

GROUNDWATER MANAGEMENT PLAN

**EXPANSION OF THE CONCRUSH RESOURCE RECOVERY FACILITY,
TERALBA**

Prepared for CONCRUSH PTY LIMITED

Prepared by RCA Australia

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RCA AUSTRALIA

ABN 53 063 515 711

92 Hill Street, CARRINGTON NSW 2294

Telephone: +61 2 4902 9200

Facsimile: +61 2 4902 9299

Email: administrator@rca.com.au

Internet: www.rca.com.au

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SUMMARY OF MONITORING REQUIREMENTS

1 INTRODUCTION

Concrush Pty Limited (Concrush) have recently been provided Approval with regards to the Expansion of the Concrush Resource Recovery Facility ("the Project") as State Significant Development (SSD 8753).

The existing Concrush facility is situated at 21 Racecourse Road, part Lot 2 DP220347 Teralba and provides recycling of concrete, asphalt, other building materials and green waste into products such as roadbase, drainage aggregates, pipe bedding and haunch, packing fines, decorative aggregates and mulches. These products are then sold for commercial, domestic and household applications. The existing Concrush site operates under Environment Protection Licence (EPL) 13351 which allows the recycling of 108,000t of waste per annum and the storage of up to 40,000t of waste material at any one time.

The Project will increase capacity up to 250,000t of waste processing per year with a maximum storage of 150,000t per year and will utilise a portion of land adjoining the southern boundary of the current facility.

SSD 8753 Approval Condition B20 states that "prior to the commencement of Stage 1 construction, the Applicant must prepare a Groundwater Management Plan (GMP) to the satisfaction of the Planning Secretary. The GMP must form part of the Construction Environmental Management Plan (CEMP) required by condition C2 and be prepared in accordance with C1." The Approval Condition also states that the document must be:

- Prepared by a suitably qualified and experienced person(s) whose appointment has been endorsed by the Planning Secretary. This document has been prepared by an environmental engineer with over twenty years' experience, in the assessment, remediation and management of contaminated land. The Planning Secretary provided endorsement of their qualifications on 14 May 2020 (Ref [1]).
- Prepared in consultation with the EPA. This document will be reviewed by the NSW EPA prior to submission.

The Approval Condition included the requirements of the GMP: these have been reconciled with the contents of this GMP in **Table 1** below.

Table 1 *Approval Conditions Address in this GMP.*

SSD Approval Condition B20 Requirement	Section Addressed
Details of the installation of a third groundwater well.	Section 2
Baseline data on groundwater levels and quality for the existing and newly installed third groundwater well.	
Details of the water table depth compared to the excavation depths of the leachate dam and artificial wetland.	Section 3, Table 5
A programme to monitor groundwater levels and quality.	Section 4
Impact assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts.	Section 4.2, Table 7
A protocol for the investigation and mitigation where the groundwater impact assessment criteria has been exceeded.	Section 5
Monitor the effectiveness of management measures and contingency actions for reducing impacts.	Section 4.2 and Section 6

SSD 8753 Approval Condition B21 states that Stage 1 construction is not to commence until the GMP “is approved by the Planning Secretary”. As such, following concurrence with the NSW EPA based on revisions made since their review, this GMP will be submitted to the Department of Planning, Division of Environment, Energy and Science (EES).

1.1 SITE IDENTIFICATION AND DESCRIPTION

The Project site is identified as part Lot 2 DP 220347, Racecourse Road Teralba.

Additional site details are shown in **Table 2** and **Figure 1** below.

Table 2 *Site Details*

Current zoning (Ref [2])	IN1 – General Industrial
Current and proposed use	Current: Existing Concrush facility and vacant/unused land Proposed: Expanded Concrush facility (see Section 1.2).
Size of site	Approximately 4.8ha (inclusive of the 2.4ha existing Concrush facility)
Surrounding land use to the:	Lot 1 DP220347
North	Industrial – car wreckers operated by others.
South	Part of Lot 2 DP220347 Industrial – scrap metal recycling yard operated by others
East	Racecourse Road and then Cockle Creek
West	Main Northern Rail line and then wetlands
Nearest sensitive receptor (human health)	Residential housing located approximately 360m south east across Cockle Creek.
Nearest sensitive receptor (environmental)	Cockle Creek located approximately 35m east and a waterbody approximately 30m west

**Figure 1** *Project Site Location and Layout (as at June 2018)*

The existing Concrush facility comprises an active industrial site which is predominantly unsealed hardstand surfacing. There is one entrance/exit at the north eastern portion off Racecourse Road and all customer traffic is directed over the weighbridge upon entry to a number of stockpiling areas in either the western portion of the site (inert materials waste materials such as concrete, tiles and bricks) or the south eastern portion of the site (green waste). There are two (2) crusher/screen machines which process the inert waste materials such as concrete, tiles and bricks in the western portion of the site and transfer the material into stockpiles or product bays in the northern portion of the site. The section of road between the raw and processed stockpiles is two (2) way. There is also an office and maintenance area, and landscaped bunds situated along the southern boundary and part of the eastern boundary.

The proposed expansion portion of the Project currently comprise vacant / unused land, with long grass and scattered shrubs and trees throughout. A cleared, predominantly gravelled area is located in the north western portion of the site and an unpaved road runs along the site's northern boundary. There are a number of fill and other anthropogenic waste stockpiles including concrete, brick, timber and metal throughout the site. The majority of these stockpiles were situated along the southern portion of site. The western portion of the site is generally flat and the eastern portion of the site gently slopes to the east and Cockle Creek.

The expansion portion of the Project has been characterised (Ref [3]) as contaminated with bonded asbestos containing material (ACM) at, and below, the surface of the site. Concentrations of hydrocarbons, phenols, cyanide and metals in soil were either not detected or were detected at low concentrations below the relevant human health commercial/industrial land use criteria (Ref [4]). There were some concentrations of hydrocarbons and metals in excess of ecological criteria (Ref [4]) however due to the proposed use of the site and the absence of a correlation between concentrations in groundwater to these concentrations, they were not considered to present a risk to the environment.

Groundwater has been assessed within the expansion component of the Project at three (3) locations. Concentrations of hydrocarbon, phenols and metals in groundwater were either not detected or were detected at low concentrations below the relevant criteria with the exception of total recoverable hydrocarbons and chromium at one (1) location and zinc at all locations in excess of the ecological criteria (Ref [5]), noting that the criteria have been identified as conservative.

Acid sulfate soil was identified (Ref [6]) at depths as shallow as 0.7m below the surface and the Wallsend acid sulfate soils risk map indicates there is a high probability of acid sulfate soil materials.

1.2 PROJECT DESCRIPTION

The Project will be constructed over two (2) stages: this GMP applies to both stages however some elements of the GMP may not apply equally to both stages.

Stage 1 comprises:

- Works on the existing Concrush facility including:
 - Deconstruction of existing maintenance shed / amenities.
 - Construction of new entry and exit point to the north eastern corner of the site including a wheel wash for exiting traffic.

- Formalisation of a tip-off area for light vehicles depositing demolition and green waste.
- Removal of landscape bund walls from southern boundary.
- Consolidation of the inert waste stockpiling and processing area to remove the central trafficable road and to re-purpose solely for processed stockpiles.
- Construction of a wet concrete wash out bay in the south western corner.
- Construction of a sediment basin in the north western corner of the site.
- Works on the expansion portion of the Project including construction of:
 - A pad for green waste storage and processing in the eastern portion of the site.
 - A leachate dam in the south east portion of the site.
 - A constructed wetland in the south eastern corner of the site.
 - A pad for raw materials and processing area and construction of a concrete block noise wall on the eastern and southern extents.
 - A maintenance shed in the south western portion of the site including car parking spaces and amenities.
 - A sediment basin in the south western corner.
 - A trafficable route from the northern portion of the site in a clockwise direction.

The schematic of Stage 1 is presented in **Figure 2** below.

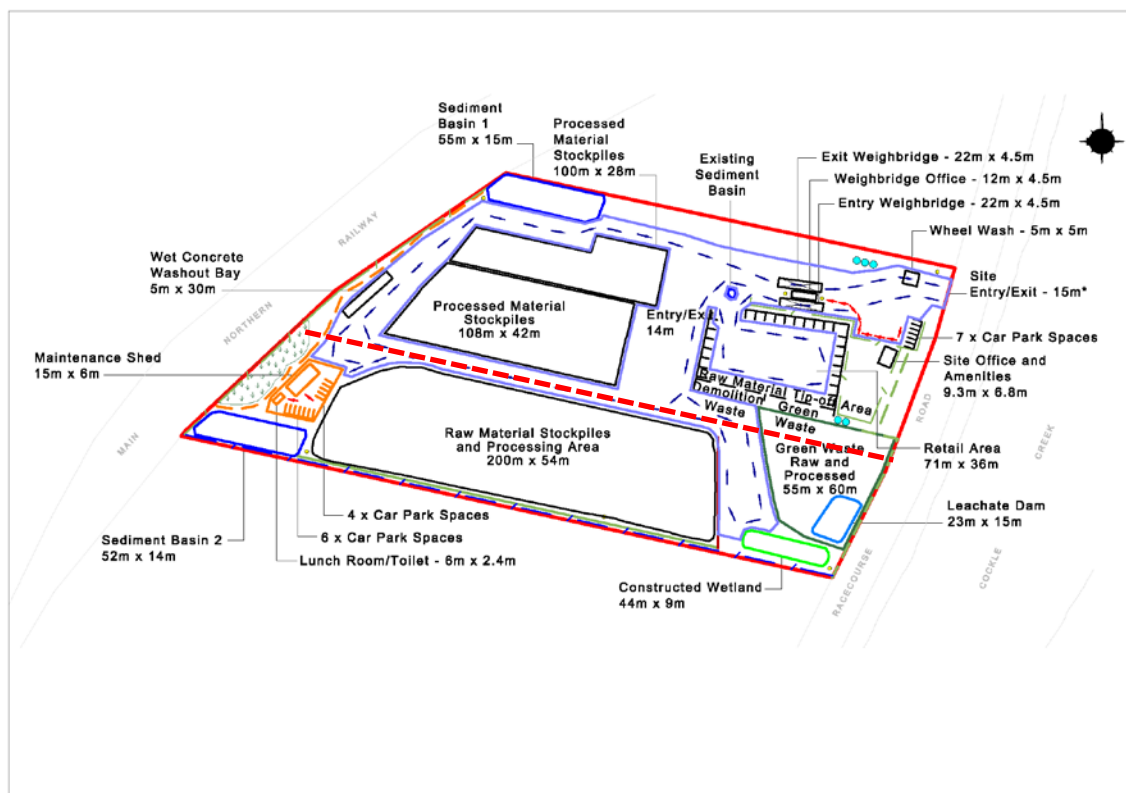


Figure 2 Stage 1 of the “Increase to Capacity” Project (approximate boundary between current facility and expansion portion in red dashed line).

It is noted that prior to any works being undertaken on the expansion portion of the Project, remediation will have to be completed.

Stage 2 comprises:

- Works on the existing Concrush facility including:
 - Alteration of the light vehicle tip-off area.
 - Addition of an exit for light vehicles only to Racecourse road adjacent the tip-off area.
 - Alteration to the orientation and size of the processed inert waste material areas.
 - Construction of two (2) weighbridges and associated office and amenities adjacent the northern boundary. These will be used exclusively for commercial vehicles. The existing weighbridges will be re-purposed for light vehicle traffic only.
 - Construction of an internal sealed haul road between the new weighbridges and the site access point. This will necessitate the relocation of three (3) water tanks currently situated at the northern boundary to one of the locations at which water tanks are to be located.
 - Alteration to the carparking areas adjacent the existing site office and amenities.
 - Installation of two (2) water tanks near the new weighbridge.

- Works on the expansion portion of the Project including:
 - Installation of two (2) water tanks on the southern boundary, two (2) adjacent to the maintenance shed and two (2) adjacent to the wet concrete washout bay (total of six (6)).
 - Minor alteration to the orientation and size of the inert waste raw stockpile and processing area.

The schematic of Stage 2 is presented in **Figure 3** below.

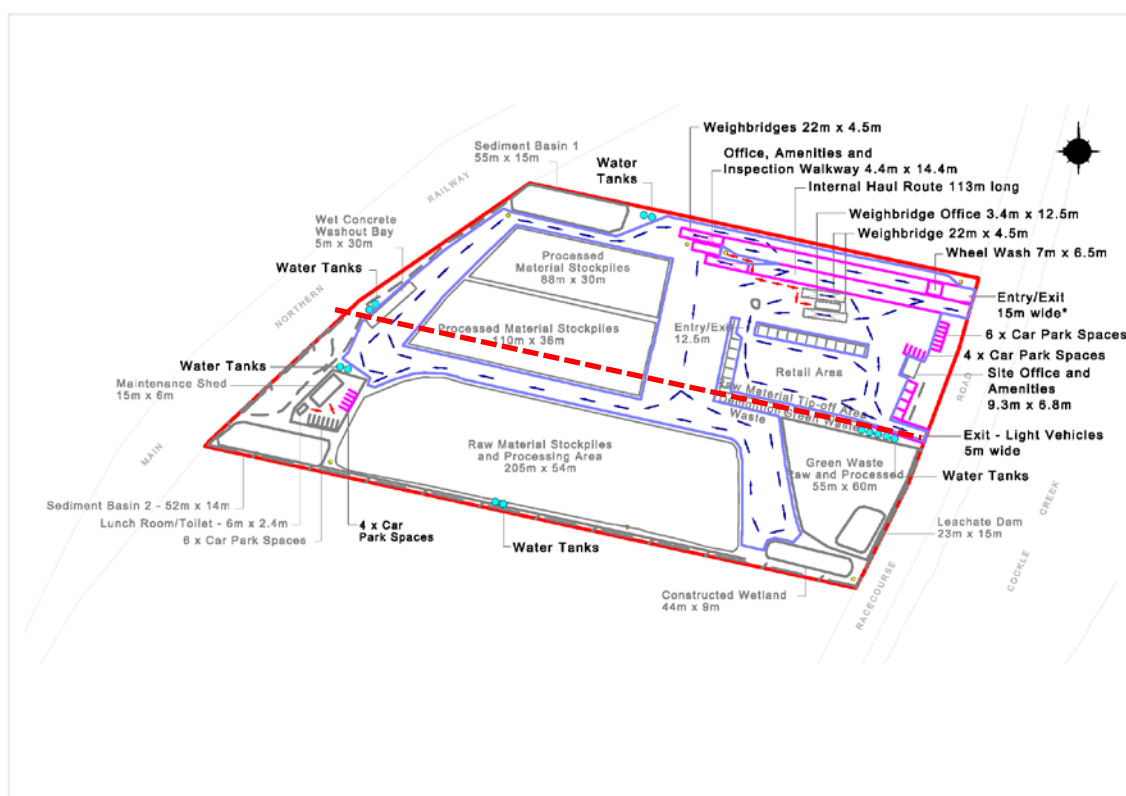


Figure 3 Stage 2 of the "Increase to Capacity" Project (approximate boundary between current facility and expansion portion in red dashed line).

2 HYDROGEOLOGY AND BASELINE GROUNDWATER CONDITIONS

Seven (7) registered groundwater bores were found within 500m of the site based on a search of the WaterNSW groundwater bore data map (realtime.data.water.com.au/water.stm) as presented in **Appendix A**. These bores are stated as being installed in 2004 within or in the vicinity of the existing Concrush facility, and were registered in one block. The bores are referred to as test bores, however no further information is provided on work summaries and Concrush have stated that current personnel have no knowledge of these bores. As such it is considered that these bores may have been mapped in the wrong location.

It is noted that there is a possibility for unregistered bores to be used in the wider area.

Two (2) groundwater wells were installed as part of an assessment (Ref [7]) of the proposed expansion component of the Project and a further well was installed as part of this GMP. The locations of the monitoring wells are presented in **Figure 4** below and the logs for these wells are included as **Appendix B**.



Figure 4 Groundwater Flow based on Data from Monitoring Wells 22 May 2020

Groundwater was encountered at between 2m and 2.5m below the surface level during drilling and at between 1.03m and 2.7m below the surface during gauging / sampling events. Survey of the monitoring wells was undertaken in June 2020 and the latest groundwater levels have been adjusted to AHD as detailed in **Table 3** below.

Table 3 *Groundwater Depths*

	During Drilling (mbgs)	Sampling 27 June 2018		Gauging 22 May 2020		Sampling 29 May 2020		Sampling & Gauging 4 September 2020	
BH1	2.0	1.03mbgs	1.15mAHD	1.7mbgs	0.48mAHD	1.25mbgs	0.93mAHD	1.03mbgs	1.15mAHD
		0.6 at low tide		1.3 & dropping		0.6 & rising		1.5 at high tide	
BH2	2.5	2.47mbgs	1.03mAHD	2.5mbgs	1.0mAHD	2.45mbgs	1.05mAHD	2.27mbgs	1.23AHD
		0.7 & dropping		1.3 & dropping		0.6 & rising		1.2 & dropping	
BH3	2.2	--		2.7mbgs	-0.58mAHD	1.47mbgs	0.65mAHD	1.18mbgs	0.94mAHD
				1.3 & dropping		1.1 & rising		1.2 & dropping	

mbgs = metres below ground surface

Tide depths and status based on Newcastle Tide Heights and Times.

It is noted that depths to groundwater during drilling are considered approximate.

Based on this, groundwater flow has been estimated as presented in **Figure 4** above, noting that the layout and number of the groundwater monitoring wells may not provide sufficient information to understand the specific groundwater flows at the site.

Based on the contours it is considered that the groundwater flow direction is predominantly towards the east towards Cockle Creek however that some groundwater also flows in a westerly direction to the wetland. It is noted that the contours derived with the data from 29th May, 30th June and 4th September were generally consistent with those derived from 22nd May, albeit at different levels.

Groundwater monitoring wells have been sampled as part of the previous assessment (Ref [7]) and this GMP: results are compared to the relevant water guidelines in **Appendix C**. Whilst the drinking water criteria (Ref [8]) have been included in **Appendix C**, RCA does not consider that these are relevant to the site. The 95% protection value for fresh water has been chosen to assess the ecological risks associated with groundwater, noting that this is conservative as Cockle Creek is tidal and has been identified to be highly disturbed (Ref [9]).

Groundwater concentrations of hydrocarbons and phenols in BH1 and BH2 were not detected in either sampling round and are therefore considered below the human health and ecological criteria (Ref [4] and Ref [5]). Concentrations of total recoverable hydrocarbons (TRH) were in excess of the ecological criterion in BH3: concentrations of other hydrocarbons were not detected and sampling in September indicated that the hydrocarbon concentrations are either not consistent or are related to non-petroleum sources. Concentrations of nutrients and metals were also non detected or at low levels below the ecological criteria (Ref [5]) with the exception of:

- Ammonia in BH3 which was in excess of ecological criteria.
- NO_x (nitrate + nitrite) in BH3 which was in excess of the ecological criterion.
- Phosphorous in BH1 which was in excess of the ecological criterion.
- Chromium in excess of the ecological criterion in BH3 only.
- Zinc in excess of the ecological criterion in four (4) of the five (5) samples from the locations in the sampling events to date.

Samples in excess of the criteria are presented in **Table 4** below. It is noted that the groundwater level in BH1 and BH3 is shallower than the applicable depth (2m) for assessment of risk from hydrocarbon vapour. As there have been no volatile fractions of hydrocarbons detected this is not considered to indicate uncertainty in the assessment. It is noted that following the application of fill to the site in accordance with the remedial action plan (RAP, Ref [3]), the groundwater will be at a depth greater than 2m below the surface.

Table 4 *Groundwater Results above Relevant Criteria*

Sample Identification (depth of aquifer)	Analyte	Criteria as relevant for depth and stratum of the sample	Concentration(s)
BH1 (1.25m)	Phosphorous	0.025 ^b	0.24
	Zinc	0.008 ^a	0.007 0.025
BH2 (2.45m)	Zinc	0.008 ^a	0.009 0.012
BH3 (1.47)	Ammonia	0.9 ^a	1.38
	NO _x	0.4 ^b	0.06
	TRH C ₆ -C ₄₀	0.07 ^a	0.34
	Chromium	0.001 ^a	0.002
	Zinc	0.008 ^a	0.118

All concentrations in mg/L.

^a Ecological Protection Level for Fresh Receiving Water (Ref [5]).

^b Lowland river criterion with coastal river environment criterion used where available (Ref [10]).

3 DEVELOPMENT INTERACTION WITH GROUNDWATER

The site will be trafficked by vehicles, operated by Concrush and customers, and there will be a workshop for vehicle maintenance in the western portion of the site. There is potential for contamination to arise from leaks and spills from the vehicles, whilst operating and during refuelling, and from the workshop. Soil and surface water are considered to be more at risk than groundwater from hydrocarbons from vehicles and workshops, however groundwater contamination could result if the leak/spill was persistent and/or undetected. Groundwater contamination would be more likely to result if surface water contamination was present in the wetlands to the west of the site: the potential for this will be limited due to the access restrictions (no operations in the wetland) and the presence of the landscaped bund which will prevent surface water directly entering the wetland.

The current proposed surfacing across the site will be a well graded material with between 10-40% fines in accordance with the recommendations for an unsealed road wearing course (Ref [11]) and a plasticity index of between 8 and 12. It is considered that this material will compact to a relatively low permeability material ($\times 10^{-6}$ - $\times 10^{-7}$ m/s) such that the infiltration through the fill materials will be reduced compared to the current levels. The site will also be graded to encourage the dispersal of surface water for operational purpose, further minimising the infiltration potential.

There are a number of excavations, refer **Figure 3**, which will be undertaken at the site during the construction, some of which will remain as part of the site features. The design depth of the excavations has been considered with the modelled depth of groundwater, refer **Figure 4**, at the location in **Table 5** below.

Table 5 *Details of Proposed Excavations*

Construction Element	Base of Excavation (mAHD)	Modelled Depth of Groundwater (mAHD)	Groundwater likely to be Encountered?
Sediment Basin 1	0.25	Presumed 1.3 maximum	Yes
Sediment Basin 2	1.3	<0.4	No
Leachate Dam	2.05	-0.6	No
Constructed Wetland	2.8	-0.6	No
Wheel Wash	1.5	Presumed 1.3 maximum	Unlikely
Concrete Washout Bay	2.0	~0.5	No

Whilst there is some uncertainty regarding groundwater levels on the existing Concrush facility, based on the information it is considered that all excavations will be situated above the groundwater table with the exception of Sediment Basin 1 which will be excavated below the depth of groundwater. As such, some extraction of groundwater is considered likely: monitoring of extracted groundwater will be required as detailed in **Section 4.1** below. It is envisaged that there may be some seepage into the excavation for the installation of the wheel wash, depending on how long it is kept open during construction and some groundwater extraction may be required for logistical purpose.

Potential groundwater contamination is considered to comprise:

- pH impacted waters from concrete fines.
- Nutrient impacted waters from the green waste area.
- Hydrocarbon impacted waters due to general trafficking of the site surface by vehicles and from the maintenance area.

Sediment is also considered to potentially accumulate within the sedimentation dams, although this would primarily be a concern during construction, and to a lesser extent the leachate pond and constructed wetlands. The presence of sediment is not considered to pose a potential risk to groundwater as it would not be considered likely to migrate through the soil strata: the potential risk to surface water has been addressed in the Water Discharge Management Plan (Ref [12]).

The leachate pond and constructed wetland will be lined with a 0.6m thick geocomposite clay liner (GCL) with a low permeability ($\times 10^{-7}$ m/s) and as such it is considered that, as long as the GCL remains intact, that there is negligible potential for leachate to enter the groundwater table. In the event that there is a structural issue with the liner that results in a leak, the leachate may migrate through the strata to groundwater approximately 2m and more below the base of the structures. In the event that the leachate pond is overtopped groundwater may potentially be impacted, although it is noted that this would only be possible in a high rainfall event / period which would dilute the leachate and likely represents more of a potential impact to surface water than groundwater. The potential contaminants are considered to be hydrocarbons, ammonia, nitrate and phosphorous.

The sedimentation dams will be lined with a high visibility marker layer below the depth of material imported for the purpose of remediation (Ref [3]) however this material is not intended to restrict flow of water into the underlying surface and subsequently into groundwater. The base of both Basins, and the wall of Sediment Basin 1 to 1.3m AHD will be lined with concrete to prevent the interaction of groundwater with the water within the Basins. Potential contaminants are considered to be limited to hydrocarbons: contaminants associated with green waste are not considered to potentially impact at the sedimentation dams.

Management measures for the protection of groundwater quality are detailed in **Table 6**.

Table 6 *Management Measures for Groundwater Protection*

Potential Source of Contamination	Management Measure
Petroleum fuels from Concrush vehicles	Routine maintenance. Daily vehicle check for indications of leaks. Refuelling of mobile and fixed plant and equipment to use modern, well maintained specialised refuelling pumps and systems. A spill kit at hand during all refuelling works.
Petroleum fuels from customer vehicles	Concrush personnel to observe vehicles on weigh bridge for potential leaks. Concrush personnel to be vigilant for indications of leaks on site in customer areas.
Workshop Operations	Appropriate receptacles for all types of wastes which will be generated to be available within an appropriately sized (1.5 x volume) bunded area. Personnel to be trained in the appropriate use and disposal of fuels, oils and other chemicals. Waste removal protocol to be implemented and managed by Yard Manager. Spill kits to be available at all refuelling stations and at areas where chemicals are being used and stored. Spill response protocol to be implemented.
Green waste area	Grading of the site to promote runoff from the green waste areas (customer drop off, stockpile and processing) leachate into the leachate pond.
Leachate Pond	Base and walls to be lined with a GCL to minimise infiltration from the base of the pond. Piped discharge to constructed wetlands to facilitate treatment of leachate. Spillway to facilitate discharge to sediment basin 2 in high rainfall events. Site inspections (refer Section 4.1).
Constructed wetlands	Base and walls to be lined with a GCL to minimise infiltration from the base of the wetland. Vegetation and depth control within wetland to facilitate treatment of leachate. Evaporation and evapotranspiration of water such that there is no discharge. Site inspections (refer Section 4.1).
Sedimentation Dam	Concrete base in Sediment Basin 2, concrete base and walls in Sediment Basin 1 to minimise infiltration and separate water from groundwater. Surface water quality monitoring (Ref [12]).

4 GROUNDWATER MONITORING

4.1 DURING CONSTRUCTION

No monitoring of groundwater contamination is considered to be required during the construction of the Project with the exception of the collection of samples from BH1 and BH3 and analysis for ammonia, nitrate and phosphorous to provide further baseline information for later comparison as discussed in **Section 4.2** below. Samples should be collected on a monthly basis for the construction period (currently envisaged to be five (5) months).

Monitoring of the groundwater level is to be undertaken at the three (3) existing monitoring wells once a week with a weighted tape or water level monitor during construction. This information will be used to inform the construction process about the likelihood of encountering groundwater during excavations and to provide information regarding the change to groundwater levels, currently not anticipated to be significant (Ref [13]), due to the application of fill at the site. The log will be required as part of the validation of the remediation (Ref [3]).

Monitoring of groundwater pH is to be undertaken at the three (3) existing monitoring wells once a week with a calibrated water quality meter. The readings are to be recorded on a register and be available for inspection as required: the log will be required as part of the validation of the remediation (Ref [3]).

Monitoring of the pH in water collected within excavations (either due to groundwater or surface/rain water) is to be undertaken on a daily basis and recorded in a log to be used as part of the validation of the remedial works (Ref [3]). If the monitoring programme shows that pH of the water in the excavations has fallen to below pH 6 then the water will require treatment by lime dosing to achieve a target pH of 6 to 8 prior to removal of water. Collected water can be discharged onto site as long as it does not enter the wetlands in the west of the site or the stormwater system.

During groundwater extraction the following is required:

- Groundwater levels are to be checked twice daily (~9am and ~3pm) in the three (3) groundwater monitoring wells prior to, during and following groundwater extraction. Groundwater levels are to be recorded on a register and be available for inspection as required: the log will be required as part of the validation of the remediation (Ref [3]).
- In the event that groundwater levels drop by more than 0.3m from the previous reading, the groundwater extraction is to cease and not to recommence until the groundwater level has recovered to its previous level. Groundwater extraction is to recommence at a lower rate to minimise the potential for significant drawdown reoccurring.
- The pH of the water to be extracted must be checked with a calibrated water quality meter. The readings are to be recorded on a register and be available for inspection as required: the log will be required as part of the validation of the remediation (Ref [3]).
- If the pH is between 6 and 8, the groundwater may be discharged onto the surface of the site. The extraction volume is to be recorded by a calibrated flow meter. No water is to be discharge beyond the site boundaries.

- If less than 6, the groundwater is to be treated with lime in accordance with the ASSMP (Ref [13]). This should be applied in a liquid form and allowed to mix through the groundwater or be actively mixed. The pH must be checked at four (4) separate locations within the excavation to confirm the successful mixing and neutralisation prior to the extraction of groundwater. The pH at the existing three (3) groundwater monitoring wells are to be checked in the event that lime application has been required.

Groundwater is not be discharged from site without a licence (from NSW EPA and/or Lake Macquarie Council) for the discharge.

A summary of the monitoring requirements is included as **Appendix D**.

4.2 DURING OPERATIONS

Following the completion of construction, monitoring will be required primarily to assess for potential leaks from the leachate pond and constructed wetlands. It is anticipated that BH2 will be decommissioned during the placement of fill at the proposed expansion component of the Project. It is not considered necessary to replace this well as it is not situated near potential contamination sources to groundwater and because long term monitoring of groundwater levels is not considered to be required.

Visual assessment of the water depth within the leachate pond and constructed wetlands is to be undertaken on a daily basis by the Yard Manager (or delegate). The assessment is to consider whether there is a noticeable depth change since the previous day's observations and take into account any rainfall between the observations. The observation is also to assess any indications of liner rupture / damage (such as objects in the ponds, visible GCL or marker layer). In the event that a potential issue is observed, the contingency plan as detailed in **Section 6** is to be implemented.

The visual inspection should also consider the potential for sedimentation of the leachate pond and the constructed wetlands to be occurring such that there may be a decreased capacity.

Monitoring of groundwater quality is to be undertaken on a monthly basis at BH1 and BH3 and is to comprise:

- Groundwater level gauging. This is recommended as part of standard industry best practice: monitoring of groundwater level data is not considered to be an area of concern for the operational site.
- Depth of well. This is recommended to assess potential sedimentation of the wells: if the well is identified to be adversely affected by silt (>0.3m loss of bore depth) the sediment is to be removed.
- Volume purged prior to collection of the sample.
- Field readings for general water quality (pH, electrical conductivity, turbidity, temperature, salinity) with a calibrated water quality meter. This is recommended as part of standard industry best practice, although the pH results would be considered a potential indicator of leachate impact and may require the implementation of the contingency plan as detailed in **Section 6**.
 - Purging is to continue until pH and EC readings have stabilised.
 - These readings are to be recorded for inclusion in the Annual Report.

- Collection and analysis of water samples for ammonia, nitrogen (nitrate and nitrite) and phosphorous. Hydrocarbons (TRH, BTEX, PAH) will be included in the analytical suite once every quarter.
 - Sampling is to be undertaken by a low flow pump: all monitoring wells will have designated tubing from the original sampling works.
 - Sampling is to be undertaken after the relevant monthly sampling of surface water in accordance with the Water Discharge Management Plan (Ref [12]) to facilitate consideration of additional potential contaminants.
 - In the event that surface water monitoring indicates the presence of other contaminants, such as metals, in excess of the criteria, these may be added to the scope of the analysis. Samples for metals are to be field filtered (0.45µm) prior to preservation in laboratory supplied containers.
 - Duplicates are to be collected at a frequency of one intralaboratory and one interlaboratory duplicate per year.
 - An equipment wash is to be collected in the event that observable hydrocarbon impact is identified within the groundwater.
- Comparison of the results to the ecological criteria for fresh and marine waters (Ref [5]) as presented in **Table 7** below. If there is contamination identified in excess of the criteria where there wasn't prior to the development commencing and/or if there is a greater than 30% increase to the average of the pre-development concentration for that sampling location, further assessment as detailed in **Section 5** is to be implemented.
- Reporting of the results in the Annual Report¹ as required by the site's EPL.

A summary of the monitoring requirements is included as **Appendix D**.

¹ It is noted that the EPL has not been issued for the expanded operations at the time of writing and as such the extent of reporting required by the EPL is unknown.

Table 7 *Groundwater Analyte Criteria*

Analyte	Fresh Water Criterion	Marine Water Criterion
TRH	0.007	
Benzene	0.95	0.7
Toluene	0.18	0.18
Ethylbenzene	0.08	0.005
meta- and para-Xylene	0.275	0.275
ortho-Xylene	0.35	0.35
Naphthalene	0.016	0.07
Phenanthrene	0.0006	0.0006
Anthracene	0.00001	0.00001
Fluoranthene	0.001	0.001
Benzo(a) pyrene	0.0001	0.0001
Ammonia	0.9	0.91
Nitrate	2.4	
NO _x (nitrate + nitrite)	0.04	
Phosphorous	0.025	

Criteria from ANZG (Ref [5]) with the exception of NO_x and phosphorous for Lowland Rivers (coastal environment where available) (Ref [10]).

5 INVESTIGATION PROTOCOL

Incidents identified with relation to groundwater during construction will be managed under the CEMP (Ref [14]) and the ASSMP (Ref [13]).

In the event that groundwater concentrations of contaminants trigger the requirement for further assessment, refer **Section 4.2**, an investigation is to be implemented by the Business Manager. The investigation will comprise:

- Discussion with the contaminated land consultant regarding the significance of the concentration of concern. Actions may include:
 - Re-sampling to confirm concentrations.
 - Speciation testing of TRH to identify whether the identified concentrations are natural hydrocarbons or related to petroleum hydrocarbons.
 - Further sampling before the next scheduled monitoring round.
 - No action. This may be the case if the concentrations exceed low reliability criteria for marine water however are below the criteria for fresh water and/or if the upgradient monitoring well indicates similar impact as the downgradient well.
- Discussion with Yard Manager re any incidents and site activities to assess whether these are the potential source of contamination.

- Site inspection to assess for potential causes of the contamination. This will include:
 - The condition of the liner within the leachate pond and constructed wetlands where the contaminant of concern is nutrients.
 - All operational machinery at site and at the workshop where hydrocarbons are the contaminant of concern.
- Actions to ensure that there is no on-going contamination of the groundwater if the source is identified. This may include:
 - Pumping of leachate / water from the leachate pond or constructed wetland to allow for repair of the liner.
 - Training of personnel with regards to appropriate use and disposal of petroleum products / use of spill kit.
 - Excavation of contaminated soil and replacement with certified material. Excavated material would be removed to a licensed waste facility based on classification as assessed by the contaminated land consultant.
 - Remediation of groundwater. This would be based on the recommendations of the contaminated land consultant and would generally only be required for groundwater concentrations which were considered to pose a risk to human health or the environment. The NSW EPA would be notified of these conditions in accordance with the requirements of the Contaminated Land Management Act.
- Preparation of an incident report for inclusion with the Annual Report.

6 CONTINGENCY PLAN

Some incidents at site may give rise to the potential for groundwater contamination and there may be actions required following the investigation protocol as identified in **Section 5. Table 8** below identifies the potential contingency actions.

Table 8 *Contingency Plan Actions for Groundwater Contamination*

Unexpected event and possible impact	Contingency action for Concrush
Fuel leak / spill from machinery	Implementation of clean-up procedures. Re-training of personnel if incident related to procedure.
Chemical leak / spill from Workshop	Implementation of clean-up procedures. Re-training of personnel if incident related to procedure. Augmentation of bunded area / storage receptacles if incident related to infrastructure.
Surface water from green waste area not entering leachate pond	Regrading of area / installation of bunds to direct surface water to leachate pond.
Water level in leachate pond / constructed wetlands dropping unexpectedly.	Detailed inspection of GCL to be undertaken. May require pumping of water from affected area to other leachate containment facility.
Sedimentation in leachate pond / constructed wetlands.	Removal of sediment back to design level to be undertaken with appropriate care to ensure integrity of GCL is not compromised.
Damage identified in leachate pond/ constructed wetlands GCL	Damage to be repaired as soon as practicable. Investigation to be undertaken as to cause of damage. Augmentation of protective layer over GCL if required.
Contaminants identified in Sedimentation Dam	Contaminants to be added to the groundwater sampling programme for next three (3) events. Investigation to be undertaken regarding potential source of contaminants and any associated actions considered necessary undertaken.
Contaminants identified in groundwater	Consultation with contaminated land consultant regarding significance of issue. Actions required to confirm significance of issue. Investigation to be undertaken regarding potential source of contaminants including consultation with Yard Manager and detailed site inspection. Actions required to stop continuation of contamination migration to groundwater. Remediation of groundwater as assessed necessary by the contaminated land consultant and/or the NSW EPA.

7 REVIEW OF THIS PLAN

Concrush have as part of their ongoing business programme, a protocol to review all management plans with the objectives of meeting environmental standards including those for water quality. The operational component of this GMP will be incorporated into the Operational Environmental Management Plan (OEMP, Ref [15]) which Concrush will review annually at the time of the Order and Exemption renewal.

The review will consider:

- Observations at the site re work practices and environmental controls;
- Comments provided by Concrush, Council or others;
- Records of environmental non-conformance;
- Changes in organisational structure;
- Changes in construction methodology;
- Changes in legislation and standards;
- Opportunities for improvement / refinement of the management of groundwater quality at the Concrush Teralba site.

Continual improvement of the OEMP will be achieved by the continual evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement. The continual improvement process will:

- Identify areas of opportunity for improvement of environmental management which leads to improved environmental performance.
- Determine causes of non-conformances and deficiencies.
- Develop and implement a plan of corrective and preventative action to address nonconformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions; and document any changes in procedures resulting from process improvement.

REFERENCES

- [1] Department of Planning, Industry & Environment, *SSD-8753 – Concrush Resource Recovery Facility, Endorsement of experts to prepare a Water Discharge Management Plan, Groundwater Management Plan and Operational Noise Management Plan*, 14 May 2020.
- [2] Lake Macquarie City Council Local Environmental Plan 2014, under the Environmental Planning and Assessment Act 1979, published 2014
- [3] RCA Australia, *Remedial Action Plan, Expansion Component, Expansion of the Concrush Resource Recovery Facility, Racecourse Road, Teralba*, RCA ref:13589-803/2, June 2020.

- [4] NEPC, *National Environment Protection (Assessment of Site Contamination) Measure*, 1999 as amended 2013.
- [5] ANZG, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.*, August 2018. Available at www.waterquality.gov.au/anz-guidelines.
- [6] NSW Acid Sulfate Soil Management Advisory Committee, *Acid Sulfate Soil Manual*, August 1998.
- [7] RCA Australia, *Baseline Contamination Assessment, Proposed Concrush Facility Expansion, Racecourse Road, Teralba*, RCA ref:13589-401/3, November 2018.
- [8] National Health and Medical Research Council, *Australian Drinking Water Guidelines*, 2011 updated 2019.
- [9] Umwelt, *Concrush Increase to Capacity Project, Environment Impact Statement*, November 2018.
- [10] ANZECC, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, October 2000.
- [11] Austroads, *Guide to Pavement Technology, Part 6: Unsealed Pavements*, 2009.
- [12] Umwelt, *Water Discharge Management Plan, Concrush Resource Recovery Facility*, Report No: 4987/ R01, May 2020.
- [13] RCA Australia, *Acid Sulfate Soil Management Plan, Expansion of the Concrush Resource Recovery Facility, Teralba*, RCA ref:13589-804, July 2020.
- [14] RCA Australia, *Construction Environmental Management Plan, Expansion of the Concrush Resource Recovery Facility, Teralba*, RCA ref: 13589-801/0, September 2020.
- [15] WSP, *Operational Environment Management Plan for Resource Recovery Facility, Racecourse Road, Teralba NSW (Development Consent SSD8753)*, ref: PS120189-ENV-REP-001 Rev B, July 2020.

GLOSSARY

BTEX	Benzene, toluene, ethylbenzene, xylene.
PAH	Polycyclic aromatic hydrocarbons. Multi-ring compounds found in fuels, oils and creosote. These are also common combustion products.
TPH	Total petroleum hydrocarbons.
TRH	Total recoverable hydrocarbons

Appendix A

Registered Groundwater Bore Details



NSW Office of Water

Work Summary

GW200158

Licence: 20BL169523

Licence Status: ACTIVE

Authorised Purpose TEST BORE
(s):

Intended Purpose(s): TEST BORE

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:

Completion Date: 10/12/2004

Final Depth:

Drilled Depth:

Contractor Name:

Driller:

Assistant Driller:

Property: N/A 21 RACECOURSE ROAD
TERALBA 2284

Standing Water Level:

GWMA: -
GW Zone: -

Salinity:
Yield:

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.59	2 220347
Licensed:	NORTHUMBERLAND	TERALBA	Whole Lot 2//220347

Region: 20 - Hunter
River Basin: - Unknown
Area/District:

CMA Map:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6353961.0
Easting: 370941.0

Latitude: 32°56'42.1"S
Longitude: 151°37'09.7"E

GS Map: -

MGA Zone: 0

Coordinate Map Interpretation
Source:

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
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Remarks

10/12/2004: Form A Remarks:

No Form A received

Bore location map received

Bore A of 7 bores (A - G)

*** End of GW200158 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200159

Licence: 20BL169523

Licence Status: ACTIVE

Authorised Purpose TEST BORE

(s):

Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:

Completion Date: 12/12/2004

Final Depth:

Drilled Depth:

Contractor Name:

Driller:

Assistant Driller:

Property: N/A 21 RACECOURSE ROAD
TERALBA 2284

Standing Water Level:

GWMA: -

GW Zone: -

Salinity:

Yield:

Site Details

Site Chosen By:

County	Parish	Cadastre
Form A: NORTH	NORTH.59	2 220347
Licensed: NORTHUMBERLAND	TERALBA	Whole Lot
		2/220347

Region: 20 - Hunter
River Basin: - Unknown
Area/District:

CMA Map:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6353979.0
Easting: 370946.0

Latitude: 32°56'41.5"S
Longitude: 151°37'09.9"E

GS Map: -

MGA Zone: 0

Coordinate Map Interpretation
Source:

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
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Remarks

12/12/2004: Form A Remarks:

No Form A received

Bore location map received

Bore B of 7 bores (A - G)

*** End of GW200159 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200160

Licence: 20BL169523

Licence Status: ACTIVE

Authorised Purpose TEST BORE

(s):

Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:

Completion Date: 10/12/2004

Final Depth:

Drilled Depth:

Contractor Name:

Driller:

Assistant Driller:

Property: N/A 21 RACECOURSE ROAD
TERALBA 2284

Standing Water Level:

GWMA: -

GW Zone: -

Salinity:

Yield:

Site Details

Site Chosen By:

County	Parish	Cadastre
Form A: NORTH	NORTH.59	2 220347
Licensed: NORTHUMBERLAND	TERALBA	Whole Lot
		2//220347

Region: 20 - Hunter
 River Basin: - Unknown
 Area/District:

CMA Map:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
 Elevation Unknown
 Source:

Northing: 6353964.0
 Easting: 370960.0

Latitude: 32°56'42.0"S
 Longitude: 151°37'10.4"E

GS Map: -

MGA Zone: 0

Coordinate Map Interpretation
 Source:

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
-------------	-----------	------------------	----------------------	---------------------	----------

Remarks

10/12/2004: Form A Remarks:

No Form A received

Bore location map recieved

Bore C of 7 bores (A - G)

*** End of GW200160 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200161

Licence: 20BL169523

Licence Status: ACTIVE

Authorised Purpose TEST BORE

(s):

Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:

Completion Date: 10/12/2004

Final Depth:

Drilled Depth:

Contractor Name:

Driller:

Assistant Driller:

Property: N/A 21 RACECOURSE ROAD
TERALBA 2284

Standing Water Level:

GWMA: -

GW Zone: -

Salinity:

Yield:

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.59	2 220347
Licensed:	NORTHUMBERLAND	TERALBA	Whole Lot 2//220347

Region: 20 - Hunter
River Basin: - Unknown
Area/District:

CMA Map:**Grid Zone:****Scale:**

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6353941.0
Easting: 370978.0

Latitude: 32°56'42.8"S
Longitude: 151°37'11.1"E

GS Map: -

MGA Zone: 0

Coordinate Map Interpretation
Source:

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
-------------	-----------	------------------	----------------------	---------------------	----------

Remarks

10/12/2004: Form A Remarks:

No Form A received

Bore location map only received

Bore D of 7 bores (A - G)

*** End of GW200161 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200162

Licence: 20BL169523

Licence Status: ACTIVE

Authorised Purpose TEST BORE

(s):

Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:

Completion Date: 10/12/2004

Final Depth:

Drilled Depth:

Contractor Name:

Driller:

Assistant Driller:

Property: N/A 21 RACECOURSE ROAD
TERALBA 2284

Standing Water Level:

GWMA: -

GW Zone: -

Salinity:

Yield:

Site Details

Site Chosen By:

County	Parish	Cadastre
Form A: NORTH	NORTH.59	2 220347
Licensed: NORTHUMBERLAND	TERALBA	Whole Lot
		2//220347

Region: 20 - Hunter
River Basin: - Unknown
Area/District:

CMA Map:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6353939.0
Easting: 370980.0

Latitude: 32°56'42.9"S
Longitude: 151°37'11.2"E

GS Map: -

MGA Zone: 0

Coordinate Map Interpretation
Source:

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
-------------	-----------	------------------	----------------------	---------------------	----------

Remarks

10/12/2004: Form A Remarks:

No Form A received

Bore location map received

Bore E of 7 bores (A - G)

*** End of GW200162 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200163

Licence: 20BL169523

Licence Status: ACTIVE

Authorised Purpose TEST BORE

(s):

Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:

Completion Date: 10/12/2004

Final Depth:

Drilled Depth:

Contractor Name:

Driller:

Assistant Driller:

Property: N/A 21 RACECOURSE ROAD
TERALBA 2284

Standing Water Level:

GWMA: -

GW Zone: -

Salinity:

Yield:

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.59	2 220347
Licensed:	NORTHUMBERLAND	TERALBA	Whole Lot 2//220347

Region: 20 - Hunter
River Basin: - Unknown
Area/District:

CMA Map:**Grid Zone:****Scale:**

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6353939.0
Easting: 370960.0

Latitude: 32°56'42.8"S
Longitude: 151°37'10.4"E

GS Map: -

MGA Zone: 0

Coordinate Map Interpretation
Source:

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
-------------	-----------	------------------	----------------------	---------------------	----------

Remarks

10/12/2004: Form A Remarks:

No Form A received

Bore location map received

Bore F of 7 bores (A - G)

*** End of GW200163 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200164

Licence: 20BL169523

Licence Status: ACTIVE

Authorised Purpose TEST BORE

(s):

Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:

Completion Date: 10/12/2004

Final Depth:

Drilled Depth:

Contractor Name:

Driller:

Assistant Driller:

Property: N/A 21 RACECOURSE ROAD
TERALBA 2284

Standing Water Level:

GWMA: -

GW Zone: -

Salinity:

Yield:

Site Details

Site Chosen By:

County	Parish	Cadastre
Form A: NORTH	NORTH.59	2 220347
Licensed: NORTHUMBERLAND	TERALBA	Whole Lot
		2//220347

Region: 20 - Hunter
River Basin: - Unknown
Area/District:

CMA Map:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6353936.0
Easting: 371010.0

Latitude: 32°56'43.0"S
Longitude: 151°37'12.3"E

GS Map: -

MGA Zone: 0

Coordinate Map Interpretation
Source:

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
-------------	-----------	------------------	----------------------	---------------------	----------

Remarks

10/12/2004: Form A Remarks:

No Form A received

Bore location map received

Bore G of 7 bores (A - G)

*** End of GW200164 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

Appendix B

Groundwater Monitoring Well Logs

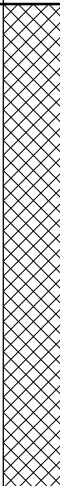
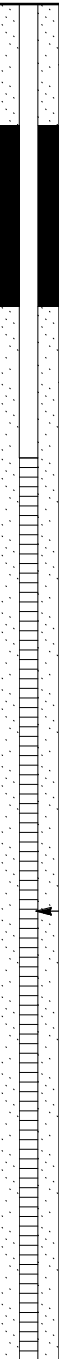
ENVIRONMENTAL BOREHOLE LOG

BH1

SHEET 1 OF 1

PROJECT No: 13589
 CLIENT: Concrush Pty Ltd
 PROJECT: Contamination Assessment
 LOCATION: Racecourse Road, Teralba

DATE COMMENCED: 18/06/2018
 DATE COMPLETED: 18/06/2018
 SURFACE RL:
 COORDS:
 DRILL MODEL: Geoprobe 6712
 DRILLER NAME:

Borehole Information					Field Material Information						
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	BORE CONSTRUCTION	
			BH1a QA2 0.10m	0.10		FILL, Sandy CLAY, brown, with some sandstone and igneous gravel	0	D		 Backfill Bentonite Gravel Screen	
			1.00m BH1b 1.10m	1.0				0			
			2.00m BH1c 2.10m	2.0				0	S		
				1.60		NATURAL, Sandy CLAY, grey		W			
				2.5							
				3.0							
				3.5							
				4.0							
				4.50		BOREHOLE BH1 TERMINATED AT 4.50 m					
LOGGED: RJL					CHECKED: FB				DATE: 20/07/2018		

ENVIRONMENTAL BOREHOLE LOG

BH2

SHEET 1 OF 2

PROJECT No: 13589
 CLIENT: Concrush Pty Ltd
 PROJECT: Contamination Assessment
 LOCATION: Racecourse Road, Teralba

DATE COMMENCED: 18/06/2018
 DATE COMPLETED: 18/06/2018
 SURFACE RL:
 COORDS:
 DRILL MODEL: Geoprobe 6712
 DRILLER NAME:

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	BORE CONSTRUCTION
			BH2a QA1 0.10m	0.00		FILL, Clayey SAND, brown, with some igneous gravel	0	D		
				0.40						
				0.5		FILL, Sandy CLAY, dark brown, with some igneous gravel and trace of coal and timber				
				1.00m						
			BH2b 1.10m	1.0			0			Backfill
				1.5						
				2.00		NATURAL, Sandy CLAY, grey				Bentonite
				2.5		Saturated at 2.5m		S		
				3.00m						Gravel
			BH2c 3.10m	3.0			0			
				3.5						
				4.0						
				4.5						Screen
LOGGED: RJL					CHECKED: FB			DATE: 20/07/2018		

ENVIRONMENTAL BOREHOLE LOG

BH2

SHEET 2 OF 2

PROJECT No: 13589
CLIENT: Concrush Pty Ltd
PROJECT: Contamination Assessment
LOCATION: Racecourse Road, Teralba

DATE COMMENCED: 18/06/2018
DATE COMPLETED: 18/06/2018
SURFACE RL:
COORDS:
DRILL MODEL: Geoprobe 6712
DRILLER NAME:

Borehole Information					Field Material Information						
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	BORE CONSTRUCTION	
				5.5		NATURAL, Sandy CLAY, grey		S			
				6.00		BOREHOLE BH2 TERMINATED AT 6.00 m					
				6.5							
				7.0							
				7.5							
				8.0							
				8.5							
				9.0							
				9.5							
LOGGED: RJL						CHECKED: FB			DATE: 20/07/2018		

Appendix C

Groundwater Monitoring Results

Groundwater Results Summary
HSL Comparison

Sample Identification	PQL	Human Health (Vapour Based) Guideline ^A		BH1	BH1	BH1	BH2	BH2	BH2	BH3	BH3
Sample Depth (m) ^B		HSL 'D'		1.03	1.25	1.03	2.47	2.45	2.27	1.47	1.2
Date		SAND 2-<4m	SAND 4-<8m	27/6/18	29/5/20	4/9/20	27/6/18	29/5/20	4/9/20	29/5/20	4/9/20
Sample Description				Turbid, dark grey, no odour	Cloudy, moderately turbid, no odour, no sheen.	Pale yellow, moderately turbid, no odour, no sheen	Turbid, dark grey, no odour	Clear, low turbidity, no odour, no sheen.	Nil collected	Pale brown turbid, no odour, no sheen	Pale brown, high turbidity, no odour, no sheen
Dominant Stratum ^C				Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation	Gauging	Investigation	Investigation
Sample collected by				RCA - ZL	RCA - RJL	RCA - RJL	RCA - ZL	RCA - RJL	RCA - RJL	RCA - RJL	RCA - RJL
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)											
Benzene	0.001	5	5	<0.001	<0.001	--	<0.001	<0.001	--	<0.001	<0.001
Toluene	0.002	NL	NL	<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002
Ethylbenzene	0.002	NL	NL	<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002
meta- and para-Xylene	0.002			<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002
ortho-Xylene	0.002			<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002
Total Xylenes	0.004	NL	NL	0.002	0.002	--	0.002	0.002	--	0.002	0.002
Polycyclic Aromatic Hydrocarbons (PAH)											
Naphthalene	0.005	NL	NL	<0.005	<0.005	--	<0.005	<0.005	--	<0.005	<0.005
Total Recoverable Hydrocarbons (TRH)											
TRH C ₆ -C ₁₀	0.02			<0.02	<0.02	--	<0.02	<0.02	--	<0.02	--
TRH >C ₁₀ -C ₁₆	0.1			<0.1	<0.1	--	<0.1	<0.1	--	<0.1	--
TRH >C ₁₆ -C ₃₄	0.1			<0.1	<0.1	--	<0.1	<0.1	--	0.23	--
TRH >C ₃₄ -C ₄₀	0.1			<0.1	<0.1	--	<0.1	<0.1	--	<0.1	--
F1	0.02	6	6	<0.02	<0.02	--	<0.02	<0.02	--	<0.02	--
F2	0.1	NL	NL	<0.1	<0.1	--	<0.1	<0.1	--	<0.1	--
Total Recoverable Hydrocarbons (TRH) silica gel cleanup											
TRH C ₆ -C ₁₀	0.02			--	--	--	--	--	--	--	<0.02
TRH _{sg} >C ₁₀ -C ₁₆	0.1			--	--	--	--	--	--	--	<0.1
TRH _{sg} >C ₁₆ -C ₃₄	0.1			--	--	--	--	--	--	--	<0.1
TRH _{sg} >C ₃₄ -C ₄₀	0.1			--	--	--	--	--	--	--	<0.1
F1	0.02	6	6	--	--	--	--	--	--	--	<0.02
F2 _{sg}	0.1	NL	NL	--	--	--	--	--	--	--	<0.1

All results are in units of mg/L

Blank Cell indicates no criterion available

PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory

F1 = TRH C₆-C₁₀ minus BTEX. F1 PQL deemed equal TRH C₆-C₁₀.

F2/F2_{sg} = TRH/TRH_{sg} >C₁₀-C₁₆ minus naphthalene. F2/F2_{sg} PQL deemed = TRH/TRH_{sg} >C₁₀-C₁₆. sg = silica gel clean up

^A ASC NEPM 1999 (as amended 2013) Vapour Based Health Screening Level (HSL) 'D' (Commercial/Industrial). It is noted that these criteria are intended for groundwater at depths of greater than 2m below the surface.

^B Sample depths presented are as encountered prior to commencement of sampling

^C Note that this is a generalisation for the purpose of comparing to the HSL criteria. Where two strata equally represented, most conservative criterion used

NL designates 'Not Limiting' indicating that the pore water concentration required to constitute a vapour risk is higher than the solubility capacity for that compound based on a petroleum mixture. Vapour is therefore not a risk for this compound.

Results for TRH have been compared to TPH guidelines.

Results shown in shading are in excess of the HSL

Where summation required (Xylene, F1, F2) calculation includes components reported as non detected as 1/2 PQL.

Sample Identification		PQL	Aquatic Ecosystem Guideline ^A				Human Health	BH1	BH1	BH1	BH2	BH2	BH2	BH3	BH3
Sample Depth (m) ^C			99%	95%	99%	95%	(Ingestion)	1.03	1.25	1.03	2.47	2.45	2.27	1.47	1.18
Date			Fresh	Fresh	Marine	Marine	Guideline ^B	27/6/18	29/5/20	4/9/20	27/6/18	29/5/20	4/9/20	29/5/20	4/9/20
Sample Description								Turbid, dark grey, no odour	Cloudy, moderately turbid, no odour, no sheen.	Pale yellow, moderately turbid, no odour, no sheen	Turbid, dark grey, no odour	Clear, low turbidity, no odour, no sheen.	Nil collected	Pale brown turbid, no odour, no sheen	Pale brown, high turbidity, no odour, no sheen
Sample Purpose								Investigation	Investigation	Investigation	Investigation	Investigation	Gauging	Investigation	Investigation
Sample collected by								RCA - ZL	RCA - RJL	RCA - RJL	RCA - ZL	RCA - RJL	RCA - RJL	RCA - RJL	RCA - RJL
Nutrients															
Ammonia as N	0.01	0.32	0.9	0.5	0.91	0.5	--	--	0.29	--	--	--	--	1.38	
Nitrite as N	0.01					3	--	--	<0.01	--	--	--	--	<0.01	
Nitrate as N ^D	0.01	1	2.4	1	2.4	50	--	--	0.04	--	--	--	--	0.06	
Nitrite + Nitrate as N ^E	0.01	0.04					--	--	0.04	--	--	--	--	0.06	
Total Phosphorus as P ^E	0.01	0.025					--	--	0.24	--	--	--	--	<0.10	
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)															
Benzene	0.001		0.95			0.001	<0.001	<0.001	--	<0.001	<0.001	--	<0.001	<0.001	
Toluene	0.002		0.18		0.18	0.8	<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002	
Ethylbenzene	0.002		0.08		0.005	0.3	<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002	
meta- and para-Xylene	0.002		0.275		0.275		<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002	
ortho-Xylene	0.002		0.35		0.35		<0.002	<0.002	--	<0.002	<0.002	--	<0.002	<0.002	
Total Xylenes	0.004					0.6	0.002	0.002	--	0.002	0.002	--	0.002	0.002	
Total Recoverable Hydrocarbons (TRH)															
TRH C ₆ -C ₁₀	0.02						<0.02	<0.02	--	<0.02	<0.02	--	<0.02	--	
TRH >C ₁₀ -C ₁₆	0.1						<0.1	<0.1	--	<0.1	<0.1	--	<0.1	--	
TRH >C ₁₆ -C ₃₄	0.1						<0.1	<0.1	--	<0.1	<0.1	--	0.23	--	
TRH >C ₃₄ -C ₄₀	0.1						<0.1	<0.1	--	<0.1	<0.1	--	<0.1	--	
TRH C ₆ -C ₄₀	0.32		0.007		0.007		0.16	0.16	--	0.16	0.16	--	0.34	--	
Total Recoverable Hydrocarbons (TRH) silica gel cleanup															
TRH C ₆ -C ₁₀	0.02						--	--	--	--	--	--	--	<0.02	
TRH _{sg} >C ₁₀ -C ₁₆	0.1						--	--	--	--	--	--	--	<0.1	
TRH _{sg} >C ₁₆ -C ₃₄	0.1						--	--	--	--	--	--	--	<0.1	
TRH _{sg} >C ₃₄ -C ₄₀	0.1						--	--	--	--	--	--	--	<0.1	
TRH C ₆ -C ₄₀	0.32		0.007		0.007		--	--	--	--	--	--	--	0.16	
Polycyclic Aromatic Hydrocarbons (PAH)															
Naphthalene	0.001/0.0001		0.016		0.07		<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Acenaphthylene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Acenaphthene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Fluorene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Phenanthrene ^D	0.001/0.0001	0.0006		0.0006			<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Anthracene ^D	0.001/0.0001	0.00001		0.00001			<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Fluoranthene ^D	0.001/0.0001	0.001		0.001			<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Pyrene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Benz(a)anthracene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Chrysene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Benzo(b)&(j)fluoranthene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Benzo(k)fluoranthene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Benzo(a) pyrene ^D	0.0005/0.00005	0.0001		0.0001		0.00001	<0.0005	<0.00005	--	<0.0005	<0.00005	--	<0.00005	--	
Indeno(1,2,3-c,d)pyrene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Dibenz(a,h)anthracene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Benzo(g,h,i)perylene	0.001/0.0001						<0.001	<0.0001	--	<0.001	<0.0001	--	<0.0001	--	
Metals															
Arsenic			0.013		0.0023	0.01	0.006	0.011	--	0.005	0.007	--	0.008	--	
Cadmium			0.0002		0.0055	0.002	<0.0001	<0.0001	--	<0.0001	<0.0001	--	<0.0001	--	
Chromium			0.001		0.0044	0.05	<0.001	0.001	--	0.001	<0.001	--	0.002	--	
Copper			0.0014		0.0013	2	<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
Lead			0.0034		0.0044	0.01	<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
Mercury ^D		0.00006		0.0001		0.001	<0.0001	<0.0001	--	<0.0001	<0.0001	--	<0.0001	--	
Nickel			0.011		0.07		0.002	0.004	--	0.005	0.002	--	0.004	--	
Zinc			0.008		0.015		0.007	0.025	--	0.009	0.012	--	0.118	--	
Phenols															
Phenols	0.001		0.32		0.4		<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
2-Chlorophenol	0.001		0.49			0.3	<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
2-Methylphenol	0.001						<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
3- & 4-Methylphenol	0.002						<0.002	<0.002	--	<0.002	<0.002	--	<0.002	--	
2-Nitrophenol	0.001						<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
2,4-Dimethylphenol	0.001						<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
2,4-Dichlorophenol	0.001		0.16			0.2	<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
2,6-Dichlorophenol	0.001						<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
4-Chlorophenol	0.001		0.22				<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
2,4,6-Trichlorophenol ^D	0.001	0.003				0.02	<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
2,3,4,6-Tetrachlorophenol ^D	0.001	0.01					<0.001	<0.001	--	<0.001	<0.001	--	<0.001	--	
Pentachlorophenol ^D	0.002	0.0036		0.011		0.01	<0.002	<0.002	--	<0.002	<0.002	--	<0.002	--	

All results are in units of mg/L
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory
^A Ecological criteria % Protection Level for Receiving Water Type.
^B Australian Drinking Water Guidelines. Ammonia criterion is aesthetic based.
^C Sample depths presented are as encountered prior to commencement of sampling
^D Updating nitrate toxicity effects on freshwater aquatic species as directed from the ANZG website
^E Guidelines for Lowland (Coastal) Rivers in NSW
^F Bioaccumulative Compounds
Ecological guidelines in *italics* are low level reliability guidelines
Ecological arsenic guideline based on As (III) for marine and As (V) for fresh, the lowest of presented guidelines.
Drinking Water arsenic guidelines are based on total arsenic
Guidelines for chromium are based on Cr (VI)
Ecological guidelines for mercury are based on inorganic mercury.
Drinking Water guidelines for mercury are based on total mercury.
Results for TRH have been compared to TPH guidelines.
Results shown in **BOLD** are those in excess of lowland (coastal) river guidelines
Results shown in shading are in excess of the 99% fresh water aquatic ecosystems guidelines
Results shown in **BOLD ITALICS** are in excess of the 95% fresh water aquatic ecosystems guidelines
Results shown in pattern shading are in excess of the 99% marine water aquatic ecosystems guidelines
Results shown in UNDERLINE are in excess of the 95% marine water aquatic ecosystems guidelines
Results shown in DOUBLE UNDERLINE are in excess of the human health (ingestion) guideline
Where summation required (Xylene,TRH,PAH) calculation includes components reported as non detected as 1/2 PQL.

Appendix D

Summary of Monitoring Requirements

Location	Frequency	Monitoring
BH1 and BH3	Monthly during construction	Ammonia, nitrate and phosphorous
BH1, BH2*, BH3	Once a week during construction	Water level
		pH
Within excavations	Daily during construction where water present	pH
Within excavations	Daily during construction after lime treatment if undertaken	pH
Within excavations	Prior to discharge during construction	pH
BH1, BH2*, BH3	Prior to groundwater extraction commencing during construction	Water level and pH
	During groundwater extraction during construction	
	24 hours after groundwater extraction during construction	
Leachate Pond and Constructed Wetlands	Daily	Visual assessment of water level change, condition of geomembrane and presence of sediment
BH1 and BH3	Monthly	Groundwater level Depth of Well Field readings Ammonia, nitrate, phosphorous
	Quarterly	TRH, BTEX, PAH

* BH2 to be included as long as it remains a viable monitoring well.