	[NT]
Date analysed	-			01/07/2022	2	01/07/2022	01/07/2022		01/07/2022	[NT]
Naphthalene	µg/L	0.2	Org-022/025	<0.2	2	<0.2	<0.2	0	103	[NT]
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	95	[NT]
Fluorene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	95	[NT]
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	108	[NT]
Anthracene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	106	[NT]
Pyrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	111	[NT]
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	93	[NT]
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	2	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	102	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	87	2	88	76	15	88	[NT]

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	298855-3
Date extracted	-			[NT]	10	01/07/2022	01/07/2022		[NT]	01/07/2022
Date analysed	-			[NT]	10	01/07/2022	01/07/2022		[NT]	01/07/2022
Naphthalene	µg/L	0.2	Org-022/025	[NT]	10	<0.2	<0.2	0	[NT]	101
Acenaphthylene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	97
Fluorene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	99
Phenanthrene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	112
Anthracene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	110
Pyrene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	115
Benzo(a)anthracene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	93
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	[NT]	10	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	96
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	[NT]	10	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	[NT]	10	89	82	8	[NT]	85

QUALITY CONTROL: Total Phenolics in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	298855-2
Date extracted	-			28/06/2022	1	28/06/2022	28/06/2022		28/06/2022	28/06/2022
Date analysed	-			28/06/2022	1	28/06/2022	28/06/2022		28/06/2022	28/06/2022
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	1	<0.05	<0.05	0	100	99

QUALITY CONTROL: Total Phenolics in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	11	28/06/2022	28/06/2022		[NT]	[NT]
Date analysed	-			[NT]	11	28/06/2022	28/06/2022		[NT]	[NT]
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	[NT]	11	<0.05	[NT]		[NT]	[NT]

QUALITY CONTROL: HM in water - dissolved					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date prepared	-			28/06/2022	1	28/06/2022	28/06/2022		28/06/2022	[NT]
Date analysed	-			28/06/2022	1	28/06/2022	28/06/2022		28/06/2022	[NT]
Arsenic-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	105	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	101	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	3	2	40	104	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	298855-2
Date prepared	-			24/06/2022	1	24/06/2022	24/06/2022		24/06/2022	24/06/2022
Date analysed	-			24/06/2022	1	24/06/2022	24/06/2022		24/06/2022	24/06/2022
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	97	95
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	96	97
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	93	90
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	<0.005	1	<0.005	<0.005	0	102	92
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	3.1	3.1	0	96	116

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	24/06/2022	24/06/2022		[NT]	[NT]
Date analysed	-			[NT]	11	24/06/2022	24/06/2022		[NT]	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	11	<0.004	[NT]		[NT]	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	11	<0.004	[NT]		[NT]	[NT]
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	[NT]	11	<0.004	[NT]		[NT]	[NT]
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Ammonia as N in water	mg/L	0.005	Inorg-057	[NT]	11	0.63	0.63	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

CHAIN OF CUSTODY - Client

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Ph 0406 350 706 / adelaide@envirolab.com.au

Client: Hazmat Services	**Client Project Name / Number / Site etc (ie report title):** N4656 - KIWEF
Contact Person: Florence Archer	
Project Mgr: Florence Archer	**PO No.:**
Sampler: FA/DH	**Envirolab Quote No. :** 16SY078
Address: Level 1 45C Fitzroy Street Carrington NSW 2294	**Date results required:** **Or choose:** standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 02 49611887 **Mob:** 0438246996	**Report format:** esdat / equis /
Email: florence.archer@hazmatservices.com.au	**Lab Comments:**

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ammonia	Phenols	Free-Cyanide/Total cyanide/dissolved cyanide	Hexavalent Chromium	Molybdenum	Lead	PAH	Free Cyanide/Dissovled Cyanide	BTEX	Heavy Metals (standard 8 + molybdenum)						Provide as much information about the sample as you can
1	E61D		22/06/2022	Water	X	X	X	X	X	X	X									
2	K5/6NN		22/06/2022	Water	X	X	X	X			X									
3	K5/6N		22/06/2022	Water	X	X	X	X			X									
4	K5/6S		22/06/2022	Water	X	X	X	X			X									
5	K5/5S		22/06/2022	Water	X			X			X									
6	K5/5N		22/06/2022	Water	X		X	X			X									
7	Rinsate 3		22/06/2022	Water										X						
8	Rinsate 4		23/06/2022	Water										X						
9	K7/1		23/06/2022	Water	X	X	X	X	X	X	X									
10	K7/4N		23/06/2022	Water	X	X	X	X	X	X	X									
11	K7/4S		23/06/2022	Water	X	X	X	X	X	X	X									
12	K7/2S		23/06/2022	Water	X	X	X	X			X									
13	K5/4		23/06/2022	Water	X		X	X			X									

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 298855
Date Received: 24.6.22
Time Received: 1645
Received by: TJ HAN
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken

Relinquished by (Company): Hazmat Services	**Received by (Company):** ELS SYDNEY	***Lab use only:***
Print Name: Damien Hendrickx	**Print Name:** TSHAN	**Samples Received:** Cool or Ambient (circle one)
Date & Time: 23/06/2022	**Date & Time:** 24.6.2022 1645	**Temperature Received at:** 10 (if applicable)
Signature:	**Signature:**	**Transported by:** Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 299097

Client Details

Client	Hazmat Services
Attention	Florence Archer
Address	PO Box 118, Carrington, NSW, 2294

Sample Details

Your Reference	**N4656 - KIWEF**
Number of Samples	11 Water
Date samples received	28/06/2022
Date completed instructions received	28/06/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	05/07/2022
Date of Issue	05/07/2022

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Results Approved By
Diego Bigolin, Inorganics Supervisor
Dragana Tomas, Senior Chemist
Giovanni Agosti, Group Technical Manager

Authorised By

Nancy Zhang, Laboratory Manager

PAHs in Water - Low Level						
Our Reference	UNITS	299097-1	299097-2	299097-3	299097-4	299097-5
Your Reference		K8/5W	K8/5E	K9/4W	K9/4E	K9/2W
Date Sampled		24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Date analysed	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Naphthalene	µg/L	<0.2	2.1	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	0.9	1.4	<0.1	<0.1	<0.1
Fluorene	µg/L	0.6	0.6	<0.1	<0.1	<0.1
Phenanthrene	µg/L	0.7	1.2	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	0.3	0.5	<0.1	<0.1	<0.1
Pyrene	µg/L	0.2	1.3	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	2.8	7.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	91	83	98	90	96

PAHs in Water - Low Level					
Our Reference	UNITS	299097-6	299097-9	299097-10	299097-11
Your Reference		K9/2E	BH21S	344A	344B
Date Sampled		24/06/2022	27/06/2022	27/06/2022	27/06/2022
Type of sample		Water	Water	Water	Water
Date extracted	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Date analysed	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Naphthalene	µg/L	<0.2	210	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	2.6	<0.1	<0.1
Acenaphthene	µg/L	<0.1	3.7	<0.1	<0.1
Fluorene	µg/L	<0.1	3.0	<0.1	<0.1
Phenanthrene	µg/L	<0.1	10	<0.1	<0.1
Anthracene	µg/L	<0.1	2.8	<0.1	<0.1
Fluoranthene	µg/L	<0.1	4.4	<0.1	<0.1
Pyrene	µg/L	<0.1	3.6	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	0.8	<0.1	<0.1
Chrysene	µg/L	<0.1	0.6	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	0.9	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	0.6	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	0.3	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	0.4	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	0.8	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	240	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	96	92	96	91

Total Phenolics in Water						
Our Reference		299097-1	299097-2	299097-9	299097-10	299097-11
Your Reference	UNITS	K8/5W	K8/5E	BH21S	344A	344B
Date Sampled		24/06/2022	24/06/2022	27/06/2022	27/06/2022	27/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	29/06/2022	29/06/2022	29/06/2022	29/06/2022	29/06/2022
Date analysed	-	29/06/2022	29/06/2022	29/06/2022	29/06/2022	29/06/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

HM in water - dissolved						
Our Reference		299097-1	299097-2	299097-5	299097-6	299097-7
Your Reference	UNITS	K8/5W	K8/5E	K9/2W	K9/2E	Rinsate 5
Date Sampled		24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Date analysed	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Arsenic-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Cadmium-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<0.1
Chromium-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Copper-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Lead-Dissolved	μg/L	<1	<1	[NA]	[NA]	<1
Mercury-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<0.05
Nickel-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Zinc-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Molybdenum-Dissolved	μg/L	34	37	18	2	<1

HM in water - dissolved					
Our Reference		299097-8	299097-9	299097-10	299097-11
Your Reference	UNITS	Rinsate 6	BH21S	344A	344B
Date Sampled		27/06/2022	27/06/2022	27/06/2022	27/06/2022
Type of sample		Water	Water	Water	Water
Date prepared	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Date analysed	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Arsenic-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Cadmium-Dissolved	μg/L	<0.1	[NA]	[NA]	[NA]
Chromium-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Copper-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Lead-Dissolved	μg/L	<1	<1	<1	<1
Mercury-Dissolved	μg/L	<0.05	[NA]	[NA]	[NA]
Nickel-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Zinc-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Molybdenum-Dissolved	μg/L	<1	540	2	1

Miscellaneous Inorganics						
Our Reference		299097-1	299097-2	299097-3	299097-4	299097-5
Your Reference	UNITS	K8/5W	K8/5E	K9/4W	K9/4E	K9/2W
Date Sampled		24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Date analysed	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	0.064	0.038	<0.004	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Ammonia as N in water	mg/L	5.2	0.98	1.0	2.2	0.67
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005

Miscellaneous Inorganics					
Our Reference		299097-6	299097-9	299097-10	299097-11
Your Reference	UNITS	K9/2E	BH21S	344A	344B
Date Sampled		24/06/2022	27/06/2022	27/06/2022	27/06/2022
Type of sample		Water	Water	Water	Water
Date prepared	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Date analysed	-	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	<0.004	0.21	0.012	0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004
Ammonia as N in water	mg/L	3.7	7.5	0.37	3.0
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005	<0.005

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically. Waters samples are filtered on receipt prior to analysis.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			05/07/2022	1	05/07/2022	05/07/2022		05/07/2022	[NT]
Date analysed	-			05/07/2022	1	05/07/2022	05/07/2022		05/07/2022	[NT]
Naphthalene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	103	[NT]
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	1	0.9	0.8	12	107	[NT]
Fluorene	µg/L	0.1	Org-022/025	<0.1	1	0.6	0.6	0	109	[NT]
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	1	0.7	0.8	13	124	[NT]
Anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	1	0.3	0.2	40	108	[NT]
Pyrene	µg/L	0.1	Org-022/025	<0.1	1	0.2	0.2	0	119	[NT]
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	95	[NT]
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	128	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	100	1	91	96	5	101	[NT]

QUALITY CONTROL: Total Phenolics in Water					Duplicate					Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	299097-2
Date extracted	-			29/06/2022	1	29/06/2022	29/06/2022		29/06/2022	29/06/2022
Date analysed	-			29/06/2022	1	29/06/2022	29/06/2022		29/06/2022	29/06/2022
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	1	<0.05	<0.05	0	102	100

QUALITY CONTROL: HM in water - dissolved					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	299097-2
Date prepared	-			01/07/2022	1	01/07/2022	01/07/2022		01/07/2022	01/07/2022
Date analysed	-			01/07/2022	1	01/07/2022	01/07/2022		01/07/2022	01/07/2022
Arsenic-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	105	107
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	103	108
Chromium-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	102
Copper-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	104	100
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	106	103
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	97	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	105	101
Zinc-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	104	102
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	34	37	8	97	101

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	299097-2
Date prepared	-			28/06/2022	1	28/06/2022	28/06/2022		28/06/2022	28/06/2022
Date analysed	-			28/06/2022	1	28/06/2022	28/06/2022		28/06/2022	28/06/2022
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	98	95
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	0.064	0.066	3	99	99
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	95	92
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	5.2	5.3	2	106	113
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	<0.005	1	<0.005	<0.005	0	95	100

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

ENVIROLAB GROUP - National phone number 1300 42 43 44

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Client: Hazmat Services	Client Project Name / Number / Site etc (ie report title): N4656 - KIWEF
Contact Person: Florence Archer	
Project Mgr: Florence Archer	PO No.:
Sampler: FA/DH	Envirolab Quote No. : 16SY078
Address: Level 1 45C Fitzroy Street Carrington NSW 2294	Date results required: Or choose: standard / same day / 1 day / 2 day / 3 day. *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 02 49611887 Mob: 0438246996	Report format: esdat / equis /
Email: florence.archer@hazmatservices.com.au	Lab Comments:

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ammonia	Phenols	Free Cyanide/Total cyanide/dissolved cyanide	Hexavalent Chromium	Molybdenum	Lead	PAH	Free Cyanide/Dissolved Cyanide	BTEX	Heavy Metals (standard 8 + molybdenum)						Comments: Provide as much information about the sample as you can
1	K8/5W		24/06/2022	Water	X	X	X	X	X	X	X									
2	K8/5E		24/06/2022	Water	X	X	X	X	X	X	X									
3	K9/4W		24/06/2022	Water	X		X	X			X									
4	K9/4E		24/06/2022	Water	X		X	X			X									
5	K9/2W		24/06/2022	Water	X		X	X	X		X									
6	K9/2E		24/06/2022	Water	X		X	X	X		X									
7	Rinsate 5		24/06/2022	Water										X						
8	Rinsate 6		27/06/2022	Water										X						
9	BH21S		27/06/2022	Water	X	X	X	X	X	X	X									
10	344A		27/06/2022	Water	X	X	X	X	X	X	X									
11	344B		27/06/2022	Water	X	X	X	X	X	X	X									

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 299097
Date Received: 28/06/22
Time Received: 1000
Received By: CA
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by (Company): Hazmat Services	Received by (Company): ELS SYD	*Lab use only:*
Print Name: Damien Hendrickx	Print Name: Christine	Samples Received: Cool or Ambient (circle one)
Date & Time: 27/06/2022	Date & Time: 28/06/22 1000	Temperature Received at: 4° (if applicable)
Signature:	Signature:	Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No:

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CERTIFICATE OF ANALYSIS 299478

Client Details

Client	Hazmat Services
Attention	Florence Archer
Address	PO Box 118, Carrington, NSW, 2294

Sample Details

Your Reference	**N4656 - KIWEF**
Number of Samples	12 Water
Date samples received	01/07/2022
Date completed instructions received	01/07/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	08/07/2022
Date of Issue	08/07/2022

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Results Approved By
Giovanni Agosti, Group Technical Manager
Josh Williams, Organics and LC Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

PAHs in Water - Low Level						
Our Reference		299478-1	299478-2	299478-3	299478-4	299478-5
Your Reference	UNITS	336A	336B	K11/3W	K11/3E	QC2
Date Sampled		28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	08/07/2022	08/07/2022	08/07/2022	08/07/2022	08/07/2022
Date analysed	-	08/07/2022	08/07/2022	08/07/2022	08/07/2022	08/07/2022
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	84	82	75	80	81

PAHs in Water - Low Level						
Our Reference		299478-8	299478-9	299478-10	299478-11	299478-12
Your Reference	UNITS	K12/10	K12/10E	K12/7E	NCIG1	NCIG2
Date Sampled		29/06/2022	29/06/2022	29/06/2022	29/06/2022	29/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	08/07/2022	08/07/2022	08/07/2022	08/07/2022	08/07/2022
Date analysed	-	08/07/2022	08/07/2022	08/07/2022	08/07/2022	08/07/2022
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	0.8	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	0.7	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	1.5	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	94	90	78	88	80

Total Phenolics in Water						
Our Reference		299478-1	299478-2	299478-3	299478-4	299478-5
Your Reference	UNITS	336A	336B	K11/3W	K11/3E	QC2
Date Sampled		28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Date analysed	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Total Phenolics in Water						
Our Reference		299478-8	299478-9	299478-10	299478-11	299478-12
Your Reference	UNITS	K12/10	K12/10E	K12/7E	NCIG1	NCIG2
Date Sampled		29/06/2022	29/06/2022	29/06/2022	29/06/2022	29/06/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Date analysed	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

HM in water - dissolved						
Our Reference		299478-1	299478-2	299478-3	299478-4	299478-5
Your Reference	UNITS	336A	336B	K11/3W	K11/3E	QC2
Date Sampled		28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Date analysed	-	06/07/2022	06/07/2022	06/07/2022	06/07/2022	06/07/2022
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Molybdenum-Dissolved	µg/L	2	<1	<1	4	<1

HM in water - dissolved						
Our Reference		299478-6	299478-7	299478-8	299478-9	299478-10
Your Reference	UNITS	Rinsate 7	Rinsate 8	K12/10	K12/10E	K12/7E
Date Sampled		28/06/2022	29/06/2022	29/06/2022	29/06/2022	29/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	05/07/2022	05/07/2022	05/07/2022	05/07/2022	05/07/2022
Date analysed	-	06/07/2022	06/07/2022	06/07/2022	06/07/2022	06/07/2022
Arsenic-Dissolved	µg/L	<1	<1	[NA]	[NA]	[NA]
Cadmium-Dissolved	µg/L	<0.1	<0.1	[NA]	[NA]	[NA]
Chromium-Dissolved	µg/L	<1	<1	[NA]	[NA]	[NA]
Copper-Dissolved	µg/L	<1	<1	[NA]	[NA]	[NA]
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	[NA]	[NA]	[NA]
Nickel-Dissolved	µg/L	<1	<1	[NA]	[NA]	[NA]
Zinc-Dissolved	µg/L	<1	<1	[NA]	[NA]	[NA]
Molybdenum-Dissolved	µg/L	<1	<1	1	<1	2

HM in water - dissolved			
Our Reference		299478-11	299478-12
Your Reference	UNITS	NCIG1	NCIG2
Date Sampled		29/06/2022	29/06/2022
Type of sample		Water	Water
Date prepared	-	05/07/2022	05/07/2022
Date analysed	-	06/07/2022	06/07/2022
Lead-Dissolved	µg/L	<1	<1
Molybdenum-Dissolved	µg/L	9	1

Miscellaneous Inorganics						
Our Reference		299478-1	299478-2	299478-3	299478-4	299478-5
Your Reference	UNITS	336A	336B	K11/3W	K11/3E	QC2
Date Sampled		28/06/2022	28/06/2022	28/06/2022	28/06/2022	28/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Date analysed	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	<0.004	<0.004	0.009	<0.004	0.008
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Ammonia as N in water	mg/L	0.83	0.58	5.6	0.50	5.7
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005

Miscellaneous Inorganics						
Our Reference		299478-8	299478-9	299478-10	299478-11	299478-12
Your Reference	UNITS	K12/10	K12/10E	K12/7E	NCIG1	NCIG2
Date Sampled		29/06/2022	29/06/2022	29/06/2022	29/06/2022	29/06/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Date analysed	-	01/07/2022	01/07/2022	01/07/2022	01/07/2022	01/07/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
Ammonia as N in water	mg/L	5.1	1.2	20	0.58	29
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically. Waters samples are filtered on receipt prior to analysis.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date extracted	-			08/07/2022	1	08/07/2022	08/07/2022		08/07/2022	[NT]
Date analysed	-			08/07/2022	1	08/07/2022	08/07/2022		08/07/2022	[NT]
Naphthalene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	90	[NT]
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	91	[NT]
Fluorene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	93	[NT]
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	100	[NT]
Anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	86	[NT]
Pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	91	[NT]
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	93	[NT]
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	90	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	81	1	84	83	1	81	[NT]

QUALITY CONTROL: Total Phenolics in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	299478-2
Date extracted	-			05/07/2022	1	05/07/2022	05/07/2022		05/07/2022	05/07/2022
Date analysed	-			05/07/2022	1	05/07/2022	05/07/2022		05/07/2022	05/07/2022
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	1	<0.05	<0.05	0	102	102

QUALITY CONTROL: HM in water - dissolved					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	299478-2
Date prepared	-			06/07/2022	1	05/07/2022	05/07/2022		06/07/2022	06/07/2022
Date analysed	-			06/07/2022	1	06/07/2022	06/07/2022		06/07/2022	06/07/2022
Arsenic-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	105	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	105	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	106	92
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	86	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	2	2	0	95	97

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	299478-2
Date prepared	-			01/07/2022	1	01/07/2022	01/07/2022		01/07/2022	01/07/2022
Date analysed	-			01/07/2022	1	01/07/2022	01/07/2022		01/07/2022	01/07/2022
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	110	91
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	95	86
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	104	104
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	0.83	0.84	1	103	115
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	<0.005	1	<0.005	<0.005	0	115	103

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

PAHs in Water - Low Level - The PQL has been raised due to interferences from analytes (other than those being tested) in sample/s 299478-10.

CHAIN OF COUNTODY - Client

ENVIROLAB GROUP

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Client: Hazmat Services	**Client Project Name / Number / Site etc (ie report title):** N4656 - KIWEF
Contact Person: Florence Archer	**PO No.:**
Project Mgr: Florence Archer	**Envirolab Quote No. :** 16SY078
Sampler: FA/DH	**Date results required:**
Address: Level 1 45C Fitzroy Street Carrington NSW 2294	**Or choose:** standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 02 49611887 **Mob:** 0438246996	**Report format:** esdat / equis /
Email: florence.archer@hazmatservices.com.au	**Lab Comments:**

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ammonia	Phenols	Free Cyanide/Total cyanide/dissolved cyanide	Hexavalent Chromium	Molybdenum	Lead	PAH	Free Cyanide/Dissolved Cyanide	BTEX	Heavy Metals (standard 8 + molybdenum)						Provide as much information about the sample as you can
	Sample information				**Tests Required**															**Comments**
1	336A		28/06/2022	Water	X	X	X	X	X	X	X									
2	336B		28/06/2022	Water	X	X	X	X	X	X	X									
3	K11/3W		28/06/2022	Water	X	X	X	X	X	X	X									
4	K11/3E		28/06/2022	Water	X	X	X	X	X	X	X									
5	QC2		28/06/2022	Water	X	X	X	X	X	X	X									
6	Rinsate 7		28/06/2022	Water										X						
7	Rinsate 8		29/06/2022	Water										X						
8	K12/10		29/06/2022	Water	X	X	X	X	X	X	X									
9	K12/10E		29/06/2022	Water	X	X	X	X	X	X	X									
10	K12/7E		29/06/2022	Water	X	X	X	X	X	X	X									
11	NCIG1		29/06/2022	Water	X	X	X	X	X	X	X									
12	NCIG2		29/06/2022	Water	X	X	X	X	X	X	X									

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 299478
Date Received: 1/7/22
Time Received: 1310
Received By: KW
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by (Company): Hazmat Services	**Received by (Company):** ELS SYD	***Lab use only:***
Print Name: Damien Hendrickx	**Print Name:** Katy Wayne	**Samples Received:** Cool or Ambient (circle one)
Date & Time: 30/06/2022	**Date & Time:** 1/7/22 1310	**Temperature Received at:** 10°C (if applicable)
Signature:	**Signature:**	**Transported by:** Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 299656

Client Details

Client	Hazmat Services
Attention	Florence Archer
Address	PO Box 118, Carrington, NSW, 2294

Sample Details

Your Reference	**N4656 - KIWEF**
Number of Samples	9 Water
Date samples received	05/07/2022
Date completed instructions received	05/07/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	12/07/2022
Date of Issue	12/07/2022

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Results Approved By
Hannah Nguyen, Metals Supervisor
Kyle Gavrily, Senior Chemist
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

PAHs in Water - Low Level						
Our Reference		299656-1	299656-2	299656-3	299656-4	299656-7
Your Reference	UNITS	K12/1W	K12/4N	KS12/6	K12/7	K10/2
Date Sampled		1/07/2022	1/07/2022	1/07/2022	1/07/2022	4/07/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	11/07/2022	11/07/2022	11/07/2022	11/07/2022	11/07/2022
Date analysed	-	11/07/2022	11/07/2022	11/07/2022	11/07/2022	11/07/2022
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	68	81	67	73	79

PAHs in Water - Low Level			
Our Reference		299656-8	299656-9
Your Reference	UNITS	K10/2N	K10/2NN
Date Sampled		4/07/2022	4/07/2022
Type of sample		Water	Water
Date extracted	-	11/07/2022	11/07/2022
Date analysed	-	11/07/2022	11/07/2022
Naphthalene	µg/L	<0.2	8.3
Acenaphthylene	µg/L	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	8.3
Surrogate p-Terphenyl-d14	%	66	72

Total Phenolics in Water						
Our Reference		299656-1	299656-2	299656-3	299656-4	299656-8
Your Reference	UNITS	K12/1W	K12/4N	KS12/6	K12/7	K10/2N
Date Sampled		1/07/2022	1/07/2022	1/07/2022	1/07/2022	4/07/2022
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/07/2022	06/07/2022	06/07/2022	06/07/2022	06/07/2022
Date analysed	-	06/07/2022	06/07/2022	06/07/2022	06/07/2022	06/07/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

HM in water - dissolved						
Our Reference		299656-1	299656-2	299656-3	299656-4	299656-5
Your Reference	UNITS	K12/1W	K12/4N	KS12/6	K12/7	Rinsate 9
Date Sampled		1/07/2022	1/07/2022	1/07/2022	1/07/2022	1/07/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	07/07/2022	07/07/2022	07/07/2022	07/07/2022	07/07/2022
Date analysed	-	07/07/2022	07/07/2022	07/07/2022	07/07/2022	07/07/2022
Arsenic-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Cadmium-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<0.1
Chromium-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Copper-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Lead-Dissolved	μg/L	1	<1	<1	<1	<1
Mercury-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<0.05
Nickel-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Zinc-Dissolved	μg/L	[NA]	[NA]	[NA]	[NA]	<1
Molybdenum-Dissolved	μg/L	3	1	1	<1	<1

HM in water - dissolved					
Our Reference		299656-6	299656-7	299656-8	299656-9
Your Reference	UNITS	Rinsate 10	K10/2	K10/2N	K10/2NN
Date Sampled		4/07/2022	4/07/2022	4/07/2022	4/07/2022
Type of sample		Water	Water	Water	Water
Date prepared	-	07/07/2022	07/07/2022	07/07/2022	07/07/2022
Date analysed	-	07/07/2022	07/07/2022	07/07/2022	07/07/2022
Arsenic-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Cadmium-Dissolved	μg/L	<0.1	[NA]	[NA]	[NA]
Chromium-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Copper-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Lead-Dissolved	μg/L	<1	<1	<1	<1
Mercury-Dissolved	μg/L	<0.05	[NA]	[NA]	[NA]
Nickel-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Zinc-Dissolved	μg/L	<1	[NA]	[NA]	[NA]
Molybdenum-Dissolved	μg/L	<1	3	8	<1

Miscellaneous Inorganics						
Our Reference		299656-1	299656-2	299656-3	299656-4	299656-7
Your Reference	UNITS	K12/1W	K12/4N	KS12/6	K12/7	K10/2
Date Sampled		1/07/2022	1/07/2022	1/07/2022	1/07/2022	4/07/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	06/07/2022	06/07/2022	06/07/2022	06/07/2022	06/07/2022
Date analysed	-	06/07/2022	06/07/2022	06/07/2022	06/07/2022	06/07/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	[NA]
Total Cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	[NA]
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	[NA]
Ammonia as N in water	mg/L	0.21	48	0.056	0.25	0.040
Hexavalent Chromium, Cr^{6+}	mg/L	<0.050	<0.005	0.01	<0.005	<0.005

Miscellaneous Inorganics			
Our Reference		299656-8	299656-9
Your Reference	UNITS	K10/2N	K10/2NN
Date Sampled		4/07/2022	4/07/2022
Type of sample		Water	Water
Date prepared	-	06/07/2022	06/07/2022
Date analysed	-	06/07/2022	06/07/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004
Total Cyanide	mg/L	0.007	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004
Ammonia as N in water	mg/L	0.48	7.6
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically. Waters samples are filtered on receipt prior to analysis.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			11/07/2022	[NT]	[NT]	[NT]	[NT]	11/07/2022	[NT]
Date analysed	-			11/07/2022	[NT]	[NT]	[NT]	[NT]	11/07/2022	[NT]
Naphthalene	µg/L	0.2	Org-022/025	<0.2	[NT]	[NT]	[NT]	[NT]	116	[NT]
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Fluorene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	109	[NT]
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	118	[NT]
Anthracene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	105	[NT]
Pyrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	112	[NT]
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	85	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	105	[NT]	[NT]	[NT]	[NT]	108	[NT]

QUALITY CONTROL: Total Phenolics in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	299656-2
Date extracted	-			06/07/2022	1	06/07/2022	06/07/2022		06/07/2022	06/07/2022
Date analysed	-			06/07/2022	1	06/07/2022	06/07/2022		06/07/2022	06/07/2022
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	1	<0.05	<0.05	0	100	103

QUALITY CONTROL: HM in water - dissolved					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date prepared	-			07/07/2022	1	07/07/2022	07/07/2022		07/07/2022	[NT]
Date analysed	-			07/07/2022	1	07/07/2022	07/07/2022		07/07/2022	[NT]
Arsenic-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	114	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	112	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	107	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	1	1	<1	0	109	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	101	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	3	2	40	103	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	299656-2
Date prepared	-			06/07/2022	1	06/07/2022	06/07/2022		06/07/2022	06/07/2022
Date analysed	-			06/07/2022	1	06/07/2022	06/07/2022		06/07/2022	06/07/2022
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	99	86
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	100	89
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	98	76
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	0.21	0.21	0	101	[NT]
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	<0.005	1	<0.050	<0.05	0	107	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

MISC_INORG: Cr PQL has been raised due to matrix interferences from analytes (other than those being tested) in the sample/s. Samples were diluted and reanalysed however same results were achieved.

CHAIN OF CUSTODY - Client

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Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
Ph 0406 350 706 / adelaide@envirolab.com.au

Client: Hazmat Services	Client Project Name / Number / Site etc (ie report title): N4656 - KIWEF
Contact Person: Florence Archer	
Project Mgr: Florence Archer	PO No.:
Sampler: FA/DH	Envirolab Quote No. : 16SY078
Address: Level 1 45C Fitzroy Street Carrington NSW 2294	Date results required: Or choose: standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 02 49611887 Mob: 0438246996	Report format: esdat / equis /
Email: florence.archer@hazmatservices.com.au	Lab Comments:

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ammonia	Phenols	Free Cyanide/Total cyanide/dissolved cyanide	Hexavalent Chromium	Molybdenum	Lead	PAH	Free Cyanide/Dissovled Cyanide	BTEX	Heavy Metals (standard 8 + molybdenum)						Provide as much information about the sample as you can
1	K12/1W		1/07/2022	Water	X	X	X	X	X	X	X									
2	K12/4N		1/07/2022	Water	X	X	X	X	X	X	X									
3	KS12/6		1/07/2022	Water	X	X	X	X	X	X	X									
4	K12/7		1/07/2022	Water	X	X	X	X	X	X	X									
5	Rinsate 9		1/07/2022	Water										X						
6	Rinsate 10		4/07/2022	Water										X						
7	K10/2		4/07/2022	Water	X			X	X	X	X									
8	K10/2N		4/07/2022	Water	X	X	X	X	X	X	X									
9	K10/2NN		4/07/2022	Water	X		X	X	X	X	X									

Relinquished by (Company): Hazmat Services	Received by (Company): ELS	*Lab use only:* 299656.
Print Name: Damien Hendrickx	Print Name: Geoff.	Samples Received: Cool or Ambient (circle one)
Date & Time: 04/07/2022	Date & Time: 5722 1140	Temperature Received at: 10 (if applicable)
Signature:	Signature:	Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 299973

Client Details

Client	Hazmat Services
Attention	Florence Archer
Address	PO Box 118, Carrington, NSW, 2294

Sample Details

Your Reference	**N4656 - KIWEF**
Number of Samples	4 Water
Date samples received	08/07/2022
Date completed instructions received	08/07/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	15/07/2022
Date of Issue	15/07/2022

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Diego Bigolin, Inorganics Supervisor
Kyle Gavrily, Senior Chemist
Loren Bardwell, Development Chemist

Authorised By

Nancy Zhang, Laboratory Manager

PAHs in Water - Low Level				
Our Reference		299973-1	299973-2	299973-3
Your Reference	UNITS	K11/1	K11/1S	QC3
Date Sampled		6/07/2022	6/07/2022	6/07/2022
Type of sample		Water	Water	Water
Date extracted	-	13/07/2022	13/07/2022	13/07/2022
Date analysed	-	14/07/2022	14/07/2022	14/07/2022
Naphthalene	µg/L	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	0.2	0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	0.19	0.1	<0.1
Surrogate p-Terphenyl-d14	%	83	91	91

Total Phenolics in Water				
Our Reference		299973-1	299973-2	299973-3
Your Reference	UNITS	K11/1	K11/1S	QC3
Date Sampled		6/07/2022	6/07/2022	6/07/2022
Type of sample		Water	Water	Water
Date extracted	-	11/07/2022	11/07/2022	11/07/2022
Date analysed	-	11/07/2022	11/07/2022	11/07/2022
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05

HM in water - dissolved					
Our Reference		299973-1	299973-2	299973-3	299973-4
Your Reference	UNITS	K11/1	K11/1S	QC3	Rinsate11
Date Sampled		6/07/2022	6/07/2022	6/07/2022	6/07/2022
Type of sample		Water	Water	Water	Water
Date prepared	-	12/07/2022	12/07/2022	12/07/2022	12/07/2022
Date analysed	-	12/07/2022	12/07/2022	12/07/2022	12/07/2022
Arsenic-Dissolved	µg/L	[NA]	[NA]	[NA]	<1
Cadmium-Dissolved	µg/L	[NA]	[NA]	[NA]	<0.1
Chromium-Dissolved	µg/L	[NA]	[NA]	[NA]	<1
Copper-Dissolved	µg/L	[NA]	[NA]	[NA]	<1
Lead-Dissolved	µg/L	<1	<1	<1	<1
Mercury-Dissolved	µg/L	[NA]	[NA]	[NA]	<0.05
Nickel-Dissolved	µg/L	[NA]	[NA]	[NA]	<1
Zinc-Dissolved	µg/L	[NA]	[NA]	[NA]	<1
Molybdenum-Dissolved	µg/L	5	<1	<1	<1

Miscellaneous Inorganics				
Our Reference		299973-1	299973-2	299973-3
Your Reference	UNITS	K11/1	K11/1S	QC3
Date Sampled		6/07/2022	6/07/2022	6/07/2022
Type of sample		Water	Water	Water
Date prepared	-	08/07/2022	08/07/2022	08/07/2022
Date analysed	-	08/07/2022	08/07/2022	08/07/2022
Weak Acid Dissociable Cyanide	mg/L	<0.004	<0.004	<0.004
Total Cyanide	mg/L	<0.004	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004
Ammonia as N in water	mg/L	0.29	6.6	6.6
Hexavalent Chromium, Cr^{6+}	mg/L	<0.005	<0.005	<0.005

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically. Waters samples are filtered on receipt prior to analysis.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			13/07/2022	1	13/07/2022	13/07/2022		13/07/2022	[NT]
Date analysed	-			14/07/2022	1	14/07/2022	14/07/2022		14/07/2022	[NT]
Naphthalene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	88	[NT]
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	83	[NT]
Fluorene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	90	[NT]
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	110	[NT]
Anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	84	[NT]
Pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	77	[NT]
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	1	0.2	<0.1	67	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	71	[NT]
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	114	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	87	1	83	86	4	101	[NT]

QUALITY CONTROL: Total Phenolics in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			11/07/2022	1	11/07/2022	11/07/2022		11/07/2022	[NT]
Date analysed	-			11/07/2022	1	11/07/2022	11/07/2022		11/07/2022	[NT]
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	1	<0.05	<0.05	0	101	[NT]

QUALITY CONTROL: HM in water - dissolved					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	[NT]
Date prepared	-			12/07/2022	1	12/07/2022	12/07/2022		12/07/2022	[NT]
Date analysed	-			12/07/2022	1	12/07/2022	12/07/2022		12/07/2022	[NT]
Arsenic-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	101	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	106	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	5	5	0	98	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			08/07/2022	1	08/07/2022	08/07/2022		08/07/2022	[NT]
Date analysed	-			08/07/2022	1	08/07/2022	08/07/2022		08/07/2022	[NT]
Weak Acid Dissociable Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	98	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	101	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	100	[NT]
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	0.29	[NT]		106	[NT]
Hexavalent Chromium, Cr^{6+}	mg/L	0.005	Inorg-024	<0.005	1	<0.005	[NT]		115	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

CHAIN OF COUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 42 43 44

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Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
Ph 0406 350 706 / adelaide@envirolab.com.au

Client: Hazmat Services	Client Project Name / Number / Site etc (ie report title): N4656 - KIWEF
Contact Person: Florence Archer	
Project Mgr: Florence Archer	PO No.:
Sampler: FA/DH	Envirolab Quote No. : 16SY078
Address: Level 1 45C Fitzroy Street Carrington NSW 2294	Date results required: Or choose: standard / same day / 1 day / 2 day / 3 day. *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 02 49611887 Mob: 0438246996	Report format: esdat / equis /
Email: florence.archer@hazmatservices.com.au	Lab Comments:

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ammonia	Phenols	Free Cyanide/Total cyanide/dissolved cyanide	Hexavalent Chromium	Molybdenum	Lead	PAH	Free Cyanide/Dissovled Cyanide	BTEX	Heavy Metals (standard 8 + molybdenum)						Comments: Provide as much information about the sample as you can
1	K11/1		6/07/2022	Water	X	X	X	X	X	X	X									
2	K11/1S		6/07/2022	Water	X	X	X	X	X	X	X									
3	QC3		6/07/2022	Water	X	X	X	X	X	X	X									
4	Rinsate 11		6/07/2022	Water										X						

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 299473
Date Received: 8.7.2022
Time Received: 1000
Received By: THAN
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by (Company): Hazmat Services	Received by (Company): ELS SYDNEY	*Lab use only:*	
Print Name: Damien Hendrickx	Print Name: THAN	Samples Received: Cool or Ambient (circle one)	
Date & Time: 07/07/2022	Date & Time: 8.7.22 1000	Temperature Received at: 10 (if applicable)	
Signature:	Signature:	Transported by: Hand delivered / courier	

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Page No: 1

CERTIFICATE OF ANALYSIS

Work Order	: **ES2221693**	Page	: 1 of 5
Client	: **HAZMAT SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: FLORENCE ARCHER	Contact	: Customer Services ES
Address	: Level 1 45C Fitzroy St Carrington 2294	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 2 4961 1887	Telephone	: +61-2-8784 8555
Project	: N4656	Date Samples Received	: 21-Jun-2022 15:29
Order number	: ----	Date Analysis Commenced	: 22-Jun-2022
C-O-C number	: ----	Issue Date	: 28-Jun-2022 16:59
Sampler	: FA/DH		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	QC1A	----	----	----	----
			Sampling date / time	20-Jun-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2221693-001	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.019**	----	----	----	----
EG050T: Total Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.004	mg/L	<0.004	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.004	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Sample ID	**QC1A**	----	----	----	----
			Sampling date / time	20-Jun-2022 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2221693-001**	--------	--------	--------	--------
				Result	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**27.9**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**61.7**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**62.1**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**72.0**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**78.8**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**75.1**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ Sydney: 277 Woodpark Rd, Smithfield NSW 2176 Ph: 02 8784 8555 E: samples.sydney@alsenviro.com
☐ Newcastle: 5 Rosegum Rd, Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsenviro.com
☐ Brisbane: 32 Shand St, Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsenviro.com
☐ Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsenviro.com
☐ Melbourne: 2-4 Westall Rd, Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsenviro.com
☐ Adelaide: 2-1 Burma Rd, Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsenviro.com
☐ Perth: 10 Hod Way, Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsenviro.com
☐ Launceston: 27 Wellington St, Launceston TAS 7250 Ph: 03 6331 2158 E: launceston@alsenviro.com

CLIENT:	Hazmat Services
OFFICE:	Level 1, 45C Fitzroy Street, Carrington NSW 2294
PROJECT:	N4129
ORDER NUMBER:	
PROJECT MANAGER:	Florence Archer — CONTACT PH: 02 4911887
SAMPLER:	FA/DH — SAMPLER MOBILE:
COC Emailed to ALS? (YES / NO)	EDD FORMAT (or default):
Email Reports to :	forence.archer@hazmatservices.com.au
Email Invoice to:	admin@hazmatservices.com.au; florence.archer@hazmatservices.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☐ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SYBQ/478

COUNTRY OF ORIGIN:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt:	8.9 °C		
Other comment:			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Florence Archer	RM	RM	
DATE/TIME: 21/6/22	DATE/TIME: 21/6 1529	DATE/TIME: 21/6 1700	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required)									Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Ammonia	Phenols	Free Cyanide/ Total Cyanide/ dissolved Cyanide	Hexavalent Chromium	Molybdenum	Lead	Total PAH	BTEX	TPH	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	QC1A	20/06/2022	Water			X	X	X	X	X	X	X			
					TOTAL										

Environmental Division
Sydney
Work Order Reference
ES2221693

Telephone : + 61-2-8784 8555

LAB OF ORIGIN: NEWCASTLE

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag

PY 21/6/22 7?30

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2223035**	Page	: 1 of 5
Client	: **HAZMAT SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: FLORENCE ARCHER	Contact	: Customer Services ES
Address	: Level 1 45C Fitzroy St Carrington 2294	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 2 4961 1887	Telephone	: +61-2-8784 8555
Project	: N4656	Date Samples Received	: 30-Jun-2022 15:53
Order number	: ----	Date Analysis Commenced	: 01-Jul-2022
C-O-C number	: ----	Issue Date	: 07-Jul-2022 14:48
Sampler	: FA/DH		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 1		
No. of samples analysed	: 1		

NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- EG050G:LOR raised due to sample matrix.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	QC2A	----	----	----	----
			Sampling date / time	28-Jun-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2223035-001	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
EG050T: Total Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.10	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.004	mg/L	<0.004	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.004	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**6.07**	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	QC2A	----	----	----	----
			Sampling date / time	28-Jun-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2223035-001	--------	--------	--------	--------
				Result	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**27.4**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**66.4**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**60.1**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**61.1**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**85.8**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**80.4**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112

CHAIN OF CUSTODY

ALS Laboratory: please tick →

Sydney: 277 Woodpark Rd, Smithfield NSW 2176 Ph: 02 8784 8555 E: samples.sydney@alsenviro.com
Newcastle: 5 Rosegum Rd, Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsenviro.com
Brisbane: 32 Shand St, Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsenviro.com
Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph: 07 4796 0600
Melbourne: 2-4 Westall Rd, Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsenviro.com
Adelaide: 2-1 Burma Rd, Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsenviro.com
Perth: 10 Hod Way, Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsenviro.com
Launceston: 27 Wellington St, Launceston TAS 7250 Ph: 03 6331 2158 E: launceston@alsenviro.com

CLIENT:	Hazmat Services
OFFICE:	Level 1, 45C Fitzroy Street, Carrington NSW 2294
PROJECT:	N4656
ORDER NUMBER:	
PROJECT MANAGER:	Florence Archer — CONTACT PH: ~~02 4911887~~ 0249611887
SAMPLER:	FA/DH — SAMPLER MOBILE:
COC Emailed to ALS? (YES / NO)	EDD FORMAT (or default):
Email Reports to :	forence.archer@hazmatservices.com.au
Email Invoice to:	admin@hazmatservices.com.au; florence.archer@hazmatservices.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☒ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SYBQ/478

COUNTRY OF ORIGIN:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt:	10.8 °C		
Other comment:			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Florence Archer	70'8	70'8	PA
DATE/TIME: 30/6/22	DATE/TIME: 30/6/22 3:53pm	DATE/TIME: 30/6/22 5pm.	DATE/TIME: 30/6/22 7:30

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).									Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Ammonia	Phenols	Free Cyanide/ Total Cyanide/ dissolved Cyanide	Hexavalent Chromium	Molybdenum	Lead	Total PAH	BTEX	TPH	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	QC2A	28/06/2022	Water			X	X	X	X	X	X	X			
				TOTAL											

LAB OF ORIGIN: NEWCASTLE

Environmental Division
Sydney
Work Order Reference
ES2223035

Telephone : + 61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved, VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic, HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass.
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle, ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag

CERTIFICATE OF ANALYSIS

Work Order	: **ES2224044**	Page	: 1 of 6
Client	: **HAZMAT SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: FLORENCE ARCHER	Contact	: Customer Services ES
Address	: Level 1 45C Fitzroy St Carrington 2294	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 2 4961 1887	Telephone	: +61-2-8784 8555
Project	: N4656	Date Samples Received	: 07-Jul-2022 16:50
Order number	: ----	Date Analysis Commenced	: 11-Jul-2022
C-O-C number	: ----	Issue Date	: 14-Jul-2022 18:14
Sampler	: FA/DH		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	QC3A	----	----	----	----
			Sampling date / time	06-Jul-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2224044-001	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
EG050T: Total Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser								
Free Cyanide	----	0.004	mg/L	<0.004	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK028SF: Weak Acid Dissociable CN by Segmented Flow Analyser								
Weak Acid Dissociable Cyanide	----	0.004	mg/L	<0.004	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**5.41**	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	QC3A	----	----	----	----
			Sampling date / time	06-Jul-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2224044-001	--------	--------	--------	--------
				Result	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	**120**	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	**110**	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	**230**	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	**210**	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	**210**	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	----	----	----	----
^ Total Xylenes	----	2	µg/L	<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L	<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	QC3A	----	----	----	----
			Sampling date / time	06-Jul-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2224044-001	--------	--------	--------	--------
				Result	----	----	----	----
EP080: BTEXN - Continued								
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**25.4**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**46.2**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**52.8**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**53.7**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**66.2**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**59.8**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**107**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**99.4**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**100.0**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

CHAIN OF CUSTODY

ALS Laboratory: please tick →

Sydney · Newcastle · Brisbane · Townsville · Melbourne · Adelaide · Perth · Launceston

CLIENT: Hazmat Services	TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	☑ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):		FOR LABORATORY USE ONLY (Circle) Custody Seal Intact? Yes No N/A
OFFICE: Level 1, 45C Fitzroy Street, Carrington NSW 2294				Free ice / frozen ice bricks present upon receipt? Yes No N/A
PROJECT: N4656	ALS QUOTE NO.: SYBQ/478	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7		Random Sample Temperature on Receipt: 18.2 °C
ORDER NUMBER:	COUNTRY OF ORIGIN:			Other comment:
PROJECT MANAGER: Florence Archer	CONTACT PH: 02 4911887			
SAMPLER: FA/DH	SAMPLER MOBILE:	RELINQUISHED BY: Florence Archer	RECEIVED BY: JN 7/7/22	RELINQUISHED BY: JN 7/7/22
COC Emailed to ALS? (YES / NO)	EDD FORMAT (or default):	DATE/TIME: 07/07/22	DATE/TIME: 1650	DATE/TIME: 1700
Email Reports to : forence.archer@hazmatservices.com.au				RECEIVED BY: PM DATE/TIME: 7/7/22 2230
Email Invoice to: admin@hazmatservices.com.au; florence.archer@hazmatservices.com.au				

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required)									Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	Ammonia	Phenols	Free Cyanide/ Total Cyanide/ dissolved Cyanide	Hexavalent Chromium	Molybdenum	Lead	Total PAH	BTEX	TPH	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	QC3A	6/07/2022	Water			X	X	X	X	X	X	X	x	x	
				TOTAL											

LAB OF ORIGIN: NEWCASTLE

Environmental Division Sydney
Work Order Reference
ES2224044

Telephone : + 61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic, N = Nitric Preserved Plastic, ORC = Nitric Preserved ORC, SH = Sodium Hydroxide/Cd Preserved, S = Sodium Hydroxide Preserved Plastic, AG = Amber Glass Unpreserved, AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved, VB = VOA Vial Sodium Bisulphate Preserved, VS = VOA Vial Sulfuric Preserved, AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass, H = HCl preserved Plastic, HS = HCl preserved Speciation bottle, SP = Sulfuric Preserved Plastic, F = Formaldehyde Preserved Glass,
Z = Zinc Acetate Preserved Bottle, E = EDTA Preserved Bottles, ST = Sterile Bottle, ASS = Plastic Bag for Acid Sulphate Soils, B = Unpreserved Bag

APPENDIX F
Field Sheets

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	KS7/1
Client:	HCCDC	**Date:**	20-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):		NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)			
c. Total Well Length:		NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:			

Well Purge Information

Purge Method:	Surface Water	Purge Depth:	—
Field Equipment:	YSI water Quality meter	Start Time:	10:25

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
						Surface water	

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1030	—	14.0	6.96	222.9	1894	7.82	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS7/1	QC1	QC1A

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	KS 2/1
Client:	**HCCDC**	**Date:**	20-6-22
Site:	**KIWEF & EPAP**	**Field Team:**	PA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):		NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)			
c. Total Well Length:		NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	Surface water	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:			

Well Purge Information

Purge Method:	—	Purge Depth:	—
Field Equipment:	YSI water Quality meter	Start Time:	10:50

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
			Surface water				

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1055	—	14.6	8.57	~~90~~ 136.5	994	8.63	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS2/1	—	—

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	KS 1/3
Client:	**HCCDC**	**Date:**	20/6/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):		NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)			
c. Total Well Length:		NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	Surface water	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:			

Well Purge Information

Purge Method:	–	Purge Depth:	–
Field Equipment:	YSI water Quality Meter	Start Time:	10:20

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
			Surface water				

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1125	–	13.8	7.20	-6.3	621	2.77	Murky, black, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS1/3	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	KS 10/1
Client:	HCCDC	**Date:**	20-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):		NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)			
c. Total Well Length:		NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	Surface water	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:			

Well Purge Information

Purge Method:	—	Purge Depth:	—
Field Equipment:	YSI Water Quality Meter	Start Time:	1140

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
				Surface water			

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1145	—	14.6	7.23	-46.4	801	1.60	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS 10/1	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	BH e29S
Client:	**HCCDC**	**Date:**	21/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.5m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)			
c. Total Well Length:	3.4m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	40mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	2.5m
Field Equipment:	Interface Probe, WQM	Start Time:	12:30pm

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
12:34	2.5L	20.5	7.97	-248.3	954	3.47	cloudy, greyish - organic odour
12:36	5L	18.2	7.96	-255.5	936	1.65	" "
12:39	10L	18.3	7.91	-255.2	979	1.57	" "
12:43	15L	18.3	7.91	-258.2	938	1.69	" "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
12:43	15L	18.3	7.91	-258.2	938	1.69	Cloudy, organic odour.

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K9/35
Client:	**HCCDC**	**Date:**	21/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA
Weather:	Fine, sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.74m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	Inground well		
c. Total Well Length:	3.74m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2L	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge - Low flow	Purge Depth:	1.74.
Field Equipment:	Interface probe, YSI WQM	Start Time:	11:50a.m.

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
12:00	2.5L	18.4	7.81	-152.7	171.1	9.33	Greyish cloudy. organic odour.
12:05	5L	18.0	7.76	-146.8	131.1	8.33	" " "
12:07	6L	18.0	7.75	-144.1	137.2	8.19	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
12:08	6L	18.0	7.75	-144.1	137.2	8.19	Cloudy. organic odour.

End Time:	12:20	Depth to Water Table:	1.74m

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K9/3N
Client:	**HCCDC**	**Date:**	21/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.75m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	- Inground well		
c. Total Well Length:	10.20m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	7.45m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	2.75m
Field Equipment:	Interface probe, YSI WQM	Start Time:	11:05am.

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
11:20am	3L	20.6	6.35	-162.5	194.4	5.95	clear. organic odour.
11:25	5L	20.6	6.31	-159.2	89.1	5.25	" "
11:30	7.5L	20.6	6.28	-157.4	72.1	5.24	" "
11:35	10L	20.6	6.27	-157.2	75.2	5.35	" "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
11:35	10L	20.6	6.27	-157.2	75.2	5.35	clear, organic odour.

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K11/2W
Client:	HCCDC	**Date:**	21/06/22
Site:	KIWEF & EPAP	**Field Team:**	FA
Weather:	Fine, Sunny.		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.7m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.41m		
c. Total Well Length:	11.46m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge & YSI WQM	Purge Depth:	1.7
Field Equipment:	Interface Probe, WQM	Start Time:	09:57

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (~~ppm~~ mg/L)	Comments (colour, odour, turbidity, etc.
09:57	2.5	18	7.45	-228.3	521	8.65	clear, organic odour.
10:02	5L	18.6	7.45	-232.5	375	8.81	" "
10:08	7.5L	18.6	7.44	-239.6	369.2	7.37	" "
10:14	10L	18.6	7.44	-247.2	375.2	6.89	" "
10:25	15L	18.6	7.41	-251.9	368.2	6.77	clear - organic odour.
10:32	20L	18.7	7.41	-255.7	374.4	6.67	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (~~ppm~~ mg/L)	Comments (colour, odour, turbidity, etc.
10:32	20L	18.7	7.39	-255.6	368.5	6.29	clear, organic odour.

End Time:	10:45	Depth to Water Table:	1.67

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	KI1/2E
Client:	HCCDC	**Date:**	21/06/22
Site:	KIWEF & EPAP	**Field Team:**	FA
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.42	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.72		
c. Total Well Length:	5.49	NAPL Interphase Depth:	–
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge, WQM (Y81).	Purge Depth:	
Field Equipment:		Start Time:	09:05am

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 ~~(ppm)~~ mg/L	Comments (colour, odour, turbidity, etc.
						84.6 / 96	
09:10	2.5L	17.7	7.17	-87.4	830	8.19	light Brown, Organic.
09:17	5L	17.9	7.07	~~-100~~ -93.4	24.4	7.73	light Brown Organic.
09:23	7L	18	7.12	-96.7	24.3	7.39	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
~~08:~~ 09:26	8L	18.1	7.12	-99.2	24.3	7.01	light Brown, Organic.

End Time:	09:35	Depth to Water Table:	0.65m

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	EG1D
Client:	HCCDC	**Date:**	22-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	5.70m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.69m		
c. Total Well Length:	29.26m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	23.56m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	~~[illegible]~~ 5.76
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1:55pm

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1400	1	23.0	7.03	-36.4	~~[illegible]~~ 44027	5.87	Clear, organic odour
1404	5	20.8	6.94	-19.3	44876	2.24	" " "
1413	10	20.6	6.42	-122.4	44047	1.77	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1413	10	20.6	6.92	122.4	44047	1.77	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
EG1D	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	E61 S
Client:	**HCCDC**	**Date:**	22-6-22
Site:	**KIWEF & EPAP**	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	–	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.68m		
c. Total Well Length:	4.63m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	–	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:		Purge Depth:	
Field Equipment:		Start Time:	

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O2 (ppm)*	*Comments (colour, odour, turbidity, etc.*
			Well Dry				

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O2 (ppm)*	*Comments (colour, odour, turbidity, etc.*
			Well Dry				

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	KS/6NN
Client:	HCCDC	**Date:**	22-6-22
Site:	KIWEF & EPAP	**Field Team:**	EA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	3.01m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.45m		
c. Total Well Length:	5.51m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.50m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	5.51m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	12:45pm

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1316	1	22.6	6.30	-196.2	639	9.98	Clear, organic odour
1321	2.5	20.2	6.10	-168.1	110.2	4.66	" " "
1327	5	20.2	6.21	-162.1	72.5	4.45	" " "
1333	7.5	20.2	6.26	-160.3	77.5	4.72	" " "
1337	10	20.2	6.29	-158.9	75.8	4.71	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1337	10	20.2	6.29	-158.9	75.8	4.71	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS/6NN	-	-

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	KS/6N
Client:	**HCCDC**	**Date:**	22-6-22
Site:	**KIWEF & EPAP**	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.23m	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.62m		
c. Total Well Length:	3.56m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	1.33m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	3.56
Field Equipment:	IP, YSI water Quality Meter	Start Time:	11:55

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1200	1	18.9	5.72	-160.6	33.7	5.25	Clear, organic odour
1205	2.5	18.7	5.47	-243.6	27.9	6.12	" " "
1212	5	18.6	5.38	-174.8	26.4	4.66	" " "
1220	7.5	18.5	5.41	-176.2	28.9	4.26	" " "
1225	10	18.5	5.43	-178.9	29.2	4.19	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1225	10	18.5	5.43	-178.9	29.2	4.19	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS/6N	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K5/6S
Client:	HCCDC	**Date:**	22-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	3.14m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.61m		
c. Total Well Length:	9.83m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	6.69m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	9.83
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	11:10am

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
11:15	1	19.8	6.93	-98.4	71.3	10.23	Clear, no odour
11:28	5	20.2	6.66	-78.1	91.0	7.46	Clear, organic odour
11:38	10	20.2	6.85	-76.7	84.0	6.97	" " "
11:48	15	22.6	6.85	-78.2	83.9	7.27	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
11:48	15	22.6	6.85	-78.2	83.9	7.27	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K5/6S	-	-

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	KS155
Client:	HCCDC	**Date:**	22-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	3.76m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	0.59m		
c. Total Well Length:	9.49m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	5.73m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	9.49
Field Equipment:	IP, YSI water Quality Meter	Start Time:	10:21

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1025	1	19.1	8.49	49.8	10.9	10.17	Clear, no odour
1035	5	20.4	7.15	-151.6	59.4	6.85	Clear, no odour
1045	10	20.4	7.13	-165.4	40.6	6.44	Clear, ~~no odour~~ organic odour
1055	15	20.6	7.12	-166.2	47.0	6.61	Clear, organic odour

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1055	15	20.6	7.12	-166.2	47.0	6.61	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
~~KS~~ KS155	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	KS/SN
Client:	HCCDC	**Date:**	22-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.89 m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.65 m		
c. Total Well Length:	3.70 m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	0.81 m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	3.70
Field Equipment:	YSI water Quality Meter IC	Start Time:	9:35

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0947	1	18.1	6.02	66.7	10.1	7.14	Clear, no odour
0951	2.5	19.4	6.19	86.7	9.7	4.85	Brown, murky, no odour
1003	5	19.7	6.70	90.0	9.0	4.92	Brown, clear, no odour
1006	7.5	19.7	7.06	80.4	27.7	7.60	" " "
1010	8.5	19.7	7.09	76.4	31.0	7.13	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1010	8.5	19.7	7.09	76.4	31.0	7.13	Brown, clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS/SN	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K7/1
Client:	HCCDC	**Date:**	23-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	4.53m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	0.57m		
c. Total Well Length:	6.66m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.13m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	6.66m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	0730

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0743	1	15.8	5.22	-220.6	20.4	6.29	Clear, organic odour
0748	2.5	19.0	7.65	-231.0	19.0	6.52	Grey, clear, organic odour
0754	5	19.1	7.37	-162.8	16.3	5.64	" " " "
0801	7.5	19.2	7.36	-169.3	11.2	5.82	" " " "
0810	9	19.1	7.35	-171.8	12.6	6.03	" " " "
	Well Dry after 9L						

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0810	9	19.1	7.35	-171.8	12.6	6.03	Grey, clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K7/1	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K7/4N
Client:	**HCCDC**	**Date:**	23-6-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	4.95m	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.26m		
c. Total Well Length:	8.99m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	4.04m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	8.99m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	0840

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O2 (ppm)*	*Comments (colour, odour, turbidity, etc.*
0851	1	20.9	7.71	-204.9	9.4	6.94	Clear, organic odour
0901	5	22.3	6.88	-176.8	25.3	4.48	Clear, no odour
0912	10	22.4	6.83	-164.4	35.8	6.32	" " "
0932	15	22.9	6.79	-160.8	34.9	6.70	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O2 (ppm)*	*Comments (colour, odour, turbidity, etc.*
0932	15	22.9	6.79	-160.8	34.9	6.70	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K7/4N	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K7/45
Client:	HCCDC	**Date:**	23-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH, LO
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	5.98m	NAPL present?	☐Yes ~~☐No~~
b. Well Stickup (ToC to ground level)	0.50m		
c. Total Well Length:	13.73m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	7.75m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	13.73m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	1000

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1010	1	21.0	6.80	-79.6	484.7	7.07	Clear, no odour
1020	5	21.6	6.76	-80.3	148.1	5.70	Yellow murky, no odour
1030	10	21.5	6.82	-77.3	231.5	6.07	Yellow, murky, no odour
1044	15	21.6	6.84	-71.4	282.1	5.71	Yellow, murky, no odour
1055	20	21.5	6.86	-70.4	219.1	4.73	Yellow, murky no odour

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1055	20	21.5	6.86	-70.4	219.1	4.73	Yellow, murky, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K7/45	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K7/2N
Client:	HCCDC	**Date:**	23-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH, LP
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	6.24m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.66m		
c. Total Well Length:	8.95m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.71m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	40mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	6.24
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1126

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
				Well DRY			

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
				Well DRY			

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
–	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K7/2S
Client:	HCCDC	**Date:**	23-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH, LP
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	6.44m	NAPL present?	☐Yes ☐~~No~~
b. Well Stickup (ToC to ground level)	0.66m		
c. Total Well Length:	11.40m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	4.96m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	11.40
Field Equipment:	YSI Water Quality Meter, IP	Start Time:	11:45

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1157	1	20.9	6.74	-34.2	357.0	8.24	Brown, murky, no odour
							Well dry after 1 litre

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1157	1	20.9	6.74	-34.2	357.0	8.24	Brown, murky, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K7/2S	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	KS/4
Client:	HCCDC	**Date:**	23-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	4.81m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.61m		
c. Total Well Length:	5.60m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	0.79m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	5.60m
Field Equipment:	IP, Water Quality Meter	Start Time:	1300

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1325	1	20.7	7.86	40.0	6.0	8.14	Clear, no odour
1330	2	20.9	6.73	77.2	3.9	6.70	" " "
							Dry after 2L

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1330	2	20.9	6.73	77.2	3.9	6.70	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS/4	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K8/SW
Client:	HCCDC	**Date:**	24-6-22
Site:	KIWEF & EPAP	**Field Team:**	DIX
Weather:	Fine, sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	4.85m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	1.79m		
c. Total Well Length:	8.03m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	3.18m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge - switched to bailer due to obstruction in well	Purge Depth:	8.03m
Field Equipment:	YSI Water Quality Meter, IP	Start Time:	0730

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0733	1	16.4	9.16	-35.0	1491	7.15	Clear, no odour
0740	2.5	16.8	8.25	-79.4	1568	5.26	" " " "
0750	5	16.8	8.21	-84.6	1592	4.99	" " " "
	Well Dry after 5L						

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0750	5	16.8	8.21	-84.6	1592	4.99	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K8/SW	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K8|SE
Client:	**HCCDC**	**Date:**	24-6-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	4.16m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	1.73m		
c. Total Well Length:	5.36m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	1.20m	Well Volume: $V = \pi\frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	5.36m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	8:20

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0834	1	16.6	9.13	-232.6	32.7	6.51	Clear, no odour
0840	2.5	19.3	10.03	-242.8	76.1	2.05	" " "
0845	5	19.3	10.21	-224.2	94.8	1.92	" " "
0851	7.5	19.3	10.28	-249.8	1531	1.68	" " "
0900	10	19.4	10.32	-262.8	2688	1.05	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0900	10	19.4	10.32	-262.8	2688	1.05	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K8|SE	-	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K9/4W
Client:	HCCDC	**Date:**	24-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH, LP
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.03m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	0.20m		
c. Total Well Length:	11.64m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	9.61m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	11.64m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	0930

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
9:39	1	17.4	8.30	-59.3	106.4	7.13	Clear, no odour
9.47	5	17.7	7.48	-74.6	52.2	7.16	Light yellow, relatively clear, no odour
10:03	10	18.0	7.29	-88.3	310.6	5.81	light yellow, relatively clear, no odour
10:16	15	18.0	7.18	-87.4	402.4	5.96	light yellow, relatively clear, no odour
10:28	20	18.1	7.18	-88.3	104.8	4.72	light yellow, relatively clear, no odour

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
10:28	20	18.1	7.18	-88.3	104.8	4.72	light yellow, relatively clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K9/4W		

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K9/2E
Client:	HCCDC	**Date:**	24-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH, LP
Weather:	Fine, sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.88 m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.28 m		
c. Total Well Length:	11.60 m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	9.72 m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50 mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	11.60m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1155

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1204	1	19.7	7.76	-132.1	5.2	3.49	Clear, no odour
1215	5	19.6	7.01	-96.8	7.9	1.94	" "
1230	10	19.5	6.98	-98.4	16.4	1.72	" "
1244	15	19.5	6.97	-122.1	440.9	0.85	" "
1255	20	19.5	6.98	-124.6	692.4	0.33	" "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1255	20	19.5	6.98	-124.6	692.4	0.33	clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K9/2E	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K9/4E
Client:	**HCCDC**	**Date:**	24-6-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH, LP
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.55m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.25m		
c. Total Well Length:	5.25m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	3.70m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	5.25
Field Equipment:	IP, YSI water Quality meter	Start Time:	1040

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O$_2$ (ppm)*	*Comments (colour, odour, turbidity, etc.*
1050	1	17.6	7.17	-105.5	87.1	3.79	Grey, murky, no odour
1051	2.5	17.5	7.13	-119.8	73.0	2.39	" " "
1056	5	16.9	6.99	-116.8	54.3	1.78	" " "
1104	7.5	16.9	7.00	-123.2	89.2	4.32	" "
1110	10	17.1	6.89	-144.7	296.7	0.54	" "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O$_2$ (ppm)*	*Comments (colour, odour, turbidity, etc.*
1110	10	17.1	6.89	-144.7	296.7	0.54	" "

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K9/4E		

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K9/2W
Client:	**HCCDC**	**Date:**	24-6-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH, LP
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.86m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.28m		
c. Total Well Length:	3.90m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.04m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	3.90
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1300

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
13:14	1	17.9	6.12	-74.8	66.9	4.35	Slightly murky, no odour
13:20	2.5	18.0	6.05	-70.1	18.8	3.24	" "
1330	5	17.9	5.80	-105.4	23.2	1.69	" "
13:44	7.5	18.0	5.80	-125.6	29.7	1.07	" "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
13:44	7.5	18.0	5.80	-125.6	29.7	1.07	Slightly murky, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K9/2W		

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	336A
Client:	HCCDC	Date:	28-6-22
Site:	KIWEF & EPAP	Field Team:	DH
Weather:	overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	5.40m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.80m		
c. Total Well Length:	6.80m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	1.40m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	6.80m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	0800

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0812	1	12.3	7.31	-121.7	9.6	6.10	Clear, no odour
0822	2.5	17.9	7.19	-124.7	16.8	3.67	Yellow, clear, no odour
0829	5	18.4	7.21	-52.1	10.8	4.36	" " " "
0836	7.5	18.6	7.20	-60.8	14.2	5.01	" " " "
0841	10	18.7	7.23	-61.2	15.1	4.99	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0841	10	18.7	7.23	-61.2	15.1	4.99	Yellow, clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
336A	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	336B
Client:	HCCDC	**Date:**	28-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	5.80m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	0.55m		
c. Total Well Length:	12.39m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	6.59m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micro purge	Purge Depth:	12.39m
Field Equipment:	IP, YSI water Quality meter	Start Time:	0905

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0916	1	19.1	6.96	~~8~~63	518	3.27	Yellow, silty, no odour
0928	5	19.0	6.72	-92.2	2546	1.79	Dark grey, silty, no odour
0942	10	19.0	6.79	-93.7	6293	1.65	" " " "
1000	15	18.9	6.85	-94.4	6891	1.78	Golden/dark yellow, no odour
1015	20	19.0	6.91	-94.8	6288	2.01	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1015	20	19.0	6.91	-94.8	6288	2.01	Gold/dark yellow, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
336B	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K11/3W
Client:	HCCDC	**Date:**	28-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.75m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.52m		
c. Total Well Length:	12.57m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	10.82m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	12.57m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	1050

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1102	1	18.4	7.44	-75.9	56.6	6.26	Clear, no odour
1114	5	19.4	6.64	-103.1	204.4	3.98	Gold/yellow, clear, no odour
1126	10	19.5	6.70	-114.5	241.2	3.82	" " " "
1140	15	19.6	6.72	-113.1	162.5	2.58	" " " "
1152	20	19.6	6.74	-119.0	159.8	2.41	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1152	20	19.6	6.74	-119.0	159.8	2.41	Gold/yellow, clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K11/3W	QC2	QC2A

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K11/3E
Client:	HCCDC	**Date:**	28-6-22
Site:	KIWEF & EPAP	**Field Team:**	DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.45m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.51m		
c. Total Well Length:	5.48m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	4.03m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	~~1220~~ 5.48m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	1220

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1230	1	18.4	7.44	-201.2	7.7	3.61	Clear, organic odour
1232	2.5	18.4	7.09	-220.9	8.5	8.24	" " "
1241	5	18.2	7.04	-216.0	8.6	2.89	" " "
1249	7.5	18.3	6.95	-200.3	8.6	2.86	Grey, murky, organic odour
1258	10	18.3	6.93	-199.3	10.2	2.97	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1258	10	18.3	6.93	-199.3	10.2	2.97	Grey, murky, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K11/3E	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K12/1W
Client:	**HCCDC**	**Date:**	1-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	DIH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	0.99m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.29m		
c. Total Well Length:	3.73m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.74m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	0.99m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	0730

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0745	1	13.5	4.48	179.7	42.8	10.84	Brown, murky, no odour
0755	2	15.9	6.69	203.9	34.1	8.97	" " "
0803	3	16.2	6.74	210.8	36.5	7.93	-- -- --
0808	4	16.3	6.81	215.4	41.3	5.99	-- -- --
0815	5	16.3	6.86	217.7	39.8	5.82	-- -- --

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0815	5	16.3	6.86	217.7	39.8	5.82	Brown, murky, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K12/1W		

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K12/1E
Client:	**HCCDC**	**Date:**	1-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH
Weather:	overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):		NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)			
c. Total Well Length:		NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:			

Well Purge Information

Purge Method:		Purge Depth:	
Field Equipment:		Start Time:	

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O₂ (ppm)*	*Comments (colour, odour, turbidity, etc.*
							Could not remove PVC
							cap from well - wedged
							on tight.
							Tried for 30 minutes

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O₂ (ppm)*	*Comments (colour, odour, turbidity, etc.*

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K12/4N
Client:	HCCDC	**Date:**	1-7-22
Site:	KIWEF & EPAP	**Field Team:**	DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.03m	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.58m		
c. Total Well Length:	12.73m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	11.70m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	12.73m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	0935

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss. O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0952	1	16.3	7.59	-72.4	16.9	4.44	Clear, no odour
1004	5	17.2	6.37	20.1	110.4	1.72	Yellow, clear, no odour
1017	10	17.5	6.31	14.6	180.0	1.47	" " "
1030	15	17.4	6.27	~~9~~ 44.0	185.6	1.15	" " "
1045	20	17.4	6.28	-47.2	190.4	0.96	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss. O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1045	20	17.4	6.28	-47.2	190.4	0.96	Yellow, clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K12/4N	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	KS 12/6
Client:	**HCCDC**	**Date:**	1-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH
Weather:	overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):		NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)			
c. Total Well Length:		NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:			

Well Purge Information

Purge Method:		Purge Depth:	
Field Equipment:		Start Time:	

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O₂ (ppm)*	*Comments (colour, odour, turbidity, etc.*
							Surface water

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O₂ (ppm)*	*Comments (colour, odour, turbidity, etc.*
1020	-	14.0	7.31	14.4	46.7	11.23	Pale brown, clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
KS 12/6	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K12/7
Client:	HCCDC	**Date:**	1-7-22
Site:	KIWEF & EPAP	**Field Team:**	DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	0.72m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.20m		
c. Total Well Length:	4.31m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	3.59m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	4.31
Field Equipment:	IP, YSI water Quality Meter	Start Time:	1135

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1145	1	16.4	7.52	104.9	1156	5.20	Clear, no odour
1149	2.5	16.4	7.44	100.9	1731	5.44	" " "
1157	5	16.1	7.34	107.7	2094	7.07	" " "
1206	7.5	16.2	7.36	116.5	2099	4.37	" " "
1215	10	16.1	7.33	119.6	11214	4.44	" " "
							Dry after 10L

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1215	10	16.1	7.33	119.6	11214	4.44	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K12/7	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	K10/2
Client:	HCCDC	**Date:**	4-7-22
Site:	KIWEF & EPAP	**Field Team:**	DK
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.03m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.88m		
c. Total Well Length:	9.97m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	7.94m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	2.03m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1015

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1018	1	16.6	7.00	130.2	10.1	11.62	No odour
1021	5	16.9	7.32	94.6	334.0	4.72	Yellow, clear, organic odour
1025	10	18.1	7.36	91.1	351.9	4.33	Yellow, murky, organic odour
1029	12.5	18.6	7.41	88.2	358.2	4.39	Brown, murky, organic odour
1035	15	18.7	7.43	86.9	362.8	4.48	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1035	15	18.7	7.43	86.9	362.8	4.48	Brown, murky, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K10/2		

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K10/2N
Client:	**HCCDC**	**Date:**	4-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH
Weather:	~~K10/2N~~ Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	6.26m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.87m		
c. Total Well Length:	10.09m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	3.83m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	6.26m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1045

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1053	1	19.5	9.78	-288.6	17.9	7.45	Clear, organic odour
1100	2	19.6	8.64	-218.3	18.4	4.65	" " "
1105	3	19.6	8.21	-212.9	21.8	5.12	" " "
							Dry after 3L

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1105	3	19.6	8.21	-212.9	21.8	5.12	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K10/2N	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K10/2NN
Client:	**HCCDC**	**Date:**	4-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	10.18m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	1.03m		
c. Total Well Length:	14.16m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	3.98m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	~~Micropurge~~ Bailer	Purge Depth:	14.16m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1115

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O$_2$ (ppm)*	*Comments (colour, odour, turbidity, etc.*
1136	1	19.5	8.39	-159.9	58.6	10.08	Clear, organic odour
1140	2.5	20.6	6.83	-247.1	10387	3.28	" " "
1144	5	20.6	6.85	-267.5	19986	2.84	Brown, clear, organic odour
1148	7.5	20.7	6.85	-271.4	20122	2.85	" " " "
1155	10	20.7	6.87	-272.3	20649	2.98	" " "
		Dry after		10L			Pump not working so
							switched to bailer

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O$_2$ (ppm)*	*Comments (colour, odour, turbidity, etc.*
1155	10	20.7	6.87	-272.3	20649	2.88	Brown, clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K10/2NN		

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	BH 21 S
Client:	HCCDC	**Date:**	27-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	5.20m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	0.30m		
c. Total Well Length:	6.48m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	1.28m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	5.20m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	0930

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0930	1	20.5	10.78	-283.3	1311	7.76	Clear, organic material, no odour
0931	2.5	20.8	10.84	-297.5	1604	2.44	" " " "
0933	5	21.0	10.89	-299.9	1596	2.06	" " " "
0935	7.5	21.0	10.92	-301.1	1656	1.83	Brown, organic odour
0938	10	21.0	10.93	-302.1	1663	1.64	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0938	10	21.0	10.93	302.1	1663	1.64	Brown, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
BH 21 S	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	344A
Client:	HCCDC	**Date:**	27-6-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	5.62m	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.75m		
c. Total Well Length:	8.48m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.86m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50 mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	8.48m
Field Equipment:	YSI water Quality Meter, IP	Start Time:	1000

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1006	1	18.8	11.06	-272.4	17.6	2.27	Clear, no odour
1011	2.5	20.4	11.20	-279.3	10.4	1.26	" " " " "
1019	5	20.6	11.22	-299.1	9.6	1.12	" " " " "
1026	7.5	20.5	11.22	-302.2	9.9	1.05	" " " " "
1032	10	20.5	11.21	-302.8	10.0	0.91	" " " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1032	10	20.5	11.21	-302.8	10.0	0.91	Clear, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
344A	-	-

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	344 B
Client:	HCCDC	**Date:**	27-6-22
Site:	KIWEF & EPAP	**Field Team:**	FD, DH
Weather:	Fine, Sunny		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	8.25m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.77m		
c. Total Well Length:	12.26m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	4.01m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	12.26m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	1050

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1055	1	16.7	7.71	-163.5	54.5	5.51	Grey, murky, no odour
1101	2.5	19.3	6.52	-56.2	39.6	0.94	Dark grey, murky, no odour
1113	5	19.5	6.45	-52.8	35.2	0.69	" " " "
1126	7.5	19.6	6.40	-83.0	33.9	0.72	" " " "
1135	10	19.5	6.49	-77.3	36.8	0.82	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1135	10	19.5	6.49	-77.3	36.8	0.82	Dark grey, murky, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
344B	-	-

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	NGIG/2
Client:	**HCCDC**	**Date:**	29/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.5m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.73		
c. Total Well Length:	13m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge.	Purge Depth:	13m
Field Equipment:	Interface Probe, YSI WQM.	Start Time:	13:20

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
13:20	2.5L	18.7	7.05	-121.7	349.	2.36	Clear, organic odour
13:30	5L	19.1	7.04	-136.7	611	1.69	" " "
13:36	7.5L	19.1	7.04	-118.9	482.3	~~1.89~~ 2.26	" " "
13:45	10L	19.1	7.04	-118.2	472.2	2.36	" " "
13:53	15L	19.1	7.04	-118.6	477.3	2.24	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
13:53	15L	19.1	7.04	-118.6	477.3	2.24	clear, organic odour.

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	NG61
Client:	**HCCDC**	**Date:**	29/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.39	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.73m.		
c. Total Well Length:	6.75m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	6.75
Field Equipment:	Interface Probe, YSI WQM.	Start Time:	12:43pm.

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
12:43	5L	18.5	8.65	-231.5	38.5	8.25	Light Brown,
12:52	7.5L	18.9	8.94	-230.2	14.7	1.89	Light Brown,
13:01	10L	18.9	8.94	-227.7	15.3	1.85	Clearish. "
13:05	12L	18.9	8.94	-227.8	14.4	1.81	Clear,

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
13:05	12L	18.9	8.94	-227.8	14.4	1.81	Clear, organic odour.

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	K12/7E
Client:	**HCCDC**	**Date:**	29/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.29m	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.35m		
c. Total Well Length:	12.1M	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50m		

Well Purge Information

Purge Method:	Micropurge	Purge Depth:	
Field Equipment:	Interface Probe, YSI WQM.	Start Time:	11:50am

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
11:50am	5L	18.0	7.09	-78.3	1635	4.89	light Brown, organic
12:05	7.5	18.1	7.08	-85.7	647	2.24	" " "
12:12	10L	18.2	7.08	-80.5	402.5	1.70	" "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
12:15	10L	18.2	7.08	-80.5	402.5	1.70	light Brown, organic

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	~~K10~~ K12/10E
Client:	**HCCDC**	**Date:**	29/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	DA.
Weather:	Overcast, cloudy		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.17m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.47		
c. Total Well Length:	4.42m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Micropurge low flow pump + Bailer	Purge Depth:	
Field Equipment:	Interface Probe, YSI WQM.	Start Time:	10:10am

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
10:10am	5L	16.3	6.94	-264.3	44230	2.26	Light grey, H_2S odour
10:18	7.5L	16.6	6.94	-267.5	46716	1.49	" sediment, H_2S odour
10:25	8.5L	16.7	6.95	-277.0	47123	0.90	Dry after 7.5L - very sedimenty

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
10:25	9.5L	16.7	6.95	-277.0	47123	0.90	Dark grey, sediments

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	~~K10/12~~ K12/10
Client:	**HCCDC**	**Date:**	29/06/22
Site:	**KIWEF & EPAP**	**Field Team:**	FA.
Weather:	Cloudy, cold		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	0.95	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.7m		
c. Total Well Length:	19.35	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):		Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Low Flow Pump	Purge Depth:	
Field Equipment:	Interface Probe + YSI WQM.	Start Time:	09:20.

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
09:20am	5L	16	6.93	-76.7	44068	2.23	light Brown organic odour
9:30am	10L	16.6	6.89	-108.2	46649	1.84	" "
09:40	15L	17.7	6.86	-107.5	44154	1.89	
9:50	20L	17.8	6.86	-108.7	44344	1.81	Clear-ish organic
9:58	25L	18.0	6.87	-106.7	43522	1.82	" "
10:05	30L	17.9	6.87	-106.8	43539	1.86	" "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
10:05	30L	17.9	6.87	-106.8	43539	1.86	Clear, organic

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	BHe 23S
Client:	**HCCDC**	**Date:**	6-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	PA, DH
Weather:	overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	—	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.72m		
c. Total Well Length:	2.30m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	—	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	~~50~~ 40mm		

Well Purge Information

Purge Method:		Purge Depth:	
Field Equipment:		Start Time:	

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
				well Dry			

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
				well Dry			

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	BHe23D
Client:	HCCDC	Date:	6-7-22
Site:	KIWEF & EPAP	Field Team:	FA, DH
Weather:	Overcast/Rain		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	3.89m	NAPL present?	☐Yes ☐~~No~~
b. Well Stickup (ToC to ground level)	0.43m		
c. Total Well Length:	10.53m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	6.64m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	3.89
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	0900

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0905	1	20.7	7.41	29.6	4562	2.27	Clear, organic odour
0910	5	20.9	7.46	-231.6	6261	2.29	" " "
0915	10	21.0	7.32	-258.0	8440	2.00	" " "
0920	15	21.1	7.27	-261.7	8434	2.21	" " "
0925	20	21.0	7.26	-262.2	8604	2.27	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0925	20	21.0	7.26	-262.2	8604	2.27	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
BHe23D	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	**Well ID:**	BHe 39D
Client:	HCCDC	**Date:**	6-7-22
Site:	KIWEF & EPAP	**Field Team:**	FA, DH
Weather:	Overcast/Rain		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.45 m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	0.42 m		
c. Total Well Length:	8.50 m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	6.05 m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	2.45
Field Equipment:	IP, YSI Water Quality meter	Start Time:	0955

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O_2 (ppm)*	*Comments (colour, odour, turbidity, etc.*
1000	1	18.5	7.91	-71.9	1136	10.01	Clear, organic odour
1005	5	17.5	7.60	-35.7	1077	5.97	" " "
1010	10	17.5	7.29	-185.7	1301	4.59	" " "
1015	15	18.2	7.24	-245.3	3119	2.62	" " "
1020	20	18.2	7.08	-247.7	3215	2.73	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O_2 (ppm)*	*Comments (colour, odour, turbidity, etc.*
1020	20	18.2	7.08	-247.7	3215	2.73	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
BHe 39D	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	BHe 39L
Client:	HCCDC	Date:	6-7-22
Site:	KIWEF & EPAP	Field Team:	FA, DH
Weather:	Overcast / Rain		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.87m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.70m		
c. Total Well Length:	4.42m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	1.55m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	2.87m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1025

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1030	1	17.1	9.36	-333.6	2962	9.28	Clear, organic odour
1035	5	17.4	7.39	-282.1	4821	5.64	" " "
1040	10	18.6	8.62	-161.6	4957	4.86	" " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O2 (ppm)	Comments (colour, odour, turbidity, etc.
1040	10	18.6	8.62	-161.6	4957	4.86	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
BHe 39L	–	–

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	K11/1
Client:	HCCDC	Date:	6-7-22
Site:	KIWEF & EPAP	Field Team:	FA, DH
Weather:	Overcast / Rain		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	1.31 m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.75 m		
c. Total Well Length:	3.57 m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.26 m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50 mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	1.31 m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1100

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1105	1	17.5	7.74	-141.3	999	6.64	Brown, murky, organic odour
1110	5	17.2	6.63	-221.6	538	4.91	— — —
1115	10	16.8	5.82	-228.3	148	2.99	— — —

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1115	10	16.8	5.82	-228.3	148	2.99	Brown, murky, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K11/1	—	—

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	K11 / 1S
Client:	HCCDC	Date:	6-7-22
Site:	KIWEF & EPAP	Field Team:	FA, DH
Weather:	Overcast / Rain		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.80m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.77m		
c. Total Well Length:	8.92m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	6.12m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	2.80m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1125

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1130	1	17.4	8.13	-182.4	4286	0.66	Brown, murky, organic odour
1135	5	18.0	7.77	-268.5	5726	2.18	" " " "
1140	10	18.0	7.77	-278.0	5530	1.83	" " " "
1148	15	18.9	7.82	-380.9	5990	1.94	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1145	15	18.9	7.82	-380.9	5990	1.94	Brown, murky, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
K11 / 1S	QC3	QC3A

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	BHe 26S
Client:	HCCDC	Date:	7-7-22
Site:	KIWEF & EPAP	Field Team:	DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	2.18m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.64m		
c. Total Well Length:	2.63m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	0.45m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	40mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	0730
Field Equipment:	IP, YSI water Quality Meter	Start Time:	2.18m

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0735	1	15.6	7.39	45.9	8.8	12.70	Clear, no odour
0740	2.5	15.8	8.11	26.8	306.4	9.51	Slightly murky, no odour
0742	5	16.0	8.36	37.2	281.4	5.32	" " " "
0744	7.5	16.0	8.42	40.8	272.8	5.13	Grey, slightly murky, no odour
0746	10	16.0	8.45	42.6	264.3	5.05	" " " "

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0746	10	16.0	8.45	42.6	264.3	5.05	Grey, slightly murky, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
BHe 26S	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	BHe 26 D
Client:	HCCDC	Date:	7-7-22
Site:	KIWEF & EPAP	Field Team:	DI+
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	3.24m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.68m		
c. Total Well Length:	6.67m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	3.43m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	40mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	3.24m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	0755

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0800	1	16.7	8.53	-208.5	3252	10.45	Clear, organic odour
0804	5	19.2	7.23	-277.2	9061	2.43	~~Clear~~ " — —
0810	10	19.4	7.24	-278.7	10493	2.24	" — —
0815	15	19.5	7.26	-280.9	10526	2.19	" " —

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
0815	15	19.5	7.26	-280.9	10526	2.19	Clear, organic odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
BHe 26D	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	RCA1
Client:	**HCCDC**	**Date:**	7-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	FA, DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	6.94m	NAPL present?	☐Yes ☒No
b. Well Stickup (ToC to ground level)	0.72m		
c. Total Well Length:	8.70m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	1.76m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	6.94m
Field Equipment:	IP, YSI Water Quality Meter	Start Time:	1100

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1102	1	19.4	9.12	-117.9	20.5	15.71	Black, turbid, no odour
1105	5	18.6	7.31	-111.9	682	3.08	" " " "
1108	10	18.6	7.22	-121.7	667	2.97	" " " "
1115	15	18.7	7.24	-115.6	650	2.77	

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1115	15	18.7	7.24	-115.6	650	2.77	Black, turbid, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
RCA1	—	—

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	N4656	Well ID:	RCA 2
Client:	HCCDC	Date:	7-7-22
Site:	KIWEF & EPAP	Field Team:	DH, PR
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	9.39m	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.78m		
c. Total Well Length:	12.10m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	2.71m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:	Bailer	Purge Depth:	9.39m
Field Equipment:	IP, YSI water Quality Meter	Start Time:	1035

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1036	1	19.5	7.20	-112.4	8306	12.05	Clear, no odour
1040	5	21.8	7.04	-178.9	10137	8.75	Dark grey, turbid, no odour
1044	7	19.3	7.07	-158.0	10497	2.13	" " " " "
							Well Dry after 7L

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
1044	7	19.3	7.07	158.0	10497	2.13	Dark grey, turbid, no odour

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID
RCA 2	—	—

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	GH001S
Client:	**HCCDC**	**Date:**	7-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	PA, DH
Weather:	Overcast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	8.95m	NAPL present?	☐Yes ☑No
b. Well Stickup (ToC to ground level)	0.27m		
c. Total Well Length:	19.95m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	~~5~~. 11m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:		Purge Depth:	
Field Equipment:		Start Time:	

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O₂ (ppm)*	*Comments (colour, odour, turbidity, etc.*
							Unable to sample due
							to obstruction about
							5m depth

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	*Volume Removed (L)*	*Temp (°C)*	*pH*	*Redox (mV)*	*EC (µS/cm)*	*Diss.O₂ (ppm)*	*Comments (colour, odour, turbidity, etc.*

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

HAZMAT SERVICES

SITE CONTAMINATION ANALYSIS – GROUND WATER SAMPLING

Project No.	**N4656**	**Well ID:**	GHD01N
Client:	**HCCDC**	**Date:**	7-7-22
Site:	**KIWEF & EPAP**	**Field Team:**	FA, DH
Weather:	Over-cast		

Water Level Data (measured as metres from Top of Casing [ToC])

a. Depth to Water Table (ToC):	5.99m	NAPL present?	☐Yes ☐No
b. Well Stickup (ToC to ground level)	0.25m		
c. Total Well Length:	9.38m	NAPL Interphase Depth:	
d. Depth of Water Column (c-a):	3.39m	Well Volume: $V = \pi \frac{d^2}{4} \times c =$	
e. Casing Diameter:	50mm		

Well Purge Information

Purge Method:		Purge Depth:	
Field Equipment:		Start Time:	

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.
							Unable to sample due
							to pipe stuck in
							well at about 2.60m depth

Purging should continue for a minimum of three bore volumes and stabilised measurements are achieved or until the bore purges dry and stabilised measurements are achieved. Stabilised measurements for pH are within 0.1 pH units; EC, redox and dissolved oxygen are within 10 % and temperature is within 0.5 °C over two successive measurements.

Well Sampling Information

Time	Volume Removed (L)	Temp (°C)	pH	Redox (mV)	EC (µS/cm)	Diss.O_2 (ppm)	Comments (colour, odour, turbidity, etc.

End Time:		Depth to Water Table:	

Sample Collection Summary

Primary Sample ID	Intra-lab Sample ID	Inter-lab Sample ID

APPENDIX G
Calibration Certificates

Certificate of Service and Calibration

Interface Meter

Heron H.Oil

Company Name	WAM Scientific
Office Address	26 Bungarra Crescent, Chipping Norton NSW 2170
Phone Number	+61 405 241 484
Contact Name	William Pak
Instrument	Heron H.Oil Interface Meter (60m)
Serial Number	01-7947
Client Name	Florence Archer (Hazmat Services)
Project Number	6071

Instrument Check			
Item	Test	Test Passed	Comments
9V Battery	Klein Tools MM300 Multimeter	✓	Battery voltage reading above 7.9V
Battery Box	Check	✓	No damage
Face and Back Plates	Check	✓	No damage
Thumb Screws	Check	✓	Rubber ends intact
Tape Hangar/Protector	Check	✓	No damage
On/Off Button	Operation	✓	Button is functional
Buzzer	Operation	✓	Intermittent tone in H_2O, solid tone in product
LED Signal Light	Operation	✓	LED light functional – green and red
Probe	Operation/Check	✓	Decontaminated, cleaned and tested
Tape	Condition/Check	✓	Decontaminated and cleaned, no damage
Connection	Check	✓	Probe and link connected correctly and tightly
PCB	Operation	✓	Unit is fully functional
Electronics Panel	Orientation	✓	Correctly aligned

Instrument Readings		
Product	Buzzer	LED Light
H_2O	Intermittent	Blinking – Red
Petroleum	Solid	Steady – Red

Declaration
WAM Scientific certifies that the above instrument was successfully tested according to manufacturer's standards and all necessary checks were conducted to ensure the instrument was fully operational prior to dispatch. The interface meter was decontaminated, cleaned and tested with a mixture of tap water and petrol, shielded from ambient light.

Checked By	William Pak
Calibration Date	15/06/2022
Calibration Due	15/12/2022

Certificate of Service and Calibration

Water Quality Meter

YSI Professional Plus

Company Name	WAM Scientific
Office Address	26 Bungarra Crescent, Chipping Norton NSW 2170
Phone Number	+61 405 241 484
Contact Name	William Pak
Instrument	YSI Professional Plus Water Quality Meter w/ 1m Quatro Cable
Serial Number	21C100012
Client Name	Florence Archer (Hazmat Services)
Project Number	6071
Comments	-

Instrument Check

Item	Test	Test Passed	Comments
2 x Alkaline C-size Batteries	Klein Tools MM300 Multimeter	✓	Both batteries reading above 2.9V
Battery Saver Function	Operation	✓	Automatically turns off after 60 minutes if idle
Unit Display	Operation	✓	Screen visible, no damage
Keypad	Operation	✓	Responsive, no damage
Connection Port and Cable	Condition/Check	✓	Clean, no damage
Monitor Housing	Condition/Check	✓	No damage
Firmware	Version	✓	4.0.0
pH Probe	Condition/Calibration	✓	Calibrated and conforms to manufacturer's specs
pH millivolts for pH 7.00	Calibration	✓	pH 7.00 calibration range between 0 mV ± 50 mV
pH millivolts for pH 4.00	Calibration	✓	pH 4 mV range +165 to +180 from 7 buffer mV value
pH slope	Calibration	✓	Range between 55 to 60 mV/pH (ideal value 59 mV)
Response time < 90 seconds	Calibration	✓	Responds to correct value within 90 seconds
ORP Probe	Condition/Calibration	✓	Calibrated and conforms to manufacturer's specs
ORP Reading	Calibration	✓	Within ± 80 mV of reference Zobell Reading
Response time < 90 seconds	Calibration	✓	Responds to correct value within 90 seconds
Conductivity/Temp Probe	Condition/Calibration	✓	Calibrated and conforms to manufacturer's specs
Conductivity Cell	Calibration	✓	Conductivity cell constant 5.0 ± 1.0 in GLP file
Clean Sensor Readings	Calibration	✓	Clean sensor reads less than 3 uS/cm in dry air
Dissolved Oxygen Probe	Condition/Calibration	✓	Calibrated and conforms to manufacturer's specs
DO Cap	Condition/Calibration	✓	1.25 mil PE membrane (yellow membrane)
DO Sensor in Use	Condition	✓	Polarographic DO sensor
DO Sensor Value	Calibration	✓	(min 4.31 uA - max 8.00 uA) Avg 6.15 uA

Instrument Readings

Parameter	Standard Used	Reference No.	Calibration Value	Observed	Actual	Units
Temperature	Centre 370 Thermometer	Room Temp.	8.6	8.7	8.6	°C
pH	pH 4.00	351750	4.01	4.05	4.01	pH
pH	pH 7.00	351621	7.00	7.05	7.00	pH
Conductivity	2760 µs/cm at 25°C	362912	2760	2819	2760	µs/cm
ORP (Ref. check only)	Zobell A & B	364644/363903	253.3	250.5	253.3	mV
Zero Dissolved O_2	$NaSO_3$ in Distilled H_2O	362832	0.0	-0.1	0.0	%
100% Dissolved O_2	100% Air Saturated H_2O	Fresh Air	100.0	115.3	100.0	%

Declaration

WAM Scientific certifies that the above instrument was successfully tested according to manufacturer's standards and all necessary checks were conducted to ensure the instrument was fully operational prior to dispatch. The calibration data supplied was obtained in accordance with manufacturer's specifications using solutions of known values.

Calibrated By	William Pak
Calibration Date	15/06/2022
Calibration Due	15/12/2022

WAM Scientific:
26 Bungarra Crescent
CHIPPING NORTON NSW 2170
T: +61 405 241 484 | +61 424 198 667
E: rentals@wamscientific.com.au
E: accounts@wamscientific.com.au

Certificate of Service and Calibration
Bladder Pump
QED MP15 Micropurge Kit

Company Name	WAM Scientific
Office Address	26 Bungarra Crescent, Chipping Norton NSW 2170
Phone Number	+61 405 241 484
Contact Name	William Pak
Instrument	QED MP15 Kit
Serial Number	Sample Pro Pump: 144816
Serial Number	MP15 Backpack: 1729
Client Name	Florence Archer (Hazmat Services)
Project Number	6071

Instrument Check			
Item	Test	Test Passed	Comments
MP15 Backpack Controller	Operation	✓	Controller operational
Gas Regulator	Condition	✓	No damage, good condition
Wrench and Tube Cutter	Condition	✓	Attached to the controller
Blue Coiled Hose	Condition	✓	No tears, clean, good condition
Tube Connection Fitting	Condition	✓	No damage
Black Canvas Bag	Condition	✓	No damage, clean
Sample Pro Pump	Condition	✓	No damage, decontaminated
Bladder	Condition	✓	1x New bladder included free of charge
Pump Fittings	Condition	✓	No damage, good condition
CO2 Gas Bottle	Check & Test	✓	1x CO2 bottle included free of charge
Kit Operation	Operation	✓	MP15 kit fully operational
Instructional Manual	-	✓	User manual included

Inclusions

The MP15 Kit should include the following items:

- QED MP15 Backpack Controller, Blue Coiled Hose with Tube Connection Fitting, Wrench and Tube Cutter, Sample Pro Pump, 1x CO2 gas bottle fitted with the MP15 Backpack, Wire Cable Hand Reel and spares/accessories box
- Additional CO2 gas bottles will be supplied upon request at an additional cost

Declaration

WAM Scientific certifies that the above instrument was successfully tested according to manufacturer's standards and all necessary checks were conducted to ensure the instrument was fully operational prior to dispatch. The pump has been decontaminated and cleaned upon return from the previous hire and is in good working order.

Checked By	William Pak
Calibration Date	15/06/2022
Calibration Due	15/12/2022

EXPERT TESTING SERVICES

Calibration and Service Report

ABN: 74 619 717 350
Contact: 02 9730 2019
Email: sales@experttesting.com.au
9/171 Power Street, Glendenning NSW 2761
Web: www.experttesting.com.au

Calibration and Service Report

Company:	Hazmat Services	**Manufacturer:**	Honeywell	**Serial #:**	594-902349
Contact:	Andrew Russell	**Instrument:**	ppbRAE 3000	**Asset #:**	-
Address:	Level 1, 45c Fitzroy Street	**Model:**	PGM7340	**Part #:**	-
	CARRINGTON NSW 2294	**Configuration:**	VOC	**Sold:**	-
Phone:	02 4961 1887	**Wireless:**	-	**Last Cal:**	26.07.2022
Fax:	02 4969 5887	**Network ID:**	-	**Job #:**	102250
Email:	andrew.russell@hazmatservices.com.au	**Unit ID:**	-	**Cal Spec:**	Std
				Order #:	6129

Item	Test	Pass/Fail	Comments	Part Code	S/W
Battery	NiCd, NiMH, Dry cell, Li Ion	✓			
Charger	Charger, Power supply	✓			
	Cradle	✓			
Pump	Flow	✓	>500ml/min		
Filter	Filter, fitting, etc	✓			
Alarms	Audible, visual, vibration	✓			
Display	Operation	✓			
Switches	Operation	✓			
PCB	Operation	✓			
Connectors	Condition	✓	Upgraded V2.22		
Firmware	Version	✓			
Datalogger	Operation	✓			
Monitor Housing	Condition	✓			
Case	Condition/Type	✓			
Sensors					
PID	Lamp	✓			
PID	Sensor	✓			
THP	Sensor	✓			

Engineer's Report

Checked unit settings and configuration – okay
Cleaned sensor electrode assembly and lamp – tested okay
Unit allowed to stabilize and zero calibration performed as per manufacturers specifications
Calibration procedure written and performed to manufacturers specification using traceable gases.

Calibration Certificate

Sensor	Type	Serial No:	Span Gas	Concentration	Traceability Lot #	CF	Reading	
							Zero	Span
PID	10.6ev	S02330447N3	Isobutylene	10ppm	WO184499		0	10ppm

Calibrated/Repaired by: **Amend Kumar** Date: **26.07.2022** Next Due: **26.01.2023**

GCC ISO 9001 Certified · GCC ISO 14001 Certified · JAS-ANZ WWW.JAS-ANZ.ORG/REGISTER

APPENDIX H
Historical Data

Hunter & Central Coast Development Corporation

Appendix G – KIWEF Area 2 Cap Maintenance Summary (Ecological Australia, 2022)

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
t: (02) 4064 8421

31 October 2022

Our ref: 20New18055

Jonathon Bourne
Daracon Group
PO Box 401 Beresfield NSW
2322

Dear Jonathon,

18055 Kooragang Island Area 2 Closure Works – Pre-clearance summary report 19th and 20th of October 2022

Daracon undertook vegetation clearing works at Kooragang Island Area 2 requiring of the removal and mulching of *Acacia saligna* (Golden Wreath Wattle) trees located in several locations around the Kooragang Islands Area 2 Closure Works area (see Figure 1 below). Ecologists were present to undertake Green and Golden Bell Frog (GGBF) pre-clearance surveys on each day prior to the commencement of clearing works and then for the duration of the works (Table 1).

Table 1: Summary of GGBF located on the 19th and 20th of October

Ecologist	19/10	20/10	
Brea Heidke	0		
Melanie Thurtell	0	0	
Julian Carson		0	
		Number of GGBF relocated	0

No GGBF were encountered in the works area on either day and no frogs of any type were seen. One *Chelodina longicollis* (Eastern Long-necked Turtle) was found on the 20th of October and relocated to a suitable water body immediately adjacent to but outside the works area. On the 19th of October *Acanthiza lineata* (Striated Thornbills) were seen in the works area, but no nests were seen and the birds relocated themselves outside of the area of works.

Figure 1. Location of vegetation clearing works for the 19th and 20th of October, 2022

Please contact me if you have any questions regarding this report.

Regards,

Frank Lemckert
Principal Ecologist