Attachment 3

White Rock Quarry Treatment Product Assessment

DATE:	31/05/2022	REFERENCE:	3097TURB
TO:	Angie Garzongutierrez	EMAIL: angie.garzongutierrez@hanson.com.au	
FROM:	Butch Uechtritz	EMAIL: butch@turbid.com.au	
SUBJECT:	White Rock Quarry Treatment Product Assessment		

Summary

From jar testing the water sample provided from the site, Turbiclear proved to be the preferred treatment product. Utilising this product in conjunction with an ifod FLOW dosing unit at the upstream inlet of a High Efficiency Sediment (HES) basin has long been the most effective way to manage impacts of sitewater runoff throughout Australia for the past decade. Further additional control options such as the iqad monitoring and control system will further reduce the risks of impacting the receiving waterway and would be seen as the 'gold standard' for site water management.

1. Introduction

Turbid has been requested to provide information as to why the treatment products presented for use at the White Rock Quarry were nominated as the preferred products.

Untreated construction site runoff poses a pollution risk to receiving environments. The key to minimising this risk is to treat as much of the generated runoff from exposed surfaces as possible with a product/process that doesn't pose a higher risk to the receiving biota.

Water treatment systems need to consider two main factors in design: flowrates and residence time. Flow rates are governed by rainfall intensity, residence time is governed by treatment product efficacy - how long does the product take to settle out suspended solids from the water column to a level acceptable to discharge.

The application of the treatment product to the untreated water, whether through automated means or manually, needs various levels of mixing depending upon the treatment product type. Insufficient mixing, time and dose amounts lead to poor removal rates.

Turbid offers a range of water treatment product types that suit individual site requirements. All products however must have a low risk of causing any potential harm to receiving biota when discharging offsite. Ecotoxicity testing has been carried out on the products Turbid offers to ensure ecological risk is minimised. The product choice then generally comes down to a balance between how it needs to be applied, how quickly it needs to settle out suspended solids and the cost associated with doing so.

Treatment product types can change during the project as different soil types are exposed or imported. Regular jar testing should be carried out to ensure the best product type is being used.

The White Rock quarry project will rely upon automated dosing units to inject a treatment product into runoff passing through a High Efficiency Sediment (HES) basin during rain events. This approach will allow for the greatest amount of runoff to be treated in a manner that minimises the risk to the receiving environment.

Jar testing has been carried out on a water sample supplied by White Rock Quarry to determine the preferred treatment products and subsequent dose rates of each for use.

2. Treatment Product options considered:

1. **TURBICLEAR**

Turbiclear is a high quality, environmentally friendly, rapid acting coagulant manufactured in Australia and extensively used throughout Australian construction and mining sites. It has played a major part in securing contractors throughout Australia with environmental awards due to its ability to treat highly turbid water.

Environmental Considerations:

TURBICLEAR™ is a pre-hydrolysed cationic coagulant comprising of Aluminium Chlorohydrate (ACH) and water. ACH is used widely in municipal water treatment plants and sewerage treatment plants globally. TURBICLEAR™ has been used on construction, mining and agricultural sites throughout Australia for surface water and groundwater treatment for years without any known toxic impacts to receiving waters biota.

ACH is tri-valent with a [1]basicity >83%, making it a fast-acting flocculating agent with low impact on treated water pH. These characteristics differentiate ACH from other forms of Aluminium based flocculating agents such as Alum Sulphate (0% basicity) and Polyaluminium Chloride (40-60% basicity). Correctly dosed, ACH will typically have no to very little effect on water pH (depending upon Total Alkalinity levels).

The speciation (the different forms of Aluminium in any water - around 5 main forms) and therefore toxicity of aluminium is generally determined by water pH value. Generally speaking, the lower the water pH (<6) the higher the likelihood of the two mainly toxic (bio-available) forms of aluminium being present in any water.

When added to water, TURBICLEAR™ rapidly hydrolyses to form Aluminium Hydroxide (a stable non-toxic form of Aluminium) which will settle out as part of the flocculated material leaving very little (if any) Aluminium residual in the treated water (supernatant) when suspended solids content (TSS) is low and pH values are between 6.5 and 8.5.

It is important to understand that Aluminium is one of the most common elements on earth. Untreated and poorly treated water with high suspended solids content will generally contain much higher levels of Aluminium than water treated effectively (low TSS concentration) with an Aluminium based product.

The toxic species (bio available forms) of aluminium within the total Aluminium concentration will depend upon the pH of the water. Speciation ratios will rapidly change depending upon the pH of the water. Therefore, a key determination of potential Aluminium toxicity risk from using TURBICLEAR™ is the concentration of the toxic forms of Aluminium in the receiving environment, which will be generally dictated by the pH (also hardness and organic carbon) of the receiving waters.

Low pH receiving waters (< 6.0) will generally already have a high concentration ratio of bioavailable Aluminium as its naturally occurring. Ensuring low total Aluminium concentrations in the discharged supernatant by having low TSS concentrations in the discharged supernatant is the key to minimising bioavailable Aluminium concentrations in the receiving waters. This is due to minimising the potential of

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[1] Basicity is the ratio of hydroxyl to aluminium ions in the hydrated complex and in general the higher the basicity, the lower will be the consumption of alkalinity in the treatment process and hence impact on treated water pH.

stable Aluminium forms in the supernatant (with a pH between 6.5 and 8.5) being converted into bioavailable forms of Aluminium at the lower pH of the receiving waters.

Ensuring a clear supernatant with a generally neutral pH is discharged into any receiving waters will minimise the risk of potential Aluminium toxicity the greatest.

Whole of effluent ecotoxicity testing of supernatant samples collected from the outlet of a High Efficiency Sediment (HES) basin treated with TURBICLEAR^{TM} was carried out on the Eastern Rainbowfish and Australian water flea. The test results clearly demonstrate at full effluent concentration (i.e. no dilution by receiving waters) no ecotoxicity impact at all was measured.

Comments:

Turbid generally recommends Turbiclear due its adaptability to changing runoff chemistry, low reliance on mixing, fast settling rates, low dose amounts (meaning more runoff can be treated than with a similar quantity of another product), low cost and low risk to receiving biota. Turbid has based the range of automated dosing units on the use of Turbiclear to treat runoff in most instances.

The NSW Environmental Protection Authority was satisfied for the use of the product on a recent project in western Sydney where 500ML of water needed to be treated and discharged from an old mine site into a receiving creek system.

The NSW Roads and Maritime Services have approved the use of Turbiclear as an alternative to gypsum- the first product to do so under the 2017 Alternative Floc/Coagulant proposed use guide.

Third party investigations have shown that Turbiclear use also reduces metal concentrations (Aluminium, Iron, Lead and Zinc to name a few), nutrients, algae and E.coli counts from construction site water runoff.

Turbiclear has for the past 6 years, and is still currently being used to treat all runoff and groundwater from a large urban development in South-East Queensland which has EPBC listed Wallum Sedge Frog populations throughout the development footprint and also discharges directly into a Ramsar listed wetland. The federal government audits the site annually to ensure all environmental attributes are not affected by construction activities with a focus on water quality.

I expect that the brief outline provided above will satisfy any concerns on the use of Turbiclear within the White Rock Quarry project.

2. TURBIFLOC

Turbifloc is a high-quality bio-polymer flocculant manufactured in Australia and used extensively throughout Australia and overseas on construction and mining sites. Turbifloc is based on the Chitosan compound (a large component of crustacean shells) and will biodegrade due to its ‘simple sugar’ complex. It has played a major part in securing contractors throughout Australia with environmental awards due to its ability to rapidly clarify highly turbid water.

Environmental Considerations:

Turbifloc is based on Chitosan - one of the most common polymers found in nature. Chitosan is a modified, natural, carbohydrate/polysaccharide polymer derived from the chitin component of the exoskeleton of crustaceans such as shrimp and prawns. It can also be described as a ‘cationic polyelectrolyte’ and is expected to coagulate negatively charged suspended particles found in turbid natural waters. Chitosan has characteristics of both coagulants and flocculants such as high cationic charge density, bridging of aggregates and precipitation, and long polymer chains.

Chitosan has limited toxicity because it is made up of primary amines and therefore has a weaker cationic charge than a cationic polymer that is comprised of quaternary amines (most cationic flocculants available) would have.

The product is created from natural biopolymers that degrade with enzymatic activity into simple sugars therefore preventing any bioaccumulation. See figure 1 below:

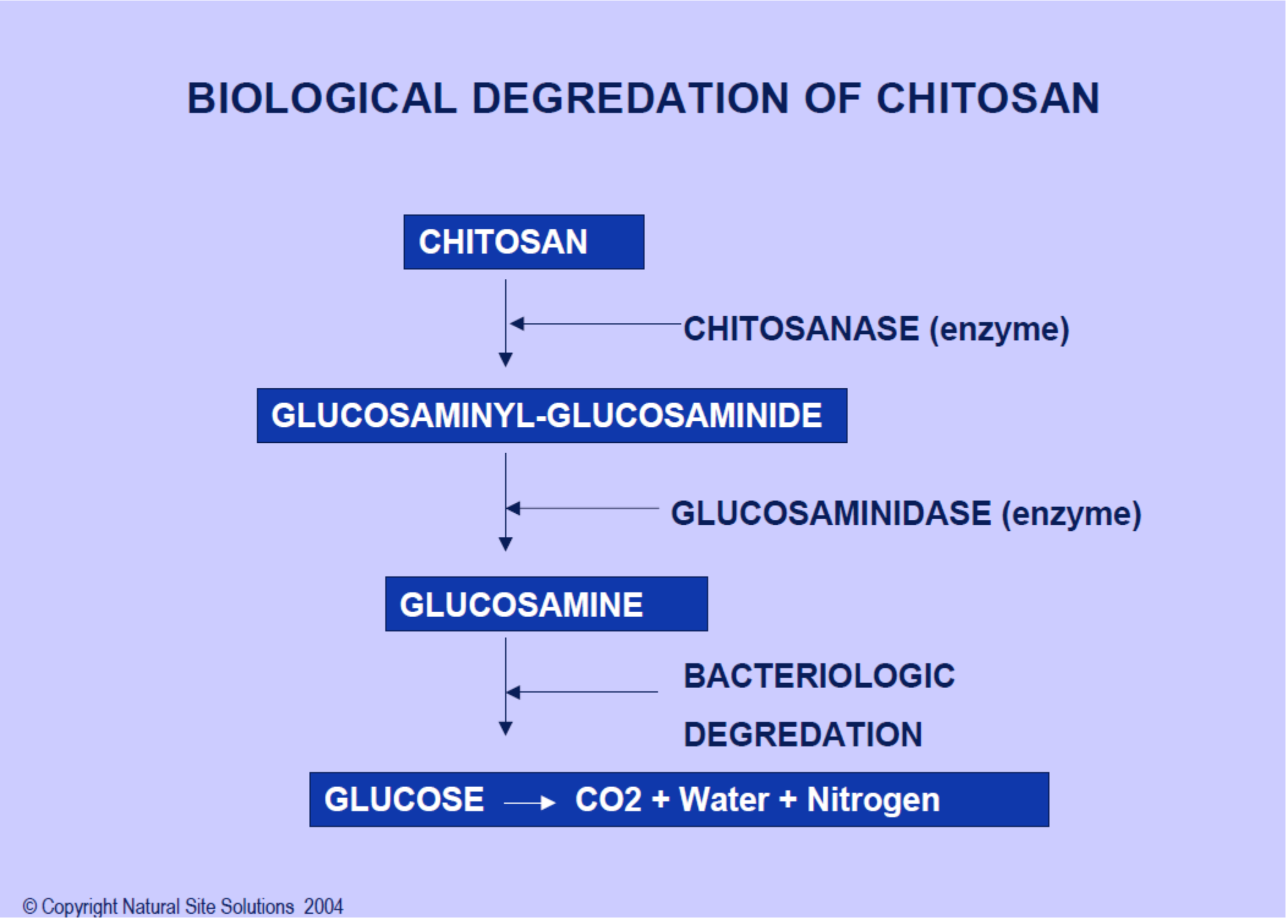

Figure 1. Biological Degradation of Chitosan

Ecotoxicity assessments have been undertaken on Turbifloc both within Australia and the USA when used in stormwater runoff treatment and have demonstrated it's low toxicity characteristics.

Comments:

The US EPA has stated via a fact sheet on Chitosan used as a pesticide that

Given its low potential for toxicity and its abundance in the natural environment, chitosan is not expected to harm people, pets, wildlife, or the environment when used according to label directions.[2]

Furthermore, the US EPA has proposed to add Chitosan to the List of Active Ingredients Permitted in Exempted Minimum Risk Pesticide Products due to its low toxicity risks.

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[2] https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/fs_PC-128930_01-Jun-03.pdf

The NSW Roads and Maritime Services have approved the use of Turbifloc as an alternative to gypsum under the 2017 Alternative Floc/Coagulant proposed use guide.

Third party investigations have shown that Turbifloc use also reduces metal concentrations (Aluminium, Iron, Lead and Zinc to name a few), nutrients, algae and E.coli counts from construction site water runoff.

I expect that the brief outline provided above will satisfy any concerns on the use of Turbifloc within the White Rock Quarry project.

3. TURBICLEAR EXTRA

Turbiclear Extra is a specially formulated blended product of the Turbiclear and the Turbifloc products giving it the preferred characteristics of both. Manufactured in Australia from the highest quality products and processes gives this product the added benefit of not just being highly effective but also environmentally friendly.

Environmental Considerations:

As per Turbiclear and Turbifloc as this product is a blend of the two individual products already identified.

Comments:

The Turbiclear Extra product has not long been developed. It has been identified as the key product to use with High Efficiency Sediment basins as it provides all the good characteristics of both the Turbiclear coagulant (low dose rates and very good clarity of supernatant) and the Turbifloc product (rapid floc settlement and stable sludge).

I expect that the brief outline provided above will satisfy any concerns on the use of Turbiclear Extra within the White Rock Quarry project.

4. TURBI GYP

Turbi Gyp is a gypsum-based coagulant. The gypsum powder is sourced from South Australia and further milled in Queensland to produce a micronized product that will go into solution faster than traditional gypsum making it a better passive product for water treatment.

Environmental Considerations:

Gypsum is calcium sulphate. Calcium sulphate has long been regarded as having low ecotoxicity risks and is actively encouraged for use when treating soil and water by authorities throughout Australia. However, there is limited published data on the aquatic ecotoxicity of calcium-based coagulants such as calcium sulphate.

Comments:

Although encouraged for use in stormwater treatment by various authorities throughout Australia, the product itself being a bi-valent cation has limited ability to charge neutralise colloidal particles in the water and is therefore less effective than other coagulants and/or flocculants in clarifying turbid water. Due to its low solubility (approximately 250g per 1000 Litres of water) and low charge neutralisation capacity leads it to take days rather than hours to settle out suspended solids from turbid water.

It because of this key characteristic that we generally don’t use the product for managing site water on construction sites requiring treatment to occur as rapidly as possible to minimise the overall risks to the receiving environment.

3. Jar Testing Results

A 10L water sample was collected by White Rock Quarry staff on the 16th of May 2022 and shipped to Turbid laboratories for analysis.

The water sample was analysed for starting pH and turbidity and subsequently subjected to various dose rates of Turbiclear, Turbifloc, Turbiclear Extra and Turbi Gyp to facilitate flocculation of the suspended solids within 1L samples. Settlement was observed over a depth of 100mm over various timeframes from 5 minutes to 1 hour.

3.1. Summary of Results

Table 1 – Summary of Analytical Results using Turbiclear

Sample ID	Matrix	pH	Turbidity	Turbiclear dose (ml/L)	Final pH	Final Turbidity	Notes
1	Water	7.2	794 NTU	0.02 – 0.12	7.2	< 10 NTU	Good flocculation and rapid settlement within 5 minutes Recommend dose rate at 40ppm

Table 2 – Summary of Analytical Results using Turbifloc

Sample ID	Matrix	pH	Turbidity	Turbifloc dose (ml/L)	Final pH	Final Turbidity	Notes
1	Water	7.2	794 NTU	0.02 – 0.12	7.2	< 10 NTU	Rapid flocculation and rapid settlement within 5 minutes Recommend dose rate at 40ppm

Table 3 – Summary of Analytical Results using Turbiclear Extra

Sample ID	Matrix	pH	Turbidity	Turbiclear Extra dose (mg/L)	Final pH	Final Turbidity	Notes
1	Water	7.2	794 NTU	0.04 – 0.12	7.2	< 10 NTU	Good flocculation and rapid settlement within 5 minutes Recommend dose rate at 60ppm

Table 4 – Summary of Analytical Results using Turbi Gyp

Sample ID	Matrix	pH	Turbidity	TurbiGyp dose (mg/L)	Final pH	Final Turbidity	Notes
1	Water	7.2	794 NTU	NA	7.2	>700	Little to no flocculation within 60 minutes

Floc report worksheets are attached in the Appendix to this memo.

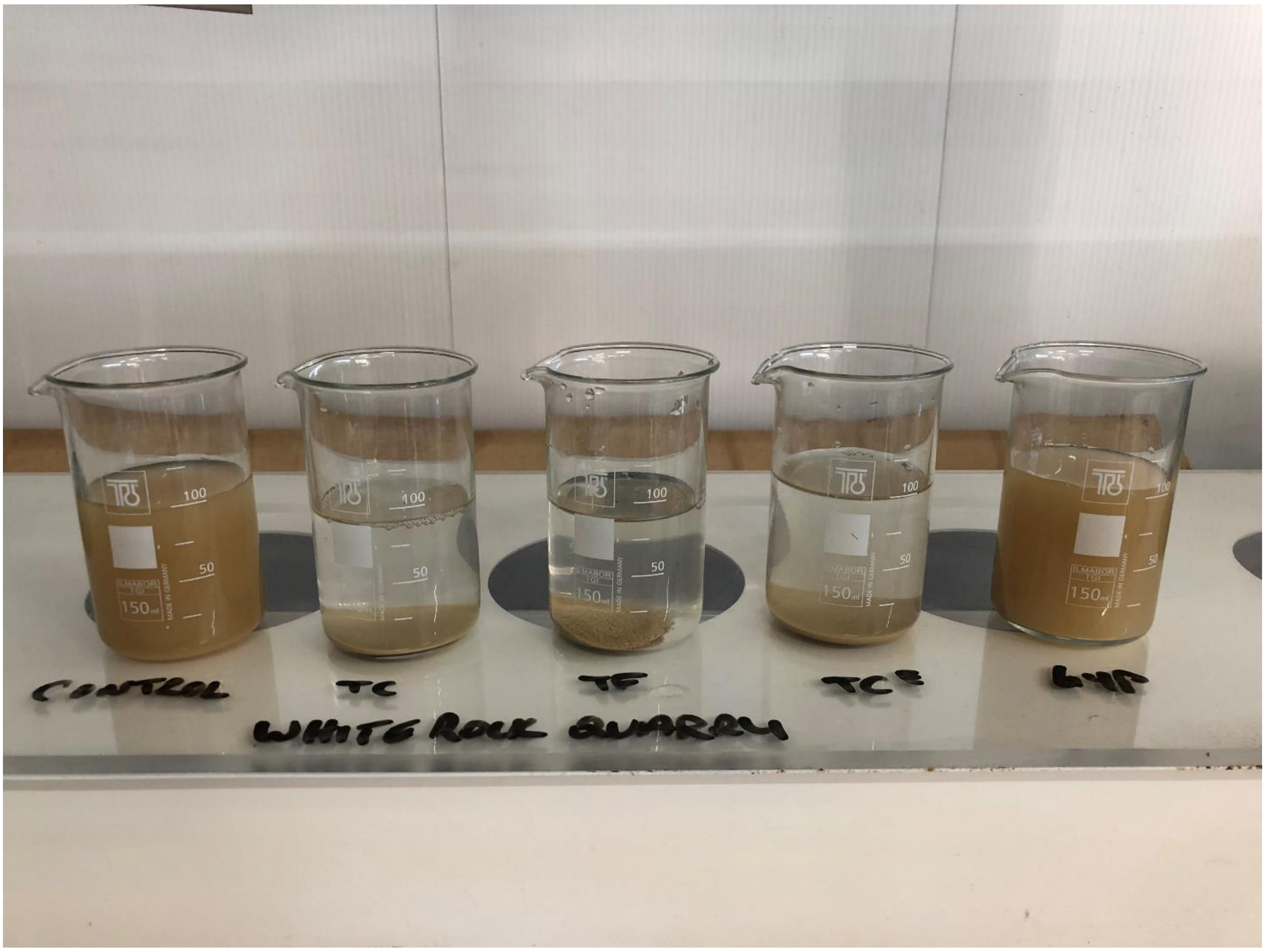

Image 1. Jar Testing results

4. Treatment Product Recommendations

From the Jar testing performed, the water reacted well with a range of products other than the gypsum-based coagulant. Dose rates were slightly below the 'normal' range experienced on construction sites starting at 20ppm. The dose 'window' was also quite large indicating the water chemistry of the sample was conducive to good flocculation. It can be reasonably considered that the Turbiclear product would be the preferred product to use at a dose rate of 40ppm. This product will give the greatest chance of getting low turbidity water being discharged from a HES basin over a wide range of flow rates. Generally, the lower the turbidity (with pH being in the neutral range of between 6.5 and 8.5), the lower the contaminants being released to the receiving environment.

As the one opportunistic sample tested above behaved as per most of the other water Turbid has treated with Turbiclear in the past, it can be reasonably assumed that Turbiclear will be the recommended product throughout the project. However, as noted above, as situations change, other types of products may be required to ensure the project minimises untreated water leaving the site and as such the full range of products Turbid offers should be available to use during the project. Turbiclear, Turbifloc and Turbiclear Extra SDS's are attached in the Appendix to this memo.

5. Application Recommendations

The proposed HES basin outlined in figure 2 will generally provide all reasonable and practicable measures to achieve the site's environmental obligations from a water quality point of view.

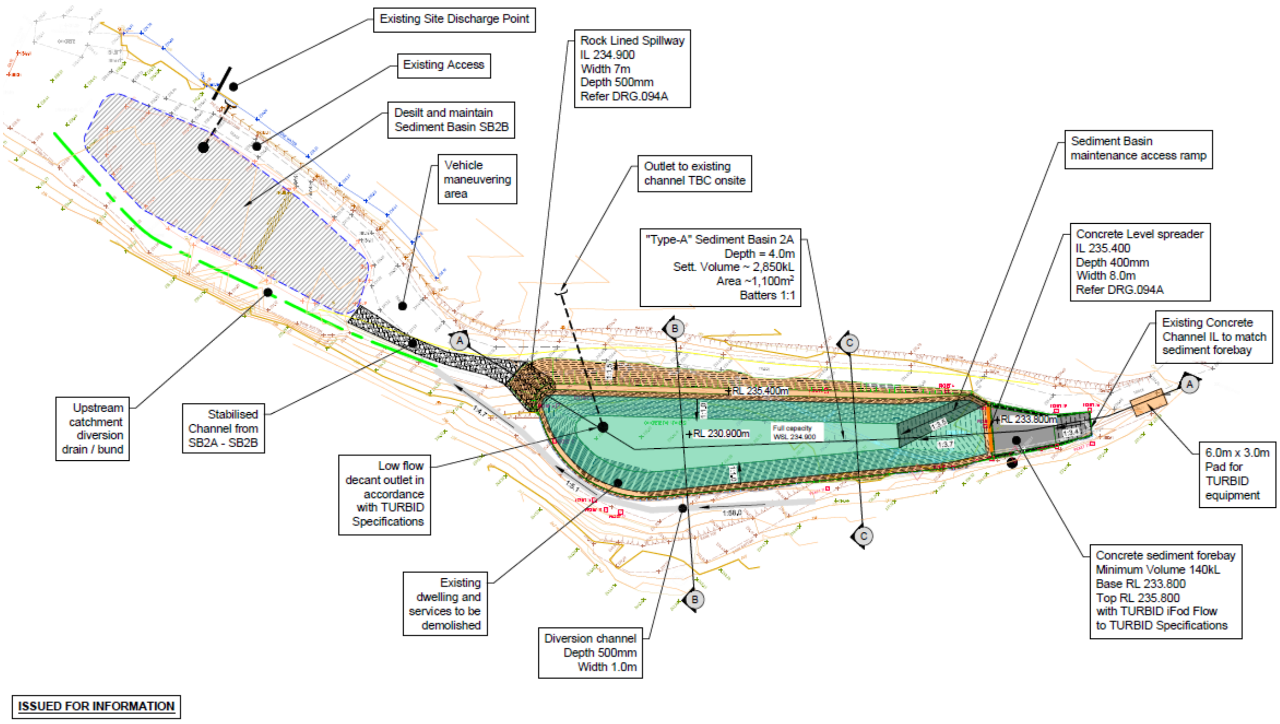

Figure 2. HES Design

Turbid recommends the following equipment to support the HES basin:

1. Ifod FLOW dosing system
    - The ifod-FLOW provides accurate dosing of treatment products utilising flow metres inside or above pipes, open drains or weirs. It will measure water flow, either generated from rain events or pumping on site, and accurately dose via a low voltage metering pump according to the run-off volume entering the basin. This ifod™ can also be connected to water quality sensors for monitoring and control purposes and linked to our cloud-based data platform for complete interoperability with our other systems.
2. Iqad
    - The iqad™ is a safety cut-off and monitoring system which utilises an internal microprocessor and logger to measure water quality parameters such as pH, turbidity, electrical conductivity and dissolved oxygen. The iqad™ is a telescopic post designed for light weight transportability and minimal storage and can be easily fixed to substrate. It is ideal for sites without easy access to power as the iqad™ is equipped with a low voltage solar power plant for operation. It is also relocatable, so can be transferred to a different section of a site as required.

- The iqad™ attaches to the discharge point of the basin and allows for the recording of the basin's discharges when occurring. The iqad™ can also control a power actuated butterfly valve installed on the discharge pipe to stop any water discharging that is not within parameters set in the site's license conditions. All information can be logged or exported from the controllers via telemetry to our cloud-based data platform.

These two systems combined provide a high level of confidence to dose and monitor the site water on the project. Water quality sensors controlling a butterfly valve on the discharge pipe of the primary HES basin will further reduce risk of uncompliant water being discharged offsite. If volumes exceed the storage of the HES (SB2A) the secondary retention basin (SB2B) will further minimise any chance of uncompliant water being discharged. When water is being stored in the retention basin (SB2B), this water can then be tested and either pumped back for treatment through the dosing system and HES basin (SB2A) or directly discharged off site.

Examples of previously installed HES basins with the proposed equipment are displayed in Images below.

Image 2. Ifod FLOW dosing system

Image 3. Ifod FLOW dosing system

Image 4. Iqad monitoring system with auto controlled shutoff valve on outlet.

6. Risk Assessment of Option Presented

As identified previously, the ultimate outcome needed to be considered when adopting a suitable management strategy is to minimise the risk of negatively impacting the receiving environment's biota. In doing this from a site water management point of view we need to consider things like trying to replicate baseline (an undisturbed catchment) water quality and quantity.

Baseline water quality and quantity changes regularly due to naturally occurring situations such as during rainfall events. At these times, high flow rates are expected in the receiving streams and elevated turbidity and associated contaminants as well. Aquatic biota are preconditioned to manage these events. By utilising a HES basin with a rapid acting treatment product, we aim to replicate the natural process by releasing water at the same time as there would ordinarily be a high flow rate in the stream, thus reducing the frequency of these impacts and further reducing any acute impacts due to dilution (eg. We are releasing slightly turbid and/or slightly different pH discharge water at a time when it can be diluted sufficiently in the base flow already occurring. Compare this to holding onto the runoff in a detention basin and then having to wait 5 days for it to be sufficiently treated and then discharged at high flow rates when the receiving stream has gone back to a low flow environment- the change in water turbidity and pH of the discharge water will have the ability to cause acute changes in the receiving water quality resulting in more stresses to the biota in the stream).

We believe that the proposed system provides for the highest chance of uncontaminated water being discharged in times of already high flow rates and minimising the negative impacts on the receiving environments aquatic biota of the projects operations.

Due to HES basins being able to provide a much better environmental outcome than traditional sediment basins, the International Erosion Control Association's Australasia's guidelines stipulate that any designers required to implement a sediment basin must use a HES basin unless they can demonstrate that an alternative management strategy can be adopted that gives the same high level of environmental control.

All management systems have a potential to fail. HES basins are no different. The system relies on a treatment product being dispensed at a rate suitable for the flow rate of the influent. It then relies on conditions within the settlement area to allow the flocked particles to settle of suspension and remain on the floor of the system.

Dosing systems can either underdose or overdose the required treatment product at times due to various factors. Generally, at these times, the target turbidity will not be achieved within a HES basin. Turbidity sensors on the outflow will therefore be able to alert operators that an issue is present. In the case of the White Rock Quarry, real time alerts can be deployed to site staff to notify of these events and the discharge line will close avoiding any water from being discharged offsite. Having the secondary basin SB2B allows for further risk mitigation in this instance. The water can then be re-treated to achieve the desired water quality and released.

HES basins can also be overwhelmed at times of high flow rates where insufficient residence time is provided for the floc to settle out and the potential for re-suspension of particles can occur due to the high velocities. At these times, the turbidity will increase to a point that shuts the discharge line and alerts operators. Once velocities return to design flow rates, the flocked particles will again settle to the floor of the system. Regular cleaning of the forebay section of the HES basin will further reduce the likelihood of this occurring as well as the selected treatment product creating a stable floc (Turbifloc will produce the most stable floc followed by Turbiclear Extra, Turbiclear and then the gypsum which is easily re-mobilised/ re-suspended). Any flocked material that does potentially leave site would generally be inert in nature from an Aluminium point of view and would have the same impact as releasing natural clays (gibbsite and bauxite) offsite which are a common occurrence throughout Australia. pH readings didn't change in the jar testing after treatment with any of the products and hence the chance of impacting the receiving environments pH from discharges from the HES basin are negligible.

Appendix A: Turbiclear SDS

SAFETY DATA SHEET - Turbiclear^{tm}

ABN: 49 158 485 039

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Unit 7, 8 Grebe St | Peregian Beach QLD 4573

t 07 5471 2290| f 07 5302 6680
e info@turbid.com.au |w turbid.com.au

1. IDENTIFICATION OF MATERIAL AND SUPPLIER

Product Name:	Turbiclear
Chemical Name:	Aluminium chlorohydrate, ACH (83-85% basic)
Supplier	TURBID PTY LTD

Emergency Contact Information

Telephone	(07) 5471 2290
Fax	(07) 5302 6680
Email	info@turbid.com.au
Address	7/8 Grebe St, Peregian Beach QLD 4753
Poisons Information Centre	Phone 13 11 26 from anywhere in Australia

2. HAZARDS IDENTIFICATION

STATEMENT OF HAZARDOUS NATURE

Classified as:	NOT HAZARDOUS according to the criteria of Safe Work Australia
Classified as	NON-DANGEROUS GOODS by the criteria of Australian Dangerous Goods Code (ADG Code) for transport by road and rail.
Risk phrases:	Not Hazardous – No criteria found
Safety phrases:	S23: Do not breathe mist, S25 Avoid contact with eyes, S36 Wear suitable protective clothing
ADG Classification:	None allocated. Not a Dangerous Good according to Australian Dangerous Goods (ADG) Code, IATA or IMDG/IMSBC criteria.
UN Number:	None allocated
None allocated	NONE. Not hazardous.
HAZARD STATEMENT:	H335: May cause respiratory irritation.
PREVENTION	P102: Keep out of reach of children. P262: Do not get in eyes, on skin, or on clothing. P281: Use personal protective equipment as required.
RESPONSE	P362: Take off contaminated clothing and wash before reuse. P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. P302+P352: IF ON SKIN: Wash with plenty of soap and water. P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P332+P313: If skin irritation occurs: Get medical advice. P337+P313: If eye irritation persists: Get medical advice.

RESPONSE (cont)	P370+P378: Not combustible. Use extinguishing media suited to burning materials
STORAGE	P403+P233: Store in a well-ventilated place. Keep container tightly closed.
DISPOSAL	P501: If they can not be recycled, dispose of contents to an approved waste disposal plant and containers to landfill (see Section 13 of this SDS).

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Reference in AICS: YES

Name	CAS Number	Proportion	TWA (mg/m^3)	STEL (mg/m3)
Aluminium chlorohydrate ACH	1327-41-9	40 to 60 %	2	Not set
Water	7732-18-5	To 100%	Not set	Not set

This is a commercial product whose exact ratio of components may vary slightly. Minor quantities of other non hazardous ingredients are also possible.
The SWA TWA exposure value is the average airborne concentration of a particular substance when calculated over a normal 8 hour working day for a 5 day working week. The STEL (Short Term Exposure Limit) is an exposure value that may be equalled (but should not be exceeded) for no longer than 15 minutes and should not be repeated more than 4 times per day. There should be at least 60 minutes between successive exposures at the STEL. The term "peak "is used when the TWA limit, because of the rapid action of the substance, should never be exceeded, even briefly.

4. FIRST AID MEASURES

Eye contact:	Flush with water for 15 minutes. Seek medical attention.
Skin contact:	Irritation unlikely, However if irritation does occur, flush with lukewarm, gently flowing water for 5 minutes
Inhalation:	Remove from source of mist, allow patient to stabilize breathing in fresh air. If symptoms persist seek medical attention.
Ingestion:	Rinse mouth with water. Do not induce vomiting. If in doubt seek medical advice.

5. FIRE FIGHTING MEASURES

Extinguishing media:	Compatible with water, foam, CO2 and dry chemical. Fires can be attacked with extinguishers to suit local flammable/combustible materials
Flash point (°C):	Material is non-flammable and non-combustible.
Auto ignition point (°C):	Not applicable.
Explosion Limits In Air (% by volume):	Not applicable.
Special Procedures:	None.
Unusual hazards:	None known.
Conditions to avoid:	None known.
Materials to avoid:	May emit some chlorine gas when in contact with very strong oxidizing agents; some heat liberated when in contact with strong acids.
Decomposition products:	Severe overheating may produce hydrogen chloride gas and aluminium oxide once water has been driven off.
Hazardous polymerization	Will not occur.

6. ACCIDENTAL RELEASE MEASURES

General Response:	Personnel involved in the clean-up should wear appropriate protective clothing as listed in section 2. Slippery when spilt.
Clean Up Procedure:	Spillage into waterways will result in some lowering of the pH and the formation of aluminium hydroxide, which has a very low toxicity. Prevent drain or sewer contamination with absorbent such as sand or sawdust etc. Collect for disposal.

7. HANDLING & STORAGE

Handling:	Observe good personal hygiene practices and recommended procedures. Wash thoroughly with soap and water after handling.
Storage:	Do not store in metal containers other than stainless steel. When storing in stainless steel, Store in a cool, dry, well-ventilated area.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

National Exposure Standards	None Established
Engineering Controls:	Good general ventilation should be sufficient for most conditions. Local exhaust ventilation may be necessary for some operations
Personal Protective Equipment:	None required
Respiratory Protection:	General exhaust ventilation should be adequate.
Eye Protection:	Safety Glasses
Skin and body protection:	Disposable latex gloves, overalls or apron as appropriate. Rubber boots can be used in wet conditions but mainly as protection from the water

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear to slightly hazy aqueous solution
Odour:	None
Boiling point (°C):	100-110ºC
Melting point (°C):	Not available
Specific Gravity (H_2O = 1):	1.36 - 1.39 at 25°C
pH	3.0 – 3.5 at 25ºC
Vapour pressure (kPa):	Not applicable
Relative vapour density:	Not applicable
Volatile by weight (%):	Roughly 50 (prolonged drying leads to product change)
Solubility in water:	Completely miscible
Evaporation rate:	Not applicable

10. STABILITY AND REACTIVITY

Chemical Stability	Stable
Conditions to avoid:	Oxidizing agents may cause exothermic reactions. Keep containers tightly closed
Decomposition products:	Severe overheating may produce hydrogen chloride gas and aluminium oxide once water has been driven off.
Hazardous polymerization:	Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity:

Oral:	LD50/oral/rat > 3311 mg/Kg
Inhalation:	Product is not volatile
Irritation:	
Skin:	Mild skin irritant. May cause skin irritation with prolonged contact
Eyes	Irritation and redness.
Chronic Toxicity:	No chronic effects
Threshold limit value:	2 mg/m3 based on Al (roughly 0.25 mg/m3 based on actual product (Ref.: ACGIH, soluble Aluminium salts)
Target organs:	There is no date to hand indicating any particular target organs.

12. ECOLOGICAL INFORMATION

Environmental fate and distribution:

Aluminium compounds are common in most soils and are the principle components of Bauxite and Gibbsite, which are common, naturally occurring minerals. When diluted by copious quantities of water (for example, to the point that the concentration is less than about 100 grams per cubic meter), this product will hydrolyze rapidly to form aluminium hydroxide, which can be expected to become a part of the natural soil profile if not recovered. Turbiclear should be stored in a location that if a leakage occurs the product will not lead directly to a natural water way to minimise any potential risk.

Ecotoxicity:
Direct Toxicity Assessment
Whole of Effluent Ecotoxicity Testing undertaken on construction site water treated with Turbiclear in 2017 indicated no effect to either the Australian freshwater flea or Eastern Rainbowfish at full concentration.

For the 48-hr acute toxicity test using the freshwater cladoceran Ceriodaphnia dubia the EC50 = >100% (at 100% concentration, no affect was observed).
For the 96-hr fish imbalance toxicity test using the eastern rainbowfish Melanotaenia splendida splendida the EC50 = >100% (at 100% concentration, no affect was observed).

Effective Concentration Method Assessment
Aquatic toxicity carried out by others on Aluminium Chlorohydrate solution indicated that:
For the 48-hr acute toxicity test using the freshwater flea *Daphnia magna* the LC50 = 397mg/L
For the 96- hr acute toxicity test using the freshwater fish *Pimelphales promelas* the LC50 = 832mg/L

Bioaccumulative Potential:

Does not bio accumulate.

13. DISPOSAL CONSIDERATIONS

Waste disposal method:
Refer to local waste disposal authority. This product can be neutralized with alkali to form a mixture of aluminium hydroxide and the chloride salt of the alkali. The resulting mixture is non- hazardous provided the resulting pH is between roughly 5 and 10.

14. TRANSPORT INFORMATION

This product does not carry a Dangerous Goods classification as corrosion tests have verified that it is not corrosive to either skin or to metals.

15. REGULATORY INFORMATION

This product is to be found in the public AICS database.

16. OTHER INFORMATION

This SDS was prepared in accordance with the Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals.

Acronyms:

ADG Code	Australian Code for the Transport of Dangerous Goods by Road and Rail (7th edition)
AICS	Australian Inventory of Chemical Substances
SWA	Safe Work Australia, formerly ASCC and NOHSC
CAS Number	Chemical Abstracts Service Registry Number
Hazchem code	Emergency action code of numbers and letters that provide information to emergency services especially firefighters
IARC	International Agency for Research on Cancer
NOS	Not otherwise specified
NTP	National Toxicology Program (USA)
R-Phase	Risk Phrase
SUSMP	Standard for the Uniform Scheduling of Medicines & Poisons
Un Number	United Nations Number

References cited:

1. American Conference of Governmental Industrial Hygienists (ACGIH), Documentation of the Threshold Limit Values and Biological Exposure Indices, 6th Edition, ACGIH, Cincinatti, Ohio, 1991.
2. Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003(1995)]
3. Registry of Toxic Effects of Chemical Substances (RTECS)
4. Sax's, Dangerous Properties of Industrial Materials, Edition 8, Ed. RJ Lewis Sr., van Nostrand Reinhold.

Revision 12: Issued 16/01/2019

This SDS summarizes to our best knowledge of health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this SDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products. Please contact the company if any further information is required.

Appendix B: Turbifloc SDS

SAFETY DATA SHEET - Turbifloc

ABN: 49 158 485 039

PO Box 199 |Peregian Beach QLD 4573
Unit 7, 8 Grebe St | Peregian Beach QLD 4573

t 07 5471 2290| f 07 5302 6680
e info@turbid.com.au |w turbid.com.au

1. IDENTIFICATION OF MATERIAL AND SUPPLIER

Product Name:	Turbifloc
Active ingredient:	Chitosan
Supplier:	TURBID PTY LTD

Emergency Contact Information

Telephone	(07) 5471 2290
Fax	(07) 5302 6680
Email	info@turbid.com.au
Address	7/8 Grebe St, Peregian Beach QLD 4753
Poisons Information Centre	Phone 13 11 26 from anywhere in Australia

2. HAZARDS IDENTIFICATION

STATEMENT OF HAZARDOUS NATURE

Classified as:	NOT HAZARDOUS according to the criteria of Safe Work Australia
Classified as	NON-DANGEROUS GOODS by the criteria of Australian Dangerous Goods Code (ADG Code) for transport by road and rail.
Risk phrases:	Not Hazardous – No criteria found
Safety phrases:	None allocated
ADG Classification:	None allocated. Not a Dangerous Good according to Australian Dangerous Goods (ADG) Code, IATA or IMDG criteria.
UN Number:	None allocated
None allocated	NONE. Not hazardous.
HAZARD STATEMENT:	May be irritating to eyes and skin
PREVENTION	P102: Keep out of reach of children. P262: Do not get in eyes, on skin, or on clothing. P281: Use personal protective equipment as required.
RESPONSE	P362: Take off contaminated clothing and wash before reuse. P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. P302+P352: IF ON SKIN: Wash with plenty of soap and water. P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P332+P313: If skin irritation occurs: Get medical advice. P337+P313: If eye irritation persists: Get medical advice.

RESPONSE (cont)	P370+P378: Not combustible. Use extinguishing media suited to burning materials
STORAGE	P403+P233: Store in a well-ventilated place. Keep container tightly closed.
DISPOSAL	Wearing protective equipment detailed above, and ensuring any ignition sources are eliminated, absorb with sodium carbonate - sodium bicarbonate, collect and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).
	Legislation: Dispose of in accordance with relevant local legislation.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Name	CAS Number	EC Number	Content
Non-Hazardous Ingredients	Not available	Not Available	Remainder
Organic Polymer (s)	-	-	<5%
Organic Acid (s)	-	-	<2%

This is a commercial product whose exact ratio of components may vary slightly. Minor quantities of other nonhazardous ingredients are also possible.

4. FIRST AID MEASURES

Eye contact:	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.
Skin contact:	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water.
Inhalation:	If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.
Ingestion:	For advice, contact a Poison Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

5. FIRE FIGHTING MEASURES

Extinguishing media:	Use an extinguishing agent suitable for the surrounding fire.
Flash point (°C):	Material is non-flammable. May evolve toxic gases (acetic acid, hydrocarbons, carbon oxides) when heated to decomposition.
Special Procedures:	None.
Unusual hazards:	None known.
Conditions to avoid:	None known.
Decomposition products:	May evolve toxic gases (acetic acid, hydrocarbons, carbon oxides) when heated to decomposition.
Advice for firefighters	Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

6. ACCIDENTAL RELEASE MEASURES

General Response:	Personnel involved in the clean-up should wear appropriate protective clothing as listed in section 8. Slippery when spilt.
Clean Up Procedure:	Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

7. HANDLING & STORAGE

Handling:	Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.
Storage:	Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Store as a Class C2 Combustible Liquid (AS1940). Turbifloc has a shelf life of 12 months. Batches should be marked with production date and expiry date of 12months.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

National Exposure Standards	None Established
Engineering Controls	Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain vapour levels below the recommended exposure standard.
Personal Protective Equipment:	
Respiratory Protection:	General exhaust ventilation should be adequate.
Eye Protection:	Wear splash-proof goggles
Skin and body protection:	Disposable latex gloves, overalls or apron as appropriate. Rubber boots can be used in wet conditions but mainly as protection from the water

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear gel
Odour:	Slight odour
Boiling point (°C):	100 °C approximately
Melting point (°C):	0 °C approximately
Specific Gravity (H_2O = 1):	1 approximately
pH	3.0 – 5 at 25ºC
Vapour pressure (kPa):	Not applicable
Relative vapour density:	Not applicable

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under normal conditions of storage
Conditions to avoid:	Avoid heat, sparks, open flames and other ignition sources. Keep containers tightly closed
Incompatible Materials	Incompatible with oxidising agents (e.g. hypochlorites), alkalis (e.g. sodium hydroxide), heat and ignition sources.
Decomposition products:	May evolve toxic gases (acetic acid, hydrocarbons, carbon oxides) when heated to decomposition.
Hazardous polymerization:	Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity:	This product is expected to be of low toxicity. Based on available data, the classification criteria are not met.
Irritation:	
Skin:	Not classified as a skin irritant. Contact may result in mild irritation, redness, pain and rash.
Eyes	Not classified as an eye irritant. However, direct contact may result in mild irritation, lacrimation, pain and redness.
Chronic Toxicity:	No chronic effects
Aspiration	Not classified as causing aspiration.
Target organs:	There is no data to hand indicating any particular target organs.

12. ECOLOGICAL INFORMATION

Environmental fate and distribution:
Chitosan is a derivative of Chitin, the world’s second most abundant biopolymer after cellulose and readily biodegrades. It is commonly obtained from natural sources such as crustaceans and fungi.

Ecotoxicity:
Not expected to be harmful to aquatic organisms.

Effective Concentration Method Assessment:
Ecotoxicity screening carried out in March 2017 indicated:

For the 96-hr acute toxicity test using the Eastern Rainbowfish (*Meloanotaenia splendida splendida*) the EC50 = >100mg/L

For the 48-hr acute toxicity test using the freshwater flea *Ceriodaphnia dubia* the EC50 = >100mg/L when diluted at a 1 in 2 ratio

Bio accumulative Potential:

Does not bio accumulate.

13. DISPOSAL CONSIDERATIONS

Waste disposal method:
Refer to local waste disposal authority. Wearing protective equipment detailed above, and ensuring any ignition sources are eliminated, absorb with sodium carbonate - sodium bicarbonate, collect and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).

Dispose of product 12 months after production/batch date

14. TRANSPORT INFORMATION

This product does not carry a Dangerous Goods classification. NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

15. REGULATORY INFORMATION

All components are listed on AICS, or are exempt..

16. OTHER INFORMATION

This SDS was prepared in accordance with the Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals.

Acronyms:
ADG Code Australian Code for the Transport of Dangerous Goods by Road and Rail (7th edition)
AICS Australian Inventory of Chemical Substances
SWA Safe Work Australia, formerly ASCC and NOHSC
CAS Number Chemical Abstracts Service Registry Number
Hazchem code Emergency action code of numbers and letters that provide information to emergency services especially firefighters
IARC International Agency for Research on Cancer
NOS Not otherwise specified
NTP National Toxicology Program (USA)
R-Phase Risk Phrase
SUSMP Standard for the Uniform Scheduling of Medicines & Poisons
Un Number United Nations Number

References cited:

1. American Conference of Governmental Industrial Hygienists (ACGIH), Documentation of the Threshold Limit Values and Biological Exposure Indices, 6th Edition, ACGIH, Cincinatti, Ohio, 1991.
2. Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003(1995)]
3. Registry of Toxic Effects of Chemical Substances (RTECS)
4. Sax's, Dangerous Properties of Industrial Materials, Edition 8, Ed. RJ Lewis Sr., van Nostrand Reinhold.

Revision 4: Issued 16 Jan 2019

This SDS summarizes to our best knowledge of health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this SDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products. Please contact the company if any further information is required.

Appendix C: Turbiclear Extra SDS

SAFETY DATA SHEET - Turbiclear *EXTRA* ™

ABN: 49 158 485 039

5 Vision Court | Noosaville QLD 4566

t 07 5471 2290

e info@turbid.com.au |w turbid.com.au

1. IDENTIFICATION OF MATERIAL AND SUPPLIER

Product Name:	**Turbiclear *EXTRA* ™**
Chemical Nature:	**Blend of Aluminium chlorohydrate, ACH (83-85% basic) and Chitosan**
Supplier	**TURBID PTY LTD**

Emergency Contact Information

Telephone	(07) 5471 2290
Fax	(07) 5471 2209
Email	info@turbid.com.au
Address	5 Vision Court, Noosaville QLD 4566
Poisons Information Centre	Phone 13 11 26 from anywhere in Australia

2. HAZARDS IDENTIFICATION

STATEMENT OF HAZARDOUS NATURE

Classified as:	NOT HAZARDOUS according to the criteria of Safe Work Australia
Classified as	NON-DANGEROUS GOODS by the criteria of Australian Dangerous Goods Code (ADG Code) for transport by road and rail.
Risk phrases:	Not Hazardous – No criteria found
Safety phrases:	S23: Do not breathe mist, S25 Avoid contact with eyes, S36 Wear suitable protective clothing
ADG Classification:	None allocated. Not a Dangerous Good according to Australian Dangerous Goods (ADG) Code, IATA or IMDG/IMSBC criteria.
UN Number:	None allocated
None allocated	NONE. Not hazardous.
HAZARD STATEMENT:	H335: May cause respiratory, eyes and skin irritation.
PREVENTION	P102: Keep out of reach of children. P262: Do not get in eyes, on skin, or on clothing. P281: Use personal protective equipment as required.
RESPONSE	P362: Take off contaminated clothing and wash before reuse. P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. P302+P352: IF ON SKIN: Wash with plenty of soap and water. P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P332+P313: If skin irritation occurs: Get medical advice. P337+P313: If eye irritation persists: Get medical advice.
RESPONSE (cont)	P370+P378: Not combustible. Use extinguishing media suited to burning materials

STORAGE	P403+P233: Store in a well-ventilated place. Keep container tightly closed.
DISPOSAL	P501: If they cannot be recycled, dispose of contents to an approved waste disposal plant and containers to landfill (see Section 13 of this SDS).

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Reference in AICS: YES

Name	CAS Number	Proportion	TWA (mg/m^3)	STEL (mg/m3)
Aluminium hydroxychloride	1324-41-9	20-30%	1	Not set
Non-Hazardous Ingredients	Not available	40-50%	Not set	Not set
Organic Polymer(s)	-	<2.5%	Not set	Not set
Organic Acid(s)	-	<1%	Not set	Not set
Water	7732-18-5	To 100%	Not set	Not set

This is a commercial product whose exact ratio of components may vary slightly. Minor quantities of other non-hazardous ingredients are also possible.

The SWA TWA exposure value is the average airborne concentration of a particular substance when calculated over a normal 8 hour working day for a 5 day working week. The STEL (Short Term Exposure Limit) is an exposure value that may be equalled (but should not be exceeded) for no longer than 15 minutes and should not be repeated more than 4 times per day. There should be at least 60 minutes between successive exposures at the STEL. The term "peak "is used when the TWA limit, because of the rapid action of the substance, should never be exceeded, even briefly.

4. FIRST AID MEASURES

Eye contact:	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Skin contact:	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Irritation is unlikely, however, if irritation does occur, flush with lukewarm, gently flowing water for 5 minutes.
Inhalation:	If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.
Ingestion:	For advice, contact a Poison Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

5. FIRE FIGHTING MEASURES

Extinguishing media:	Compatible with water, foam, CO2 and dry chemical. Fires can be attacked with extinguishers to suit local flammable/combustible materials.
Flash point (°C):	Material is non-flammable. May evolve toxic gases (acetic acid, hydrocarbons, carbon oxides) when heated to decomposition.
Auto ignition point (°C):	Not applicable.
Explosion Limits in Air (% by volume):	Not applicable.
Special Procedures:	None.
Unusual hazards:	None known.
Conditions to avoid:	None known.
Materials to avoid:	May emit some chlorine gas when in contact with very strong oxidizing agents; some heat liberated when in contact with strong acids.
Decomposition products:	Severe overheating may produce hydrogen chloride gas and aluminium oxide once water has been driven off. May evolve toxic gases (acetic acid, hydrocarbons, carbon oxides) when heated to decomposition.
Hazardous polymerization:	Will not occur.
Advice for firefighters:	Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

6. ACCIDENTAL RELEASE MEASURES

General Response:	Personnel involved in the clean-up should wear appropriate protective clothing as listed in section 2. Slippery when spilt.
Clean Up Procedure:	Spillage into waterways will result in some lowering of the pH and the formation of aluminium hydroxide, which has a very low toxicity. Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

7. HANDLING & STORAGE

Handling:	Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.
Storage:	Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Do not store in metal containers other than stainless steel. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Store as a Class C2 Combustible Liquid (AS1940).
	Turbiclear Extra has a shelf life of 12 months. Batches should be marked with production date and expiry date of 12months.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

National Exposure Standards	None Established
Engineering Controls:	Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain vapour levels below the recommended exposure standard.
Personal Protective Equipment:	None Required.
Respiratory Protection:	General exhaust ventilation should be adequate.

Eye Protection:	Wear splash-proof goggles.
Skin and body protection:	Disposable latex gloves, overalls or apron as appropriate. Rubber boots can be used in wet conditions but mainly as protection from the water.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear to slightly hazy gel.
Odour:	Slight odour.
Boiling point (°C):	Approximately 100°C
Melting point (°C):	Approximately 0°C
Specific Gravity (H2O = 1):	1.18-1.20 at 25°C
pH	3.0 – 5 at 25ºC
Vapour pressure (kPa):	Not applicable.
Relative vapour density:	Not applicable.
Volatile by weight (%):	Roughly 50 (prolonged drying leads to product change)
Solubility in water:	Completely miscible
Evaporation rate:	Not applicable

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under normal conditions of storage.
Conditions to avoid:	Avoid heat, sparks, open flames and other ignition sources. Oxidizing agents may cause exothermic reactions. Keep containers tightly closed.
Incompatible Materials	Incompatible with oxidising agents (e.g. hypochlorites), alkalis (e.g. sodium hydroxide), heat and ignition sources.

Decomposition products:	May evolve toxic gases (acetic acid, hydrocarbons, hydrogen chloride gas, aluminium oxide and carbon oxides) when heated to decomposition.
Hazardous polymerization:	Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity:	
Oral:	LD50/oral/rat > 3311 mg/Kg
Inhalation:	Product is not volatile.
Irritation:	
Skin:	Mild skin irritant. May cause skin irritation with prolonged contact
Eyes	Irritation and redness.
Chronic Toxicity:	No chronic effects
Threshold limit value:	2 mg/m3 based on Al (roughly 0.25 mg/m3 based on actual product (Ref.: ACGIH, soluble Aluminium salts)
Target organs:	There is no date to hand indicating any particular target organs.

12. ECOLOGICAL INFORMATION

Environmental fate and distribution:

Aluminium compounds are common in most soils and are the principle components of Bauxite and Gibbsite, which are common, naturally occurring minerals. When diluted by copious quantities of water (for example, to the point that the concentration is less than about 200 grams per cubic meter), this product will hydrolyze rapidly to form aluminium hydroxide, which can be expected to become a part of the natural soil profile if not recovered. Turbiclear Extra should be stored in a location that if a leakage occurs the product will not lead directly to a natural water way to minimise any potential risk. Chitosan is a derivative of Chitin, the world's second most abundant biopolymer after cellulose and readily biodegrades. It is commonly obtained from natural sources such as crustaceans and fungi.

Ecotoxicity:

Direct Toxicity Assessment

Whole of Effluent Ecotoxicity Testing undertaken on construction site water treated with a component of Turbiclear Extra in 2017 indicated no effect to either the Australian freshwater flea or Eastern Rainbowfish at full concentration.

For the 48-hr acute toxicity test using the freshwater cladoceran Ceriodaphnia dubia the EC50 = >100% (at 100% concentration, no affect was observed).

For the 96-hr fish imbalance toxicity test using the eastern rainbowfish Melanotaenia splendida splendida the EC50 = >100% (at 100% concentration, no affect was observed).

Effective Concentration Method Assessment

Aquatic toxicity carried out by others on Aluminium Chlorohydrate solution indicated that:

For the 48-hr acute toxicity test using the freshwater flea *Daphnia magna* the LC50 = 397mg/L

For the 96- hr acute toxicity test using the freshwater fish *Pimelphales promelas* the LC50 = 832mg/L

Bioaccumulative Potential:

Does not bio accumulate.

13. DISPOSAL CONSIDERATIONS

Waste disposal method:

Refer to local waste disposal authority. Containers should be emptied as completely as practical before disposal. If possible, recycle product and containers either in-house or send to recycle company. If this is not practical, send to a commercial waste disposal site.

Wearing protective equipment detailed above, and ensuring any ignition sources are eliminated, absorb with sodium carbonate - sodium bicarbonate, collect and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).

14. TRANSPORT INFORMATION

This product does not carry a Dangerous Goods classification as corrosion tests have verified that it is not corrosive to either skin or to metals.

15. REGULATORY INFORMATION

All components are listed on AICS database or are exempt.

16. OTHER INFORMATION

This SDS was prepared in accordance with the Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals.

Acronyms:

ADG Code Australian Code for the Transport of Dangerous Goods by Road and Rail (7th edition)

AICS Australian Inventory of Chemical Substances

SWA Safe Work Australia, formerly ASCC and NOHSC

CAS Number Chemical Abstracts Service Registry Number

Hazchem code Emergency action code of numbers and letters that provide information to emergency services especially firefighters

IARC International Agency for Research on Cancer

NOS Not otherwise specified

NTP National Toxicology Program (USA)

R-Phase Risk Phrase

SUSMP Standard for the Uniform Scheduling of Medicines & Poisons

Un Number United Nations Number

References cited:

1. American Conference of Governmental Industrial Hygienists (ACGIH), Documentation of the Threshold Limit Values and Biological Exposure Indices, 6th Edition, ACGIH, Cincinatti, Ohio, 1991.

2. Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003(1995)]

3. Registry of Toxic Effects of Chemical Substances (RTECS)

4. Sax's, Dangerous Properties of Industrial Materials, Edition 8, Ed. RJ Lewis Sr., van Nostrand Reinhold.

Revision 2: Issued 20 Feb 20

This SDS summarizes to our best knowledge of health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this SDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products. Please contact the company if any further information is required.

Appendix D: Floc Report Worksheets

Attachment 4

White Rock Quarry Sediment Basin 2 Flocculant and Coagulant – Active Treatment Management Plan

White Rock Quarry

Sediment Basin 2 Flocculant and Coagulant – Active Treatment Management Plan

Title	Sediment Basin 2 flocculant and coagulant – Active Treatment Management Plan
Author	Hanson Construction Materials Pty Ltd
Document number	HCM-WR-WRQ-SB2-001

Issue	Date	Revision description
1.0	December 2021	Initial document

Hanson Construction Materials Pty Ltd

Dec 2021

i. Contents

1. Introduction

Construction and maintenance of the Sediment Basin 2 (SB2) require the use of a flocculant or coagulant to treat sediment runoff to meet required water quality limits prior to discharge from site.

This proposal has been developed by Hanson to demonstrate the effectiveness of the proposed management measures for the treatment of surface water within SB2 through the construction of a Type A High Efficiency Sediment (HES) basin and use of an automatic dosing unit incorporating the use of Turbiclear.

The proposal details how surface water would be treated using Turbiclear prior to discharge from SB2. It details how Turbiclear will be appropriately managed on site, and how Hanson will ensure treated water is suitable for discharge in accordance with legislative requirements, including the *Environment Protection Act 1993.*

2. Proposed flocculant and/or coagulant

2.1. Turbiclear

Product name: Turbiclear

Chemical Name: Aluminium chlorohydrate, ACH (83-85% basic)

Chemical Composition/Information on Ingredients

Name	**CAS Number**	**Proportion**	**TWA (mg/m3)**	**STEL (mg/m3)**
Aluminium chlorohydrate ACH	1327-41-9	40 to 60 %	2	Not set
Water	7732-18-5	To 100%	Not set	Not set

Ecotoxicity

Direct Toxicity Assessment:

Water treated with Turbiclear is reported to have no effect on Australian Water fleas or fish from a previous study undertaken in New South Wales.

The study investigated the ecotoxicity of water leaving a High Efficiency Sediment (HES) basin that had an automatic dosing unit (Turbid Flocbox) injecting Turbiclear directly into the stormwater runoff entering the treatment system. The water leaving the HES basin was tested using whole of effluent testing (WET) in March 2017 and concluded:

The 48-hr acute toxicity test using the freshwater cladoceran *Ceriodaphnia dubia* indicated that the EC50 = >100% (at 100% concentration, no affect was observed).

The 96-hr fish imbalance toxicity test using the Eastern Rainbowfish *Melanotaenia splendida splendida* the EC50 = >100% (at 100% concentration, no affect was observed).

Full details are supplied in Attachment 1 – Turbidclear Ecotoxicity Results.

Effective Concentration Method Assessment:

Aquatic toxicity testing carried out by Summit Research Labs (www.summittchem.com) on Aluminium Chlorohydrate in the United States concluded that:

The 48-hr LC50 for the freshwater flea *Daphnia magna* was 397mg/L

The 96-hr LC50 for the freshwater fish *Pimelphales promelas* was 832mg/L

2.2. Why Turbiclear has been proposed and is appropriate for use

Turbiclear is a high quality, environmentally friendly, rapid acting coagulant supplied by Turbid Water Solutions ‘Turbid’, a company focused on achieving better environmental outcomes from application to HES basins.

The adoption of Turbiclear as the water treatment product on site will allow water to be automatically treated with dosing systems (on the basin), increase the turnover rate of manually treating sediment basins where practical, increase the amount of sediment and other contaminants (nutrients, metals-including Aluminium, and bacteria) removed from runoff and achieve better environmental outcomes.

Some key advantages are:

- Concentrated and 2 to 3 times more effective than other coagulant agents. Lower dosing required
- Easy to apply liquid
- Can be automatically dosed using the Turbid dosing systems reducing the risk of overdosing
- Excellent treated water clarity
- Settles quickly
- Works over a wide pH range (6-9) without needing correction
- Reduced alkalinity consumption compared to other agents, therefore, very little pH drop
- Very low levels of trace elements
- Forms inert sludge, re-useable on site
- Non-Dangerous, Not Hazardous Good
- Contains no sulfates

2.3. When Turbiclear will be used

Turbiclear will be used in the instance that surface water quality within the SB2 basin are not able to achieve the required 50 NTU water quality criteria prior to being released from the basin.

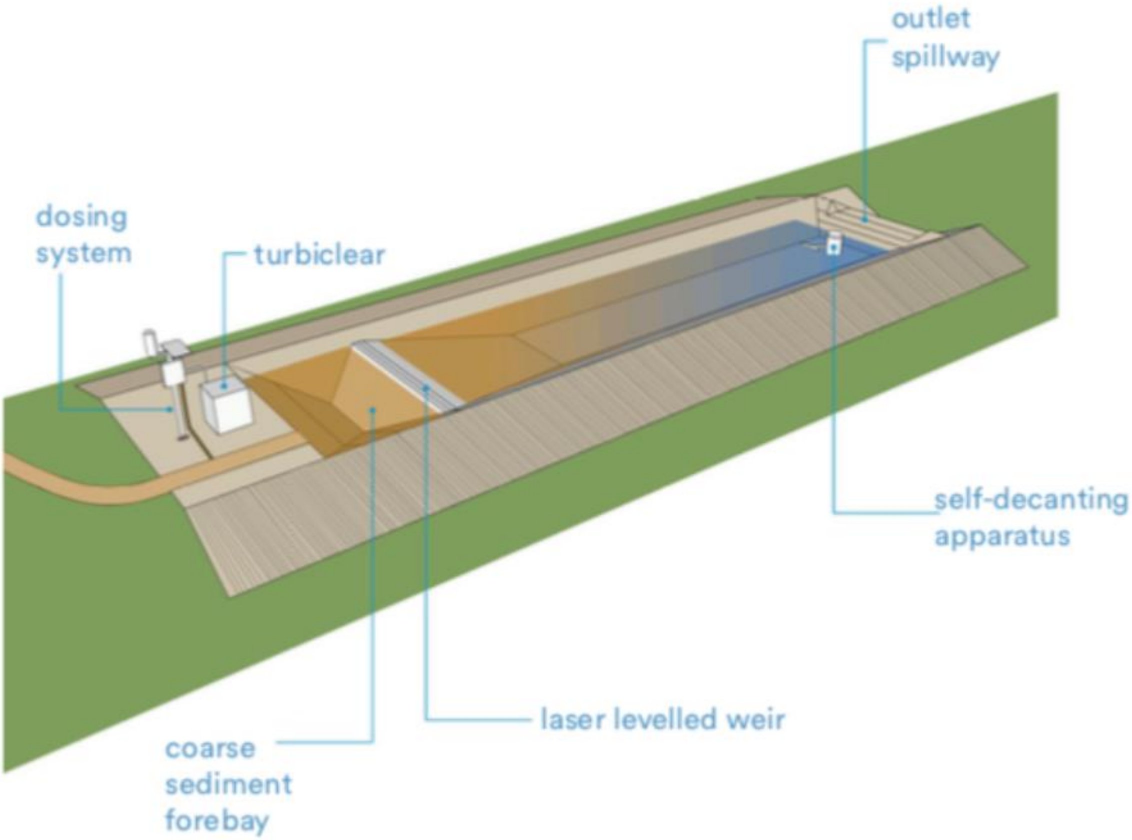
3. Flocculation methodology

3.1. Water treatment structures and equipment

Image 1 below illustrates the typical structure and equipment to be used, such as dosing equipment, pumps, and sediment trap forebays.

Detail design of the SB2 Type A HES basin is provided within Drawing No. 1901.DRG.093 – Sediment Basin SB2 TYPE-A 1 in 5y Layout Plan, Drawing No. 1901.DRG.094AR1 – Sediment Basin SB2 Detail Plan and Drawing No. 1901.DRG.094BR1 – Sediment Basin SB2 Detail Plan.

Image 1. High Efficiency Sediment Basin Diagram



KEY COMPONENTS:

1. DOSING SYSTEM

An automated system is provided at the start of the basin to deliver a dose of chemical coagulant to enhance the settlement of fine and dispersive sediment. The dosing system will be triggered by incoming flowrate

1.1 Ifod-FLOW

The ifod-FLOW provides accurate dosing of treatment products utilising flow metres inside or above pipes, open drains or weirs. It will measure water flow, either generated from rain events or pumping on site, and accurately dose via a low voltage metering pump according to the run off volume entering the basin. This ifod™ can also be connected to water quality sensors for monitoring and control purposes. See Attachment 2 - Ifod Manual.

2. **COARSE SEDIMENT FOREBAY:**
   This is the first cell of the basin and is where the majority of mixing of the coagulant with runoff occurs and is also where the majority of coarse sediment is deposited

3. **LEVEL-SPREADER/WEIR:**
   The level-spreader acts to distribute the flow across the full width of the basin so that velocities are minimised and settling is enhanced.

4. **SETTLING ZONE**
   This second cell of the basin is where settling of fine and dispersive sediment occurs. The fine particle size and slow settling velocities require this cell to be large so that non-turbulent settling can occur

5. **OUTLET STRUCTURES**
   The outlet structure of the basin will be comprised of an automatically height adjustable decant system.

3.2. Dosage rates

Dosage rates will be determined and continually updated as per the jar testing procedure below.

Turbiclear generally has a dose rate of approximately 40-50 ppm (with the full range of outliers between 5-100ppm). Turbid Water Solutions provide support and assistance in the optimal dose rates and usage of Turbiclear.

Preliminary jar testing undertaken by Turbid of a sample from the site demonstrated that Turbiclear performed favourably as expected at 50ppm dosing rate achieving less than 10 NTU within 5 minutes.

Additional jar testing will be undertaken during the commissioning of the dosing unit once the new SB2 basin has been constructed.

Site personnel will be trained in jar testing methodology to be carried out during the operation of the dosing unit to optimise dosing rates.

Jar Testing Procedure

The jar testing procedure described herein is provided by Turbid Water Solutions to assist in undertaking field jar tests to inform selection of appropriate water treatment product(s) and dose rates.

Method

STEP ONE: Collect samples of raw water:

1. Raw water samples should be representative of the sediment laden water to be treated by the flocculating agent.
2. It is recommended a minimum of three litres of raw water is collected for use in the jar tests.
3. Grab samples taken shortly after a runoff event and from 30cm below the free water surface near to the inlet of the sediment basin to be treated is preferred.

4. Measure and record the pH of the raw water sample(s) prior to commencing the jar test. If pH is below 6.5 the raw water sample may require buffering with a sprinkle of hydrated lime prior to commencing the Jar Test. Apply only enough hydrated lime to raise the pH of the raw water to between 7 and 8.

STEP TWO: Prepare 1% diluted sample of the flocculating agent(s) to be tested:

5. It is recommended at least two flocculating agents be tested for each site.

6. Prepare separate 1% solution of each flocculating agent (that is 1ml of the flocculating agent diluted in 99ml of clean rainwater).

STEP THREE: Add 1% flocculating solution to raw water.

7. Using a syringe, add in 1ml increments the 1% solution of flocculating agent to a 1L sample of raw water, stirring rapidly for around 10-15 seconds.

8. After each 1ml increment inspect the raw water sample as flow velocities within jar/bottle slow for the formation of ‘flocs’ (like seen in a snow-globe).

9. Look for a clear portion of at least 5cm depth to form at the surface within 2 to 3 minutes after stirring has ceased.

10. If a clear portion doesn’t fully form within a few minutes add the next increment of 1% solution of flocculating agent, stirring rapidly for 10-15 seconds.

11. Repeat this procedure until the required clear portion is observed and keep a record (Step 6) of the number of 1ml increments added.

12. Measure the pH of the final flocked raw water sample to confirm the pH is within acceptable discharge limits for the site. If measured pH is below discharge criteria it may require addition of lime (or similar) to buffer up the pH, and if still higher, the addition of acid may be required.

13. If flocs are not forming within a reasonable time after adding a large number (>15 for Turbiclear) increments of the 1% solution of flocculating agent it is possible the alkalinity of the raw water sample may be too low and requires adjustment. Abandon the current jar test and prepare a new raw water sample as per Step One and add a sprinkle of an alkalinity increaser to raise the alkalinity.

14. If after adding a sprinkle of alkalinity increaser the 1% solution of flocculating agent does NOT form flocs it may be necessary to consider testing an alternative flocculating agent.

STEP 4: Determine required dose rate and dose rate window

15. The total amount (# of increments) of 1% solution of flocculating agent required to achieve the 5cm clear portion within 2 to 3 minutes provides the minimum dose rate required for the sediment basin.

16. For example, if 5ml (i.e. 5 x 1ml increments) of a 1% solution of flocculating agent was required then the dose rate is 0.05ml per litre of raw water in the sediment basin (i.e. 50L per megalitre of raw water in the sediment basin).

17. The dose rate window is the dose rate range within which the 1% solution of flocculating agent is observed to be effective. This is determined by continuing to add 1ml increments of the 1% solution of flocculating agent to the raw water sample using the procedure in Step 3 until such time the 5cm clear portion no longer forms within the 2 to 3-minute timeframe (which indicates the

raw water sample has been “over-dosed”). The total amount (# of increments) of 1% solution of flocculating agent that was added to reach this point of “over-dosing” represents the upper limit of the dose rate window.

18. It is recommended the starting dose rate for treating the sediment basin be set just above the minimum dose rate to avoid risk of “over-dosing” the basin.

STEP 5: Verify Test Results

19. Repeat Step 3 and Step 4 on a second 1L sample of raw water to verify the initial results.

20. If the results are only marginally different from the initial test, then use an average of the two sets of results to set the required dose rate.

21. If the results are markedly different from the initial test, then it will be necessary to conduct at least one additional jar test to gain confidence in the required dose rate.

STEP 6: Record Jar Test Data and Results

22. Record the results of each jar test on a Floc Report Worksheet as per the example in Appendix 1.

3.3. Preparing the flocculant/coagulant for use

Turbiclear is supplied in 1000 L IBCs, with a tap. No further mixing is required for it to be applied to water. IBCs are used globally for the bulk handling of chemicals and provide safe guards to prevent spills. Any potential spills will quickly crystallise and can be removed for future use or disposed of.

Personnel will be responsible for the use of Turbiclear on the site.

For Automated Dosing Systems (selected application)

Automated dosing systems store a reservoir of Turbiclear as part of their system set up. These are generally an external 1000L IBC and hose connection.

For Manual Treatments (allowed as contingency)

Depending on the size of the basin and dosage volumed required, Turbiclear will be directly applied from the IBC. Volumes can be calculated from the level gauge on the IBC in 10L increments.

3.4. Application of the flocculant/coagulant

Turbiclear can be applied via various methods depending upon the basin needing treatment.

Common application methods include:

1. Automated through a Turbid automatic dosing unit
2. Manually by either spray casting from water trucks, spray casting with pump sets set up on the basin, drip feeding into the suction or discharge line of a pump set circulating a sediment basin.

The Type A HES SB2 specific application will be automated through the use of a Ifod-Flow automatic dosing system and will be monitored by trained personnel.

3.5. Discharging treated water

Water quality will be monitored prior to discharge from the SB2 basin. If the criteria described in the Table 3.5 below is not met, additional water management and or treatment measures may be required, including manual application of Turbidclear if required. As a contingency measure the current SB2 may also be used to provide extra settlement time before discharging to the creek.

Table 3.5: Water Quality Discharge Criteria

Parameter	Discharge criteria	Analysis method	Frequency
Total suspended solids	<50mg/L	Turbidity sensor	Every discharge event
pH	6.5 – 8.5	Probe	Every discharge event

4. Storage and location

1000L Intermediate Bulk Container (IBC) will be stored next to the bunded chemical container. Spill kits and SDS data sheets will be available at the chemical storage container. The location where the Turbiclear will be stored is outlined within Drawing No. 1901.DRG.093 – Sediment Basin SB2 TYPE-A 1 in 5y Layout Plan

5. Disposal

Priority will be for the re-use/recycling of used IBC used in the storage of the product. If they cannot be recycled, disposal of contents and containers to an EPA approved waste disposal facility will be undertaken.

Removal of retained sediment within SB2 will occur when necessary. Soil removed from within the basin will be reused within the Site as a beneficial reuse and incorporated into the rehabilitation of the quarry. Site specific sediment analysis undertaken from sediments collected within the jar testing indicated improved cation exchange properties (ability to hold nutrients etc) for rehabilitated landform soil medium. However, it has been recommended that the sediment be blended with other overburden products onsite to further enhance the soil properties. See Attachment 3 – Pro Ag Soil analysis.

As the ‘shelf life’ of Turbiclear is in the range of 5 years, it is highly unlikely that the products will reach their shelf life during the operation of SB2.

6. Transport, handling and WHS considerations

This product does not carry a Dangerous Goods nor Hazardous classification as corrosion tests have verified that it is not corrosive to either skin or to metals. No specific PPE is required, however reusable latex gloves, and general site PPE should be used as appropriate. Rubber boots can be used in wet conditions but mainly as protection from the water/mud.

IBCs are to be moved via designated loaders and manual handling of smaller containers should be limited to comply with safe handling techniques.

All staff involved with handling of the product will be trained in correct handling techniques.

7. Record keeping

The following records maintained:

1. Initial commissioning calibration and jar test results
2. Periodic jar test results
3. Water quality monitoring results
4. Sediment removal records

Attachment 1

Toxicity Test Report: TR1469/1

(Page 1 of 2)

Accredited for compliance with ISO/IEC 17025

Client:	Fulton Hogan Foxground Berry Bypass NSW	**ESA Job #:**	PR1469
		Date Sampled:	6 March 2017
		Date Received:	7 March 2017
Attention:	Sam Leigh	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL1469_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
8035	HES Basin Out	Aqueous sample, pH 7.8*, conductivity 121.0µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.
8036	SB18500E Out	Aqueous sample, pH 7.7*, conductivity 378µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	48-hr acute toxicity test using the freshwater cladoceran *Ceriodaphnia dubia*
Test Protocol:	ESA SOP 101 (ESA 2011), based on USEPA (2002) and Bailey *et al*. (2000)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The samples were serially diluted with Dilute Mineral Water (DMW) to achieve the test concentrations. A DMW control was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	10 March 2017 at 1600h

Sample 8035: *HES Basin Out*		Sample 8036: *SB18500E Out*		*Vacant*
Concentration (%)	**% Unaffected (Mean ± SD)**	**Concentration (%)**	**% Unaffected (Mean ± SD)**	
DMW Control	90.0 ± 11.6	DMW Control	90.0 ± 11.6	
6.3	80.0 ± 16.3	6.3	100 ± 0.0	
12.5	90.0 ± 11.6	12.5	100 ± 0.0	
25	95.0 ± 10.0	25	100 ± 0.0	
50	95.0 ± 10.0	50	100 ± 0.0	
100	100 ± 0.0	100	100 ± 0.0	
48-hr EC10 = >100%		**48-hr EC10 = >100%**		
48-hr EC50 = >100%		**48-hr EC50 = >100%**		
NOEC = 100%		**NOEC = 100%**		
LOEC = >100%		**LOEC = >100%**		

QA/QC Parameter	**Criterion**	**This Test**	**Criterion met?**
Control mean % unaffected	≥90.0%	90.0%	Yes
Reference Toxicant within cusum chart limits	185.0-231.1mg KCl/L	212.1mg KCl/L	Yes

Toxicity Test Report: TR1469/2 (Page 1 of 2)

Accredited for compliance with ISO/IEC 17025

Client:	Fulton Hogan Foxground Berry Bypass NSW	**ESA Job #:**	PR1469
		Date Sampled:	6 March 2017
		Date Received:	7 March 2017
Attention:	Sam Leigh	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL1469_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
8035	HES Basin Out	Aqueous sample, pH 7.8*, conductivity 121.0µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.
8036	SB18500E Out	Aqueous sample, pH 7.7*, conductivity 378µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	96-hr fish imbalance toxicity test using the eastern rainbowfish *Melanotaenia splendida splendida*
Test Protocol:	ESA SOP 117 (ESA 2015), based on USEPA (2002)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The samples were serially diluted with dilute mineral water (DMW) to achieve the test concentrations. A DMW control was tested concurrently with the samples.
Source of Test Organisms:	In-house cultures
Test Initiated:	11 March 2017 at 1300h (Lab ID 8035) and 12 March 2017 at 1200h (Lab ID 8036)

Sample 8035: *HES Basin Out*		Sample 8036: *SB18500E Out*		*Vacant*
Concentration (%)	**% Unaffected (Mean ± SD)**	**Concentration (%)**	**% Unaffected (Mean ± SD)**	
DMW Control	100 ± 0.0	DMW Control	100 ± 0.0	
6.3	100 ± 0.0	6.3	100 ± 0.0	
12.5	100 ± 0.0	12.5	100 ± 0.0	
25	95.0 ± 10.0	25	100 ± 0.0	
50	100 ± 0.0	50	100 ± 0.0	
100	100 ± 0.0	100	100 ± 0.0	
96-hr EC10 = >100% **96-hr EC50 = >100%** **NOEC = 100%** **LOEC = >100%**		**96-hr EC10 = >100%** **96-hr EC50 = >100%** **NOEC = 100%** **LOEC = >100%**		

QA/QC Parameter	**Criterion**	**This Test**	**Criterion met?**
Control mean % unaffected (11/03/17)	≥80.0%	100%	Yes
Control mean % unaffected (12/03/17)	≥80.0%	100%	Yes
Reference Toxicant within cusum chart limits	8.0-134.0µg Cu/L	45.2µg Cu/L	Yes

Attachment 2

IFOD™ MANUAL

CLIENT:

The ifod-FLOW was developed by Turbid in response to the need for contractors to dewater standing water around site into the sediment basin after a rainfall event. The ifod-FLOW does not rely on rainfall but rather reads flow entering the basin and doses according to this. This allows contractors to pump standing water through the inflow point, or divert runoff through the inflow point, which will then be treated.

The ifod-FLOW is a more accurate dosing system than the rain activated systems as there is no guesswork involved in runoff generated from site entering basin.

The system comprises a 12-volt solar power pack, datalogger, flow meter and 12v dosing pump.

Two types of flow meters can be used:

A. Ultrasonic sensor: An ultrasonic sensor is located above the inflow of water and measures the depth. The datalogger then converts this into a volume.

B. Area Velocity Flow Meter (AVFM): An AVFM is located within the flow of water and uses a doppler and ultrasonic to measure the velocity and depth of the water. These are used where an inflow pipe or structure is flooded as an ultrasonic sensor does not work in this application.

As the flow sensor measures the volume of water entering, the datalogger will activate the pump at a prescribed volume (e.g. every 1,000 litres). Again, the dose rate is required and the running time of the pump is determined by this. The coagulant is then injected into the incoming flow of water into the basin enabling mixing as the water enters the basin.

The ifod-FLOW can be complemented with water quality sensors to measure the incoming water quality. When used in conjunction with outflow sensors, water quality improvement can be monitored.

The addition of inflow sensors also allows the ifod-FLOW to control when dosing occurs based on water quality parameters.

INSTALLATION

The ifod-FLOW is a 12 volt post mounted system similar to the ifod-RAIN.

The ifod-FLOW picks up flow in the channel or pipe and converts this to a volume. Coagulant is then dosed (pumped) into the channel, mixing with the incoming waterflow.

The system requires some type of inlet structure, such as a concrete channel of pipe, for the sensors to be mounted into or above.

An ultrasonic or area velocity meter can be used for these systems. These sensors require some programming before installation.

An ultrasonic sensor can be located above a trapezoidal channel, stepped weir or pipe.

An AVFM is located within a pipe or culvert.

The pump is connected to one or multiple IBC’s allowing enough coagulant for multiple rain events. The discharge pipe from the pump is located above the flow of water into the basin.

MAINTENANCE

Refer to the ifod-FLOW maintenance checklist.

turbid
WATER SOLUTIONS

ABN: 49 158 485 039
5 Vision Court Noosaville
t 07 5471 2290 | m 0422 375 664 | f 07 5302 6680
e info@turbid.com.au | w turbid.com.au

ifod-FLOW MAINTENANCE
INSPECTION CHECKLIST

SITE: **INSPECTION DATE:**

INSPECTING OFFICER (Full Name):

SIGNATURE:

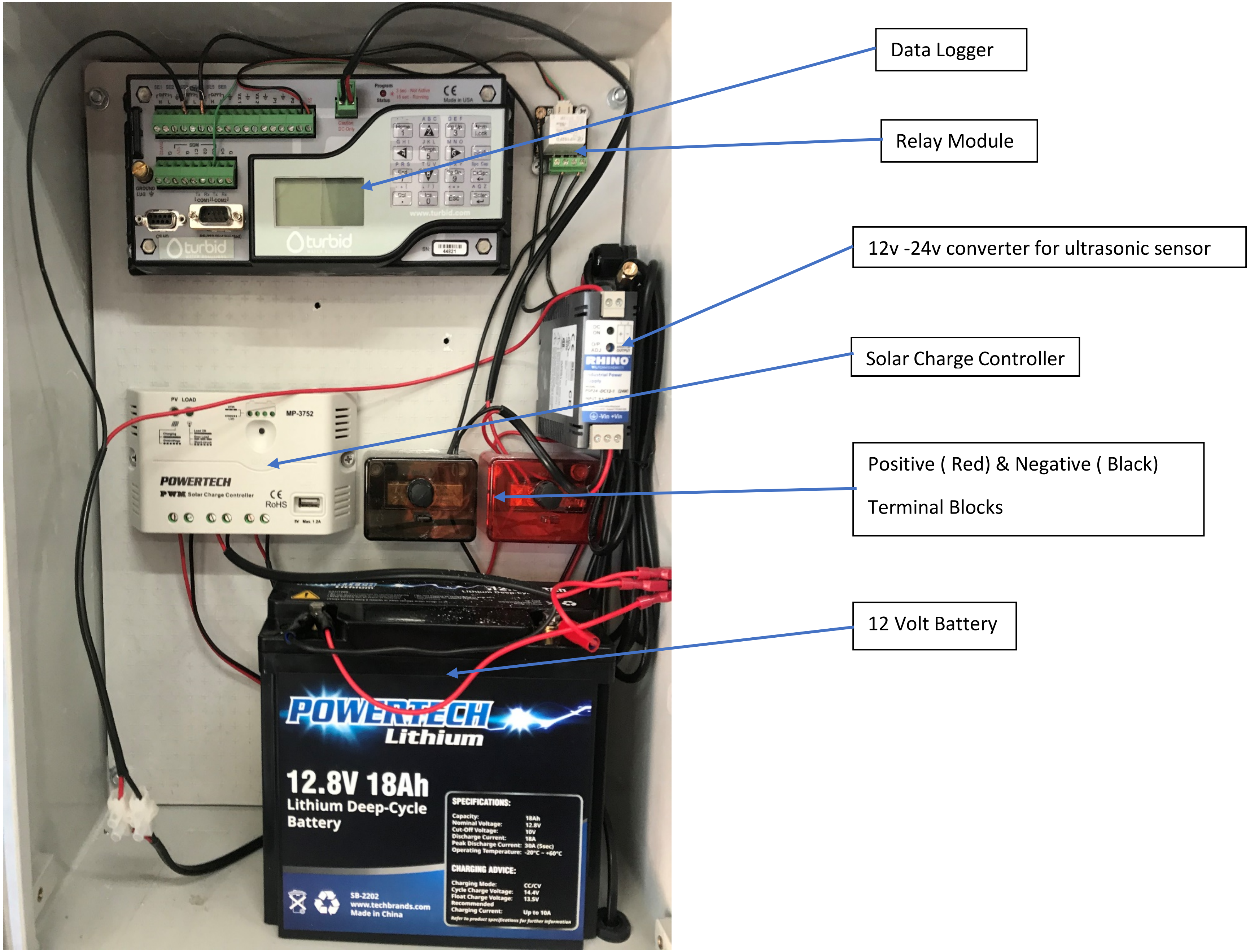
✓	**ITEM**
	Standing water levels and quality
	Decant system free from debris and in order
	Inflow point well-formed and intact
	Forebay free from overbuild-up of sediment
	Turbiclear levels adequate until next Turbid visitation
	Turbiclear storage container in good order
	Supply/discharge lines free from potential blockages
	Discharge line discharging into inflow channel
	IFOD enclosure and post in good order
	IFOD solar panel surface clean and facing north
	IFOD operational (test)
	Monitoring station sensors submerged in water and clean
	Monitoring station cables in good order
	Monitoring station enclosure and post in good order
	Monitoring station solar panel clean and facing north
	Sensors reading accurately (calibrate if required)

Turbiclear usage (L) since last inspection:

NOTES:

Ifod Trouble shooting Guide / site staff

Issue	**Possible Cause**	**Action required**
No Coagulant being dispensed during inflow or simulated inflow	Empty supply	refill IBCs
(simulated inflow being the placement of object below sensor at bottom of pipe)	Taps off on IBC / Lid closed on IBC	open tap / open lid
	Pump not running	Check Pump / hard wire to check / replace pump
	Relay faulty	Check light on relay turning on and off / replace relay
	Blocked dosing line	Check/replace line . Contact Turbid
	Disconnected Dosing line	Reconnect line
	Battery Low/ Flat	Check battery / clean solar panel / Replace Battery / Replace Solar Panel
	Not enough inflow	Place object below sensor at bottom of pipe/culvert to simulate flow.
	12-24 volt converter failed	Check light on converter
	Loose wiring	check all wiring is connected
	other	contact Turbid
Coagulant being dispensed with no inflow	Ultrasonic sensor malfunctioning	Turn system off and on again .(green plug on datalogger) If this continues turn off.
	Ultrasonic sensor failed	Contact Turbid
	Program / data logger malfunctioning	Contact Turbid
	other	Contact Turbid
Doser operating but water not cleaning up	Dose rate incorrect for incoming water	Jar test and adjust dose rate
	Incorrect Treatment Product for incoming water	Jar test and adjust dose rate/product
	pH too low or high	adjust pH with Lime or Acid
	Water Entering Basin from other sources	Eliminate water entering from other sources
	other	Contact Turbid


Data Logger
Relay Module
12v -24v converter for ultrasonic sensor
Solar Charge Controller
Positive (Red) & Negative (Black)
Terminal Blocks
12 Volt Battery

<u>Mounted Ultrasonic Sensor and coagulant discharge line above flow of water</u>

Inflow Datalogger Adjustment.

The inflow data logger is a CR850 datalogger with LCD screen that allows site staff to check sensor readings, adjust dose rates and trigger the pump manually.

Dose Rates may need to be adjusted when water quality is not achieving desired outcomes.

To check sensor readings.

Press ‘enter’ on the logger’s keypad until the public table appears. Scroll down until the desired parameter is visible. These values will be live values of the sensors at that point in time.

- To adjust dosing rates.
  Press ‘enter’ on the logger’s keypad until the public table appears. Scroll down until ‘u-pump run time’ is visible. Press enter once selected. Change pump run time and press ‘esc’.

- To adjust dose frequency
  Scroll down the public table until ‘U-dose trigger volume’ appears. Press enter and change volume dosing frequency. Normally set at 1000 litres.

- To trigger the pump.
  Press ‘enter’ on the logger’s keypad until the public table appears. Scroll down until ‘c- run pump’ is visible. Press enter once selected and scroll to ‘true’. The pump will then trigger. Press ‘esc’.

Jar Testing Procedure

The jar testing procedure described herein is provided by Turbid Water Solutions to assist our clients undertake their own jar tests to inform selection of appropriate water treatment product(s) for their site.

If additional assistance or advice is required, please do not hesitate to contact a Turbid representative.

Method

STEP ONE: Collect samples of raw water:

1. Raw water samples should be representative of the sediment laden water to be treated by the flocculating agent.
2. It is recommended a minimum of three litres of raw water is collected for use in the jar tests.
3. Grab samples taken shortly after a runoff event and from 30cm below the free water surface near to the inlet of the sediment basin to be treated is preferred.
4. Measure and record the pH of the raw water sample(s) prior to commencing the jar test. If pH is below 6.5 the raw water sample may require buffering with a sprinkle of hydrated lime prior to commencing the Jar Test. *Apply only enough hydrated lime to raise the pH of the raw water to between 7 and 8.5*.

If there is no raw water available on site for collection it will be necessary to create 'indicative' raw water samples. This is done by collecting representative soil samples from the soil profile(s) expected to be disturbed by construction activities (screened through a 1mm sieve to remove the coarse fraction) and mixing discrete and composites of the collected soil samples with a clean water source (ideally local rainwater) at a rate of 10g/L to produce a suite of indicative raw water samples. This procedure will produce 'indicative' raw water samples with a notional TSS concentration of 10,000mg/L.

STEP TWO: Prepare 1% diluted sample of the flocculating agent(s) to be tested:

5. It is recommended at least two flocculating agents be tested for each site.
6. Prepare separate 1% solution of each flocculating agent (that is 1ml of the flocculating agent diluted in 99ml of clean rainwater).

STEP THREE: Add 1% flocculating solution to raw water.

7. Using a syringe, add in 1ml increments the 1% solution of flocculating agent to a 1L sample of raw water, stirring rapidly for around 10-15 seconds.
8. After each 1ml increment inspect the raw water sample as flow velocities within jar/bottle slow for the formation of 'flocs' (like seen in a snow-globe).
9. Look for a clear portion of at least 5cm depth to form at the surface within 2 to 3 minutes after stirring has ceased.
10. If a clear portion doesn't fully form within a few minutes add the next increment of 1% solution of flocculating agent, stirring rapidly for 10-15 seconds.
11. Repeat this procedure until the required clear portion is observed and keep a record (Step 6) of the number of 1ml increments added.

12. Measure the pH of the final flocced raw water sample to confirm the pH falls within acceptable discharge limits for the site. If measured pH is below discharge criteria it may require addition of lime (or similar) to buffer up the pH.
13. If flocs are not forming within a reasonable time after adding a large number (>50) increments of the 1% solution of flocculating agent, it is possible the alkalinity of the raw water sample may be too low and requires adjustment. Abandon the current jar test and prepare a new raw water sample as per Step One and add a sprinkle of superfine gypsum to raise the alkalinity.
14. If after adding a sprinkle of superfine Gypsum the 1% solution of flocculating agent does NOT form flocs it may be necessary to consider testing an alternative flocculating agent.

STEP 4: Determine required dose rate and dose rate window

15. The total amount (# of increments) of 1% solution of flocculating agent required to achieve the 5cm clear portion within 2 to 3 minutes provides the minimum dose rate required for the sediment basin.
16. For example, if 5ml (i.e. 5 x 1ml increments) of a 1% solution of flocculating agent was required then the dose rate is 0.05ml per litre of raw water in the sediment basin (i.e. 50L per megalitre of raw water in the sediment basin).
17. The dose rate window is the dose rate range within which the 1% solution of flocculating agent is observed to be effective. This is determined by continuing to add 1ml increments of the 1% solution of flocculating agent to the raw water sample using the procedure in Step 3 until such time the 5cm clear portion no longer forms within the 2 to 3-minute timeframe (which indicates the raw water sample has been “over-dosed”). The total amount (# of increments) of 1% solution of flocculating agent that was added to reach this point of “over-dosing” represents the upper limit of the dose rate window.
18. It is recommended the starting dose rate for treating the sediment basin be set just above the minimum dose rate to avoid risk of “over-dosing” the basin.

STEP 5: Verify Test Results

19. Repeat Step 3 and Step 4 on a second 1L sample of raw water to verify the initial results.
20. If the results are only marginally different from the initial test, then use an average of the two sets of results to set the required dose rate.
21. If the results are markedly different from the initial test, then it will be necessary to conduct at least one additional jar test to gain confidence in the required dose rate.

STEP 6: Record Jar Test Data and Results

22. Record the results of each jar test.

Attachment 3

ProAg
soil management

6th September 2021

Hanson Quarries
per Matthew Jones
Groundwork Plus
P O Box 854
Nuriootpa SA 5355

<u>Re: Hanson Quarries Sediment Analysis</u>

Introduction

I understand that Hanson Quarries are trialling processes that will enhance the settlement of fine soil particles from waste water. Two samples of this soil solution were delivered to Pro Ag Soil Management The sediment was allowed to settle out of the solutions so the water could be siphoned off before finally drying the soil over a number of days. The samples were then submitted to Apal Laboratory for analysis.

The aim of this investigation is to assess and analyse the sediment soil to determine its suitability for blending with other quarry materials for reuse in areas to be revegetated.

Sediment Assessment and Analysis

The two samples submitted and were labelled:

- 44560
- 44697

Horticultural Analysis

The samples were forwarded to Apal Laboratory in Hindmarsh for complete horticultural analysis (H1) including the following parameters:
Texture, pH, EC, Chloride, Boron, Organic Matter, Nitrogen, Sulphur, Phosphorous, Trace Elements (Fe, Mn, Cu, Zn), Cation Exchange Capacity, Exchangeable Cations (Na, Ca, Mg, K) and Ca:Mg Ratio.

Apal Laboratory Horticultural Analysis

 # copies of Apal data reports will be forwarded with this document

The results from analysis of the two samples are similar for all parameters, so the following interpretation and summary will apply to both. The results are summarised in the table below.

Sediment Samples 44560 & 44697

Unit	Found	Comment
Texture (MIR)	Silty Loam	Very fine material - >60% silt and clay
ECEC	Good	Good nutrient holding capacity
Organic carbon	Marginal	Will improve when vegetation is established
pH	Very High	Strongly alkaline – select suitable species for planting
Available N	Low	Apply nitrogen fertiliser before planting
Phosphorus	Low	Apply acidic phosphorus fertiliser before planting (MAP)
P Availability (PBI)	Low	P availability reduced by the alkaline conditions
Sulphur	High	
Potassium	Low	Potassium low as % of cations - fertiliser needed
Ca:Mg balance	Good	No lime or gypsum is needed
Trace elements	Good	All trace elements are well supplied
Salinity (EC)	Elevated	Conductivity requires plants with moderate salt tolerance
Chloride	Good	
Sodicity (ESP)	Good	Soil is non-sodic

Table 1

The most significant issues identified that are relevant for plant rootzone material:

- Fine texture – the sediment is likely to have poor structure and slow infiltration rates unless it is blended with coarser materials.
- Cation Exchange Capacity – the samples have enough clay particles present to provide good nutrient holding capacity
- Strongly alkaline pH. Take into account when selecting planting material.
- Nutrient deficiencies – nitrogen, phosphorus and potassium are all low but can be added in a preplant fertiliser program
- Conductivity and sodium. EC (salinity) is elevated so select plant species with moderate salt tolerance. Sodium concentration (mg/kg) is above the desired level but is low in balance with the other cations (ESP). The soils should be stable and non-dispersive.

Summary

As tested, these fine textured sediments are not suitable for use as planting media, however they would have value as blends with other coarser quarry waste materials, by adding exchange capacity and nutrients including trace elements.

Although salinity is elevated, this is likely to be diluted by blending with other materials and will leach out over time. The conductivity found will not affect most native species.

The analysis found no other toxicities present that would compromise plant growth. It is possible that aluminium compounds have been used as flocculation agents, however plant aluminium toxicity will only be an issue in acidic soils. You will note that in the laboratory results, exchangeable aluminium levels are very low in these alkaline samples.

Sediment Amendment Program

I recommend that blends of sediment and other materials are first produced and samples analysed, before determining what amendments and fertilisers are needed to prepare them for planting.

Please contact me if you have any questions about my interpretation or recommended program

Phil Barnett

Phil Barnett
Soil Consultant

APAL
Australian Precision Ag Laboratory

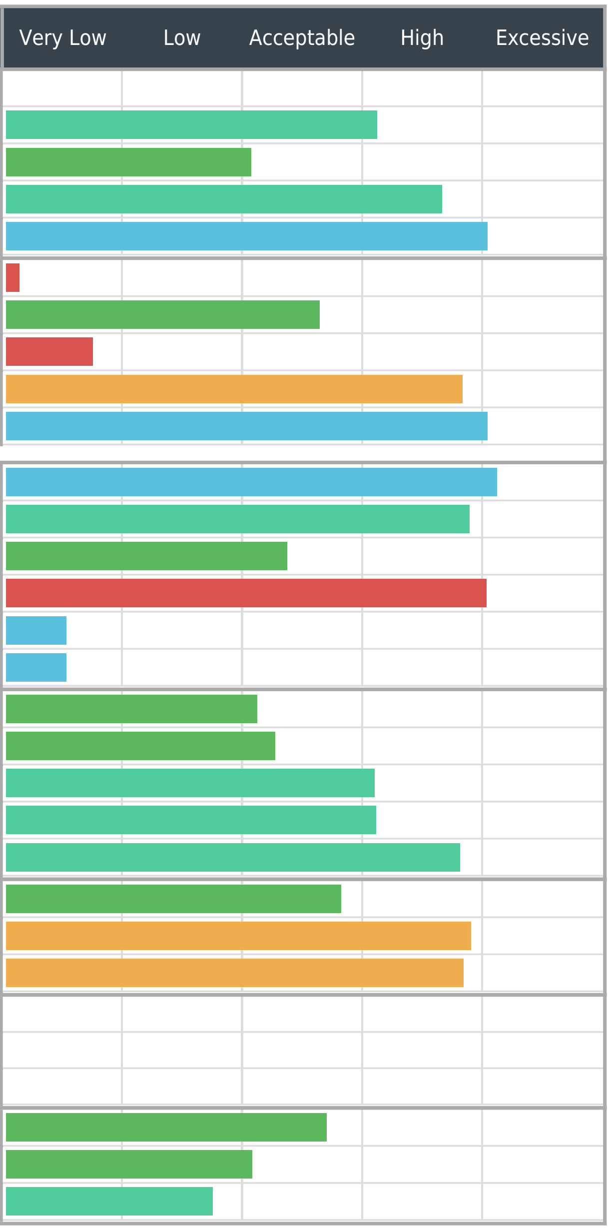
SOIL ANALYSIS

ProAg soil management

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850001
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44560
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

		Unit	Desired Level	Level Found	c.mol/kg
	MIR - Aus Soil Texture			Silty loam	
	ECEC	cmol/kg	5.00-25.0	27.5	
	Organic Carbon (W&B)	%	0.900-1.80	0.940	
	pH 1:5 water	pH units	6.50-7.50	8.46	
	pH CaCl2 (following 4A1)	pH units	5.50-6.50	8.08	
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg	20-50	1.1	
	Ammonium - N (2M KCl)	mg/kg	2.0-10	7.0	
	Colwell Phosphorus	mg/kg	34-40	13	
	PBI + Col P		35.0-70.0	217	
	MCP Sulfur (S)	mg/kg	8.0-20	110	
Exchangeable cations	Calcium (Ca) - AmmAc	mg/kg	1000-2000	4450	22.2
	Magnesium (Mg) - AmmAc	mg/kg	150-200	448	3.68
	Potassium (K) - AmmAc	mg/kg	150-220	175	0.447
	Sodium (Na) - AmmAc	mg/kg	15.0-120	261	1.14
	Exchangeable aluminium	cmol/kg	0.10-0.35	<0.02	
	Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Trace Elements	Boron	mg/kg	0.50-2.0	0.64	
	Iron (Fe)	mg/kg	10-70	25	
	Manganese (Mn)	mg/kg	1.0-10	13	
	Copper (Cu)	mg/kg	0.50-1.0	1.3	
	Zinc (Zn)	mg/kg	0.50-1.0	4.2	
Salt	Chloride	mg/kg	15-400	320	
	Salinity EC 1:5	dS/m	0.025-0.15	0.46	
	Ece	dS/m	0.10-1.5	4.3	
Physical	MIR - Clay	%		21.5	
	MIR - Sand (+20 micron)	%		34.1	
	MIR - Silt (2-20 micron)	%		44.4	
Ratios	Ca:Mg Ratio		2.0-8.0	6.0	
	K:Mg Ratio		0.10-0.50	0.12	
	GTRI		0.020-0.070	0.020	



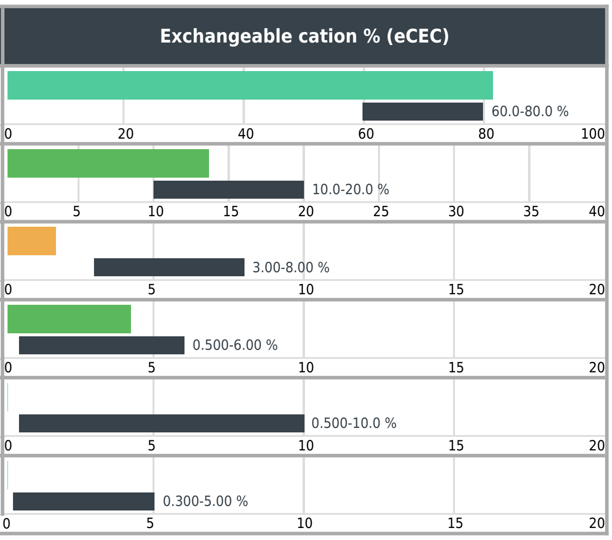
SOIL ANALYSIS

APAL Australian Precision Ag Laboratory

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850001
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44560
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

		Unit	Desired Level	Level Found
Exch. cation %	Calcium	%	60.0-80.0	80.8
	Magnesium	%	10.0-20.0	13.4
	Potassium	%	3.00-8.00	1.60
	Sodium	%	0.500-6.00	4.10
	Aluminium	%	0.500-10.0	0.00
	Hydrogen	%	0.300-5.00	0.00



NOTE: Apal Laboratory will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

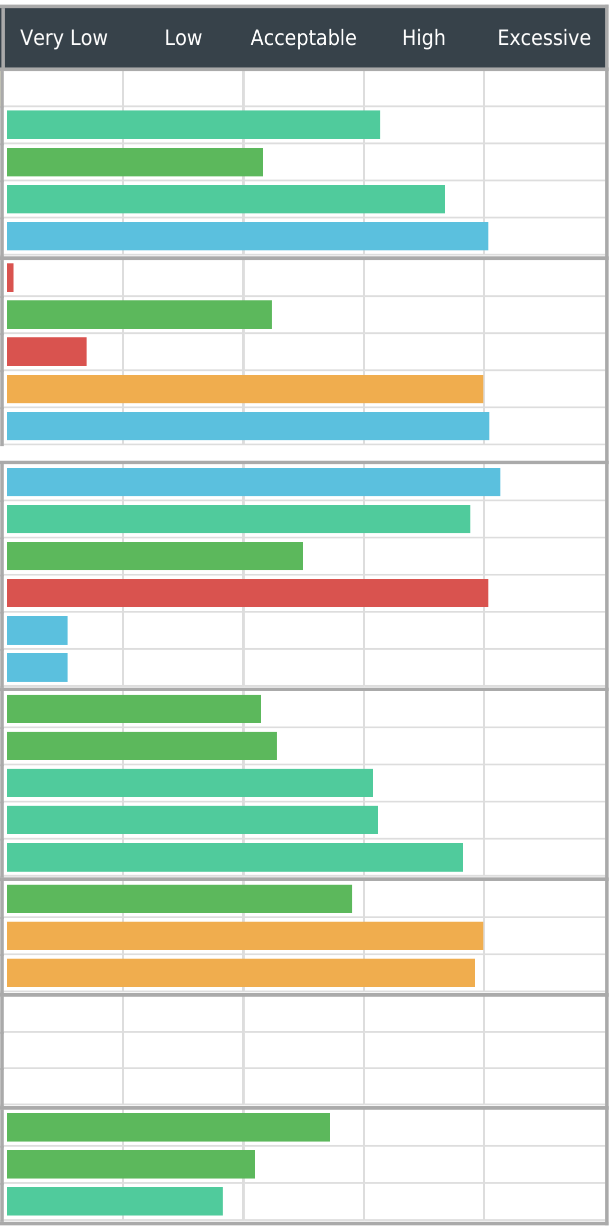
APAL
Australian Precision Ag Laboratory

SOIL ANALYSIS

ProAg soil management

Agent:	Pro Ag Soil Management	**Report Date:**	31/08/2021
Agent Address:	82 William Street, NORWOOD, SA, 5067	**Sampling Date:**	NA
Client:	Hanson	**Date Received:**	24/08/2021
Test Set or Quotation:	H1	**Sample Name:**	Sample 44697
Barcode:	110850003	**Crop:**	Dryland Pasture
Batch Number:	25375	**Sample Depth:**	NA
Submission ID:	80274	**GPS Start:**	NA
		GPS End:	NA

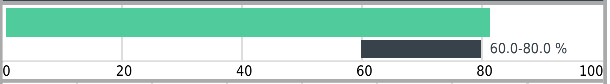
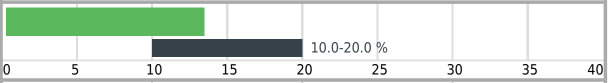
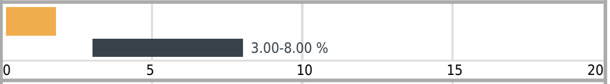
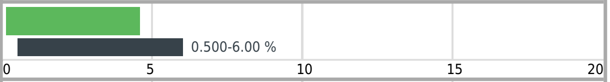
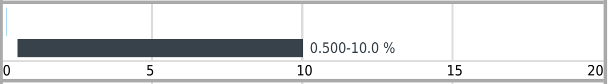
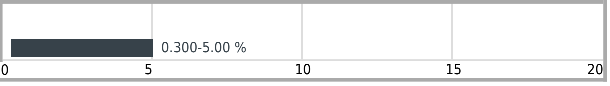
		Unit	Desired Level	Level Found	c.mol/kg
	MIR - Aus Soil Texture			Silty loam	
	ECEC	cmol/kg	5.00-25.0	27.7	
	Organic Carbon (W&B)	%	0.900-1.80	1.02	
	pH 1:5 water	pH units	6.50-7.50	8.47	
	pH CaCl2 (following 4A1)	pH units	5.50-6.50	8.06	
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg	20-50	<1	
	Ammonium - N (2M KCl)	mg/kg	2.0-10	3.7	
	Colwell Phosphorus	mg/kg	34-40	12	
	PBI + Col P		35.0-70.0	245	
	MCP Sulfur (S)	mg/kg	8.0-20	140	
Exchangeable cations	Calcium (Ca) - AmmAc	mg/kg	1000-2000	4480	22.4
	Magnesium (Mg) - AmmAc	mg/kg	150-200	445	3.66
	Potassium (K) - AmmAc	mg/kg	150-220	183	0.468
	Sodium (Na) - AmmAc	mg/kg	15.0-120	285	1.24
	Exchangeable aluminium	cmol/kg	0.10-0.35	<0.02	
	Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Trace Elements	Boron	mg/kg	0.50-2.0	0.67	
	Iron (Fe)	mg/kg	10-70	25	
	Manganese (Mn)	mg/kg	1.0-10	12	
	Copper (Cu)	mg/kg	0.50-1.0	1.4	
	Zinc (Zn)	mg/kg	0.50-1.0	4.3	
Salt	Chloride	mg/kg	15-400	350	
	Salinity EC 1:5	dS/m	0.025-0.15	0.49	
	Ece	dS/m	0.10-1.5	4.6	
Physical	MIR - Clay	%		19.2	
	MIR - Sand (+20 micron)	%		39.2	
	MIR - Silt (2-20 micron)	%		41.6	
Ratios	Ca:Mg Ratio		2.0-8.0	6.1	
	K:Mg Ratio		0.10-0.50	0.13	
	GTRI		0.020-0.070	0.020	



SOIL ANALYSIS

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850003
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44697
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

		Unit	Desired Level	Level Found	Exchangeable cation % (eCEC)
Exch. cation %	Calcium	%	60.0-80.0	80.6	
	Magnesium	%	10.0-20.0	13.2	
	Potassium	%	3.00-8.00	1.70	
	Sodium	%	0.500-6.00	4.50	
	Aluminium	%	0.500-10.0	0.00	
	Hydrogen	%	0.300-5.00	0.00	

NOTE: Apal Laboratory will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

Attachment 5

Recovered Products Plan - White Rock Quarry Sediment Basin (SB2) ame

A.M. ENVIRONMENTAL
CONSULTING

RECOVERED PRODUCTS PLAN
WHITE ROCK QUARRY
SEDIMENTATION BASIN (SB2)

Horsnells Gully Road, Horsnell Gully, South Australia

Prepared For: Hanson Construction Materials Pty Ltd

7 June 2022

Document reference

2129 R1

Issue and revision record

Revision	Date	Originator	Checker	Description
A	7 June 2022	AM	AM	Draft

Prepared by

A.M. Environmental Consulting Pty Ltd

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EXECUTIVE SUMMARY

A.M. Environmental Consulting Pty Ltd (AME) was commissioned by Groundwork Plus (SA) Pty Ltd (Groundwork Plus) on behalf of Construction Materials Pty Ltd (Hanson) to consider information provided and conduct environmental soil sampling from recovered sediments at the White Rock Quarry, located on Horsnells Gully Road, Horsnell Gully, South Australia (the Site).

The work is aimed at demonstrating compliance for sediments recovered from Sedimentation Basin 2 (SB2) with the SA EPA (2013). Standard for the Production and Use of Waste Derived Fill, October 2013 and also the NEPC (1999). National Environment Protection (Assessment of Site Contamination) Measure, December 1999 (ASC NEPM) as amended in 2013.

Naturally occurring site sourced fine components are collected in sedimentation collection systems from the site and are retained on-site. Soils from the primary sedimentation system (without flocculant) were sampled analysed for a broad SA EPA Waste Fill Screen and the concentrations did not exceed these or NEPM environmental guidelines. Therefore, there are no chemicals within the background sediments that present a potential environmental or human health risk. Flocculants are not currently used in the sediment collection systems. The soils comprised a fine grained silty component which is not suitable in current form as a growing medium primarily because of the grain size and absence of nutrients to facilitate plant growth. Therefore, enhancement with other site sourced material and nutrients will be required. However, it is important to note that this does not constitute treatment or remediation or processing for another use, the fine soils just need to be incorporated with other soils in order to reach the required nature for plant growth.

Construction and maintenance of the proposed new Sediment Basin 2 (SB2) requires the use of a flocculant (Turbiclear) to treat sediment runoff to meet required water quality limits prior to discharge from site. Therefore, the primary question becomes whether the residual flocculant within the recovered sediment fines is suitable for re-use within rehabilitation works at the site. The documentation from the manufacturer of Turbiclear states that the compounds do not present an environmental risk.

Preliminary testing and consideration of the site soils and flocculant were conducted by Proag Soil Management consultants who did not report any material limitations with respect to re-use. Reference was made to consideration of aluminium however it should be noted that the background soil concentrations also indicate the present of naturally occurring aluminium. Therefore, the natural flora and fauna at the site already have evolved with aluminium in soils and therefore are considered suitable for re-instatement at the site. It is also important to note that because of the nature of the particle sizes the soils would be placed beneath shallow root zones and more suitable growing medium.

It is our view that the information provided does not indicate that the flocked sediment would present a material environmental or human health impact and therefore should be considered suitable for re-use within the site.

It is recommended that an increased density of sediment samples post the addition of the flocculant be analysed once operational in order to confirm the above. The management of sediment and re-use should be incorporated into existing site management plans.

Contents

1.0 Introduction

1.1 Background

A.M. Environmental Consulting Pty Ltd (AME) was commissioned by Groundwork Plus (SA) Pty Ltd (Groundwork Plus) on behalf of Construction Materials Pty Ltd (Hanson) to consider information provided and conduct environmental soil sampling from recovered sediments at the White Rock Quarry, located on Horsnells Gully Road, Horsnell Gully, South Australia (the Site).

The work is aimed at demonstrating compliance with the SA EPA (2013). Standard for the Production and Use of Waste Derived Fill, October 2013 and also the NEPC (1999). National Environment Protection (Assessment of Site Contamination) Measure, December 1999 (ASC NEPM) as amended in 2013.

It is important to note that the broader site which includes sediment (i.e. naturally occur within the excavated materials which are then exported from site) is managed through the overall site management plan. This overarching plan and subsequent documents provide detailed background information, management responsibilities and quality assurance and corrective feedback loops. Therefore, this information has not been repeated in this document for the recovered products but included as reference in the appendices.

The Site entails the Private Mine (PM) 188 which currently operates under the approved Mine Operation Plan (MOP) dated August 2004.

The White Rock Quarry operates under a *MINE OPERATIONS PLAN* prepared for Hanson (MOP) which is currently under review and will published in the future. This document provides the background information in relation to the quarry and operational and management system elements and would incorporate the outcomes of this recovered products process.

The MOP includes Drawing No. 1901.DRG.028 – Site Location provides an understanding of the locality of the is provided as Figure 1.1 below. Drawing No. 1901.DRG.073 – Site Layout Plan provides a more detailed image of the current disturbance area and locations of Site relevant items and is provided as Figure 1,2 below.

Figure 1.1: Map showing stockpile location and regional context

Figure 1.2: Stockpile locations

1.2 Purpose and details of the proposal

1.2.1. Reason for fill

Hanson has prepared the *White Rock Quarry Sediment Basin 2 Flocculant and Coagulant – Active Treatment Management Plan* dated December 2021 (Reference HCM-WR-WRQ-SB2-001) which is included in Appendix B.

Construction and maintenance of the Sediment Basin 2 (SB2) requires the use of a flocculant coagulant to treat sediment runoff to meet required water quality limits prior to discharge from site.

This proposal has been developed by Hanson to demonstrate the effectiveness of the proposed management measures for the treatment of surface water within SB2 through the construction of a Type A High Efficiency Sediment (HES) basin and use of an automatic dosing unit incorporating the use of Turbiclear.

The proposal details how surface water would be treated using Turbiclear prior to discharge from SB2. It details how Turbiclear will be appropriately managed on site, and how Hanson will ensure treated water is suitable for discharge in accordance with legislative requirements, including the Environment Protection Act 1993.

1.2.2. Net benefit

The Site has been in operation since at least 1946 and has supplied competent construction materials to the greater Adelaide area over the past 70 years. The Ferraro family operated the quarry in the early years and the land was proclaimed as a PM on 4 October 1973. The Pioneer Group of Companies procured the land and PM in approximately 1991. Hanson later procured the land and the PM in 2007. Operations at the quarry pre date the introduction of the Mining Act 1971 (the Act).

The Site has been highlighted by the State Government as a Strategic Resource Area (SRA). An SRA is an area within the greater Adelaide region, or near a regional centre that is of key economic value to South Australia due to the quantity or quality of construction materials or mineral resources that are extracted or contained within that area.

The Site supports affordable construction materials to local residential, commercial and infrastructure development in the Adelaide Metropolitan Area. The protection of SRA's is of importance to the state due to the enabling factor of keeping overall costs as low as possible to the consumer and therefore increasing affordability in both personal and business ventures within South Australia. Throughout engagement Hanson have received feedback regarding the potential to supply materials from hard rock resources such as Kanmantoo as an alternative to White Rock Quarry. While Kanmantoo is both an important asset to Hanson and a State significant resource, the freight component of construction materials is a major component within the final cost of the end product to the consumer, the location of White Rock Quarry is therefore a critical factor to ensuring affordable supply of construction materials to market. There are alternate hard rock sources within proximity of the Site however, competition drives lower resource pricing to the end consumer which is of importance to the state. The close proximity of the Site to the Adelaide Metropolitan Area is of significance and has been considered by Hanson in the business case and decision making process to undertake further exploratory works as a part of this MOP Review process.

1.2.3. Proposed timeframe for the activity, volume(s) required and destination location(s)

Every 12 months the sediment would be collected in the settling basins, removed and re-used within the site for rehabilitation purposes. It is expected that approximately 200 tonnes would be recovered annually.

The soils would be stored and reused as appropriate once dry at the location in Figure 1.2. Noting that the site is effectively a closed system and any run-off from stockpiled soil (if occurred) would be recaptured within existing sedimentation basin upstream of SB2.

The soils primarily comprise naturally occurring fine clay silt with limited other inclusions.

The location of the current and proposed sediment collection system for SB2 is outlined in Figure 1.3 and Figure 1.4 below.

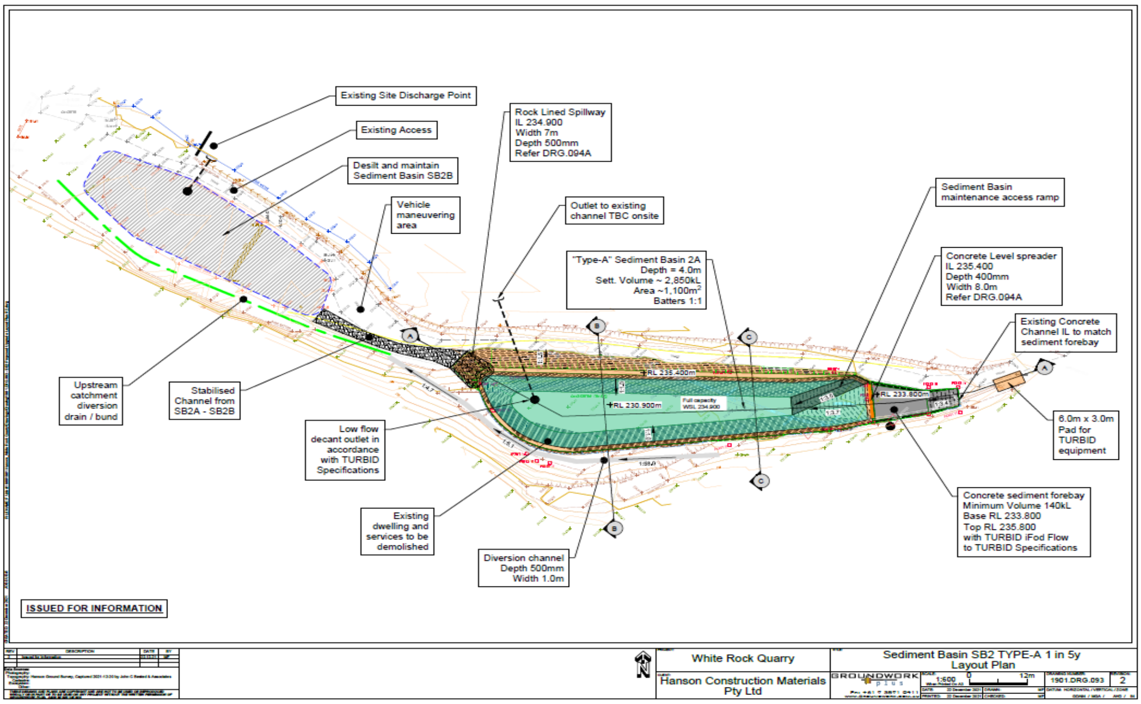


Figure 1.3: Proposed new sedimentation basin

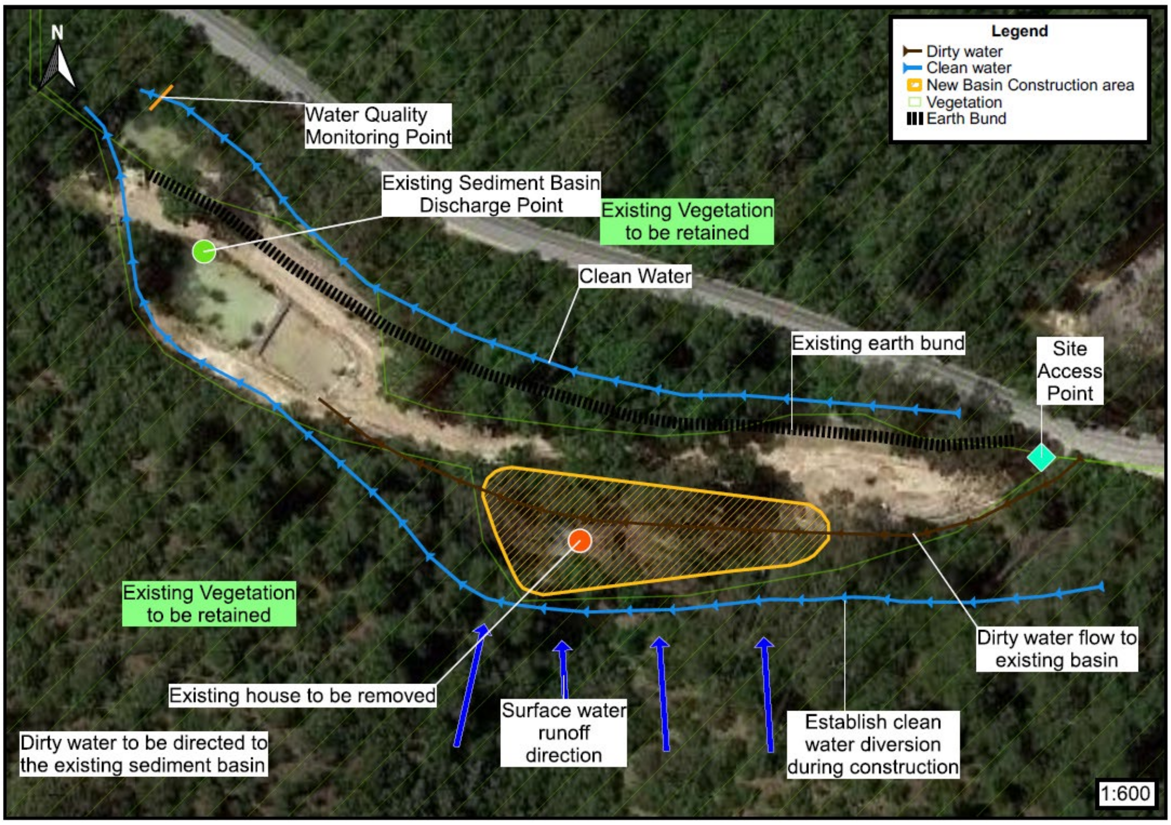


Figure 1.4: Proposed new sedimentation basin

1.3 Aim

The aim is to assess the potential for gross or widespread soil contamination to exist as a result of the sediment which would preclude its re-use within the site.

1.4 Scope of work

The following work scope was undertaken:

- Consideration of information from the following sources:
    - Site walkover
    - Consideration of information provided by client
- Assessment of soils from recovered sediment stockpiles already existing on-site in order to conduct a preliminary screening level assessment, comprising:
    - Sample retrieval on 27 May 2022 from seven (7) primary soil locations and two duplicates from a stockpile of approximately 60 tonnes.
    - Logging of the materials encountered
    - Screening of soil samples in the field using a Photo Ionisation Detector (PID) to assess the presence of volatile organic compounds
    - Chemical analysis of selected soil samples for broad SA EPA Waste Screens
    - Implementation of a QA/QC program
    - Data interpretation and reporting comprising comparison with the WDT and NEPM guidelines.

2.0 Regulatory and Assessment Framework

2.1 Site contamination

Soil contamination has the potential to impact adversely on human health and the environment; however, in order for a significant or identifiable risk to be present, there must be an exposure pathway. The exposure pathway comprises the following:

- Source – The presence of a substance that may cause harm.
- Receptor – The presence of a receptor which might be harmed at an exposure point.
- Pathway – The existence of a means or mechanism of exposing a receptor to the source.

In the absence of a plausible exposure pathway there can be minimal risk. Therefore, the presence of 'something measurable' i.e. a concentration of a chemical does not necessarily imply that there is measurable human harm. It is necessary to have a significant source of contamination, an appropriate or effective pathway for this to be presented to a receptor, and the receptor must have a negative response to this exposure. Hence, the nature and importance of sources, receptors and exposure routes will vary with every site, situation, intended end use and environmental setting. It should also be noted that management measures to address any aspect of the above can reduce the significance of any risks.

2.2 Environment Protection Act, 1993

In South Australia, the assessment, management and remediation of site contamination is regulated by the *Environment Protection Act 1993* (EP Act). The EP Act defines site contamination in section 5B as follows:

> *(1) For the purposes of this Act, site contamination exists at a site if—*
>
> > *(a) chemical substances are present on or below the surface of the site in concentrations above the background concentrations (if any); and*
> >
> > *(b) the chemical substances have, at least in part, come to be present there as a result of an activity at the site or elsewhere; and*
> >
> > *(c) the presence of the chemical substances in those concentrations has resulted in—*
> >
> > > *(i) actual or potential harm to the health or safety of human beings that is not trivial, taking into account current or proposed land uses; or*
> > >
> > > *(ii) actual or potential harm to water that is not trivial; or*
> > >
> > > *(iii) other actual or potential environmental harm that is not trivial, taking into account current or proposed land uses.*
>
> *(2) For the purposes of this Act, environmental harm is caused by the presence of chemical substances—*
>
> > *(a) whether the harm is a direct or indirect result of the presence of the chemical substances; and*
> >
> > *(b) whether the harm results from the presence of the chemical substances alone or the combined effects of the presence of the chemical substances and other factors.*
>
> *(3) For the purposes of this Act, site contamination does not exist at a site if circumstances of a kind prescribed by regulation apply to the site.*

Based on the above, the first stage in determining whether site contamination exists is to assess whether chemical substances have been added to the site through an activity and whether these substances are above background concentrations. The second stage is to assess whether the chemical substances have resulted in actual or potential harm to the health or safety of human beings or the environment that is not trivial.

The professional assessment of site contamination and consequential risk to human health and the environment is guided by the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM), Australian Standards and several guidelines prepared the EPA. The NEPM operates as an environment protection policy under the EP Act.

If site contamination is determined to be present at a site, the EP Act provides mechanisms to assign responsibility for the contamination and appropriate assessment and/or remediation of the contamination.

2.3 Assessment guidelines

The scope of works and methodology adopted for the assessment were generally based on the guidance provided in the following documents:

- SA EPA publication Guidelines for the assessment and remediation of site contamination (2018, amended 2019) (the GAR).
- ANZECC/NHMR.C (1992). Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites
- NEPC (1999). National Environment Protection (Assessment of Site Contamination) Measure, December 1999 (ASC NEPM) as amended in 2013
- Standards Australia. Guide to the investigation and sampling of sites with potentially contaminated soil – AS 4482.1-2005
- Environment Protection (Water Quality) Policy 2015
- ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality
- SA EPA (2013). *Standard for the Production and Use of Waste Derived Fill*, October 2013.

2.3.1 NEPM (Assessment of Site Contamination) as amended in 2013

The NEPM provides a nationally consistent framework for assessing the presence and significance of site contamination in soil and groundwater. The NEPM methodology is based on assessing the potential for an unacceptable risk to human health or the environment by comparing concentrations of chemical substances to conservative, generic investigation levels for various environmental settings and land use scenarios.

Investigation levels are defined in the NEPM as 'concentrations of a contaminant above which further appropriate investigation and evaluation will be required'. They are not clean up or response levels. A response level is defined as 'the concentration of a contaminant at a specific site based on a site assessment for which some form of response is required to provide an adequate margin of safety to protect public health and/or the environment'.

The NEPM health investigation levels (HILs) are based on conservative assumptions around providing protection to a young child living or playing on the site and subjected to exposure to contaminated soils. The most stringent HILs are assigned to sensitive land uses such as residential, childcare centres and primary schools. Where the land use provides for reduced access to soils, or reduced time in the setting for a child (e.g. high-density residential apartments or an industrial site), higher HILs are set in the NEPM. If an investigation level is exceeded at a site, the nature of the appropriate response is typically determined by site-specific environmental or human health risk assessment. NEPM HIL A (Residential) is conservatively used in this assessment.

NEPM ecological investigation levels (EILs) are provided for Arsenic, Copper, Chromium III, DDT, naphthalene, Nickel, Lead and Zinc in soil for the protection of terrestrial ecosystems. These are based on a species sensitivity distribution model developed for Australian conditions, and have been developed for areas of ecological significance, urban residential areas/public open space and commercial and industrial uses. The protection levels are dependent on these land use settings, with areas of ecological significance having the most protection. The NEPM aged EILs for urban residential areas/public open space are used in this assessment.

The NEPM ecological screening level (ESLs) are concentrations above which further appropriate investigation and evaluation would be required. ESLs broadly apply to coarse- and fine-grained soils and various land uses and are generally applicable to the top 2 m of soil. The NEPM ESLs (urban residential & public open space) are used in this assessment.

2.3.2 SA EPA (2013). Standard for the Production and Use of Waste Derived Fill, October 2013

This standard describes the information and processes that are required by the Environment Protection Authority (EPA) to support the beneficial reuse of a range of wastes specifically recovered for use as fill. This standard will be used to help assess proposals and determine compliance with the Environment Protection Act 1993 (EP Act) to ensure that the production and use of waste derived fill constitutes a genuine waste resource recovery and reuse activity, as distinct from waste disposal.

Risk-based approach The EPA has testing, submission and approval requirements for WDF that apply a risk-based approach with consideration to both the chemicals present within the WDF and the source of the waste. Default chemical criteria for reuse of these wastes as WDF are provided.

2.3.3 Canadian Soil Quality Guidelines (SQGs) for the Protection of Environmental Health

The Canadian Council of Ministers for the Environment (CCME) CCME 2010 SQG (Residential/parkland) environmental guidelines are used in this assessment in the absence of NEPM EILs.

2.3.4 Ecological Soil Screening Levels (Eco-SSLs)

The United States Environmental Protection Agency (USEPA) Eco-SSLs for plants, soil invertebrates and wildlife are used in this assessment in the absence of NEPM EILs and CCME 2010 SQGE (Residential/parkland) criteria. The most conservative guidelines from plants, soil invertebrates and wildlife criteria are adopted.

2.4 Data quality objectives

The data quality objective (DQO) process is a seven-step iterative planning approach that is used to define the type, quantity and quality of data needed to inform decisions relating to the environmental condition of a site. A summary of the process is provided in Table 2.1 and 2.2.

Table 2.1: Data quality objectives

Step	Requirement	Comment
1	State the problem	The fundamental issue is the demonstration that sediment from SB2 which will comprise natural site soils and residual flocculant is suitable for re-use within the quarry. The assessment aims to use multiple lines of evidence to screen for gross or widespread issues which may present a potential liability and require remediation. Sufficient information is required to satisfy the requirements of the SA EPA.
2	Identify the decision/goal of the study	Information is required about the nature of the site sediments to be recovered. The goals of the field investigation and sampling programs were to obtain background screening level information on the potential for widespread or gross distribution of chemicals in soils at the locations assessed and whether these soils are suitable for re-use.
3	Identify the information inputs	Information required to support decisions and recommendations includes details on the media e.g. fill/natural soil; field observations and measurements (e.g. PID) and chemical concentrations from soil samples to be assessed against the adopted guidelines. The inputs required to address the study goals are also outlined in this report and include: ■ Previous site data ■ Proposed soil use ■ Appropriate guideline documents for fieldwork and assessment, and the above guideline criteria for comparison against laboratory results ■ Appropriately experienced environmental staff ■ Geological data and information ■ Hydrogeological data ■ Soil samples at accessible locations ■ Laboratory analysis of the above media by NATA accredited laboratories and analytical methods for the chemicals of concern in soil and soil vapour ■ Observations regarding the presence of building materials or other waste materials ■ Observations of odours and discolouration of the soil and surface water media ■ Consideration of potential transport mechanisms ■ Consideration of potential exposure pathways ■ Quality assurance and quality control (QA/QC) data.
4	Define the boundaries of the study	The fourth step involves specifying the spatial and temporal aspects of the environmental media that the data must represent to support decision(s). The matters to consider at this stage include: ■ the geographical extent of the proposed investigation, as provided in Figure 1.2. ■ temporal boundaries ■ the land use boundaries of soils re-use to be assessed per the NEPM land use guidelines ■ the lateral and vertical intervals in which contamination distribution is encountered ■ Evidence of potential contamination on land outside of the site boundary and which might have the potential to impact on the site through soil, soil vapour or groundwater migration. Conditions can change with time; however, the temporal aspects of the site will be considered in terms of consideration of previous information against information to the be obtained as part of this study. The vertical extent of the site will include surface soils, shallow fill and natural soils.

Step	Requirement	Comment
5	Develop the analytical approach	The fifth step involves defining the parameter of interest, specifying the action level, and integrating information from Steps 1-4 into a single statement that gives a logical basis for choosing between alternative actions. Noting that soil sampling can only be conducted at accessible locations. However, this information would be used to interpolate / infer about the potential for gross or widespread impacts likely to preclude the use or requirement remediation/management measures to be implemented. Acceptable limits adopted in the assessment are defined in the report assessment guidelines in this report.
6	Specify performance or acceptance criteria	Relevant performance and/or acceptance criteria were determined for quality assurance/quality control purposes and comparison of soil analytical results to appropriate assessment criteria. The method to address the acceptable limits on decision errors has been based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness. The project DQIs have been established to set acceptance limits on field and laboratory data collected for this investigation. Laboratory procedure acceptance limits are set at different levels for different laboratories. Non-compliances with acceptance limits are to be documented and discussed. Noting that at this stage there is only a limited data set because of on-site restrictions.
7	Develop the plan for obtaining data	The seventh step involves identifying the most resource-effective sampling and analysis design for generating the data that is required to satisfy the DQOs. The collection of data was optimised by the development of an appropriate sampling and analytical strategy and included: ▪ The division of work into distinct sections for consideration as outlined in this report ▪ The consideration of the most suitable sampling and assessment methods and options ▪ The selection of site assessment guidelines based on the site context and the optimisation of the site redevelopment at the time of assessment.

Table 2.2 Acceptable limits

DQI	Field	Laboratory	Acceptability Limits
Completeness	▪ All critical locations sampled ▪ All samples collected (from grid and depth) ▪ Standard Operating Procedures (SOPs) appropriate and complied with ▪ Experienced sampler ▪ Documentation correct	▪ All critical samples analysed and all analytes analysed according to SOPs ▪ Appropriate methods ▪ Appropriate practical quantitation limits (PQL) ▪ Sample documentation complete ▪ Sample holding times complied with	As per NEPM (2013) < nominated criteria As per NEPM (2013) and WDF Guidelines
Comparability	▪ Sample SOPs used on each occasion ▪ Experienced sampler ▪ Site climatic conditions Same types of samples collected	▪ Same analytical methods used (including clean-up) ▪ Sample PQL (justify/quantify if different) ▪ Same laboratories (NATA accredited)	As per NEPM (2013) < nominated criteria As per NEPM (2013)and WDF Guidelines

	■ Use of the same kinds of instruments	■ Same units	
Representativeness	■ Appropriate media sampled according to SOP ■ All relevant media sampled ■ The analytical suite targets the contaminants of concern	All samples analysed according to SOP	
Precision	■ SOPs appropriate and complied with ■ Collection of blind and split duplicate samples	Analysis of: ■ Blind duplicate samples (1 in 10 samples) ■ Split duplicate samples (1 in 20 samples) ■ Laboratory duplicate samples ■ Laboratory prepared trip blank (1 sampling round)	RPD of 30 to 50% RPD of 30 to 50% RPD of 30 to 50% Non-detect for COC
Accuracy	■ SOPs appropriate and complied with ■ Collection of rinsate blanks ■ Field trip blanks ■ Field rinsates ■ Method blanks	Analysis of: ■ Matrix spikes acceptability ranges ■ Matrix spike duplicates ■ Surrogate spikes ■ Laboratory control samples ■ Laboratory prepared spikes	Typically 70 to 130% RPD of <30% 70 to 130% 70 to 130% 70 to 130%

3.0 Site Information

3.1 Site description and photographs

A site visit was conducted on 27 May 2022 by an AME representative.

The site primarily comprises a portion of the overall quarry and where sediment had been stockpiled. The location is shown in Figures 3.1 and 3.2 below.

There were no observed areas of waste disposal or stained or odorous liquids or material on the surface.

Figure 3.1: Stockpile location

Figure 3.2: Stockpile location

Site walkover photographs are shown in Photos 3.1-3.4 below.

Photo 3.1: Main sediment collection system and source of stockpiled soil

Photo 3.2: Location of proposed basin.

Photo 3.3: Stockpiled soil

Photo 3.4: Stockpiled soil

3.2 Aesthetic considerations

Aesthetic considerations relate to the presence of low-concern or non-hazardous inert foreign material (refuse) in soil or fill resulting from human activity. There are no specific numeric aesthetic guidelines; however, site assessment requires balanced consideration of the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity. The following observations were made in relation to aesthetic issues at the site:

- There were no significant odours (e.g. strong residual petroleum hydrocarbon odours)
- There was no hydrocarbon sheen on the site surface
- There were no discoloured chemical deposits or stains with chemical waste.
- There was no putrescible refuse, including material that may generate hazardous levels of methane, such as a deep-fill profile of green waste or large quantities of timber waste

3.3 Surrounding land use

The surrounding land use is outlined in the MOP.

3.4 Topographic features

The surrounding land use is outlined in the MOP.

3.5 Regional soil, geology and hydrogeology

A summary of the regional soil, geology and hydrogeology is presented in the MOP.

3.6 Acid sulphate soils

The CSIRO Atlas of Australian Acid Sulphate Soils Atlas of Australian Acid Sulfate Soils indicates low potential for acid sulphate soils to exist.

4.0 Background Information

4.1 Sediment Basin 2 flocculant and coagulant – Active Treatment Management Plan

Hanson Construction Materials Pty Ltd has prepared a reported title Sediment Basin 2 flocculant and coagulant – Active Treatment Management Plan dated December 2021 (Reference HCM-WR-WRQ-SB2-001 Dec 2021).

Construction and maintenance of the Sediment Basin 2 (SB2) require the use of a flocculant or coagulant to treat sediment runoff to meet required water quality limits prior to discharge from site.

This proposal has been developed by Hanson to demonstrate the effectiveness of the proposed management measures for the treatment of surface water within SB2 through the construction of a Type A High Efficiency Sediment (HES) basin and use of an automatic dosing unit incorporating the use of Turbiclear.

The proposal details how surface water would be treated using Turbiclear prior to discharge from SB2. It details how Turbiclear will be appropriately managed on site, and how Hanson will ensure treated water is suitable for discharge in accordance with legislative requirements, including the Environment Protection Act 1993.

Removal of retained sediment within SB2 will occur when necessary. Soil removed from within the basin will be reused within the Site as a beneficial reuse and incorporated into the rehabilitation of the quarry. Site specific sediment analysis undertaken from sediments collected within the jar testing indicated improved cation exchange properties (ability to hold nutrients etc) for rehabilitated landform soil medium. However, it has been recommended that the sediment be blended with other overburden products onsite to further enhance the soil properties.

This Active Treatment Management Plan report indicated the following:

> ***Direct Toxicity Assessment:***
> *Water treated with Turbiclear is reported to have no effect on Australian Water fleas or fish from a previous study undertaken in New South Wales.*
>
> *The study investigated the ecotoxicity of water leaving a High Efficiency Sediment (HES) basin that had an automatic dosing unit (Turbid Flocbox) injecting Turbiclear directly into the stormwater runoff entering the treatment system. The water leaving the HES basin was tested using whole of effluent testing (WET) in March 2017 and concluded:*
>
> *The 48-hr acute toxicity test using the freshwater cladoceran Ceriodaphnia dubia indicated that the EC50 = >100% (at 100% concentration, no affect was observed).*
>
> *The 96-hr fish imbalance toxicity test using the Eastern Rainbowfish Melanotaenia splendida splendida the EC50 = >100% (at 100% concentration, no affect was observed).*
>
> *Full details are supplied in Attachment 1 – Turbidclear Ecotoxicity Results.*

4.2 ProAg Soil Management report Hanson Quarries Sediment Analysis dated 6th September 2021.

ProAg Soil Management conducted some limited screening assessment of sediment samples from the site and prepared a report which is included in Appendix C1.

This report indicated the following:

> *Summary*
> *As tested, these fine textured sediments are not suitable for use as planting media, however*

they would have value as blends with other coarser quarry waste materials, by adding exchange capacity and nutrients including trace elements.

The analysis found no other toxicities present that would compromise plant growth. It is possible that aluminium compounds have been used as flocculation agents, however plant aluminium toxicity will only be an issue in acidic soils. You will note that in the laboratory results, exchangeable aluminium levels are very low in these alkaline samples.

Although salinity is elevated, this is likely to be diluted by blending with other materials and will leach out over time. The conductivity found will not affect most native species.

The analysis found no other toxicities present that would compromise plant growth. It is possible that aluminium compounds have been used as flocculation agents, however plant aluminium toxicity will only be an issue in acidic soils. You will note that in the laboratory results, exchangeable aluminium levels are very low in these alkaline samples.

Sediment Amendment Program
I recommend that blends of sediment and other materials are first produced and samples analysed, before determining what amendments and fertilisers are needed to prepare them for planting.

4.3 ProAg Soil Assessment & Analysis Hanson White Rock Quarry Date: 3 July 2020

Pro Ag Soil Management also conducted an assessment and sampling of overburden and other materials at the Hanson White Rock Quarry, Horsnell Gully, to provide information for a rehabilitation and revegetation plan for the site. The aim was to collect samples of all materials that could potentially be used as planting media in rehabilitation areas, including overburden and quarry products. Germination and establishment should be enhanced by applying appropriate amendments based on soil analysis to speed up the process of turning the overburden into living soil. This report is included in Appendix C2.

4.4 Details of the chemical and physical product specifications for WDF produced at the facility.

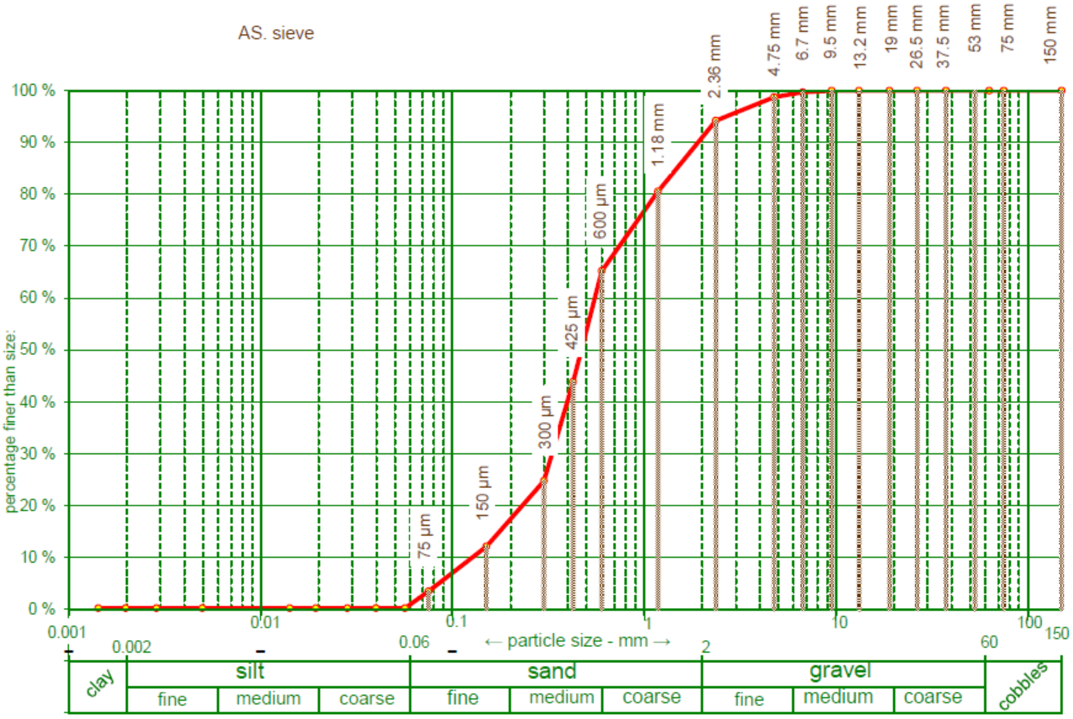
The following information was provided in the ProAg report:

Sediment Samples 44560 & 44697

Unit	Found	Comment
Texture (MIR)	Silty Loam	Very fine material - >60% silt and clay
ECEC	Good	Good nutrient holding capacity
Organic carbon	Marginal	Will improve when vegetation is established
pH	Very High	Strongly alkaline – select suitable species for planting
Available N	Low	Apply nitrogen fertiliser before planting
Phosphorus	Low	Apply acidic phosphorus fertiliser before planting (MAP)
P Availability (PBI)	Low	P availability reduced by the alkaline conditions
Sulphur	High	
Potassium	Low	Potassium low as % of cations - fertiliser needed
Ca:Mg balance	Good	No lime or gypsum is needed
Trace elements	Good	All trace elements are well supplied
Salinity (EC)	Elevated	Conductivity requires plants with moderate salt tolerance
Chloride	Good	
Sodicity (ESP)	Good	Soil is non-sodic

Table 1

The client provided the following particle size distribution information:



5.0 Screening Level Recovered Material Soil Assessment

5.1 Rationale

Selected soil samples were obtained from accessible locations from recovered sediment from another basin.

These soils came from the primary sedimentation collection system and are considered to be a good representation of the chemical nature of the site soils with respect to the WDF guidelines.

The rationale was based on the assessment of the areas of environmental interest to assess for the presence of indicators of potential soil contamination and/or residual chemicals. This information would be compared to the site history research and preliminary assessment risk in order to assess the likelihood of potential site contamination impacts being present or not.

5.2 Methodology

Sample retrieval on 27 May 2022 of seven (7) primary samples and two (2) duplicate samples from approximately 60 tonnes of sediment retrieved from the primary sediment catchment.

Samples were freighted directly to the NATA accredited laboratory. A chain of custody document was completed listing sample numbers, date of collection and analyses required and was signed by each person transferring and accepting custody.

The analytical methods used are described in the analytical laboratory certificate provided in Appendix E.

These sampling locations are approximately shown in Figure 5.1.

The detailed soil assessment methodology that was followed, including key elements of the quality assurance (QA) program, is presented in Table 5.1.

Table 5.1: Soil assessment methodology

Activity	Details
Field procedures	Field procedures were undertaken in general accordance with the NEPM (2013) and AS4482.1-2005.

Activity	Details
Soil sampling	Representative soil samples were generally collected from the top of each soil horizon using Nitrile gloves. Samples were retrieved by an experienced AME representative.
Rinsate sample	A Rinsate sample was not retrieved as samples did not come into contact with the sampling equipment.
Duplicate sampling	Field duplicate soil samples were collected to provide a check on sample variability, laboratory performance and accuracy. An intra-laboratory duplicate sample was retrieved and analysed at the primary laboratory and an inter-laboratory duplicate sample was retrieved and analysed at the secondary laboratory.
Trip blank	Trip blank samples accompanied the soil samples in the esky to the laboratory and was tested for BTEX.
Laboratories used and NATA accreditation	Eurofins MGT (primary laboratory) and Envirolab (secondary laboratory for QC purposes) are NATA accredited for the analyses undertaken. The laboratory analysis and chain of custody documentation and certified analytical certificates are included in Appendix D.
Sample preservation and storage	Samples were placed in laboratory supplied containers and stored in chilled eskies. Samples were then freighted to the NATA accredited laboratories of Eurofins MGT and Envirolab.
Sample labelling	A unique sample number was generally used to label and clearly identify each sample.
Sample tracking	Chain of custody documentation was used for the transport of all samples to the laboratory and is included in Appendix G. The chain of custody documentation was completed listing sample numbers, date of collection and analyses required. This was signed by each person transferring and accepting custody.
Soil PID screening	All soil samples were screened in the field for the presence of volatile organic compounds using a PID, which was calibrated using isobutylene gas prior to use. The PID meter calibration certificate is presented in Appendix E.
EILs	NEPM EIL values were calculated. The results are retained on file for comparison with future assessment works when EIL's will be calculated.

The sampling location plan is provided in Figure 5.1 below.

Figure 5.1: Sample retrieval location plan

5.3 Chemical analysis

The sample list and associated analytical testing is presented in the chain of custody documentation included in Appendix D. Selected soil samples were tested for broad SA EPA Waste Screens and selected individual analytes. The analytical methods used are described on copies of the analytical laboratory certificates provided in Appendix D.

5.4 Guidelines

The guidelines used for the assessment of the analytical results were the concentrations provided in the SA EPA (2013). Standard for the Production and Use of Waste Derived Fill, October 2013 and the NEPM which are presented in Table 5.2.

Table 5.2: Applicable soil assessment guidelines

Criteria	Applicability
NEPM Health investigation levels (HILs)	

Criteria	Applicability
NEPM HIL A/B	Concentrations of a contaminant above which further evaluation would be required. HILs are generic to all soil types and generally apply to the top 3m of soil.
NEPM Ecological investigation levels (EILs)	
NEPM EIL (urban residential areas & public open space) – Aged in high traffic area	Concentrations of contaminants above which further appropriate investigation and evaluation would be required. EILs depend on specific soil physicochemical properties and land use scenarios and generally apply to the top 2m of soil. A contaminant incorporated in soil for at least two years is considered to be aged for the purpose of EIL derivation.
NEPM Petroleum hydrocarbon management limits	
NEPM management limits (residential, parkland & public open space) – fine	Limited to petroleum hydrocarbon compounds. They are maximum values that should remain in a site following evaluation of human health and ecological risks and risks to groundwater resources and apply to all soil depths based on site-specific considerations. These limits are to consider the formation of light non-aqueous phase liquids, fire and explosion risks and damage to buried infrastructure.
Ecological screening levels (ESLs) for petroleum hydrocarbons	
NEPM ESLs (urban residential & public open space) – fine	Concentrations above which further appropriate investigation and evaluation would be required. ESLs broadly apply to coarse- and fine-grained soils and various land uses. They are generally applicable to the top 2 m of soil. Note that the Benzo(a)pyrene NEPM ESL guidelines have been replaced by the updated CCME guidelines which are used in this assessment.
Health screening levels (HSLs) for petroleum hydrocarbons	
HSL A & B for Clay	Concentrations above which further appropriate investigation and evaluation would be required. HSLs depend on physicochemical properties of soil, as these affect hydrocarbon vapour movement in soil, and the characteristics of building structures. HSLs apply to different soil types, land uses and depths below surface to >4 m and have a range of limitations.

5.5 Results

5.5.1 Soil observations

The soils generally comprised a cream/orange silty clay. There were no visual or olfactory indicators of gross or widespread potential contamination that were noted.

5.5.2 PID results

A PID was calibrated with isobutylene to broadly detect VOCs. The PID results from the soil samples retrieved were each measured at 0 ppm. This indicates that the likelihood of volatile gases being present in the soil at the site is low.

5.5.3 Laboratory results

The laboratory results for each of the soil samples analysed for the chemicals of interest were below the adopted criteria. The analytical results are detailed in the certified laboratory certificates are provided in Appendix D. The concentrations reported did not exceed NEPM of WDF guideline concentrations.

5.6 Quality assurance/quality control

5.6.1 Data validation

A summary of the quality assurance/quality control (QA/QC) activities undertaken to ensure integrity of the soil data collected is provided in Table 5.3.

A trip blank was analysed for BTEX and Rinsate for heavy metals by MGT Eurofins Pty Ltd.

Table 5.3 Data validation

QA/QC requirement	Acceptable?	Comments
Samples collected in accordance with standard operating procedures, incorporating appropriate sections of AS 4482.1 – 2005 and AS 4482.2-1999 for sampling of non-volatile components.	Yes	None
Samples delivered to laboratory with correct preservative.	Yes	None
Samples delivered to laboratory within sample holding times.	Yes	None
All analyses NATA accredited.	Yes	None
Required number of sample duplicates analysed.	Yes	None
Sample duplicates reported RPDs within limits set by AS4482.1.	Yes	RPDs are discussed in Section 6.6.2 and summarised below..
Laboratory limits of reporting (LOR)	Yes	The LORs are presented in the laboratory certificates of analysis. All LORs are suitable for the purposes of this investigation.
Trip blank	Yes	Trip blank accompanied the soil samples in the esky to the laboratory and was tested for BTEX. The results were reported as below LOR.
Rinsate	Yes	Rinsate samples were not retrieved.

5.6.2 Duplicate analysis

Field duplicate (blind replicate) soil samples were collected to provide a check on sample variability and laboratory performance and accuracy.

Validation and interpretation of the quality control data was undertaken by calculating the relative percentage differences (RPDs) for the primary sample and duplicate sample concentrations. The RPD value for an analyte was calculated using the formula:

RPD (%) = 100((x1 – x2)/x) where x1, x2 = duplicate results and x = mean of duplicate results.

According to AS4482.1-2005, typical RPD values for soils range from ±30 to ±50%; an RPD within the range of -50% to 50% is considered to show acceptable agreement and, conversely, data is considered to have poor agreement where an RPD is outside this range unless there are mitigating circumstances described.

Table 5.4 Soil intra-laboratory and inter-laboratory QC samples

Primary Sample	Replicate Sample (intra-lab)	Replicate Sample (inter-lab)	Analytes	Relative Percent Difference	Acceptable for this assessment?
VS1	Dup 1	-	Metals	Comparable.	Yes
VS2	-	Dup 2	Metals,	Comparable	Yes

6.0 Conceptual Site Model and Assessment of Risk

6.1 Purpose

The development of a Conceptual Site Model (CSM) is an essential part of all site assessments and provides the framework for identifying if and how a site may have become contaminated and how potential receptors may be exposed to contamination, either in the present or the future. The complexity of the CSM corresponds to the scale and complexity of the known or potential contamination impacts.

The CSM identifies complete and potential pathways between the known or potential contamination source(s) and receptor(s). Where the pathway between a source and a receptor is incomplete, the exposure to chemical substances via that pathway cannot occur, however the potential for that pathway to be completed (for example, by abstraction of groundwater or a change in land use) should also be considered in the assessment.

The CSM in Table 6.3 was developed based on an understanding of the site setting and the soil and groundwater assessment described in this report.

6.2 Context

The site setting, geology and hydrogeology, historical use and chemicals of environmental interest are outlined in earlier sections of this report.

6.3 Accuracy and Relevance of Information

The ASC NEPM outlines that consideration of the accuracy, relevance and whether data gaps are present or material to the assessment. Limited information was available with respect to a detailed understanding of historical offsite land uses. However, sufficient information is considered to have been obtained in relation to the site land use and low likelihood of potentially contaminating activities being present at the site. The data obtained and supplied by others is considered to be accurate, independent and suitable for the purpose of this assessment.

It will be necessary to confirm the nature and concentrations of sediments from the basin once it has been installed and then representatives samples of site fine material and residual flocculant can be confirmed.

6.4 Risk analysis

The CSM in Table 6.3 ranks the residual environmental and human health risks posed by the site for the proposed use using the risk matrix in Figure 6.1 and Tables 6.1-6.2.

This risk assessment takes into account that the literal consideration of risk as an abstract term based on what may or may not be present also needs to be expressed in commercial terms. Commercial terms relate to the potential expenditure and time that a proponent may need to reach a final development and/or the costs of associated assessment and management measures. It is noted that when considering risk, a lower risk is not necessarily insignificant, but rather the issue whilst present is either manageable or materially would not impede/preclude the development, although there may still be items to consider and close out. Although this may entail time and expense, it is not considered material to the viability the project as a percentage of the overall development costs.

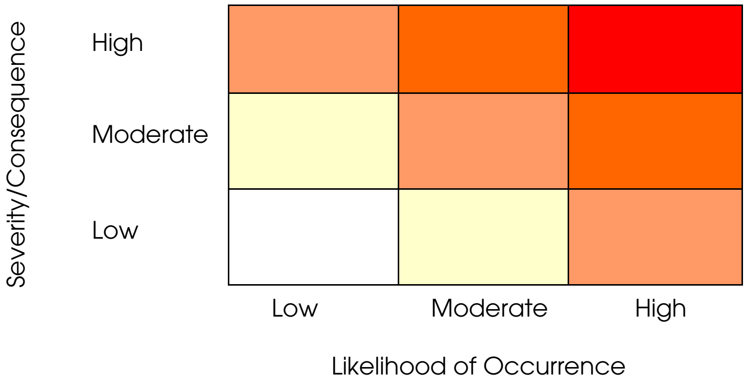


Figure 6.1 CSM residual risk matrix

Table 6.1 Severity/consequence definitions

Severity/consequence	Definition
Low	Negligible environmental and human health impacts, negligible threat to groundwater and negligible resultant soil vapour from known previous/current/adjacent land uses following site development which would reduce exposure pathways without significant management or remediation.
Moderate	If present, the nature of site contamination under some exposure scenarios could present an environmental or human health risk, threaten groundwater or result in soil vapour. Site development would reduce exposure pathways without significant management or remediation.
High	If site contamination is present, its nature is expected to present a significant environmental human health risk, threaten groundwater and/or result in soil vapour.

Table 6.2 CSM residual risk rating

Risk	Definition
Low	The concentrations reported do not exceed the adopted guidelines and the proposed site development is such that there would be no access to subsurface soils once developed and groundwater would not be abstracted for use, thereby the proposed development is conceptually of a negligible risk and no further work is considered warranted.
Low-Moderate	Individual and isolated concentrations of some chemicals exceed guideline concentrations, however when considered in conjunction with the exposure scenarios and the nature of the proposed development, there is no evidence to warrant more detailed assessment, remediation or mitigation.
Moderate	There are domain(s) at the site where individual concentration(s) and statistically averaged concentrations exceed the adopted guidelines and require either minor remedial measures or documented mitigation/management measures. For example, the risk profile within open space, garden or landscaped areas may be marginally higher than below sealed areas where there is no access to subsurface soils once developed. In this instance, supplementary assessment works may include vertical and horizontal delineation, offsite disposal/capping of some soils and associated qualitative human and/or environmental health risk assessment. Information may need to be documented with the Certificate(s) of Title.
Moderate-High	The adopted guidelines have been exceeded and more extensive remediation/mitigation is required. Demonstration of the acceptability of risk would require quantitative, human and/or environmental risk assessment. Information may need to be documented with the Certificate(s) of Title.
High	Concentrations of chemicals of interest are widespread and significantly exceed the adopted guideline concentrations. The risk profile is such that either the site is precluded from use or requires extensive and detailed remediation and environmental risk assessment. Information may need to be documented with the Certificate(s) of Title.

Table 6.3: Conceptual Site Model for proposed re-development (refer to Figure 6.1 and Tables 6.1-6.2 for risk analysis matrix used)[1]

Transport/exposure mechanism	Potential receptor(s)	Unmitigated exposure pathway completeness	Unmitigated likelihood of occurrence	Unmitigated consequence severity	Unmitigated risk for undefined generic residential land use	Management measure(s) based on this assessment	Mitigated/residual likelihood of occurrence	Mitigated/residual consequence severity	Residual risk for proposed land use
Soil contamination									
Access to soils	Site workers	Incomplete exposure pathway as there were no potentially material contaminating activities listed for the site and that ultimate development would have limited access to subsurface soils.	Low	Low	Low	Sampling once sedimentation basin implemented and sediments available.	Low	Low	Low
Surficial runoff	Downgradient recreational users of local surface water Flora and fauna Biota supporting ecological processes	Stormwater runoff is managed as part of onsite management and the key generator of this soil material. Capture of sediment is a primary issue in relation to the site management.	Moderate	Moderate	Moderate	Adhere to appropriate EMP as required.	Low	Low	Low
Vapour	Construction workers Maintenance workers accessing service pits/manholes Future visitors	Incomplete exposure pathway given concentrations less the LOR and given the nature of the site.	Low	Low	Low	Not required.	Low	Low	Low
Use by plants	Flora and fauna	The site exists with these fine components present. Agricultural assessment will be required to confirm suitability of re-use options.	Low	Low	Low	Sampling once sedimentation basin implemented.	Low	Low	Low
Groundwater contamination									
Extraction and use of groundwater at the site.	Residents Visitors Landscaping workers	Incomplete exposure pathway as no groundwater is proposed for abstraction at the site. If groundwater were to be abstracted then its suitability for use should be assessed.	Low	Low	Low	No abstraction.	Low	Low	Low
Extraction and use of groundwater off-site for potable and/or recreational use	Existing or potential domestic users of downgradient groundwater	Likely incomplete exposure pathway.	Low	Low	Low	Not required.	Low	Low	Low
Vapour	Construction workers Residents Maintenance workers accessing service pits/manholes Future visitors	No evidence of potentially contaminating activity and results less than LOR.	Low	Low	Low	Not required.	Low	Low	Low
Use by plants	Flora and fauna	Incomplete exposure pathway as no groundwater is proposed for abstraction at the site.	Low	Low	Low	Not required.	Low	Low	Low

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[1] CSM based on proposed future land use

7.0 Conclusion

A.M. Environmental Consulting Pty Ltd (AME) has considered the information provided and conducted screening level soil assessment of background soil sediments collected from the sediment catchment system.

The soils comprise a fine grained silty component which is not suitable in current form as a growing medium primarily because of the grain size and absence of nutrients to facilitate plant growth.

The concentrations reported from sediment sampling do not exceed the WDF guidelines or NEPM EIL's.

The proposed approach is for a supplementary sedimentation basin to be constructed at the site. This will be dosed with a commercially available and widely used flocculant. Supporting information was provided which stated that there were limited eco toxicological impacts from the flocculant.

Horticultural testing was conducted which did not indicate any material issues with the sediment other than its grain size and absence of nutrients and recommended that it could be incorporated into site rehabilitation works.

Based on the above information it is considered that the primary issue in relation to reuse would relate to residual concentrations of aluminium from the flocculant. It is important to note that the background sediment was also analysed for aluminium and it is evident that the background soils contain concentrations of naturally occurring aluminium. It is also important to note that because of the nature of the particle sizes the soils would be placed beneath shallow root zones and more suitable growing medium.

Therefore, it is considered that rehabilitation of quarry with localised species is unlikely to result in material impact given the already existing background concentrations. However, we recommend that once commissioned validation sampling and assessment be conducted on the recovered sediment to confirm.

8.0 Important Information

AME has prepared this report based on generally accepted practices and standards in operation at the time that it was prepared. No other warranty is made as to the professional advice included in this report. All parties should satisfy themselves that the scope of work conducted and reported herein meets their specific needs before relying on this document.

AME believes that its opinions have been developed according to the professional standard of care for the environmental consulting profession at the date of this document. That standard of care may change as new methods and practices of exploration, testing, analysis and remediation develop in the future, which may produce different results.

Environmental conditions are created by natural processes and human activity, and as such may change over time e.g. groundwater levels may rise or fall, contamination may migrate and fill may be added to the site. This report therefore presents a point in time assessment of the site, and as such can only be valid for the time at which the investigation was undertaken.

Any investigation such as that contained in this report can examine only a fraction of the subsurface conditions at the site. There remains a risk that pockets of contamination or other hazards may not be identified as investigations are necessarily based on sampling at localised points. Certain indicators or evidence of hazardous substances or conditions may have been outside the portion of the subsurface investigated or monitored, and thus may not have been identified or their full significance appreciated. As such, the identified environmental conditions reported are only valid at the points of direct sampling and any derived or interpolated conditions may differ from these targeted locations and cannot be assumed to be indicative of the remainder of the site.

The methodology adopted and the sources of information used are outlined in this report. AME has limited its investigation to the scope agreed for this contract and it is possible that additional sampling and analysis could produce different results and/or opinions. AME has made no independent verification of this information beyond the agreed scope of works and assumes no responsibility for any inaccuracies or omissions.

This assessment assumes that the proposed development meets requirements as outlined in the Building Code of Australia and Australian Standards. If these recommendations are not met, there is potential for the exposure and therefore risk to building users to be higher than that presented in this assessment.

The soil descriptions contained in this report have not been prepared for engineering design purposes and the reinstatement of any sampling locations were not conducted in accordance with any supervised filling or geotechnical standard. The term suitable has been used in the context of a request from the planning authority and means that the concentrations reported did not exceed the guideline concentrations adopted for the proposed land use/exposure pathway. It also assumes that the surrounding land use is already considered to be suitable therefore we are interested in material deviations over and above natural or background or similar conditions already constructed over.

This report does not include the assessment or consideration of hazardous building materials, including asbestos. Such materials should be assessed and managed by a qualified and licensed assessor/contractor. It also does not include assessment of airborne pollution, microbiology, or mould.

In general, the available scientific information pertaining to contamination is insufficient to provide a thorough understanding of all of the potential toxic properties of chemicals to which humans may be exposed. The majority of the toxicological knowledge of chemicals comes from experiments with laboratory animals, where there may be interspecies differences in chemical absorption, metabolism, excretion and toxic response. There may also be uncertainties concerning the relevance of animal studies using exposure routes that differ from human exposure routes. In addition, the frequent necessity to extrapolate results of short-term or sub chronic animal studies to humans exposed over a lifetime has inherent uncertainty. Therefore, in order to conduct an environmental assessment, it is necessary to take into account these inherent uncertainties and extrapolate information from the data that is available, considered current and endorsed as acceptable for the assessment of risks to human health. There is therefore inherent uncertainty in the process, and to compensate for uncertainty, conservative assumptions are often made that result in an overestimation rather than an underestimation of risk.

All advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole. This report does not purport to give legal advice as this can only be given by qualified legal practitioners. This document does not represent a Site Contamination Audit Report.

9.0 References

- ANZECC/NHMR.C (1992). Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites

- Department for Environment and Water. Groundwater Database website. Available at: https://www.waterconnect.sa.gov.au

- Department of Planning, Transport and Infrastructure. Property Assist website. Available at: http://maps.sa.gov.au/plb/

- *Environment Protection Act 1993*

- *Environment Protection Regulations 2009*

- NEPM (1999) (as amended 2013) National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council, Australia

- NHMRC (2011 updated 2017). Australian Drinking Water Guidelines 6, Version 3.4 Updated October 2017, National Water Quality Management Strategy, National Health and Medical Research Council and Natural Resource Management Ministerial Council, Commonwealth of Australia.

- SA EPA Public Register Directory – Site contamination index. Available: http://www.epa.sa.gov.au/data_and_publications/site_contamination_index/search-the-contamination-register

- Standards Australia. Guide to the investigation and sampling of sites with potentially contaminated soil – AS 4482.1-2005.

- EPA publication Guidelines for the assessment and remediation of site contamination (2018, amended 2019) (the GAR).

10.0 Appendix

Appendix A: MOP (to be provided when available)

Appendix B: Flocculant report

White Rock Quarry

Sediment Basin 2 Flocculant and Coagulant – Active Treatment Management Plan

Title	Sediment Basin 2 flocculant and coagulant – Active Treatment Management Plan
Author	Hanson Construction Materials Pty Ltd
Document number	HCM-WR-WRQ-SB2-001

Issue	Date	Revision description
1.0	December 2021	Initial document

Hanson Construction Materials Pty Ltd

Dec 2021

i. Contents

1. Introduction

Construction and maintenance of the Sediment Basin 2 (SB2) require the use of a flocculant or coagulant to treat sediment runoff to meet required water quality limits prior to discharge from site.

This proposal has been developed by Hanson to demonstrate the effectiveness of the proposed management measures for the treatment of surface water within SB2 through the construction of a Type A High Efficiency Sediment (HES) basin and use of an automatic dosing unit incorporating the use of Turbiclear.

The proposal details how surface water would be treated using Turbiclear prior to discharge from SB2. It details how Turbiclear will be appropriately managed on site, and how Hanson will ensure treated water is suitable for discharge in accordance with legislative requirements, including the *Environment Protection Act 1993.*

2. Proposed flocculant and/or coagulant

2.1. Turbiclear

Product name: Turbiclear

Chemical Name: Aluminium chlorohydrate, ACH (83-85% basic)

Chemical Composition/Information on Ingredients

Name	**CAS Number**	**Proportion**	**TWA (mg/m3)**	**STEL (mg/m3)**
Aluminium chlorohydrate ACH	1327-41-9	40 to 60 %	2	Not set
Water	7732-18-5	To 100%	Not set	Not set

Ecotoxicity

Direct Toxicity Assessment:

Water treated with Turbiclear is reported to have no effect on Australian Water fleas or fish from a previous study undertaken in New South Wales.

The study investigated the ecotoxicity of water leaving a High Efficiency Sediment (HES) basin that had an automatic dosing unit (Turbid Flocbox) injecting Turbiclear directly into the stormwater runoff entering the treatment system. The water leaving the HES basin was tested using whole of effluent testing (WET) in March 2017 and concluded:

The 48-hr acute toxicity test using the freshwater cladoceran *Ceriodaphnia dubia* indicated that the EC50 = >100% (at 100% concentration, no affect was observed).

The 96-hr fish imbalance toxicity test using the Eastern Rainbowfish *Melanotaenia splendida splendida* the EC50 = >100% (at 100% concentration, no affect was observed).

Full details are supplied in Attachment 1 – Turbidclear Ecotoxicity Results.

Effective Concentration Method Assessment:

Aquatic toxicity testing carried out by Summit Research Labs (www.summittchem.com) on Aluminium Chlorohydrate in the United States concluded that:

The 48-hr LC50 for the freshwater flea *Daphnia magna* was 397mg/L

The 96-hr LC50 for the freshwater fish *Pimelphales promelas* was 832mg/L

2.2. Why Turbiclear has been proposed and is appropriate for use

Turbiclear is a high quality, environmentally friendly, rapid acting coagulant supplied by Turbid Water Solutions ‘Turbid’, a company focused on achieving better environmental outcomes from application to HES basins.

The adoption of Turbiclear as the water treatment product on site will allow water to be automatically treated with dosing systems (on the basin), increase the turnover rate of manually treating sediment basins where practical, increase the amount of sediment and other contaminants (nutrients, metals-including Aluminium, and bacteria) removed from runoff and achieve better environmental outcomes.

Some key advantages are:

- Concentrated and 2 to 3 times more effective than other coagulant agents. Lower dosing required
- Easy to apply liquid
- Can be automatically dosed using the Turbid dosing systems reducing the risk of overdosing
- Excellent treated water clarity
- Settles quickly
- Works over a wide pH range (6-9) without needing correction
- Reduced alkalinity consumption compared to other agents, therefore, very little pH drop
- Very low levels of trace elements
- Forms inert sludge, re-useable on site
- Non-Dangerous, Not Hazardous Good
- Contains no sulfates

2.3. When Turbiclear will be used

Turbiclear will be used in the instance that surface water quality within the SB2 basin are not able to achieve the required 50 NTU water quality criteria prior to being released from the basin.

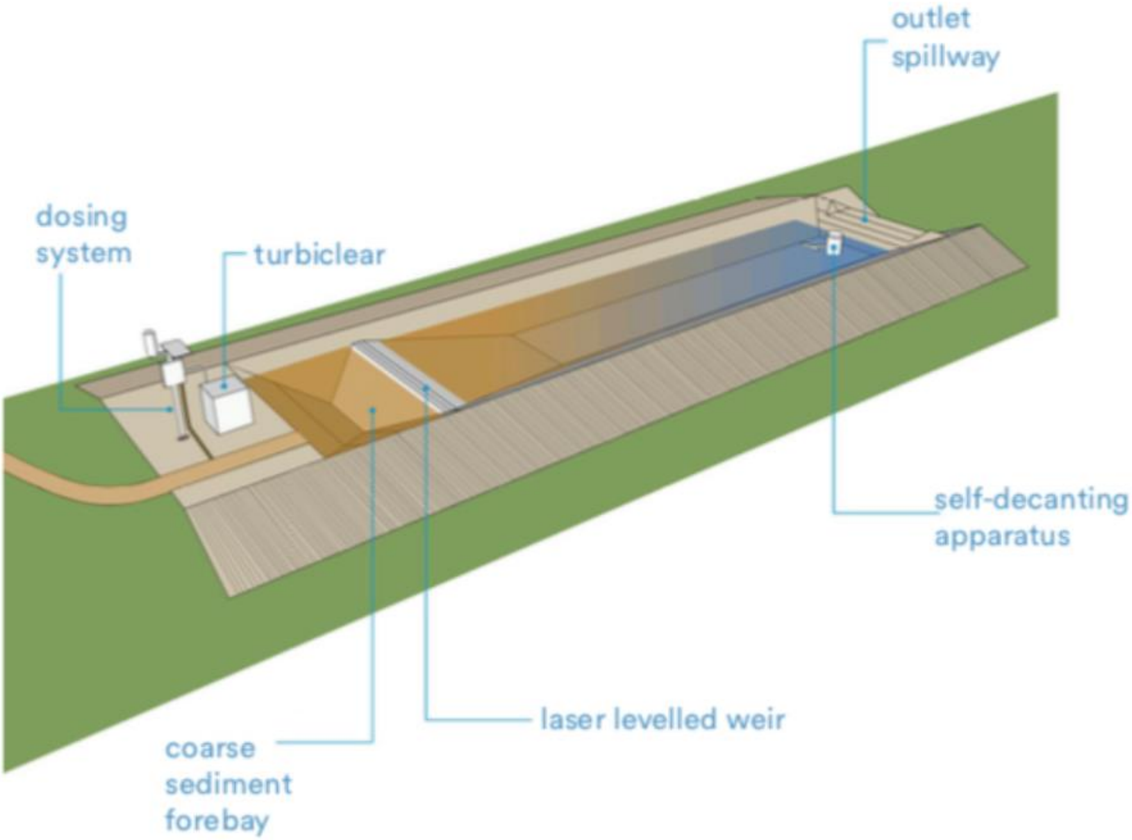
3. Flocculation methodology

3.1. Water treatment structures and equipment

Image 1 below illustrates the typical structure and equipment to be used, such as dosing equipment, pumps, and sediment trap forebays.

Detail design of the SB2 Type A HES basin is provided within Drawing No. 1901.DRG.093 – Sediment Basin SB2 TYPE-A 1 in 5y Layout Plan, Drawing No. 1901.DRG.094AR1 – Sediment Basin SB2 Detail Plan and Drawing No. 1901.DRG.094BR1 – Sediment Basin SB2 Detail Plan.

Image 1. High Efficiency Sediment Basin Diagram



KEY COMPONENTS:

1. DOSING SYSTEM

An automated system is provided at the start of the basin to deliver a dose of chemical coagulant to enhance the settlement of fine and dispersive sediment. The dosing system will be triggered by incoming flowrate

1.1 Ifod-FLOW

The ifod-FLOW provides accurate dosing of treatment products utilising flow metres inside or above pipes, open drains or weirs. It will measure water flow, either generated from rain events or pumping on site, and accurately dose via a low voltage metering pump according to the run off volume entering the basin. This ifod™ can also be connected to water quality sensors for monitoring and control purposes. See Attachment 2 - Ifod Manual.

2. **COARSE SEDIMENT FOREBAY:**
   This is the first cell of the basin and is where the majority of mixing of the coagulant with runoff occurs and is also where the majority of coarse sediment is deposited

3. **LEVEL-SPREADER/WEIR:**
   The level-spreader acts to distribute the flow across the full width of the basin so that velocities are minimised and settling is enhanced.

4. **SETTLING ZONE**
   This second cell of the basin is where settling of fine and dispersive sediment occurs. The fine particle size and slow settling velocities require this cell to be large so that non-turbulent settling can occur

5. **OUTLET STRUCTURES**
   The outlet structure of the basin will be comprised of an automatically height adjustable decant system.

3.2. Dosage rates

Dosage rates will be determined and continually updated as per the jar testing procedure below.

Turbiclear generally has a dose rate of approximately 40-50 ppm (with the full range of outliers between 5-100ppm). Turbid Water Solutions provide support and assistance in the optimal dose rates and usage of Turbiclear.

Preliminary jar testing undertaken by Turbid of a sample from the site demonstrated that Turbiclear performed favourably as expected at 50ppm dosing rate achieving less than 10 NTU within 5 minutes.

Additional jar testing will be undertaken during the commissioning of the dosing unit once the new SB2 basin has been constructed.

Site personnel will be trained in jar testing methodology to be carried out during the operation of the dosing unit to optimise dosing rates.

Jar Testing Procedure

The jar testing procedure described herein is provided by Turbid Water Solutions to assist in undertaking field jar tests to inform selection of appropriate water treatment product(s) and dose rates.

Method

STEP ONE: Collect samples of raw water:

1. Raw water samples should be representative of the sediment laden water to be treated by the flocculating agent.
2. It is recommended a minimum of three litres of raw water is collected for use in the jar tests.
3. Grab samples taken shortly after a runoff event and from 30cm below the free water surface near to the inlet of the sediment basin to be treated is preferred.

4. Measure and record the pH of the raw water sample(s) prior to commencing the jar test. If pH is below 6.5 the raw water sample may require buffering with a sprinkle of hydrated lime prior to commencing the Jar Test. Apply only enough hydrated lime to raise the pH of the raw water to between 7 and 8.

STEP TWO: Prepare 1% diluted sample of the flocculating agent(s) to be tested:

5. It is recommended at least two flocculating agents be tested for each site.

6. Prepare separate 1% solution of each flocculating agent (that is 1ml of the flocculating agent diluted in 99ml of clean rainwater).

STEP THREE: Add 1% flocculating solution to raw water.

7. Using a syringe, add in 1ml increments the 1% solution of flocculating agent to a 1L sample of raw water, stirring rapidly for around 10-15 seconds.

8. After each 1ml increment inspect the raw water sample as flow velocities within jar/bottle slow for the formation of 'flocs' (like seen in a snow-globe).

9. Look for a clear portion of at least 5cm depth to form at the surface within 2 to 3 minutes after stirring has ceased.

10. If a clear portion doesn't fully form within a few minutes add the next increment of 1% solution of flocculating agent, stirring rapidly for 10-15 seconds.

11. Repeat this procedure until the required clear portion is observed and keep a record (Step 6) of the number of 1ml increments added.

12. Measure the pH of the final flocked raw water sample to confirm the pH is within acceptable discharge limits for the site. If measured pH is below discharge criteria it may require addition of lime (or similar) to buffer up the pH, and if still higher, the addition of acid may be required.

13. If flocs are not forming within a reasonable time after adding a large number (>15 for Turbiclear) increments of the 1% solution of flocculating agent it is possible the alkalinity of the raw water sample may be too low and requires adjustment. Abandon the current jar test and prepare a new raw water sample as per Step One and add a sprinkle of an alkalinity increaser to raise the alkalinity.

14. If after adding a sprinkle of alkalinity increaser the 1% solution of flocculating agent does NOT form flocs it may be necessary to consider testing an alternative flocculating agent.

STEP 4: Determine required dose rate and dose rate window

15. The total amount (# of increments) of 1% solution of flocculating agent required to achieve the 5cm clear portion within 2 to 3 minutes provides the minimum dose rate required for the sediment basin.

16. For example, if 5ml (i.e. 5 x 1ml increments) of a 1% solution of flocculating agent was required then the dose rate is 0.05ml per litre of raw water in the sediment basin (i.e. 50L per megalitre of raw water in the sediment basin).

17. The dose rate window is the dose rate range within which the 1% solution of flocculating agent is observed to be effective. This is determined by continuing to add 1ml increments of the 1% solution of flocculating agent to the raw water sample using the procedure in Step 3 until such time the 5cm clear portion no longer forms within the 2 to 3-minute timeframe (which indicates the

raw water sample has been “over-dosed”). The total amount (# of increments) of 1% solution of flocculating agent that was added to reach this point of “over-dosing” represents the upper limit of the dose rate window.

18. It is recommended the starting dose rate for treating the sediment basin be set just above the minimum dose rate to avoid risk of “over-dosing” the basin.

STEP 5: Verify Test Results

19. Repeat Step 3 and Step 4 on a second 1L sample of raw water to verify the initial results.

20. If the results are only marginally different from the initial test, then use an average of the two sets of results to set the required dose rate.

21. If the results are markedly different from the initial test, then it will be necessary to conduct at least one additional jar test to gain confidence in the required dose rate.

STEP 6: Record Jar Test Data and Results

22. Record the results of each jar test on a Floc Report Worksheet as per the example in Appendix 1.

3.3. Preparing the flocculant/coagulant for use

Turbiclear is supplied in 1000 L IBCs, with a tap. No further mixing is required for it to be applied to water. IBCs are used globally for the bulk handling of chemicals and provide safe guards to prevent spills. Any potential spills will quickly crystallise and can be removed for future use or disposed of.

Personnel will be responsible for the use of Turbiclear on the site.

For Automated Dosing Systems (selected application)

Automated dosing systems store a reservoir of Turbiclear as part of their system set up. These are generally an external 1000L IBC and hose connection.

For Manual Treatments (allowed as contingency)

Depending on the size of the basin and dosage volumed required, Turbiclear will be directly applied from the IBC. Volumes can be calculated from the level gauge on the IBC in 10L increments.

3.4. Application of the flocculant/coagulant

Turbiclear can be applied via various methods depending upon the basin needing treatment.

Common application methods include:

1. Automated through a Turbid automatic dosing unit
2. Manually by either spray casting from water trucks, spray casting with pump sets set up on the basin, drip feeding into the suction or discharge line of a pump set circulating a sediment basin.

The Type A HES SB2 specific application will be automated through the use of a Ifod-Flow automatic dosing system and will be monitored by trained personnel.

3.5. Discharging treated water

Water quality will be monitored prior to discharge from the SB2 basin. If the criteria described in the Table 3.5 below is not met, additional water management and or treatment measures may be required, including manual application of Turbidclear if required. As a contingency measure the current SB2 may also be used to provide extra settlement time before discharging to the creek.

Table 3.5: Water Quality Discharge Criteria

Parameter	Discharge criteria	Analysis method	Frequency
Total suspended solids	<50mg/L	Turbidity sensor	Every discharge event
pH	6.5 – 8.5	Probe	Every discharge event

4. Storage and location

1000L Intermediate Bulk Container (IBC) will be stored next to the bunded chemical container. Spill kits and SDS data sheets will be available at the chemical storage container. The location where the Turbiclear will be stored is outlined within Drawing No. 1901.DRG.093 – Sediment Basin SB2 TYPE-A 1 in 5y Layout Plan

5. Disposal

Priority will be for the re-use/recycling of used IBC used in the storage of the product. If they cannot be recycled, disposal of contents and containers to an EPA approved waste disposal facility will be undertaken.

Removal of retained sediment within SB2 will occur when necessary. Soil removed from within the basin will be reused within the Site as a beneficial reuse and incorporated into the rehabilitation of the quarry. Site specific sediment analysis undertaken from sediments collected within the jar testing indicated improved cation exchange properties (ability to hold nutrients etc) for rehabilitated landform soil medium. However, it has been recommended that the sediment be blended with other overburden products onsite to further enhance the soil properties. See Attachment 3 – Pro Ag Soil analysis.

As the ‘shelf life’ of Turbiclear is in the range of 5 years, it is highly unlikely that the products will reach their shelf life during the operation of SB2.

6. Transport, handling and WHS considerations

This product does not carry a Dangerous Goods nor Hazardous classification as corrosion tests have verified that it is not corrosive to either skin or to metals. No specific PPE is required, however reusable latex gloves, and general site PPE should be used as appropriate. Rubber boots can be used in wet conditions but mainly as protection from the water/mud.

IBCs are to be moved via designated loaders and manual handling of smaller containers should be limited to comply with safe handling techniques.

All staff involved with handling of the product will be trained in correct handling techniques.

7. Record keeping

The following records maintained:

1. Initial commissioning calibration and jar test results
2. Periodic jar test results
3. Water quality monitoring results
4. Sediment removal records

Attachment 1

Toxicity Test Report: TR1469/1

(Page 1 of 2)

Accredited for compliance with ISO/IEC 17025

Client:	Fulton Hogan Foxground Berry Bypass NSW	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1469 6 March 2017 7 March 2017
Attention:	Sam Leigh	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL1469_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
8035	HES Basin Out	Aqueous sample, pH 7.8*, conductivity 121.0µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.
8036	SB18500E Out	Aqueous sample, pH 7.7*, conductivity 378µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	48-hr acute toxicity test using the freshwater cladoceran *Ceriodaphnia dubia*
Test Protocol:	ESA SOP 101 (ESA 2011), based on USEPA (2002) and Bailey *et al*. (2000)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The samples were serially diluted with Dilute Mineral Water (DMW) to achieve the test concentrations. A DMW control was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	10 March 2017 at 1600h

Sample 8035: *HES Basin Out*		Sample 8036: *SB18500E Out*		*Vacant*
Concentration (%)	**% Unaffected (Mean ± SD)**	**Concentration (%)**	**% Unaffected (Mean ± SD)**	
DMW Control	90.0 ± 11.6	DMW Control	90.0 ± 11.6	
6.3	80.0 ± 16.3	6.3	100 ± 0.0	
12.5	90.0 ± 11.6	12.5	100 ± 0.0	
25	95.0 ± 10.0	25	100 ± 0.0	
50	95.0 ± 10.0	50	100 ± 0.0	
100	100 ± 0.0	100	100 ± 0.0	
48-hr EC10 = >100% **48-hr EC50 = >100%** **NOEC = 100%** **LOEC = >100%**		**48-hr EC10 = >100%** **48-hr EC50 = >100%** **NOEC = 100%** **LOEC = >100%**		

QA/QC Parameter	**Criterion**	**This Test**	**Criterion met?**
Control mean % unaffected	≥90.0%	90.0%	Yes
Reference Toxicant within cusum chart limits	185.0-231.1mg KCl/L	212.1mg KCl/L	Yes

Toxicity Test Report: TR1469/2

(Page 1 of 2)

Accredited for compliance with ISO/IEC 17025

Client:	Fulton Hogan Foxground Berry Bypass NSW	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1469 6 March 2017 7 March 2017
Attention:	Sam Leigh	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL1469_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
8035	HES Basin Out	Aqueous sample, pH 7.8*, conductivity 121.0µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.
8036	SB18500E Out	Aqueous sample, pH 7.7*, conductivity 378µS/cm*, total ammonia <2.0mg/L*. Sample received at 5ºC* in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	96-hr fish imbalance toxicity test using the eastern rainbowfish *Melanotaenia splendida splendida*
Test Protocol:	ESA SOP 117 (ESA 2015), based on USEPA (2002)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The samples were serially diluted with dilute mineral water (DMW) to achieve the test concentrations. A DMW control was tested concurrently with the samples.
Source of Test Organisms:	In-house cultures
Test Initiated:	11 March 2017 at 1300h (Lab ID 8035) and 12 March 2017 at 1200h (Lab ID 8036)

Sample 8035: *HES Basin Out*		Sample 8036: *SB18500E Out*		*Vacant*
Concentration (%)	**% Unaffected (Mean ± SD)**	**Concentration (%)**	**% Unaffected (Mean ± SD)**	
DMW Control	100 ± 0.0	DMW Control	100 ± 0.0	
6.3	100 ± 0.0	6.3	100 ± 0.0	
12.5	100 ± 0.0	12.5	100 ± 0.0	
25	95.0 ± 10.0	25	100 ± 0.0	
50	100 ± 0.0	50	100 ± 0.0	
100	100 ± 0.0	100	100 ± 0.0	
96-hr EC10 = >100% **96-hr EC50 = >100%** **NOEC = 100%** **LOEC = >100%**		**96-hr EC10 = >100%** **96-hr EC50 = >100%** **NOEC = 100%** **LOEC = >100%**		

QA/QC Parameter	**Criterion**	**This Test**	**Criterion met?**
Control mean % unaffected (11/03/17)	≥80.0%	100%	Yes
Control mean % unaffected (12/03/17)	≥80.0%	100%	Yes
Reference Toxicant within cusum chart limits	8.0-134.0µg Cu/L	45.2µg Cu/L	Yes

Attachment 2

IFOD™ MANUAL

CLIENT:

The ifod-FLOW was developed by Turbid in response to the need for contractors to dewater standing water around site into the sediment basin after a rainfall event. The ifod-FLOW does not rely on rainfall but rather reads flow entering the basin and doses according to this. This allows contractors to pump standing water through the inflow point, or divert runoff through the inflow point, which will then be treated.

The ifod-FLOW is a more accurate dosing system than the rain activated systems as there is no guesswork involved in runoff generated from site entering basin.

The system comprises a 12-volt solar power pack, datalogger, flow meter and 12v dosing pump.

Two types of flow meters can be used:

A. Ultrasonic sensor: An ultrasonic sensor is located above the inflow of water and measures the depth. The datalogger then converts this into a volume.

B. Area Velocity Flow Meter (AVFM): An AVFM is located within the flow of water and uses a doppler and ultrasonic to measure the velocity and depth of the water. These are used where an inflow pipe or structure is flooded as an ultrasonic sensor does not work in this application.

As the flow sensor measures the volume of water entering, the datalogger will activate the pump at a prescribed volume (e.g. every 1,000 litres). Again, the dose rate is required and the running time of the pump is determined by this. The coagulant is then injected into the incoming flow of water into the basin enabling mixing as the water enters the basin.

The ifod-FLOW can be complemented with water quality sensors to measure the incoming water quality. When used in conjunction with outflow sensors, water quality improvement can be monitored.

The addition of inflow sensors also allows the ifod-FLOW to control when dosing occurs based on water quality parameters.

INSTALLATION

The ifod-FLOW is a 12 volt post mounted system similar to the ifod-RAIN.

The ifod-FLOW picks up flow in the channel or pipe and converts this to a volume. Coagulant is then dosed (pumped) into the channel, mixing with the incoming waterflow.

The system requires some type of inlet structure, such as a concrete channel of pipe, for the sensors to be mounted into or above.

An ultrasonic or area velocity meter can be used for these systems. These sensors require some programming before installation.

An ultrasonic sensor can be located above a trapezoidal channel, stepped weir or pipe.

An AVFM is located within a pipe or culvert.

The pump is connected to one or multiple IBC’s allowing enough coagulant for multiple rain events. The discharge pipe from the pump is located above the flow of water into the basin.

MAINTENANCE

Refer to the ifod-FLOW maintenance checklist.

turbid
WATER SOLUTIONS

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e info@turbid.com.au | w turbid.com.au

ifod-FLOW MAINTENANCE
INSPECTION CHECKLIST

SITE: **INSPECTION DATE:**

INSPECTING OFFICER (Full Name):

SIGNATURE:

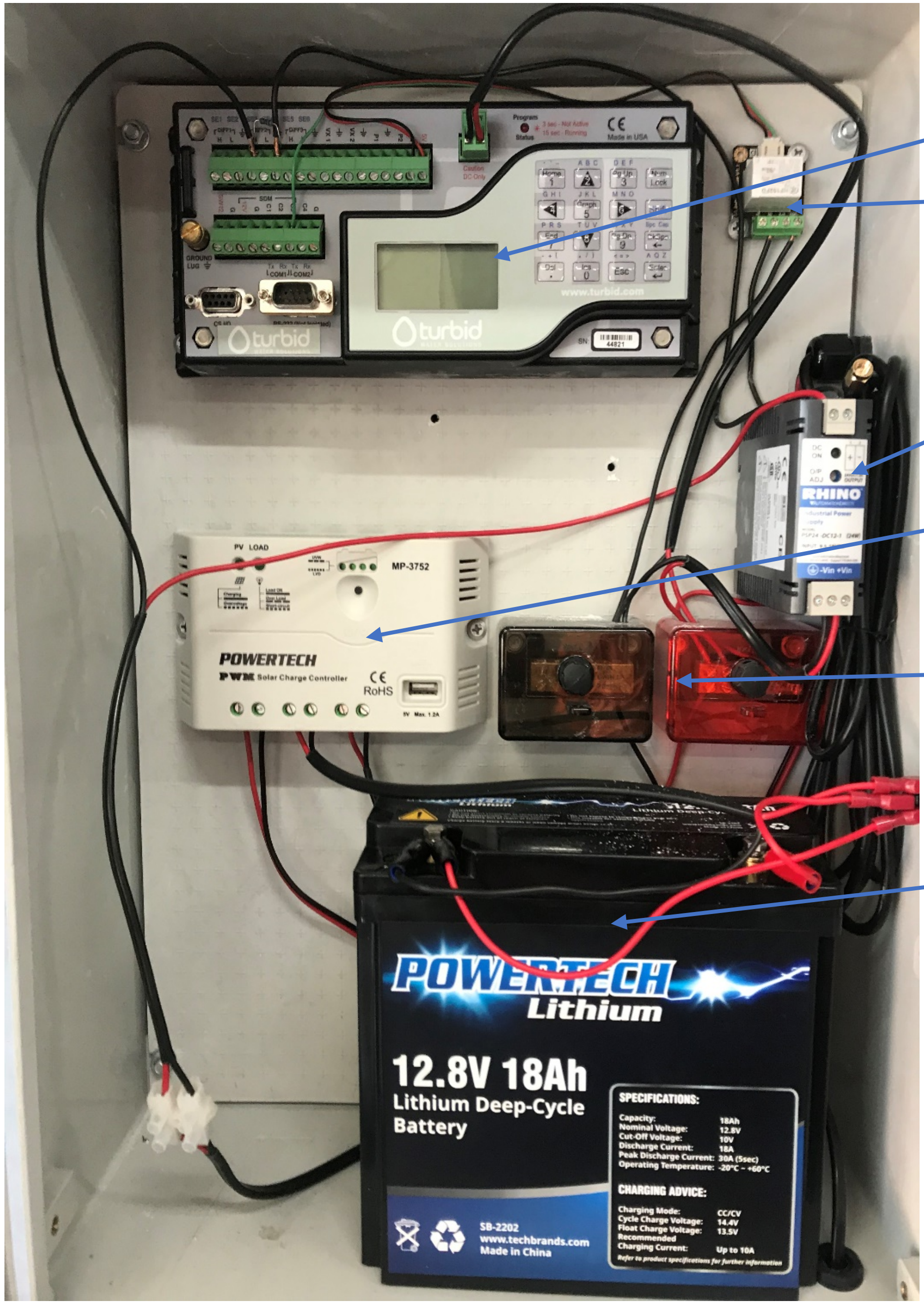
✓	**ITEM**
	Standing water levels and quality
	Decant system free from debris and in order
	Inflow point well-formed and intact
	Forebay free from overbuild-up of sediment
	Turbiclear levels adequate until next Turbid visitation
	Turbiclear storage container in good order
	Supply/discharge lines free from potential blockages
	Discharge line discharging into inflow channel
	IFOD enclosure and post in good order
	IFOD solar panel surface clean and facing north
	IFOD operational (test)
	Monitoring station sensors submerged in water and clean
	Monitoring station cables in good order
	Monitoring station enclosure and post in good order
	Monitoring station solar panel clean and facing north
	Sensors reading accurately (calibrate if required)

Turbiclear usage (L) since last inspection:

NOTES:

Ifod Trouble shooting Guide / site staff

Issue	**Possible Cause**	**Action required**
No Coagulant being dispensed during inflow or simulated inflow	Empty supply	refill IBCs
(simulated inflow being the placement of object below sensor at bottom of pipe)	Taps off on IBC / Lid closed on IBC	open tap / open lid
	Pump not running	Check Pump / hard wire to check / replace pump
	Relay faulty	Check light on relay turning on and off / replace relay
	Blocked dosing line	Check/replace line . Contact Turbid
	Disconnected Dosing line	Reconnect line
	Battery Low/ Flat	Check battery / clean solar panel / Replace Battery / Replace Solar Panel
	Not enough inflow	Place object below sensor at bottom of pipe/culvert to simulate flow.
	12-24 volt converter failed	Check light on converter
	Loose wiring	check all wiring is connected
	other	contact Turbid
Coagulant being dispensed with no inflow	Ultrasonic sensor malfunctioning	Turn system off and on again .(green plug on datalogger) If this continues turn off.
	Ultrasonic sensor failed	Contact Turbid
	Program / data logger malfunctioning	Contact Turbid
	other	Contact Turbid
Doser operating but water not cleaning up	Dose rate incorrect for incoming water	Jar test and adjust dose rate
	Incorrect Treatment Product for incoming water	Jar test and adjust dose rate/product
	pH too low or high	adjust pH with Lime or Acid
	Water Entering Basin from other sources	Eliminate water entering from other sources
	other	Contact Turbid



Data Logger

Relay Module

12v -24v converter for ultrasonic sensor

Solar Charge Controller

Positive (Red) & Negative (Black)

Terminal Blocks

12 Volt Battery

Mounted Ultrasonic Sensor and coagulant discharge line above flow of water

Inflow Datalogger Adjustment.

The inflow data logger is a CR850 datalogger with LCD screen that allows site staff to check sensor readings, adjust dose rates and trigger the pump manually.

Dose Rates may need to be adjusted when water quality is not achieving desired outcomes.

To check sensor readings.

Press ‘enter’ on the logger’s keypad until the public table appears. Scroll down until the desired parameter is visible. These values will be live values of the sensors at that point in time.

- To adjust dosing rates.
  Press ‘enter’ on the logger’s keypad until the public table appears. Scroll down until ‘u-pump run time’ is visible. Press enter once selected. Change pump run time and press ‘esc’.

- To adjust dose frequency
  Scroll down the public table until ‘U-dose trigger volume’ appears. Press enter and change volume dosing frequency. Normally set at 1000 litres.

- To trigger the pump.
  Press ‘enter’ on the logger’s keypad until the public table appears. Scroll down until ‘c- run pump’ is visible. Press enter once selected and scroll to ‘true’. The pump will then trigger. Press ‘esc’.

Jar Testing Procedure

The jar testing procedure described herein is provided by Turbid Water Solutions to assist our clients undertake their own jar tests to inform selection of appropriate water treatment product(s) for their site.

If additional assistance or advice is required, please do not hesitate to contact a Turbid representative.

Method

STEP ONE: Collect samples of raw water:

1. Raw water samples should be representative of the sediment laden water to be treated by the flocculating agent.
2. It is recommended a minimum of three litres of raw water is collected for use in the jar tests.
3. Grab samples taken shortly after a runoff event and from 30cm below the free water surface near to the inlet of the sediment basin to be treated is preferred.
4. Measure and record the pH of the raw water sample(s) prior to commencing the jar test. If pH is below 6.5 the raw water sample may require buffering with a sprinkle of hydrated lime prior to commencing the Jar Test. *Apply only enough hydrated lime to raise the pH of the raw water to between 7 and 8.5*.

If there is no raw water available on site for collection it will be necessary to create ‘indicative’ raw water samples. This is done by collecting representative soil samples from the soil profile(s) expected to be disturbed by construction activities (screened through a 1mm sieve to remove the coarse fraction) and mixing discrete and composites of the collected soil samples with a clean water source (ideally local rainwater) at a rate of 10g/L to produce a suite of indicative raw water samples. This procedure will produce ‘indicative’ raw water samples with a notional TSS concentration of 10,000mg/L.

STEP TWO: Prepare 1% diluted sample of the flocculating agent(s) to be tested:

5. It is recommended at least two flocculating agents be tested for each site.
6. Prepare separate 1% solution of each flocculating agent (that is 1ml of the flocculating agent diluted in 99ml of clean rainwater).

STEP THREE: Add 1% flocculating solution to raw water.

7. Using a syringe, add in 1ml increments the 1% solution of flocculating agent to a 1L sample of raw water, stirring rapidly for around 10-15 seconds.
8. After each 1ml increment inspect the raw water sample as flow velocities within jar/bottle slow for the formation of ‘flocs’ (like seen in a snow-globe).
9. Look for a clear portion of at least 5cm depth to form at the surface within 2 to 3 minutes after stirring has ceased.
10. If a clear portion doesn’t fully form within a few minutes add the next increment of 1% solution of flocculating agent, stirring rapidly for 10-15 seconds.
11. Repeat this procedure until the required clear portion is observed and keep a record (Step 6) of the number of 1ml increments added.

12. Measure the pH of the final flocced raw water sample to confirm the pH falls within acceptable discharge limits for the site. If measured pH is below discharge criteria it may require addition of lime (or similar) to buffer up the pH.
13. If flocs are not forming within a reasonable time after adding a large number (>50) increments of the 1% solution of flocculating agent, it is possible the alkalinity of the raw water sample may be too low and requires adjustment. Abandon the current jar test and prepare a new raw water sample as per Step One and add a sprinkle of superfine gypsum to raise the alkalinity.
14. If after adding a sprinkle of superfine Gypsum the 1% solution of flocculating agent does NOT form flocs it may be necessary to consider testing an alternative flocculating agent.

STEP 4: Determine required dose rate and dose rate window

15. The total amount (# of increments) of 1% solution of flocculating agent required to achieve the 5cm clear portion within 2 to 3 minutes provides the minimum dose rate required for the sediment basin.
16. For example, if 5ml (i.e. 5 x 1ml increments) of a 1% solution of flocculating agent was required then the dose rate is 0.05ml per litre of raw water in the sediment basin (i.e. 50L per megalitre of raw water in the sediment basin).
17. The dose rate window is the dose rate range within which the 1% solution of flocculating agent is observed to be effective. This is determined by continuing to add 1ml increments of the 1% solution of flocculating agent to the raw water sample using the procedure in Step 3 until such time the 5cm clear portion no longer forms within the 2 to 3-minute timeframe (which indicates the raw water sample has been “over-dosed”). The total amount (# of increments) of 1% solution of flocculating agent that was added to reach this point of “over-dosing” represents the upper limit of the dose rate window.
18. It is recommended the starting dose rate for treating the sediment basin be set just above the minimum dose rate to avoid risk of “over-dosing” the basin.

STEP 5: Verify Test Results

19. Repeat Step 3 and Step 4 on a second 1L sample of raw water to verify the initial results.
20. If the results are only marginally different from the initial test, then use an average of the two sets of results to set the required dose rate.
21. If the results are markedly different from the initial test, then it will be necessary to conduct at least one additional jar test to gain confidence in the required dose rate.

STEP 6: Record Jar Test Data and Results

22. Record the results of each jar test.

Attachment 3

6th September 2021

Hanson Quarries
per Matthew Jones
Groundwork Plus
P O Box 854
Nuriootpa SA 5355

Re: Hanson Quarries Sediment Analysis

Introduction

I understand that Hanson Quarries are trialling processes that will enhance the settlement of fine soil particles from waste water. Two samples of this soil solution were delivered to Pro Ag Soil Management The sediment was allowed to settle out of the solutions so the water could be siphoned off before finally drying the soil over a number of days. The samples were then submitted to Apal Laboratory for analysis.

The aim of this investigation is to assess and analyse the sediment soil to determine its suitability for blending with other quarry materials for reuse in areas to be revegetated.

Sediment Assessment and Analysis

The two samples submitted and were labelled:

- 44560
- 44697

Horticultural Analysis

The samples were forwarded to Apal Laboratory in Hindmarsh for complete horticultural analysis (H1) including the following parameters:
Texture, pH, EC, Chloride, Boron, Organic Matter, Nitrogen, Sulphur, Phosphorous, Trace Elements (Fe, Mn, Cu, Zn), Cation Exchange Capacity, Exchangeable Cations (Na, Ca, Mg, K) and Ca:Mg Ratio.

Apal Laboratory Horticultural Analysis

 # copies of Apal data reports will be forwarded with this document

The results from analysis of the two samples are similar for all parameters, so the following interpretation and summary will apply to both. The results are summarised in the table below.

Sediment Samples 44560 & 44697

Unit	Found	Comment
Texture (MIR)	Silty Loam	Very fine material - >60% silt and clay
ECEC	Good	Good nutrient holding capacity
Organic carbon	Marginal	Will improve when vegetation is established
pH	Very High	Strongly alkaline – select suitable species for planting
Available N	Low	Apply nitrogen fertiliser before planting
Phosphorus	Low	Apply acidic phosphorus fertiliser before planting (MAP)
P Availability (PBI)	Low	P availability reduced by the alkaline conditions
Sulphur	High	
Potassium	Low	Potassium low as % of cations - fertiliser needed
Ca:Mg balance	Good	No lime or gypsum is needed
Trace elements	Good	All trace elements are well supplied
Salinity (EC)	Elevated	Conductivity requires plants with moderate salt tolerance
Chloride	Good	
Sodicity (ESP)	Good	Soil is non-sodic

Table 1

The most significant issues identified that are relevant for plant rootzone material:

- Fine texture – the sediment is likely to have poor structure and slow infiltration rates unless it is blended with coarser materials.
- Cation Exchange Capacity – the samples have enough clay particles present to provide good nutrient holding capacity
- Strongly alkaline pH. Take into account when selecting planting material.
- Nutrient deficiencies – nitrogen, phosphorus and potassium are all low but can be added in a preplant fertiliser program
- Conductivity and sodium. EC (salinity) is elevated so select plant species with moderate salt tolerance. Sodium concentration (mg/kg) is above the desired level but is low in balance with the other cations (ESP). The soils should be stable and non-dispersive.

Summary

As tested, these fine textured sediments are not suitable for use as planting media, however they would have value as blends with other coarser quarry waste materials, by adding exchange capacity and nutrients including trace elements.

Although salinity is elevated, this is likely to be diluted by blending with other materials and will leach out over time. The conductivity found will not affect most native species.

The analysis found no other toxicities present that would compromise plant growth. It is possible that aluminium compounds have been used as flocculation agents, however plant aluminium toxicity will only be an issue in acidic soils. You will note that in the laboratory results, exchangeable aluminium levels are very low in these alkaline samples.

Sediment Amendment Program

I recommend that blends of sediment and other materials are first produced and samples analysed, before determining what amendments and fertilisers are needed to prepare them for planting.

Please contact me if you have any questions about my interpretation or recommended program

Phil Barnett

Phil Barnett
Soil Consultant

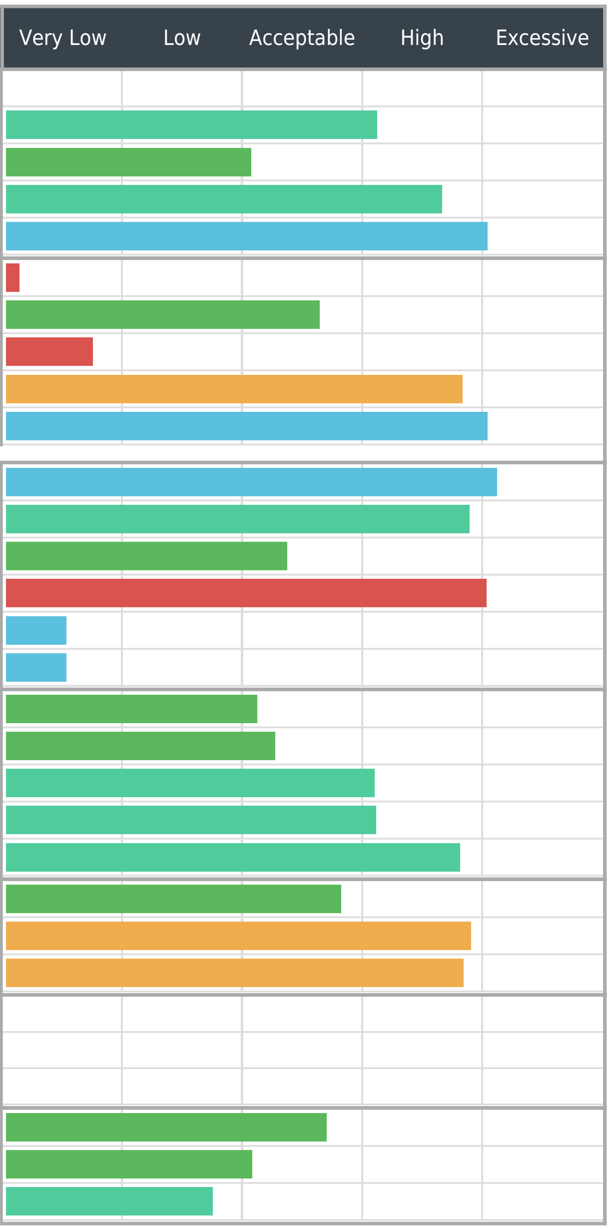
APAL
Australian Precision Ag Laboratory

SOIL ANALYSIS

Agent:	Pro Ag Soil Management
Agent Address:	82 William Street, NORWOOD, SA, 5067
Client:	Hanson
Test Set or Quotation:	H1
Barcode:	110850001
Batch Number:	25375
Submission ID:	80274

Report Date:	31/08/2021
Sampling Date:	NA
Date Received:	24/08/2021
Sample Name:	Sample 44560
Crop:	Dryland Pasture
Sample Depth:	NA
GPS Start:	NA
GPS End:	NA

		Unit	Desired Level	Level Found	c.mol/kg
	MIR - Aus Soil Texture			Silty loam	
	ECEC	cmol/kg	5.00-25.0	27.5	
	Organic Carbon (W&B)	%	0.900-1.80	0.940	
	pH 1:5 water	pH units	6.50-7.50	8.46	
	pH CaCl2 (following 4A1)	pH units	5.50-6.50	8.08	
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg	20-50	1.1	
	Ammonium - N (2M KCl)	mg/kg	2.0-10	7.0	
	Colwell Phosphorus	mg/kg	34-40	13	
	PBI + Col P		35.0-70.0	217	
	MCP Sulfur (S)	mg/kg	8.0-20	110	
Exchangeable cations	Calcium (Ca) - AmmAc	mg/kg	1000-2000	4450	22.2
	Magnesium (Mg) - AmmAc	mg/kg	150-200	448	3.68
	Potassium (K) - AmmAc	mg/kg	150-220	175	0.447
	Sodium (Na) - AmmAc	mg/kg	15.0-120	261	1.14
	Exchangeable aluminium	cmol/kg	0.10-0.35	<0.02	
	Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Trace Elements	Boron	mg/kg	0.50-2.0	0.64	
	Iron (Fe)	mg/kg	10-70	25	
	Manganese (Mn)	mg/kg	1.0-10	13	
	Copper (Cu)	mg/kg	0.50-1.0	1.3	
	Zinc (Zn)	mg/kg	0.50-1.0	4.2	
Salt	Chloride	mg/kg	15-400	320	
	Salinity EC 1:5	dS/m	0.025-0.15	0.46	
	Ece	dS/m	0.10-1.5	4.3	
Physical	MIR - Clay	%		21.5	
	MIR - Sand (+20 micron)	%		34.1	
	MIR - Silt (2-20 micron)	%		44.4	
Ratios	Ca:Mg Ratio		2.0-8.0	6.0	
	K:Mg Ratio		0.10-0.50	0.12	
	GTRI		0.020-0.070	0.020	



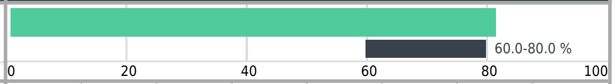
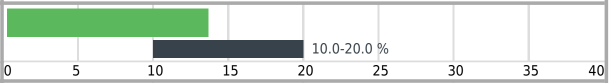
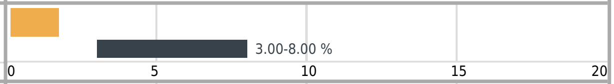
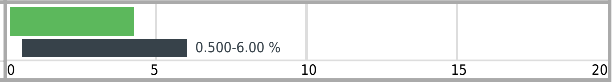
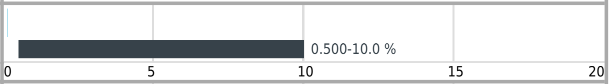
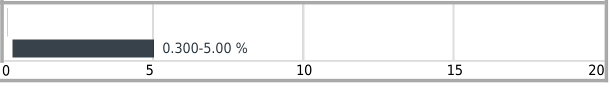
APAL
Australian Precision Ag Laboratory

SOIL ANALYSIS

ProAg
soil management

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850001
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44560
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

		Unit	Desired Level	Level Found	Exchangeable cation % (eCEC)
Exch. cation %	Calcium	%	60.0-80.0	80.8	
	Magnesium	%	10.0-20.0	13.4	
	Potassium	%	3.00-8.00	1.60	
	Sodium	%	0.500-6.00	4.10	
	Aluminium	%	0.500-10.0	0.00	
	Hydrogen	%	0.300-5.00	0.00	

NOTE: Apal Laboratory will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

APAL
Australian Precision Ag Laboratory

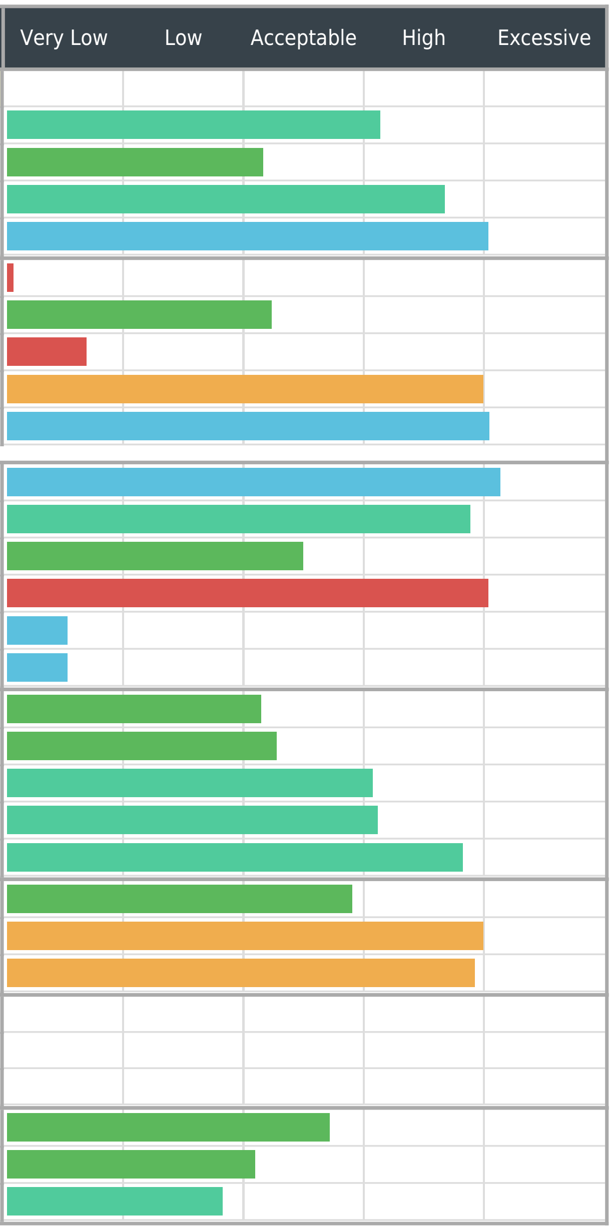
SOIL ANALYSIS

ProAg
soil management

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850003
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44697
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

		Unit	Desired Level	Level Found	c.mol/kg
	MIR - Aus Soil Texture			Silty loam	
	ECEC	cmol/kg	5.00-25.0	27.7	
	Organic Carbon (W&B)	%	0.900-1.80	1.02	
	pH 1:5 water	pH units	6.50-7.50	8.47	
	pH CaCl2 (following 4A1)	pH units	5.50-6.50	8.06	
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg	20-50	<1	
	Ammonium - N (2M KCl)	mg/kg	2.0-10	3.7	
	Colwell Phosphorus	mg/kg	34-40	12	
	PBI + Col P		35.0-70.0	245	
	MCP Sulfur (S)	mg/kg	8.0-20	140	
Exchangeable cations	Calcium (Ca) - AmmAc	mg/kg	1000-2000	4480	22.4
	Magnesium (Mg) - AmmAc	mg/kg	150-200	445	3.66
	Potassium (K) - AmmAc	mg/kg	150-220	183	0.468
	Sodium (Na) - AmmAc	mg/kg	15.0-120	285	1.24
	Exchangeable aluminium	cmol/kg	0.10-0.35	<0.02	
	Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Trace Elements	Boron	mg/kg	0.50-2.0	0.67	
	Iron (Fe)	mg/kg	10-70	25	
	Manganese (Mn)	mg/kg	1.0-10	12	
	Copper (Cu)	mg/kg	0.50-1.0	1.4	
	Zinc (Zn)	mg/kg	0.50-1.0	4.3	
Salt	Chloride	mg/kg	15-400	350	
	Salinity EC 1:5	dS/m	0.025-0.15	0.49	
	Ece	dS/m	0.10-1.5	4.6	
Physical	MIR - Clay	%		19.2	
	MIR - Sand (+20 micron)	%		39.2	
	MIR - Silt (2-20 micron)	%		41.6	
Ratios	Ca:Mg Ratio		2.0-8.0	6.1	
	K:Mg Ratio		0.10-0.50	0.13	
	GTRI		0.020-0.070	0.020	



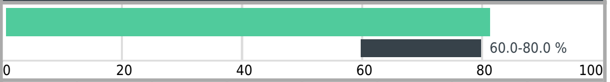
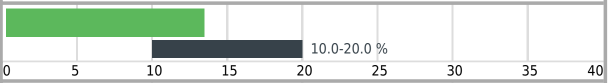
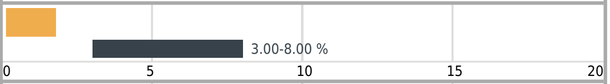
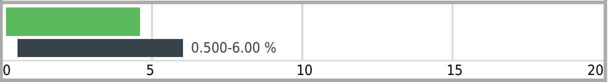
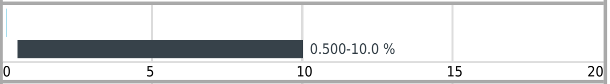
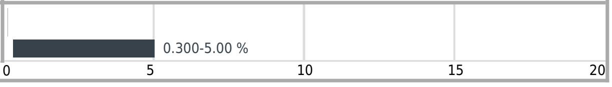
APAL
Australian Precision Ag Laboratory

SOIL ANALYSIS

ProAg soil management

Agent:	Pro Ag Soil Management
Agent Address:	82 William Street, NORWOOD, SA, 5067
Client:	Hanson
Test Set or Quotation:	H1
Barcode:	110850003
Batch Number:	25375
Submission ID:	80274

Report Date:	31/08/2021
Sampling Date:	NA
Date Received:	24/08/2021
Sample Name:	Sample 44697
Crop:	Dryland Pasture
Sample Depth:	NA
GPS Start:	NA
GPS End:	NA

		Unit	Desired Level	Level Found	Exchangeable cation % (eCEC)
Exch. cation %	Calcium	%	60.0-80.0	80.6	
	Magnesium	%	10.0-20.0	13.2	
	Potassium	%	3.00-8.00	1.70	
	Sodium	%	0.500-6.00	4.50	
	Aluminium	%	0.500-10.0	0.00	
	Hydrogen	%	0.300-5.00	0.00	

NOTE: Apal Laboratory will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

Appendix C: ProAg Reports

Appendix C1: *ProAg Soil Management report Hanson Quarries Sediment Analysis dated 6th September 2021*

ProAg
soil management

6th September 2021

Hanson Quarries
per Matthew Jones
Groundwork Plus
P O Box 854
Nuriootpa SA 5355

Re: Hanson Quarries Sediment Analysis

Introduction

I understand that Hanson Quarries are trialling processes that will enhance the settlement of fine soil particles from waste water. Two samples of this soil solution were delivered to Pro Ag Soil Management The sediment was allowed to settle out of the solutions so the water could be siphoned off before finally drying the soil over a number of days. The samples were then submitted to Apal Laboratory for analysis.

The aim of this investigation is to assess and analyse the sediment soil to determine its suitability for blending with other quarry materials for reuse in areas to be revegetated.

Sediment Assessment and Analysis

The two samples submitted and were labelled:

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- 44697

Horticultural Analysis

The samples were forwarded to Apal Laboratory in Hindmarsh for complete horticultural analysis (H1) including the following parameters:
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Apal Laboratory Horticultural Analysis

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The results from analysis of the two samples are similar for all parameters, so the following interpretation and summary will apply to both. The results are summarised in the table below.

Sediment Samples 44560 & 44697

Unit	Found	Comment
Texture (MIR)	Silty Loam	Very fine material - >60% silt and clay
ECEC	Good	Good nutrient holding capacity
Organic carbon	Marginal	Will improve when vegetation is established
pH	Very High	Strongly alkaline – select suitable species for planting
Available N	Low	Apply nitrogen fertiliser before planting
Phosphorus	Low	Apply acidic phosphorus fertiliser before planting (MAP)
P Availability (PBI)	Low	P availability reduced by the alkaline conditions
Sulphur	High	
Potassium	Low	Potassium low as % of cations - fertiliser needed
Ca:Mg balance	Good	No lime or gypsum is needed
Trace elements	Good	All trace elements are well supplied
Salinity (EC)	Elevated	Conductivity requires plants with moderate salt tolerance
Chloride	Good	
Sodicity (ESP)	Good	Soil is non-sodic

Table 1

The most significant issues identified that are relevant for plant rootzone material:

- Fine texture – the sediment is likely to have poor structure and slow infiltration rates unless it is blended with coarser materials.
- Cation Exchange Capacity – the samples have enough clay particles present to provide good nutrient holding capacity
- Strongly alkaline pH. Take into account when selecting planting material.
- Nutrient deficiencies – nitrogen, phosphorus and potassium are all low but can be added in a preplant fertiliser program
- Conductivity and sodium. EC (salinity) is elevated so select plant species with moderate salt tolerance. Sodium concentration (mg/kg) is above the desired level but is low in balance with the other cations (ESP). The soils should be stable and non-dispersive.

Summary

As tested, these fine textured sediments are not suitable for use as planting media, however they would have value as blends with other coarser quarry waste materials, by adding exchange capacity and nutrients including trace elements.

Although salinity is elevated, this is likely to be diluted by blending with other materials and will leach out over time. The conductivity found will not affect most native species.

The analysis found no other toxicities present that would compromise plant growth. It is possible that aluminium compounds have been used as flocculation agents, however plant aluminium toxicity will only be an issue in acidic soils. You will note that in the laboratory results, exchangeable aluminium levels are very low in these alkaline samples.

Sediment Amendment Program

I recommend that blends of sediment and other materials are first produced and samples analysed, before determining what amendments and fertilisers are needed to prepare them for planting.

Please contact me if you have any questions about my interpretation or recommended program

Phil Barnett

Phil Barnett
Soil Consultant

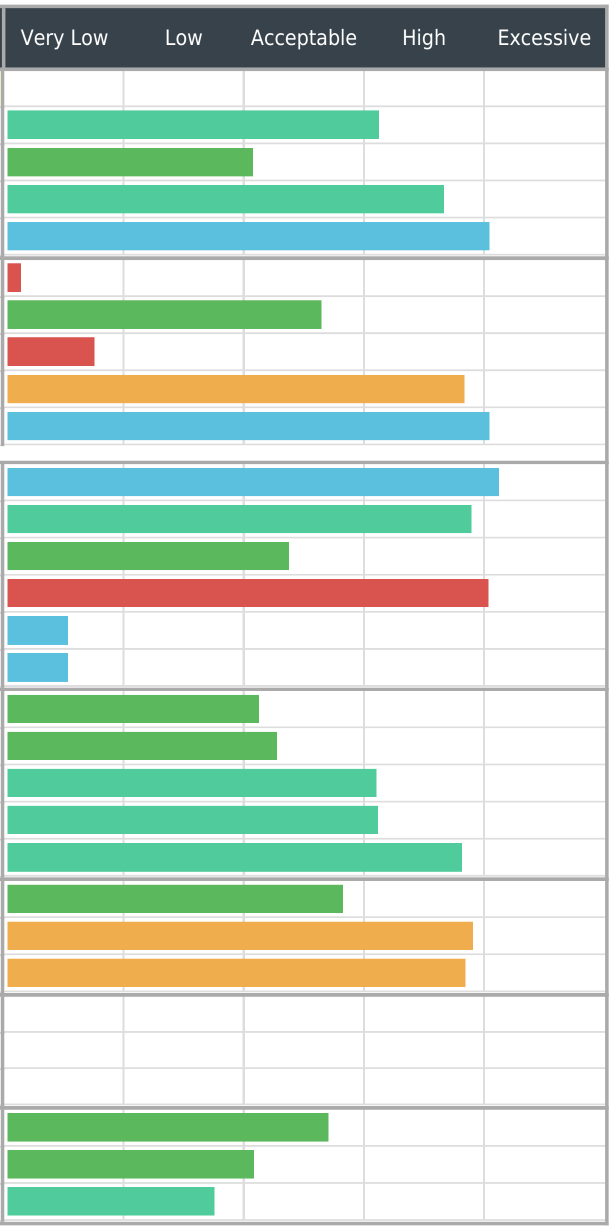
APAL
Australian Precision Ag Laboratory

SOIL ANALYSIS

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850001
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44560
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

		Unit	Desired Level	Level Found	c.mol/kg
	MIR - Aus Soil Texture			Silty loam	
	ECEC	cmol/kg	5.00-25.0	27.5	
	Organic Carbon (W&B)	%	0.900-1.80	0.940	
	pH 1:5 water	pH units	6.50-7.50	8.46	
	pH CaCl2 (following 4A1)	pH units	5.50-6.50	8.08	
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg	20-50	1.1	
	Ammonium - N (2M KCl)	mg/kg	2.0-10	7.0	
	Colwell Phosphorus	mg/kg	34-40	13	
	PBI + Col P		35.0-70.0	217	
	MCP Sulfur (S)	mg/kg	8.0-20	110	
Exchangeable cations	Calcium (Ca) - AmmAc	mg/kg	1000-2000	4450	22.2
	Magnesium (Mg) - AmmAc	mg/kg	150-200	448	3.68
	Potassium (K) - AmmAc	mg/kg	150-220	175	0.447
	Sodium (Na) - AmmAc	mg/kg	15.0-120	261	1.14
	Exchangeable aluminium	cmol/kg	0.10-0.35	<0.02	
	Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Trace Elements	Boron	mg/kg	0.50-2.0	0.64	
	Iron (Fe)	mg/kg	10-70	25	
	Manganese (Mn)	mg/kg	1.0-10	13	
	Copper (Cu)	mg/kg	0.50-1.0	1.3	
	Zinc (Zn)	mg/kg	0.50-1.0	4.2	
Salt	Chloride	mg/kg	15-400	320	
	Salinity EC 1:5	dS/m	0.025-0.15	0.46	
	Ece	dS/m	0.10-1.5	4.3	
Physical	MIR - Clay	%		21.5	
	MIR - Sand (+20 micron)	%		34.1	
	MIR - Silt (2-20 micron)	%		44.4	
Ratios	Ca:Mg Ratio		2.0-8.0	6.0	
	K:Mg Ratio		0.10-0.50	0.12	
	GTRI		0.020-0.070	0.020	

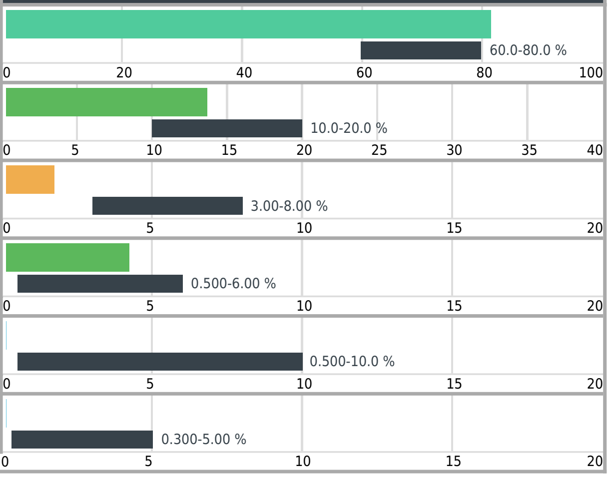


SOIL ANALYSIS

Agent:	Pro Ag Soil Management	**Report Date:**	31/08/2021
Agent Address:	82 William Street, NORWOOD, SA, 5067	**Sampling Date:**	NA
Client:	Hanson	**Date Received:**	24/08/2021
Test Set or Quotation:	H1	**Sample Name:**	Sample 44560
Barcode:	110850001	**Crop:**	Dryland Pasture
Batch Number:	25375	**Sample Depth:**	NA
Submission ID:	80274	**GPS Start:**	NA
		GPS End:	NA

		Unit	Desired Level	Level Found
Exch. cation %	Calcium	%	60.0-80.0	80.8
	Magnesium	%	10.0-20.0	13.4
	Potassium	%	3.00-8.00	1.60
	Sodium	%	0.500-6.00	4.10
	Aluminium	%	0.500-10.0	0.00
	Hydrogen	%	0.300-5.00	0.00

Exchangeable cation % (eCEC)



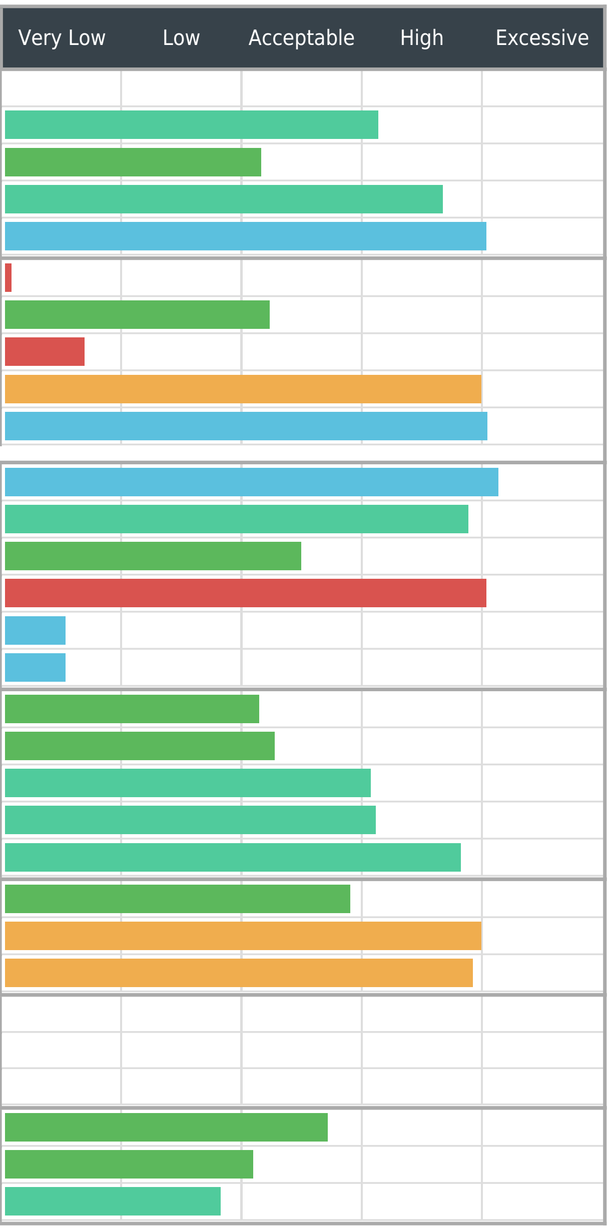
NOTE: Apal Laboratory will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

SOIL ANALYSIS

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850003
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44697
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

		Unit	Desired Level	Level Found	c.mol/kg
	MIR - Aus Soil Texture			Silty loam	
	ECEC	cmol/kg	5.00-25.0	27.7	
	Organic Carbon (W&B)	%	0.900-1.80	1.02	
	pH 1:5 water	pH units	6.50-7.50	8.47	
	pH CaCl2 (following 4A1)	pH units	5.50-6.50	8.06	
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg	20-50	<1	
	Ammonium - N (2M KCl)	mg/kg	2.0-10	3.7	
	Colwell Phosphorus	mg/kg	34-40	12	
	PBI + Col P		35.0-70.0	245	
	MCP Sulfur (S)	mg/kg	8.0-20	140	
Exchangeable cations	Calcium (Ca) - AmmAc	mg/kg	1000-2000	4480	22.4
	Magnesium (Mg) - AmmAc	mg/kg	150-200	445	3.66
	Potassium (K) - AmmAc	mg/kg	150-220	183	0.468
	Sodium (Na) - AmmAc	mg/kg	15.0-120	285	1.24
	Exchangeable aluminium	cmol/kg	0.10-0.35	<0.02	
	Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Trace Elements	Boron	mg/kg	0.50-2.0	0.67	
	Iron (Fe)	mg/kg	10-70	25	
	Manganese (Mn)	mg/kg	1.0-10	12	
	Copper (Cu)	mg/kg	0.50-1.0	1.4	
	Zinc (Zn)	mg/kg	0.50-1.0	4.3	
Salt	Chloride	mg/kg	15-400	350	
	Salinity EC 1:5	dS/m	0.025-0.15	0.49	
	Ece	dS/m	0.10-1.5	4.6	
Physical	MIR - Clay	%		19.2	
	MIR - Sand (+20 micron)	%		39.2	
	MIR - Silt (2-20 micron)	%		41.6	
Ratios	Ca:Mg Ratio		2.0-8.0	6.1	
	K:Mg Ratio		0.10-0.50	0.13	
	GTRI		0.020-0.070	0.020	



SOIL ANALYSIS

APAL Australian Precision Ag Laboratory

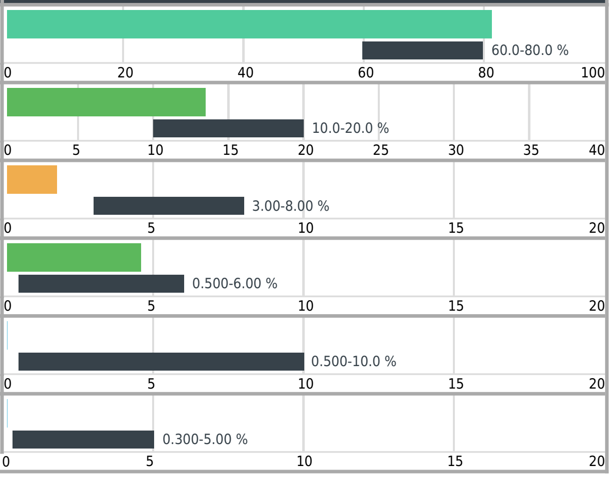
ProAg soil management

Agent: Pro Ag Soil Management
Agent Address: 82 William Street,
NORWOOD, SA, 5067
Client: Hanson
Test Set or Quotation: H1
Barcode: 110850003
Batch Number: 25375
Submission ID: 80274

Report Date: 31/08/2021
Sampling Date: NA
Date Received: 24/08/2021
Sample Name: Sample 44697
Crop: Dryland Pasture
Sample Depth: NA
GPS Start: NA
GPS End: NA

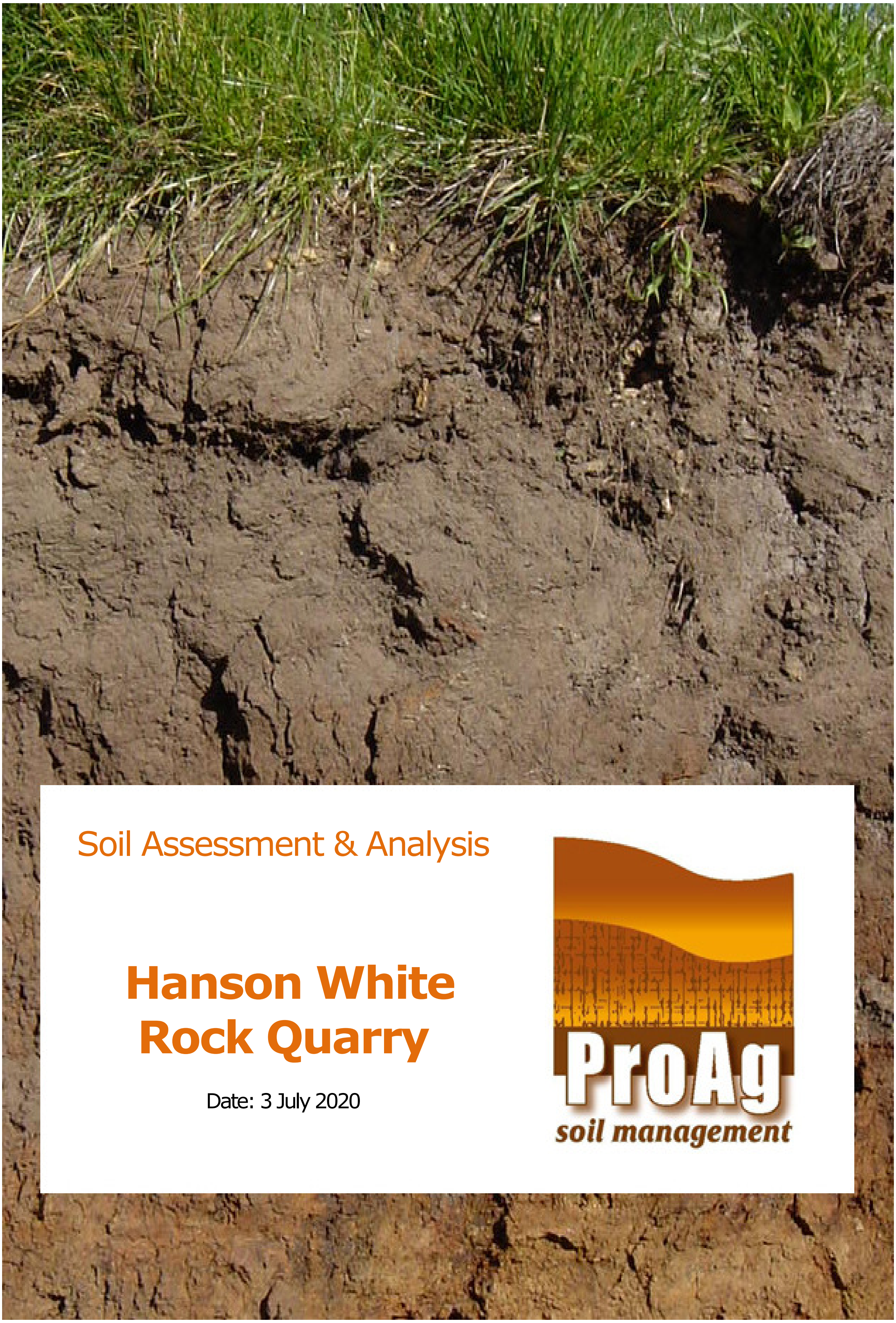
		Unit	Desired Level	Level Found
Exch. cation %	Calcium	%	60.0-80.0	80.6
	Magnesium	%	10.0-20.0	13.2
	Potassium	%	3.00-8.00	1.70
	Sodium	%	0.500-6.00	4.50
	Aluminium	%	0.500-10.0	0.00
	Hydrogen	%	0.300-5.00	0.00

Exchangeable cation % (eCEC)



NOTE: Apal Laboratory will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

Appendix C2: *ProAg Soil Assessment & Analysis Hanson White Rock Quarry Date: 3 July 2020*



Soil Assessment & Analysis

Hanson White Rock Quarry

Date: 3 July 2020

ProAg soil management

Introduction

Pro Ag Soil Management conducted an assessment and sampling of overburden and other materials at the Hanson White Rock Quarry, Horsnell Gully, to provide information for a rehabilitation and revegetation plan for the site.

The assessment and sampling were carried out by Soil Consultant Phil Barnett during a site visit on 19th June 2020 with Quarry Manager Michael Harvey. The aim was to collect samples of all materials that could potentially be used as planting media in rehabilitation areas, including overburden and quarry products.

There is no topsoil available on site and previous revegetation programs have involved planting tube-stock trees and shrubs into prepared quarry overburden without the addition of site salvaged or imported topsoil.

Weeds appear in the overburden soon after the batters have been formed *(see Fig.1)* and where left un-planted are followed over time by trees and shrubs seeded naturally from surrounding vegetation.

Fig 1 Volunteer growth on overburden

The overburden in the eastern sector that has been undisturbed for a period of time, appeared to be free draining and un-compacted and so should not present a barrier to root penetration.

From observation it is apparent that revegetation and successful rehabilitation can be achieved on batters comprised of quarry overburden.

On this site the revegetation batters are likely to be relatively steep and slopes left exposed under construction are susceptible to erosion until covered by volunteer grasses, weeds and tube-stock plants. Therefore, a rehabilitation plan should include stabilizing the batters as soon as possible after construction by seeding grasses in a Hydromulch mix with an aim to achieve 70% coverage as soon as possible.

In addition to stabilizing the batters, the inclusion of native grasses and understory plants in the planting mix will add to the environmental value of the revegetated areas.

When the slope has been stabilized with grasses, additional trees and shrubs could then be planted as tube-stock if a denser stand was needed.

Germination and establishment should be enhanced by applying appropriate amendments based on soil analysis to speed up the process of turning the overburden into living soil.

Representative Sampling

Four representative samples were collected for analysis to provide information for designing the revegetation program.

- Overburden East
- Overburden West
- Quarry Sand
- PM3

Methodology

Twenty subsamples were collected with a stainless steel trowel at each site and the thoroughly mixed to produce a representative sample for analysis.

Laboratory Analysis

The samples were then submitted to Apal Laboratory for H1 complete analysis which includes MIR Texture, ECEC, pH, Organic Carbon, NO3, NH4, Phosphorus (Colwell), MCP Sulphur, Exchangeable Cations (Ca, Mg, K, Na, Al, H), trace elements (B, Fe, Mn, Cu, Zn), EC1:5< ECe and Chloride.

Samples were also assessed for slaking and dispersion.

Overburden East

This material has been in place for several years and supports weed and tree growth *(see Fig 2).*

Fig.2 Overburden East

Overburden West

Recently stockpiled material from the western side of the quarry *(see Fig 3).*

Fig.3 Overburden West Stockpile

Quarry Sand

Clean sand quarry product from the stockpile *(see Fig.4).*

Fig.4 Quarry Sand Stockpile

PM3

PM3 road-base product from the stockpile *(see Fig.5).*

Fig.5 PM3 Stockpile

Summary of Analysis

The lab graph reports and data in Excell format are attached with this report.

There are significant differences between the materials tested, including between the two overburden samples.

Overburden East *(see attached graph reports)*

Dispersion Test

The Overburden East sample showed no dispersion after 20 hours and is relatively stable *(See Fig. 6).*

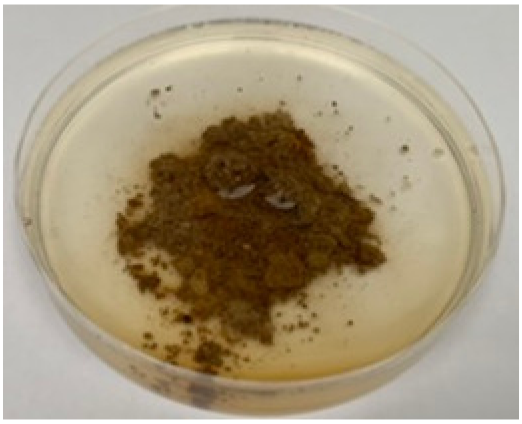


Fig. 6

Laboratory Analysis Summary

Unit	Found	Comment
ECEC	Good	Excellent nutrient holding capacities
Organic carbon	Low	Apply seed with high carbon soil conditioner
pH	High	Strongly alkaline – select suitable species
Available N	Very Low	Add nitrogen fertiliser
Phosphorus	Very Low	Use slow release mineral fertiliser at planting
Sulphur	Marginal	
Potassium	Very Low	Use slow release mineral fertiliser at planting
Cation balance	Good	
Trace elements	Low	B, Fe, Zn - Add low rates to the planting mix
Salinity (EC)	Low	
Sodicity (ESP)	Low	

Table 1

This sample has the highest exchange capacity of the materials tested and so has excellent nutrient holding ability. Organic matter level is low but that can be addressed in the seeding program by adding high carbon amendments. The material is strongly alkaline so this needs to be considered when selecting plant species for these sites and when choosing appropriate amendments.

The Ca:Mg Ratio is in the acceptable range and suggests that the material will remain open with good structure and will not tend to compact.

Major elements nitrogen, phosphorus and potassium are very low but local native plant species do not need high nutrient levels. It is recommended to add some standard nitrogen fertiliser for early growth because of the lack of organic matter and a low rate of phosphorus and potassium in a slowly available mineral fertiliser as part of the planting mix *(see program for revegetation below).*
Trace elements boron, iron and zinc are low and the very small amounts required can be added to the planting mix

There are no toxicities evident in these results with conductivity (salinity), chlorides and sodium all at low levels.

This is the best material of the samples tested because it is stable, has good exchange capacity, some organic matter and has a proven ability to support plant growth. Use similar material to this for building the surface profile (250mm) of all batters to be revegetated.

Overburden West *(see attached graph reports)*

Dispersion Test

The Overburden West sample showed strong dispersion after 20 hours with about 1/3 of the original volume dispersed outwards and is therefore relatively unstable *(See Fig. 7).*

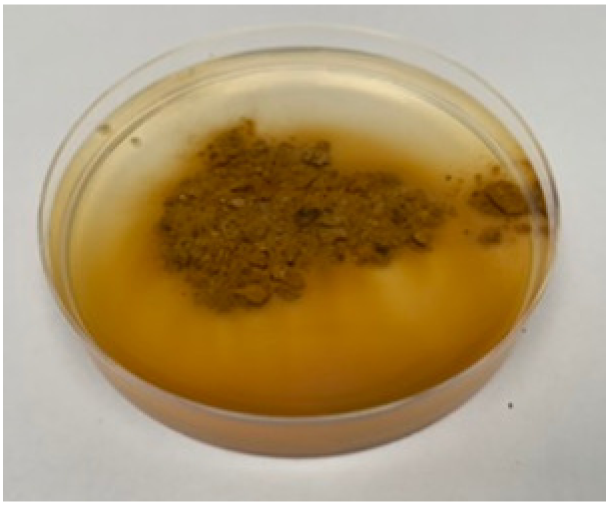


Fig. 7

Laboratory Analysis Summary

Unit	Found	Comment
ECEC	Moderate	Adequate nutrient holding capacity
Organic carbon	Very Low	
pH	High	Strongly alkaline
Available N	Very low	Add nitrogen fertiliser
Phosphorus	Very low	Use slow release mineral fertiliser at planting
Sulphur	good	
Potassium	Low	Use slow release mineral fertiliser at planting
Cation balance	Poor	Very low Ca:Mg – add gypsum
Trace elements	Low	B, Fe, Zn - Add low rates to the planting mix
Exchangeable Al	High	
Salinity (EC)	Low	
Sodicity (ESP)	High	Sodic and dispersive – add gypsum

Table 2

This overburden has many characteristics that are similar to the eastern sample, like reasonable exchange capacity and similar pH and nutrient levels. However, it also has significant limitations that need to be addressed if it were to be used in the upper profile for planting.

There are significant imbalances between cations with calcium very low and magnesium very high which is likely to have an impact on the availability of some elements to plants. Although not saline, sodium is very high (sodicity) and likely to cause dispersion and poor structure in these materials. The high exchangeable sodium is the cause of the instability observed in the dispersion test.

The overburden could be improved by the addition and incorporation of gypsum before planting

This overburden material should be treated with gypsum and used in the base when constructing revegetation batters and topped with better quality material from the eastern zone before planting.

Quarry Sand *(see attached graph reports)*

Dispersion Test

The Quarry Sand sample showed no dispersion after 20 hours and is relatively stable *(See Fig. 8).*

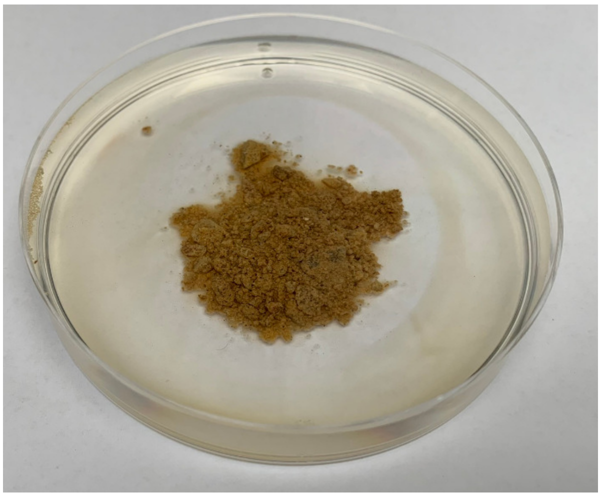


Fig. 8

Summary

Unit	Found	Comment
ECEC	Very low	Limited holding capacity
Organic carbon	Very Low	
pH	High	Moderately alkaline
Available N	Very Low	
Phosphorus	Very Low	
Sulphur	Very Low	
Potassium	Very Low	
Cation balance	Very Low	
Trace elements	Very Low	
Salinity (EC)	Good	
Sodicity (ESP)	Acceptable	

Table 3

This almost purely sand product only has a trace of clay present to provide very limited nutrient holding capacity. As a result, it is deficient in organic matter and all major and trace elements. Biological activity will also be limited in this material and in its present state it would not be able to support the establishment of healthy plant growth.

According to Michael Harvey, weeds do not establish on quarry sand stockpiles which is an indication of its poor plant growing characteristics.

Quarry sand would not be suitable for use in the upper profile of revegetation areas. It could however be successfully blended with Overburden West if necessary, as long as the blend was tested and amended before planting

PM3 *(see attached graph reports)*

Dispersion Test

The PM3 sample showed no dispersion after 20 hours and is relatively stable *(See Fig. 9).*

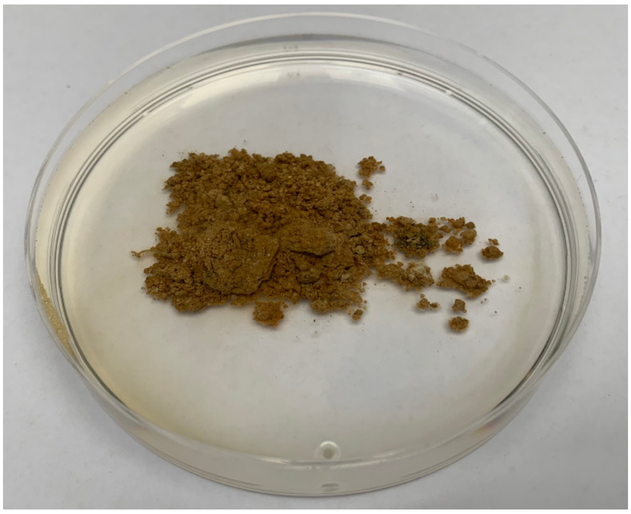


Fig. 9

Summary

Unit	Found	Comment
ECEC	Very low	Limited holding capacity
Organic carbon	Very Low	
pH	High	Moderately alkaline
Available N	Very Low	
Phosphorus	Very Low	
Sulphur	Good	
Potassium	Very Low	
Cation balance	Very Low	
Trace elements	Very Low	B, Fe, Zn
Salinity (EC)	Good	
Sodicity (ESP)	Acceptable	

Table 4

This quarry product appears to comprised of gravel and a finer component of quarry sand. As a result, the product has only a trace of clay present to give very limited nutrient holding capacity. It is deficient in organic matter and most major and trace elements. Biological activity will also be limited in this material and in its present state it would not be able to support the establishment of healthy plant growth.

PM3 would not be suitable for use in the upper profile of revegetation areas. It could however be successfully blended with Overburden West *if necessary as long as the blend was tested and amended before planting*

Slope summary

The most important limiting factor in batter surface stabilization is the degree of slope and this will determine the approach taken.

The following table *(see Table 4)* is a general summary of the best options for various slopes adapted from *"Guideline for batter surface stabilization using vegetation" NSW Roads & Maritime Service* and based on my Hydromulching industry experience. Slopes are defined as:

4h:1v – moderate slope
3h:1v – steep slope
2h:1v – steep slope
1.5h:1v – very steep slope

The characteristics of each revegetation site should be assessed before deciding on the optimum approach for planting and erosion control with reference to Tables 5 & 6 below.

Revegetation Technique Summary

Slope	Technique	Relative cost	Est $/m²	Erosion control	Comment
4h-3h:1v	Tubestock	Moderate		Slow	Trees and shrubs only
	Broadcast seed	Low		Slow	Roots needed to hold soil
	Hydroseeding	Low	$0.75	Slow	Roots needed to hold soil
	Hydromulching	Moderate	$1.15	Rapid	Binders included in mulch
4h-3h:1v no topsoil	Biotic soil medium + Hydromulch	High	$4.15	Rapid	Binders included in mulch
2h:1v	Hydromulching BFM	Moderate	$1.40	Rapid	Bonded fibre matrix + binders
2h:1v no topsoil	Biotic soil medium + BFM	High	$4.40	Rapid	Seed applied in BSM & covered by BFM
1.5h:1v	High rates BFM	Moderate	$2.80	Rapid	Bonded fibre matrix + binder
1.5h:1v with no topsoil	Biotic Soil Medium +High rates BFM	High	$5.80	Rapid	Seed applied in BSM & covered by BFM

1h:1v	Geospray synthetic erosion blanket	Very High	$40.00	Immediate	No vegetation can be sown with the blanket

Table 5

Duration of erosion protection

Technique	Duration
Broadcast / tubestock	None until plants establish
Hydroseeding	None until plants establish
Hydromulching (eg straw mulch)	2 – 6 months for mulch. Longer if plants establish successfully
Hydromulching – Bonded Fibre Matrix (BFM)	8 – 12 months for BFM. Longer if plants establish successfully.
Biotic Soil Medium + Hydromulch BFM	12 – 18 months for BSM + BFM. Longer if plants establish successfully.

Table65

Program for Revegetation

The following describes an optimum program for White Rock Quarry. This program will provide immediate erosion protection and create the right conditions for successful germination and establishment of grasses, shrubs and trees.

Revegetation program:

- Prepare the batters as close as is practical to the time of seeding so the overburden material is friable and there is limited time for weeds to establish.

- Use Overburden East material on the batter surface rootzone layers. Ensure that there is at least 250mm of this overburden as the top layer of the batter for surface root establishment.

- Also ensure that there is an additional base of at least 1.5m of overburden with physical characteristics suitable for root establishment such as a range of particle sizes and an absence of large pore spaces or voids. Overburden West would be suitable for this layer.

- Amend the Overburden West material with 3t/ha of gypsum before the surface layer is laid down.

- Where possible limit the slope to a maximum steepness of 2h:1v (50%) to reduce erosion risk. Although steeper slopes can be successfully seeded and stabilized, they require much higher rates of mulch, stickers and binding agents *(see Table 5).* Hand planting of tube-stock becomes more difficult on steeper slopes.

- Sample the material in the top 200mm of the batter surface as soon as possible after construction and submit it for full horticultural soil analysis (eg Apal Laboratory H1 Test + Dispersion).

- Conduct a mapping survey (3D aerial) of the areas to be revegetated to accurately establish planting area and steepness of slopes to calculate seeding and mulching rates.

- The optimum time for seeding is after good rains have fallen in the autumn and when the top 150mm is moist. Hand watering could be useful to support tube-stock planted at other less ideal times, however it is not practical for seed germination over wider areas in the warmer and drier months.

- Hydraulically spray on a seed mix that contains native grasses, shrubs and trees of local provenance. Also include a cover crop like sterile Ryecorn (*Secale cereale*) to provide fast surface coverage and stability.

- Add soil amendments like lime or gypsum if identified as needed in the pre-planting soil analysis results.

- Because there will be no topsoil on the batters, it would be beneficial to hydraulically apply biotic soil media (BSM) at a rate determined by the organic matter content of the batter material. The combination of high carbon and organic soil conditioners, mineral nutrients and microbial inoculants will stimulate growth of beneficial microorganisms and accelerate the process of turning overburden into active soil. The BSM will also hold applied nutrients in the rootzone and prevent loss in runoff water.

- Add any major or minor elements appropriate for the species planted that are identified as deficient in the pre-planting soil analysis results.

- If Overburden East is used as surface material and biotic soil media (BSM) applied, add the following to the planting mix per hectare:

    - 100kg Sulphate of Ammonia
    - 100kg Sulphate of Potash
    - 3 kg Zinc Sulphate
    - 2 kg Borax

  - If no Biotic Soil Media (BSM) is applied then also include the following to the planting mix:

    500kg/ha High Carbon Soil Conditioner
    400kg Slow Release Mineral fertiliser

  - To hold the slopes and provide erosion control until the seedling roots have established, apply Hydromulch BFM (bonded fibre matrix). When applied over Biotic Soil Media, indicative rates for differing slopes are 3000kg BFM/ha for 2h:1v and 3500kg BFM/ha for 1.5h:1v. Hydromulching (eg with straw mulch) could be used on slopes of 3h:1v and below.

  - Hydromulch BFM will give up to eighteen months of erosion protection by which time plant roots will be sufficiently established to hold the slope surface.

- Allow the site to establish for at least a year and then assess plant and species coverage. If there are any gaps, fill them with appropriate tube-stock plants.

  The steps above describe an ideal program and although it could be modified, any changes should take into account potential compromises to surface stability and the rate and diversity of plant establishment *(see Tables 5 & 6).*

I am available to discuss the results of the soil analysis and this report so please contact me if you have any queries.

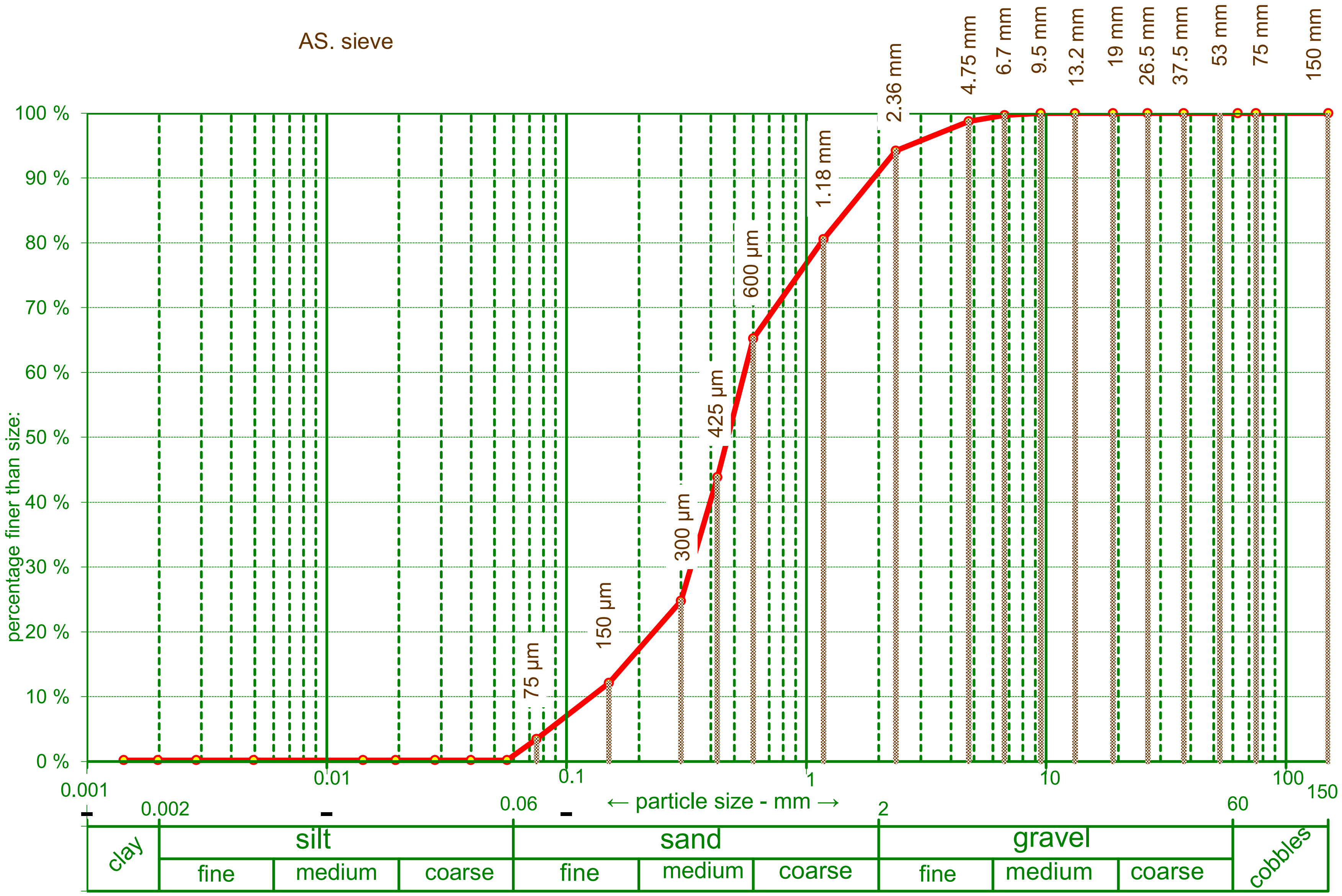
Phil Barnett

Phil Barnett
Soil Consultant

Disclaimer: The conclusions and recommendations included in this report are limited by the data available at the time of preparation. Soil is a continuum that may vary considerably between sampling and observation points and it is not possible to see, describe or measure everything that may exist below the soil surface. In practice sampling, soil survey techniques and laboratory analysis of samples will not always identify every characteristic of a soil or area assessed.

Attachments:

1. Apal Laboratory graph reports
2. Laboratory analysis data Excell format
3. Laboratory data summary Excell format


AS. sieve
75 µm
150 µm
300 µm
425 µm
600 µm
1.18 mm
2.36 mm
4.75 mm
6.7 mm
9.5 mm
13.2 mm
19 mm
26.5 mm
37.5 mm
53 mm
75 mm
150 mm
100 %
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
0 %
percentage finer than size:
0.001
0.01
0.1
1
10
100
150
0.002
0.06
2
60
← particle size - mm →
clay
silt
fine
medium
coarse
sand
fine
medium
coarse
gravel
fine
medium
coarse
cobbles

Appendix D: Chain of Custody and Certified Analytical Reports

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 276339

Client Details

Client	Hanson Australia Pty Ltd
Attention	Simon Kitson
Address	Level 8, 2-12 Macquarie Street, Parramatta, NSW, 2150

Sample Details

Your Reference	**White Rock Quarry**
Number of Samples	1 Sediment
Date samples received	19/08/2021
Date completed instructions received	20/08/2021

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	27/08/2021
Date of Issue	27/08/2021

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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

Authorised By

Nancy Zhang, Laboratory Manager

Particle Size Distribution in Soils		
Our Reference		276339-1
Your Reference	UNITS	Sediment
Date Sampled		17/08/2021
Type of sample		Sediment
Date prepared	-	25/08/2021
Date analysed	-	26/08/2021
Cobbles >75mm	%	<1
Cobbles/Coarse Gravel 63-75mm	%	<1
Coarse Gravel 37.5-63mm	%	<1
Coarse Gravel 26.5-37.5mm	%	<1
Coarse Gravel 19-26.5mm	%	<1
Medium Gravel 13.2-19mm	%	<1
Medium Gravel 9.5-13.2mm	%	<1
Medium Gravel 6.7-9.5mm	%	<1
Medium Gravel 4.75-6.7mm	%	1
Fine Gravel 2.36-4.75mm	%	5
Very Coarse Sand 1.18-2.36mm	%	14
Coarse Sand 0.6-1.18mm	%	15
Medium Sand 0.425-0.6mm	%	21
Medium Sand 0.3-0.425mm	%	19
Fine Sand 0.15-0.3mm	%	13
Very Fine Sand 0.075-0.15mm	%	9
Coarse Silt 0.020-0.075mm	%	3
Fine Silt 0.002-0.020mm	%	<1
Clay <0.002mm	%	<1

Method ID	Methodology Summary
Inorg-107	Particle Size Distribution using AS1269.3.6.3 and AS1269.3.6.1 and in house INORG-107.

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.

* 2 Day Please *

III

CHAIN OF CUSTODY RECORD

Eurofins | Environment Testing ABN 50 005 085 521

☐ **Sydney Laboratory**
Unit F3 Bld.F 16 Mars Road Lane Cove West NSW 2066
02 9900 8400 EnviroSampleNSW@eurofins.com

☐ **Brisbane Laboratory**
Unit 1 21 Smallwood Place Murarrie QLD 4172
07 3902 4600 EnviroSampleQLD@eurofins.com

☐ **Perth Laboratory**
Unit 2 91 Leach Highway Kewdale WA 6105
EnviroSampleWA@eurofins.com

☐ **Melbourne Laboratory**
6 Monterey Road Dandenong South VIC 3175
03 8564 5000 EnviroSampleVic@eurofins.com

Company	AME	**Project №**	Hanson lawP
Address		**Project Name**	
Contact Name	AM	**Project Manager**	
Phone №	0407352036	**EDD Format** ESdat, EQuIS etc	
Special Directions	Dup2 → Envirolab (HM(8)) - 2 day	**Sampler(s)**	
Purchase Order	* 2 Day *	**Handed over by**	
Quote ID №		**Email for Invoice**	
		Email for Results	

Analyses — Where metals are requested, please specify "Total" or "Filtered". SUITE code must be used to attract SUITE pricing.

№	Client Sample ID	Sampled Date/Time dd/mm/yy hh:mm	Matrix Solid (S) Water (W)	CA EMA Wht Soil	HM(8)	R21	BTEX
1	VS 1	27/5/21	Soil	✓			
2	2	↓	↓		✓		
3	3			✓			
4	4				✓		
5	5			✓			
6	6				✓		
7	7				✓		
8	Dup1				✓		
9	Dup2						
10	EIL		Soil			✓	
	TRIP	↓	W				✓

Total Counts

Containers — Change container type & size if necessary.
500mL Plastic | 250mL Plastic | 125mL Plastic | 200mL Amber Glass | 40mL VOA vial | 500mL PFAS Bottle | Jar (Glass or HDPE) | Other (Asbestos AS4964, WA Guidelines)

Required Turnaround Time (TAT)
Default will be 5 days if not ticked.
◆Surcharge will apply
☐ Overnight (reporting by 9am)◆
☐ Same day◆ ☐ 1 day◆
☐ 2 days◆ ☐ 3 days◆
☐ 5 days (Standard)
☐ Other(

Sample Comments / Dangerous Goods Hazard Warning

Method of Shipment	☐ Courier (#)	☐ Hand Delivered	☐ Postal	Name		Signature		Date	Time
Laboratory Use Only	Received By	Michael Young	SYD | BNE | MEL | PER | [✓ ADL] | NTL | DRW	Signature		Date	27/5/21	Time 1:12pm	Temperature 18.0°C
	Received By		SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature		Date		Time	Report №

Eurofins Environment Testing Australia Pty Ltd

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | Environment Testing Standard Terms and Conditions unless agreed otherwise. A copy is available on request.

Jake 892607 18.4 / 20.4

* 2Day Please *

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COPY

26

CHAIN OF CUSTODY RECORD

Eurofins | Environment Testing ABN 50 005 085 521

☐ **Sydney Laboratory**
Unit F3 Bld.F 16 Mars Road Lane Cove West NSW 2066
02 9900 8400 EnviroSampleNSW@eurofins.com

☐ **Brisbane Laboratory**
Unit 1 21 Smallwood Place Murarrie QLD 4172
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☐ **Perth Laboratory**
Unit 2 91 Leach Highway Kewdale WA 6105
08 9251 9600 EnviroSampleWA@eurofins.com

☐ **Melbourne Laboratory**
6 Monterey Road Dandenong South VIC 3175
03 8564 5000 EnviroSampleVic@eurofins.com

Company: AME
Address:
Contact Name: AY
Phone №: 0407352036
Special Directions: Dp2 → Envirolab (HM(8)) - 2day
Purchase Order: * 2 Day *
Quote ID №:

Project №: Hanson / AWP
Project Name:
Project Manager:
EDD Format (ESdat, EQuIS etc):

Sampler(s):
Handed over by:
Email for Invoice:
Email for Results:

Required Turnaround Time (TAT)
Default will be 5 days if not ticked.
♦Surcharge will apply
☐ Overnight (reporting by 9am)♦
☐ Same day♦ ☐ 1 day♦
☐ 2 days♦ ☐ 3 days♦
☐ 5 days (Standard)
☐ Other( )

Analyses: Where metals are requested, please specify "Total" or "Filtered". SUITE code must be used to attract SUITE pricing.

Containers: Change container type & size if necessary.

№	Client Sample ID	Sampled Date/Time dd/mm/yy hh:mm	Matrix Solid (S) Water (W)	CA EPA Waste Soil	~~HM(8)~~ HM(8)	R21	BTEX	500mL Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL VOA vial	500mL PFAS Bottle	Jar (Glass or HDPE)	Other (Asbestos AS4964, WA Guidelines)	Sample Comments / Dangerous Goods Hazard Warning
1	VS 1	27/5/21	Soil	✓												
2	2	↓	↓		✓											
3	3			✓												
4	4				✓											
5	5			✓												
6	6				✓											
7	7				✓											
8	Dp1				✓											
9	Dp2															
10	~~[illegible]~~ EIL	↓	~~Soil~~			✓										
	TRIP	↓	W				✓									
			Total Counts													

Method of Shipment: ☐ Courier (#) ☐ Hand Delivered ☐ Postal Name Signature Date Time

Laboratory Use Only	Received By	Michael Young	SYD | BNE | MEL | PER | [✓ ADL] | NTL | DRW	Signature		Date	27/5/21	Time	1:12pm	Temperature	18.0°C
	Received By		SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature		Date		Time		Report №	

Eurofins Environment Testing Australia Pty Ltd

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | Environment Testing Standard Terms and Conditions unless agreed otherwise. A copy is available on request.

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eurofins

Environment Testing

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

AM Environmental Consulting P/L
7 Rudd Crt
Bridgewater
SA 5155

Attention: **-Ashley Moule (all SRA/REPORTS)**

Report **892607-S-V2**
Project name HANSON LAWP
Received Date May 27, 2022

Client Sample ID **Sample Matrix** **Eurofins Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**VS1** **Soil** **M22-My0069438** **May 27, 2022**	**VS2** **Soil** **M22-My0069439** **May 27, 2022**	**VS3** **Soil** **M22-My0069440** **May 27, 2022**	**VS4** **Soil** **M22-My0069441** **May 27, 2022**
Total Recoverable Hydrocarbons						
TRH C6-C9	20	mg/kg	< 20	-	< 20	-
TRH C10-C14	20	mg/kg	< 20	-	< 20	-
TRH C15-C28	50	mg/kg	< 50	-	< 50	-
TRH C29-C36	50	mg/kg	< 50	-	< 50	-
TRH C10-C36 (Total)	50	mg/kg	< 50	-	< 50	-
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	< 0.5	-
TRH C6-C10	20	mg/kg	< 20	-	< 20	-
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	-	< 20	-
TRH >C10-C16	50	mg/kg	< 50	-	< 50	-
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	-	< 50	-
TRH >C16-C34	100	mg/kg	< 100	-	< 100	-
TRH >C34-C40	100	mg/kg	< 100	-	< 100	-
TRH >C10-C40 (total)*	100	mg/kg	< 100	-	< 100	-
Volatile Organics						
Tetrachloroethene	0.5	mg/kg	< 0.5	-	< 0.5	-
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	-
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	-
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	-
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	-
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	-
Xylenes - Total*	0.3	mg/kg	< 0.3	-	< 0.3	-
4-Bromofluorobenzene (surr.)	1	%	142	-	70	-
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	0.6	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	1.2	-
Acenaphthene	0.5	mg/kg	< 0.5	-	< 0.5	-
Acenaphthylene	0.5	mg/kg	< 0.5	-	< 0.5	-
Anthracene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	-
Chrysene	0.5	mg/kg	< 0.5	-	< 0.5	-

Client Sample ID **Sample Matrix** **Eurofins Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**VS1** **Soil** **M22-My0069438** **May 27, 2022**	**VS2** **Soil** **M22-My0069439** **May 27, 2022**	**VS3** **Soil** **M22-My0069440** **May 27, 2022**	**VS4** **Soil** **M22-My0069441** **May 27, 2022**
Polycyclic Aromatic Hydrocarbons						
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	-
Fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	-
Fluorene	0.5	mg/kg	< 0.5	-	< 0.5	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Naphthalene	0.5	mg/kg	< 0.5	-	< 0.5	-
Phenanthrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Pyrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Total PAH*	0.5	mg/kg	< 0.5	-	< 0.5	-
2-Fluorobiphenyl (surr.)	1	%	69	-	79	-
p-Terphenyl-d14 (surr.)	1	%	94	-	84	-
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	< 0.05	-
a-HCH	0.05	mg/kg	< 0.05	-	< 0.05	-
Aldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
b-HCH	0.05	mg/kg	< 0.05	-	< 0.05	-
d-HCH	0.05	mg/kg	< 0.05	-	< 0.05	-
Dieldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan I	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan II	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin ketone	0.05	mg/kg	< 0.05	-	< 0.05	-
g-HCH (Lindane)	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	< 0.05	-
Methoxychlor	0.05	mg/kg	< 0.05	-	< 0.05	-
Toxaphene	0.5	mg/kg	< 0.5	-	< 0.5	-
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Dibutylchlorendate (surr.)	1	%	78	-	87	-
Tetrachloro-m-xylene (surr.)	1	%	112	-	120	-
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1221	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1232	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1242	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1248	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1254	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1260	0.1	mg/kg	< 0.1	-	< 0.1	-
Total PCB*	0.1	mg/kg	< 0.1	-	< 0.1	-
Dibutylchlorendate (surr.)	1	%	78	-	87	-
Tetrachloro-m-xylene (surr.)	1	%	112	-	120	-

Client Sample ID			**VS1**	**VS2**	**VS3**	**VS4**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M22-My0069438**	**M22-My0069439**	**M22-My0069440**	**M22-My0069441**
Date Sampled			**May 27, 2022**	**May 27, 2022**	**May 27, 2022**	**May 27, 2022**
Test/Reference	LOR	Unit				
Phenols (Halogenated)						
2-Chlorophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2.4-Dichlorophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2.4.5-Trichlorophenol	1	mg/kg	< 1	-	< 1	-
2.4.6-Trichlorophenol	1	mg/kg	< 1	-	< 1	-
2.6-Dichlorophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
4-Chloro-3-methylphenol	1	mg/kg	< 1	-	< 1	-
Pentachlorophenol	1	mg/kg	< 1	-	< 1	-
Tetrachlorophenols - Total	10	mg/kg	< 10	-	< 10	-
Total Halogenated Phenol*	1	mg/kg	< 1	-	< 1	-
Phenols (non-Halogenated)						
2-Cyclohexyl-4.6-dinitrophenol	20	mg/kg	< 20	-	< 20	-
2-Methyl-4.6-dinitrophenol	5	mg/kg	< 5	-	< 5	-
2-Nitrophenol	1.0	mg/kg	< 1	-	< 1	-
2.4-Dimethylphenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2.4-Dinitrophenol	5	mg/kg	< 5	-	< 5	-
2-Methylphenol (o-Cresol)	0.2	mg/kg	< 0.2	-	< 0.2	-
3&4-Methylphenol (m&p-Cresol)	0.4	mg/kg	< 0.4	-	< 0.4	-
Total cresols*	0.5	mg/kg	< 0.5	-	< 0.5	-
4-Nitrophenol	5	mg/kg	< 5	-	< 5	-
Dinoseb	20	mg/kg	< 20	-	< 20	-
Phenol	0.5	mg/kg	< 0.5	-	< 0.5	-
Phenol-d6 (surr.)	1	%	56	-	64	-
Total Non-Halogenated Phenol*	20	mg/kg	< 20	-	< 20	-
Chromium (hexavalent)	1	mg/kg	< 1	-	< 1	-
Chromium (trivalent)	5	mg/kg	15	-	14	-
Cyanide (total)	5	mg/kg	< 5	-	< 5	-
% Moisture	1	%	21	26	23	21
Heavy Metals						
Aluminium	20	mg/kg	11000	17000	11000	14000
Arsenic	2	mg/kg	2.4	3.4	2.4	2.8
Barium	10	mg/kg	130	-	120	-
Beryllium	2	mg/kg	< 2	-	< 2	-
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	15	24	14	20
Cobalt	5	mg/kg	9.1	-	8.4	-
Copper	5	mg/kg	34	54	31	44
Iron	20	mg/kg	23000	-	24000	-
Lead	5	mg/kg	21	25	75	24
Manganese	5	mg/kg	460	-	920	-
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	8.2	13	6.2	11
Silver	2	mg/kg	< 2	-	< 2	-
Zinc	5	mg/kg	60	73	58	70

Client Sample ID			VS5	VS6	VS7	DUP1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M22-My0069442	M22-My0069443	M22-My0069444	M22-My0069445
Date Sampled			May 27, 2022	May 27, 2022	May 27, 2022	May 27, 2022
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons						
TRH C6-C9	20	mg/kg	< 20	-	-	-
TRH C10-C14	20	mg/kg	< 20	-	-	-
TRH C15-C28	50	mg/kg	< 50	-	-	-
TRH C29-C36	50	mg/kg	< 50	-	-	-
TRH C10-C36 (Total)	50	mg/kg	< 50	-	-	-
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	-	-
TRH C6-C10	20	mg/kg	< 20	-	-	-
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	-	-	-
TRH >C10-C16	50	mg/kg	< 50	-	-	-
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	-	-	-
TRH >C16-C34	100	mg/kg	< 100	-	-	-
TRH >C34-C40	100	mg/kg	< 100	-	-	-
TRH >C10-C40 (total)*	100	mg/kg	< 100	-	-	-
Volatile Organics						
Tetrachloroethene	0.5	mg/kg	< 0.5	-	-	-
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	-	-
Toluene	0.1	mg/kg	< 0.1	-	-	-
Ethylbenzene	0.1	mg/kg	< 0.1	-	-	-
m&p-Xylenes	0.2	mg/kg	< 0.2	-	-	-
o-Xylene	0.1	mg/kg	< 0.1	-	-	-
Xylenes - Total*	0.3	mg/kg	< 0.3	-	-	-
4-Bromofluorobenzene (surr.)	1	%	74	-	-	-
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	-	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	-	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	-	-
Acenaphthene	0.5	mg/kg	< 0.5	-	-	-
Acenaphthylene	0.5	mg/kg	< 0.5	-	-	-
Anthracene	0.5	mg/kg	< 0.5	-	-	-
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	-	-
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	-	-
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	-	-
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	-	-
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	-	-
Chrysene	0.5	mg/kg	< 0.5	-	-	-
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	-	-
Fluoranthene	0.5	mg/kg	< 0.5	-	-	-
Fluorene	0.5	mg/kg	< 0.5	-	-	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	-	-
Naphthalene	0.5	mg/kg	< 0.5	-	-	-
Phenanthrene	0.5	mg/kg	< 0.5	-	-	-
Pyrene	0.5	mg/kg	< 0.5	-	-	-
Total PAH*	0.5	mg/kg	< 0.5	-	-	-
2-Fluorobiphenyl (surr.)	1	%	94	-	-	-
p-Terphenyl-d14 (surr.)	1	%	99	-	-	-

Client Sample ID **Sample Matrix** **Eurofins Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**VS5** **Soil** **M22-My0069442** **May 27, 2022**	**VS6** **Soil** **M22-My0069443** **May 27, 2022**	**VS7** **Soil** **M22-My0069444** **May 27, 2022**	**DUP1** **Soil** **M22-My0069445** **May 27, 2022**
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	-	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	-	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	-	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	-	-
a-HCH	0.05	mg/kg	< 0.05	-	-	-
Aldrin	0.05	mg/kg	< 0.05	-	-	-
b-HCH	0.05	mg/kg	< 0.05	-	-	-
d-HCH	0.05	mg/kg	< 0.05	-	-	-
Dieldrin	0.05	mg/kg	< 0.05	-	-	-
Endosulfan I	0.05	mg/kg	< 0.05	-	-	-
Endosulfan II	0.05	mg/kg	< 0.05	-	-	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	-	-
Endrin	0.05	mg/kg	< 0.05	-	-	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	-	-
Endrin ketone	0.05	mg/kg	< 0.05	-	-	-
g-HCH (Lindane)	0.05	mg/kg	< 0.05	-	-	-
Heptachlor	0.05	mg/kg	< 0.05	-	-	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	-	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	-	-
Methoxychlor	0.05	mg/kg	< 0.05	-	-	-
Toxaphene	0.5	mg/kg	< 0.5	-	-	-
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	-	-	-
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	-	-	-
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.1	-	-	-
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.1	-	-	-
Dibutylchlorendate (surr.)	1	%	63	-	-	-
Tetrachloro-m-xylene (surr.)	1	%	147	-	-	-
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	-	-	-
Aroclor-1221	0.1	mg/kg	< 0.1	-	-	-
Aroclor-1232	0.1	mg/kg	< 0.1	-	-	-
Aroclor-1242	0.1	mg/kg	< 0.1	-	-	-
Aroclor-1248	0.1	mg/kg	< 0.1	-	-	-
Aroclor-1254	0.1	mg/kg	< 0.1	-	-	-
Aroclor-1260	0.1	mg/kg	< 0.1	-	-	-
Total PCB*	0.1	mg/kg	< 0.1	-	-	-
Dibutylchlorendate (surr.)	1	%	63	-	-	-
Tetrachloro-m-xylene (surr.)	1	%	147	-	-	-
Phenols (Halogenated)						
2-Chlorophenol	0.5	mg/kg	< 0.5	-	-	-
2.4-Dichlorophenol	0.5	mg/kg	< 0.5	-	-	-
2.4.5-Trichlorophenol	1	mg/kg	< 1	-	-	-
2.4.6-Trichlorophenol	1	mg/kg	< 1	-	-	-
2.6-Dichlorophenol	0.5	mg/kg	< 0.5	-	-	-
4-Chloro-3-methylphenol	1	mg/kg	< 1	-	-	-
Pentachlorophenol	1	mg/kg	< 1	-	-	-
Tetrachlorophenols - Total	10	mg/kg	< 10	-	-	-
Total Halogenated Phenol*	1	mg/kg	< 1	-	-	-

Client Sample ID			VS5	VS6	VS7	DUP1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M22-My0069442**	**M22-My0069443**	**M22-My0069444**	**M22-My0069445**
Date Sampled			May 27, 2022	May 27, 2022	May 27, 2022	May 27, 2022
Test/Reference	LOR	Unit				
Phenols (non-Halogenated)						
2-Cyclohexyl-4.6-dinitrophenol	20	mg/kg	< 20	-	-	-
2-Methyl-4.6-dinitrophenol	5	mg/kg	< 5	-	-	-
2-Nitrophenol	1.0	mg/kg	< 1	-	-	-
2.4-Dimethylphenol	0.5	mg/kg	< 0.5	-	-	-
2.4-Dinitrophenol	5	mg/kg	< 5	-	-	-
2-Methylphenol (o-Cresol)	0.2	mg/kg	< 0.2	-	-	-
3&4-Methylphenol (m&p-Cresol)	0.4	mg/kg	< 0.4	-	-	-
Total cresols*	0.5	mg/kg	< 0.5	-	-	-
4-Nitrophenol	5	mg/kg	< 5	-	-	-
Dinoseb	20	mg/kg	< 20	-	-	-
Phenol	0.5	mg/kg	< 0.5	-	-	-
Phenol-d6 (surr.)	1	%	54	-	-	-
Total Non-Halogenated Phenol*	20	mg/kg	< 20	-	-	-
Chromium (hexavalent)	1	mg/kg	< 1	-	-	-
Chromium (trivalent)	5	mg/kg	18	-	-	-
Cyanide (total)	5	mg/kg	< 5	-	-	-
% Moisture	1	%	21	20	21	22
Heavy Metals						
Aluminium	20	mg/kg	13000	14000	12000	12000
Arsenic	2	mg/kg	2.7	2.9	2.6	2.6
Barium	10	mg/kg	130	-	-	-
Beryllium	2	mg/kg	< 2	-	-	-
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	18	20	17	16
Cobalt	5	mg/kg	9.8	-	-	-
Copper	5	mg/kg	36	43	38	36
Iron	20	mg/kg	25000	-	-	-
Lead	5	mg/kg	20	24	19	24
Manganese	5	mg/kg	450	-	-	-
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	9.8	11	9.1	8.2
Silver	2	mg/kg	< 2	-	-	-
Zinc	5	mg/kg	66	67	60	66

Client Sample ID			EIL
Sample Matrix			**Soil**
Eurofins Sample No.			**M22-My0069446**
Date Sampled			May 27, 2022
Test/Reference	LOR	Unit	
% Moisture	1	%	22
% Clay	1	%	6.0
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	1100
pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	0.1	pH Units	9.0
Total Organic Carbon	0.1	%	1.5

Client Sample ID			**EIL**
Sample Matrix			**Soil**
Eurofins Sample No.			**M22-My0069446**
Date Sampled			**May 27, 2022**
Test/Reference	LOR	Unit	
Heavy Metals			
Aluminium	20	mg/kg	15000
Iron	20	mg/kg	29000
Heavy Metals			
Iron (%)	0.01	%	2.9
Cation Exchange Capacity			
Cation Exchange Capacity	0.05	meq/100g	29

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
SA Waste Screen			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Volatile Organics	Melbourne	May 30, 2022	7 Days
- Method: USEPA 8260 - MGT 350A Volatile Organics by GCMS			
BTEX	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2010 BTEX and Volatile TRH			
Polycyclic Aromatic Hydrocarbons	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Organochlorine Pesticides	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water (USEPA 8270)			
Polychlorinated Biphenyls	Melbourne	May 30, 2022	28 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water (USEPA 8082)			
Phenols (Halogenated)	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Phenols (non-Halogenated)	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Chromium (hexavalent)	Melbourne	May 30, 2022	28 Days
- Method: LTM-INO-4100 Hexavalent Chromium by Spectrometric detection			
Cyanide (total)	Melbourne	May 30, 2022	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
SA Waste Metals : Metals M14SA	Melbourne	May 30, 2022	28 Days
- Method: LTM-MET-3030 by ICP-OES (hydride ICP-OES for Mercury)			
% Moisture	Melbourne	May 28, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			
NEPM Screen for Soil Classification			
% Clay	Brisbane	May 31, 2022	14 Days
- Method: LTM-GEN-7040			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Melbourne	May 30, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	Melbourne	May 30, 2022	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Total Organic Carbon	Melbourne	May 31, 2022	28 Days
- Method: LTM-INO-4060 Total Organic Carbon in water and soil			
Heavy Metals	Melbourne	May 31, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Cation Exchange Capacity	Melbourne	May 31, 2022	28 Days
- Method: LTM-MET-3060 Cation Exchange Capacity by bases & Exchangeable Sodium Percentage			
Metals M8	Melbourne	May 30, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			

Company Name: AM Environmental Consulting P/L
Address: 7 Rudd Crt
Bridgewater
SA 5155

Project Name: HANSON LAWP

Order No.:
Report #: 892607
Phone: 0407 352 036
Fax:

Received: May 27, 2022 1:12 PM
Due: May 31, 2022
Priority: 2 Day
Contact Name: -Ashley Moule (all SRA/REPORTS)

Eurofins Analytical Services Manager : Michael Cassidy

Sample Detail						Metals M8	BTEX	Moisture Set	NEPM Screen for Soil Classification	SA Waste Screen
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
Sydney Laboratory - NATA # 1261 Site # 18217										
Brisbane Laboratory - NATA # 1261 Site # 20794									X	
Mayfield Laboratory - NATA # 1261 Site # 25079										
Perth Laboratory - NATA # 2377 Site # 2370										
External Laboratory										
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**					
1	VS1	May 27, 2022		Soil	M22-My0069438			X		X
2	VS2	May 27, 2022		Soil	M22-My0069439	X		X		
3	VS3	May 27, 2022		Soil	M22-My0069440			X		X
4	VS4	May 27, 2022		Soil	M22-My0069441	X		X		
5	VS5	May 27, 2022		Soil	M22-My0069442			X		X
6	VS6	May 27, 2022		Soil	M22-My0069443	X		X		

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Sample Detail						Metals M8	BTEX	Moisture Set	NEPM Screen for Soil Classification	SA Waste Screen
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
Sydney Laboratory - NATA # 1261 Site # 18217										
Brisbane Laboratory - NATA # 1261 Site # 20794									X	
Mayfield Laboratory - NATA # 1261 Site # 25079										
Perth Laboratory - NATA # 2377 Site # 2370										
External Laboratory										
7	VS7	May 27, 2022		Soil	M22-My0069444	X		X		
8	DUP1	May 27, 2022		Soil	M22-My0069445	X		X		
9	EIL	May 27, 2022		Soil	M22-My0069446			X	X	
10	TRIP	May 27, 2022		Water	M22-My0069447		X			
Test Counts						5	1	9	1	3

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
ppm: parts per million
org/100 mL: Organisms per 100 millilitres
mg/L: milligrams per litre
ppb: parts per billion
NTU: Nephelometric Turbidity Units
µg/L: micrograms per litre
%: Percentage
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Volatile Organics							
Tetrachloroethene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total*	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-HCH	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-HCH	mg/kg	< 0.05			0.05	Pass	
d-HCH	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan II	mg/kg	< 0.05			0.05	Pass	
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-HCH (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.05			0.05	Pass	
Toxaphene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.1			0.1	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.1			0.1	Pass	
Aroclor-1242	mg/kg	< 0.1			0.1	Pass	
Aroclor-1248	mg/kg	< 0.1			0.1	Pass	
Aroclor-1254	mg/kg	< 0.1			0.1	Pass	
Aroclor-1260	mg/kg	< 0.1			0.1	Pass	
Total PCB*	mg/kg	< 0.1			0.1	Pass	
Method Blank							
Phenols (Halogenated)							
2-Chlorophenol	mg/kg	< 0.5			0.5	Pass	
2.4-Dichlorophenol	mg/kg	< 0.5			0.5	Pass	
2.4.5-Trichlorophenol	mg/kg	< 1			1	Pass	
2.4.6-Trichlorophenol	mg/kg	< 1			1	Pass	
2.6-Dichlorophenol	mg/kg	< 0.5			0.5	Pass	
4-Chloro-3-methylphenol	mg/kg	< 1			1	Pass	
Pentachlorophenol	mg/kg	< 1			1	Pass	
Tetrachlorophenols - Total	mg/kg	< 10			10	Pass	
Method Blank							
Phenols (non-Halogenated)							
2-Cyclohexyl-4.6-dinitrophenol	mg/kg	< 20			20	Pass	
2-Methyl-4.6-dinitrophenol	mg/kg	< 5			5	Pass	
2-Nitrophenol	mg/kg	< 1			1.0	Pass	
2.4-Dimethylphenol	mg/kg	< 0.5			0.5	Pass	
2.4-Dinitrophenol	mg/kg	< 5			5	Pass	
2-Methylphenol (o-Cresol)	mg/kg	< 0.2			0.2	Pass	
3&4-Methylphenol (m&p-Cresol)	mg/kg	< 0.4			0.4	Pass	
4-Nitrophenol	mg/kg	< 5			5	Pass	
Dinoseb	mg/kg	< 20			20	Pass	
Phenol	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Chromium (hexavalent)	mg/kg	< 1			1	Pass	
Cyanide (total)	mg/kg	< 5			5	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Barium	mg/kg	< 10			10	Pass	
Beryllium	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Cobalt	mg/kg	< 5			5	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Copper	mg/kg	< 5			5	Pass	
Iron	mg/kg	< 20			20	Pass	
Lead	mg/kg	< 5			5	Pass	
Manganese	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Silver	mg/kg	< 2			2	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons							
TRH C6-C9	%	103			70-130	Pass	
TRH C10-C14	%	127			70-130	Pass	
Naphthalene	%	75			70-130	Pass	
TRH C6-C10	%	110			70-130	Pass	
TRH >C10-C16	%	129			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	109			70-130	Pass	
Toluene	%	103			70-130	Pass	
Ethylbenzene	%	104			70-130	Pass	
m&p-Xylenes	%	104			70-130	Pass	
Xylenes - Total*	%	104			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	106			70-130	Pass	
Acenaphthylene	%	123			70-130	Pass	
Anthracene	%	128			70-130	Pass	
Benz(a)anthracene	%	79			70-130	Pass	
Benzo(a)pyrene	%	91			70-130	Pass	
Benzo(b&j)fluoranthene	%	80			70-130	Pass	
Benzo(g.h.i)perylene	%	91			70-130	Pass	
Benzo(k)fluoranthene	%	107			70-130	Pass	
Chrysene	%	94			70-130	Pass	
Dibenz(a.h)anthracene	%	72			70-130	Pass	
Fluoranthene	%	115			70-130	Pass	
Fluorene	%	107			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	72			70-130	Pass	
Naphthalene	%	102			70-130	Pass	
Phenanthrene	%	103			70-130	Pass	
Pyrene	%	120			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
Chlordanes - Total	%	105			70-130	Pass	
4.4'-DDD	%	106			70-130	Pass	
4.4'-DDE	%	119			70-130	Pass	
4.4'-DDT	%	79			70-130	Pass	
a-HCH	%	99			70-130	Pass	
Aldrin	%	103			70-130	Pass	
b-HCH	%	82			70-130	Pass	
d-HCH	%	88			70-130	Pass	
Dieldrin	%	90			70-130	Pass	
Endosulfan I	%	93			70-130	Pass	
Endosulfan II	%	108			70-130	Pass	
Endosulfan sulphate	%	99			70-130	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endrin	%	113			70-130	Pass	
Endrin aldehyde	%	117			70-130	Pass	
Endrin ketone	%	87			70-130	Pass	
g-HCH (Lindane)	%	126			70-130	Pass	
Heptachlor	%	103			70-130	Pass	
Heptachlor epoxide	%	103			70-130	Pass	
Hexachlorobenzene	%	95			70-130	Pass	
Methoxychlor	%	76			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	121			70-130	Pass	
LCS - % Recovery							
Phenols (Halogenated)							
2-Chlorophenol	%	113			25-140	Pass	
2.4-Dichlorophenol	%	129			25-140	Pass	
2.4.5-Trichlorophenol	%	122			25-140	Pass	
2.4.6-Trichlorophenol	%	89			25-140	Pass	
2.6-Dichlorophenol	%	103			25-140	Pass	
4-Chloro-3-methylphenol	%	104			25-140	Pass	
Pentachlorophenol	%	94			25-140	Pass	
Tetrachlorophenols - Total	%	128			25-140	Pass	
LCS - % Recovery							
Phenols (non-Halogenated)							
2-Cyclohexyl-4.6-dinitrophenol	%	34			25-140	Pass	
2-Methyl-4.6-dinitrophenol	%	62			25-140	Pass	
2-Nitrophenol	%	82			25-140	Pass	
2.4-Dimethylphenol	%	106			25-140	Pass	
2.4-Dinitrophenol	%	43			25-140	Pass	
2-Methylphenol (o-Cresol)	%	85			25-140	Pass	
3&4-Methylphenol (m&p-Cresol)	%	95			25-140	Pass	
4-Nitrophenol	%	89			25-140	Pass	
Dinoseb	%	76			25-140	Pass	
Phenol	%	93			25-140	Pass	
LCS - % Recovery							
Chromium (hexavalent)	%	110			70-130	Pass	
Cyanide (total)	%	108			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	99			80-120	Pass	
Barium	%	101			80-120	Pass	
Beryllium	%	91			80-120	Pass	
Cadmium	%	95			80-120	Pass	
Chromium	%	103			80-120	Pass	
Cobalt	%	107			80-120	Pass	
Copper	%	95			80-120	Pass	
Iron	%	113			80-120	Pass	
Lead	%	105			80-120	Pass	
Manganese	%	106			80-120	Pass	
Mercury	%	97			80-120	Pass	
Nickel	%	90			80-120	Pass	
Silver	%	96			80-120	Pass	
Zinc	%	97			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons				Result 1					
TRH C6-C9	M22-My0069438	CP	%	93			70-130	Pass	
Naphthalene	M22-My0069438	CP	%	93			70-130	Pass	
TRH C6-C10	M22-My0069438	CP	%	91			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	M22-My0069438	CP	%	97			70-130	Pass	
Toluene	M22-My0069438	CP	%	97			70-130	Pass	
Ethylbenzene	M22-My0069438	CP	%	98			70-130	Pass	
m&p-Xylenes	M22-My0069438	CP	%	98			70-130	Pass	
o-Xylene	M22-My0069438	CP	%	99			70-130	Pass	
Xylenes - Total*	M22-My0069438	CP	%	98			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	M22-My0065489	NCP	%	83			70-130	Pass	
Acenaphthylene	M22-My0065489	NCP	%	88			70-130	Pass	
Anthracene	M22-My0065489	NCP	%	96			70-130	Pass	
Benz(a)anthracene	M22-My0065489	NCP	%	91			70-130	Pass	
Benzo(a)pyrene	M22-My0065489	NCP	%	73			70-130	Pass	
Benzo(b&j)fluoranthene	M22-My0065489	NCP	%	92			70-130	Pass	
Benzo(g.h.i)perylene	M22-My0065489	NCP	%	95			70-130	Pass	
Benzo(k)fluoranthene	M22-My0065489	NCP	%	90			70-130	Pass	
Chrysene	M22-My0065489	NCP	%	80			70-130	Pass	
Dibenz(a.h)anthracene	M22-My0065489	NCP	%	72			70-130	Pass	
Fluoranthene	M22-My0065489	NCP	%	86			70-130	Pass	
Fluorene	M22-My0065489	NCP	%	82			70-130	Pass	
Indeno(1.2.3-cd)pyrene	M22-My0065489	NCP	%	102			70-130	Pass	
Naphthalene	M22-My0065489	NCP	%	80			70-130	Pass	
Phenanthrene	M22-My0065489	NCP	%	74			70-130	Pass	
Pyrene	M22-My0065489	NCP	%	90			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
Chlordanes - Total	M22-My0055296	NCP	%	109			70-130	Pass	
4.4'-DDD	M22-My0055296	NCP	%	119			70-130	Pass	
4.4'-DDE	M22-My0055296	NCP	%	96			70-130	Pass	
4.4'-DDT	M22-My0055296	NCP	%	90			70-130	Pass	
a-HCH	M22-My0055296	NCP	%	128			70-130	Pass	
Aldrin	M22-My0055296	NCP	%	87			70-130	Pass	
b-HCH	M22-My0055296	NCP	%	126			70-130	Pass	
d-HCH	M22-My0055296	NCP	%	112			70-130	Pass	
Dieldrin	M22-My0055296	NCP	%	88			70-130	Pass	
Endosulfan I	M22-My0055296	NCP	%	113			70-130	Pass	
Endosulfan II	M22-My0055296	NCP	%	118			70-130	Pass	
Endosulfan sulphate	M22-My0055296	NCP	%	94			70-130	Pass	
Endrin	M22-My0055296	NCP	%	100			70-130	Pass	
Endrin aldehyde	M22-My0055296	NCP	%	89			70-130	Pass	
Endrin ketone	M22-My0055296	NCP	%	100			70-130	Pass	
g-HCH (Lindane)	M22-My0055296	NCP	%	93			70-130	Pass	
Heptachlor	M22-My0055296	NCP	%	121			70-130	Pass	
Heptachlor epoxide	M22-My0055296	NCP	%	98			70-130	Pass	
Hexachlorobenzene	M22-My0055296	NCP	%	110			70-130	Pass	
Methoxychlor	M22-My0055296	NCP	%	77			70-130	Pass	
Spike - % Recovery									

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Phenols (Halogenated)				Result 1					
2-Chlorophenol	M22-My0065489	NCP	%	85			30-130	Pass	
2.4-Dichlorophenol	M22-My0065489	NCP	%	102			30-130	Pass	
2.4.5-Trichlorophenol	M22-My0065489	NCP	%	90			30-130	Pass	
2.4.6-Trichlorophenol	M22-My0065489	NCP	%	75			30-130	Pass	
2.6-Dichlorophenol	M22-My0065489	NCP	%	80			30-130	Pass	
4-Chloro-3-methylphenol	M22-My0065489	NCP	%	78			30-130	Pass	
Pentachlorophenol	M22-My0065489	NCP	%	61			30-130	Pass	
Tetrachlorophenols - Total	M22-My0065489	NCP	%	99			30-130	Pass	
Spike - % Recovery									
Phenols (non-Halogenated)				Result 1					
2-Cyclohexyl-4.6-dinitrophenol	M22-My0063689	NCP	%	41			30-130	Pass	
2-Methyl-4.6-dinitrophenol	M22-My0065489	NCP	%	34			30-130	Pass	
2-Nitrophenol	M22-My0065489	NCP	%	66			30-130	Pass	
2.4-Dimethylphenol	M22-My0065489	NCP	%	94			30-130	Pass	
2.4-Dinitrophenol	M22-My0069459	NCP	%	36			30-130	Pass	
2-Methylphenol (o-Cresol)	M22-My0065489	NCP	%	65			30-130	Pass	
3&4-Methylphenol (m&p-Cresol)	M22-My0065489	NCP	%	72			30-130	Pass	
4-Nitrophenol	M22-My0065489	NCP	%	74			30-130	Pass	
Dinoseb	M22-My0065489	NCP	%	58			30-130	Pass	
Phenol	M22-My0065489	NCP	%	69			30-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	M22-My0065414	NCP	%	90			75-125	Pass	
Barium	M22-My0069438	CP	%	96			75-125	Pass	
Beryllium	M22-My0065414	NCP	%	97			75-125	Pass	
Cadmium	M22-My0065414	NCP	%	80			75-125	Pass	
Chromium	M22-My0065414	NCP	%	103			75-125	Pass	
Cobalt	M22-My0065414	NCP	%	105			75-125	Pass	
Copper	M22-My0065414	NCP	%	102			75-125	Pass	
Iron	M22-My0064800	NCP	%	112			75-125	Pass	
Lead	M22-My0065414	NCP	%	113			75-125	Pass	
Manganese	M22-My0065414	NCP	%	123			75-125	Pass	
Mercury	M22-My0065414	NCP	%	102			75-125	Pass	
Nickel	M22-My0065414	NCP	%	101			75-125	Pass	
Silver	M22-My0065414	NCP	%	82			75-125	Pass	
Zinc	M22-My0065414	NCP	%	112			75-125	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons				Result 1					
TRH C10-C14	M22-My0069440	CP	%	130			70-130	Pass	
TRH >C10-C16	M22-My0069440	CP	%	127			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons				Result 1	Result 2	RPD			
TRH C6-C9	M22-My0063978	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	M22-My0069438	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	M22-My0069438	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	M22-My0069438	CP	mg/kg	< 50	< 50	<1	30%	Pass	
Naphthalene	M22-My0063978	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	M22-My0063978	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH >C10-C16	M22-My0069438	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	M22-My0069438	CP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	M22-My0069438	CP	mg/kg	< 100	< 100	<1	30%	Pass	

Duplicate									
Volatile Organics				Result 1	Result 2	RPD			
Tetrachloroethene	M22-My0063978	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	M22-My0063978	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	M22-My0063978	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	M22-My0063978	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	M22-My0063978	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	M22-My0063978	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total*	M22-My0063978	NCP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-HCH	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-HCH	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-HCH	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-HCH (Lindane)	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	M22-My0069438	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Toxaphene	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	

Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1221	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1242	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1248	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1254	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1260	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Total PCB*	M22-My0069438	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Phenols (Halogenated)				Result 1	Result 2	RPD			
2-Chlorophenol	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2.4-Dichlorophenol	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2.4.5-Trichlorophenol	M22-My0069438	CP	mg/kg	< 1	< 1	<1	30%	Pass	
2.4.6-Trichlorophenol	M22-My0069438	CP	mg/kg	< 1	< 1	<1	30%	Pass	
2.6-Dichlorophenol	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
4-Chloro-3-methylphenol	M22-My0069438	CP	mg/kg	< 1	< 1	<1	30%	Pass	
Pentachlorophenol	M22-My0069438	CP	mg/kg	< 1	< 1	<1	30%	Pass	
Tetrachlorophenols - Total	M22-My0069438	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Duplicate									
Phenols (non-Halogenated)				Result 1	Result 2	RPD			
2-Cyclohexyl-4.6-dinitrophenol	M22-My0069438	CP	mg/kg	< 20	< 20	<1	30%	Pass	
2-Methyl-4.6-dinitrophenol	M22-My0069438	CP	mg/kg	< 5	< 5	<1	30%	Pass	
2-Nitrophenol	M22-My0069438	CP	mg/kg	< 1	< 1	<1	30%	Pass	
2.4-Dimethylphenol	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2.4-Dinitrophenol	M22-My0069438	CP	mg/kg	< 5	< 5	<1	30%	Pass	
2-Methylphenol (o-Cresol)	M22-My0069438	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
3&4-Methylphenol (m&p-Cresol)	M22-My0069438	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
4-Nitrophenol	M22-My0069438	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Dinoseb	M22-My0069438	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Phenol	M22-My0069438	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Chromium (hexavalent)	M22-My0065022	NCP	mg/kg	< 1	< 1	<1	30%	Pass	
% Moisture	M22-My0069424	NCP	%	9.4	9.6	2.0	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	M22-My0069438	CP	mg/kg	11000	11000	<1	30%	Pass	
Arsenic	M22-My0068339	NCP	mg/kg	6.4	6.6	3.0	30%	Pass	
Barium	M22-My0068339	NCP	mg/kg	59	58	1.0	30%	Pass	
Beryllium	M22-My0068339	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Cadmium	M22-My0068339	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M22-My0068339	NCP	mg/kg	36	35	1.0	30%	Pass	
Cobalt	M22-My0068339	NCP	mg/kg	9.8	9.7	2.0	30%	Pass	
Copper	M22-My0068339	NCP	mg/kg	25	26	1.0	30%	Pass	
Iron	M22-My0068339	NCP	mg/kg	26000	25000	2.0	30%	Pass	
Lead	M22-My0068339	NCP	mg/kg	31	32	2.0	30%	Pass	
Manganese	M22-My0068339	NCP	mg/kg	120	120	2.0	30%	Pass	
Mercury	M22-My0068339	NCP	mg/kg	0.1	0.1	3.0	30%	Pass	
Nickel	M22-My0068339	NCP	mg/kg	20	21	1.0	30%	Pass	
Silver	M22-My0068339	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Zinc	M22-My0068339	NCP	mg/kg	93	94	1.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25°C as rec.)	M22-My0068393	NCP	uS/cm	860	1100	26	30%	Pass	

Comments

V2: Aluminium results added to all samples with metals analsysis.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs

Authorised by:

Michael Cassidy	Analytical Services Manager
Edward Lee	Senior Analyst-Organic
Harry Bacalis	Senior Analyst-Volatile
Jonathon Angell	Senior Analyst-Inorganic
Joseph Edouard	Senior Analyst-Organic
Linda Chouman	Senior Analyst-Sample Properties
Mary Makarios	Senior Analyst-Metal
Scott Beddoes	Senior Analyst-Inorganic

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

\- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

AM Environmental Consulting P/L
7 Rudd Crt
Bridgewater
SA 5155

Attention: **-Ashley Moule (all SRA/REPORTS)**

Report **892607-W**
Project name HANSON LAWP
Received Date May 27, 2022

Client Sample ID			**TRIP**
Sample Matrix			**Water**
Eurofins Sample No.			**M22-My0069447**
Date Sampled			**May 27, 2022**
Test/Reference	LOR	Unit	
BTEX			
Benzene	0.001	mg/L	< 0.001
Toluene	0.001	mg/L	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002
o-Xylene	0.001	mg/L	< 0.001
Xylenes - Total*	0.003	mg/L	< 0.003
4-Bromofluorobenzene (surr.)	1	%	75

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
SA Waste Screen			
BTEX	Melbourne	May 30, 2022	14 Days
- Method: LTM-ORG-2010 BTEX and Volatile TRH			

Company Name:	AM Environmental Consulting P/L	**Order No.:**	
Address:	7 Rudd Crt Bridgewater SA 5155	**Report #:**	892607
		Phone:	0407 352 036
		Fax:	
Project Name:	HANSON LAWP		

Received: May 27, 2022 1:12 PM
Due: May 31, 2022
Priority: 2 Day
Contact Name: -Ashley Moule (all SRA/REPORTS)

Eurofins Analytical Services Manager : Michael Cassidy

Sample Detail						Metals M8	BTEX	Moisture Set	NEPM Screen for Soil Classification	SA Waste Screen
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
Sydney Laboratory - NATA # 1261 Site # 18217										
Brisbane Laboratory - NATA # 1261 Site # 20794									X	
Mayfield Laboratory - NATA # 1261 Site # 25079										
Perth Laboratory - NATA # 2377 Site # 2370										
External Laboratory										
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**					
1	VS1	May 27, 2022		Soil	M22-My0069438			X		X
2	VS2	May 27, 2022		Soil	M22-My0069439	X		X		
3	VS3	May 27, 2022		Soil	M22-My0069440			X		X
4	VS4	May 27, 2022		Soil	M22-My0069441	X		X		
5	VS5	May 27, 2022		Soil	M22-My0069442			X		X
6	VS6	May 27, 2022		Soil	M22-My0069443	X		X		

Company Name: AM Environmental Consulting P/L
Address: 7 Rudd Crt
Bridgewater
SA 5155

Project Name: HANSON LAWP

Order No.:
Report #: 892607
Phone: 0407 352 036
Fax:

Received: May 27, 2022 1:12 PM
Due: May 31, 2022
Priority: 2 Day
Contact Name: -Ashley Moule (all SRA/REPORTS)

Eurofins Analytical Services Manager : Michael Cassidy

Sample Detail						Metals M8	BTEX	Moisture Set	NEPM Screen for Soil Classification	SA Waste Screen
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
Sydney Laboratory - NATA # 1261 Site # 18217										
Brisbane Laboratory - NATA # 1261 Site # 20794									X	
Mayfield Laboratory - NATA # 1261 Site # 25079										
Perth Laboratory - NATA # 2377 Site # 2370										
External Laboratory										
7	VS7	May 27, 2022		Soil	M22-My0069444	X		X		
8	DUP1	May 27, 2022		Soil	M22-My0069445	X		X		
9	EIL	May 27, 2022		Soil	M22-My0069446			X	X	
10	TRIP	May 27, 2022		Water	M22-My0069447		X			
Test Counts						5	1	9	1	3

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
ppm: parts per million
org/100 mL: Organisms per 100 millilitres
mg/L: milligrams per litre
ppb: parts per billion
NTU: Nephelometric Turbidity Units
µg/L: micrograms per litre
%: Percentage
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
BTEX									
Benzene			mg/L	< 0.001			0.001	Pass	
Toluene			mg/L	< 0.001			0.001	Pass	
Ethylbenzene			mg/L	< 0.001			0.001	Pass	
m&p-Xylenes			mg/L	< 0.002			0.002	Pass	
o-Xylene			mg/L	< 0.001			0.001	Pass	
Xylenes - Total*			mg/L	< 0.003			0.003	Pass	
LCS - % Recovery									
BTEX									
Benzene			%	94			70-130	Pass	
Toluene			%	97			70-130	Pass	
Ethylbenzene			%	97			70-130	Pass	
m&p-Xylenes			%	98			70-130	Pass	
Xylenes - Total*			%	98			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
BTEX				Result 1					
Benzene	M22-My0067490	NCP	%	92			70-130	Pass	
Toluene	M22-My0067490	NCP	%	99			70-130	Pass	
Ethylbenzene	M22-My0067490	NCP	%	95			70-130	Pass	
m&p-Xylenes	M22-My0067490	NCP	%	98			70-130	Pass	
o-Xylene	M22-My0067490	NCP	%	94			70-130	Pass	
Xylenes - Total*	M22-My0067490	NCP	%	97			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	M22-My0067489	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Toluene	M22-My0067489	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Ethylbenzene	M22-My0067489	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
m&p-Xylenes	M22-My0067489	NCP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	M22-My0067489	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total*	M22-My0067489	NCP	mg/L	< 0.003	< 0.003	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Catherine Wilson	Analytical Services Manager
Carroll Lee	Senior Analyst-Volatile

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Eurofins shall not be liable for loss, cost, damages or expenses incurred by the client, or any other person or company, resulting from the use of any information or interpretation given in this report. In no case shall Eurofins be liable for consequential damages including, but not limited to, lost profits, damages for failure to meet deadlines and lost production arising from this report. This document shall not be reproduced except in full and relates only to the items tested. Unless indicated otherwise, the tests were performed on the samples as received.

Appendix E: PID Calibration Certificate

ECO Environmental

Environmental monitoring
& sampling equipment
Rentals and sales.

Tel: +61 8 9328 2900
fax: +61 8 9328 2677
eco@ecoenvironmental.com.au
www.ecoenvironmental.com.au
214 Lord St Perth WA 6000

Equipment Information

Instrument: BWPID ULTRA 3
Serial Number: Serial #: 12038000

Equipment Check

	Enclosed	Returned	Comment
BW Ultra	☑	☐	
Probe	☑	☐	
Power Adaptor	☑	☐	
Battery Charger	☑	☐	
Quick Reference Guide	☑	☐	
User Manual USB	☑	☐	
Tubing and luer lock attachment	☑	☐	
Sintered Filter, spare external filter + paper and Screwdriver	☑	☐	
Laminated Field Sheet	☑	☐	

Sensor Report

Bottle ID: Isobutylene 219737-10 4 Mix Gas 958051707

Installed	Fresh Air - Pass	Span Value - Pass	High Alarm Limit	Low Alarm Limit
☑ PID	☑ 0	☑ 100ppm	100ppm	50ppm
☑ H_2S	☑ 0	☑ 25ppm	15ppm	10ppm
☑ CO	☑ 0	☑ 100ppm	200ppm	30ppm
☑ LEL	☑ 0	☑ 50% (Methane 2.5%)	10%	5%
☑ O_2	☑ 20.9%	☑ 18%	23.5%	19.5%

Inspection Details

	Pass	Comment
Decon90 wash of meter and case	☑	
Inspection for faults, corrosion, damage	☑	
Check Probe is airtight	☑	
Meter in good working order, clean and ready for use	☑	

This is to certify that where possible, this instrument has been calibrated in accordance with the manufacturer's calibration procedure as recommended in the instrument service manual.

ECO Standard Rental Terms & Conditions apply to all equipment calibrations.

Regards

Dave McGraw 18/2/22

Equipment Specialist
ECO Environmental

Attachment 14

Hanson White Rock Quarry Water Quality Monitoring Plan




Hanson Construction Materials

White Rock Quarry

Water Quality Monitoring Plan

November 2021

Licence Number: EPA 12714

Responsible Person(s):

Simon Kitson (Quarry Manager)

Angie Garzon Gutierrez (Environmental Compliance & Planning Officer)

Water Data Services Pty Ltd

www.waterdata.com.au

1 Erudina Avenue
Edwardstown
SA 5039

P 08 8374 3522

Date: Monday 1st November 2021

Document Identification:

Title: White Rock Quarry Water Quality Monitoring Plan

Licence Number: EPA 12714

Name of Site: Hanson White Rock Quarry

Address of Site: Horsnell Gully Road, Horsnell Gully

Prepared by: Brad Nicholson, Water Data Services

Date of Submission: 1st November 2021

Version Number: v6.0

Client Contact:

Angie Garzon Gutierrez
Environmental Compliance and Planning Officer
Hanson Construction Materials Pty Ltd
55 Galway Avenue
Marleston, South Australia 5033
Mobile 0408 011 837
E-mail angie.garzongutierrez@hanson.com.au

Contractor:

Prepared and submitted by:
Brad Nicholson
Chief Executive Officer (Senior Hydrological Engineer)
Water Data Services Pty Ltd
1 Erudina Ave
Edwardstown SA 5039
Telephone 08 8374 3522
E-mail brad.nicholson@waterdata.com.au

Table of Contents

List of Tables

List of Figures

1. Introduction

The EPA Licence (Licence Number EPA 12714) identifies Hanson Construction Material's obligations and requirements related to water quality discharge monitoring at the White Rock Quarry site.

In 2017 an Environmental Protection Order was issued by EPA SA which stipulated the requirement for Hanson to submit an Environmental Improvement Programme (EIP) to the EPA for review. After a review and consultation process, the Environmental Improvement Programme was approved by the EPA on 29th September 2017 which included additional flow and water quality monitoring and reporting requirements for the site.

A letter was issued by the EPA on 24th September 2021 in relation to the EIP which stipulated as part of this correspondence, a number of further changes to the flow and water quality monitoring and reporting requirements for the White Rock Quarry site.

This Monitoring Plan has been developed using the EPA guidelines *'Regulatory monitoring and testing – Monitoring plans requirements' (EPA 2006)* and addresses all monitoring objectives and requirements associated with Hanson's original EPA Licence (12714) and all additional monitoring and reporting requirements associated with the EIP.

2. Monitoring Objectives

In 2015, a monitoring plan was developed, issued and approved (*WDS 2015*) which addressed all aspects of the EPA Licence requirements and specified the water quality and quantity monitoring and reporting requirements for stormwater leaving the White Rock Quarry site, including:

- The location for undertaking flow and water quality monitoring activities,
- The methodology for monitoring flow and water quality
- The sampling, testing and analysis procedures
- The trigger value for water quality exceedances
- The method for determining sediment loads from the site; and
- Annual flow and water quality reporting requirements.

In September 2017, a number of additional assessment and reporting requirements and initiatives were implemented to support and inform the actions specified in the White Rock Quarry Environmental Improvement Programme (Hanson 2017) and included:

- Daily assessment of telemetered flow and water quality discharge data
- Investigations into identified water quality exceedances
- Quarterly reporting against the EIP which included a flow and water quality report card

On 24th September 2021, a letter was issued to Hanson in relation to the EPA licence and subsequent EIP in place for the site, and as part of this correspondence, specified a number of revisions to the water quality monitoring and reporting requirements for the site, including:

- Provision for Water Quality monitoring at the outfall to SB2
- Implementation of management strategies to mitigate turbidity sensor obstruction and fouling.
- Standardisation of water quality exceedance reporting to summarise the total number of days in a reporting period in which the 24-hour average turbidity exceeds ANZECC Fresh and Marine Water Quality Guidelines (50 NTU)
- Revision of the 2015 Monitoring Plan to align with all aspects of the EPA Licence, EIP and subsequent directives by 1st November 2021.

This Monitoring Plan builds upon the 2015 Monitoring Plan and addresses all additional monitoring and reporting requirements referenced above.

A reference table showing where specific objectives are addressed in this Monitoring Plan is presented in Table 2-1 below.

Table 2-1 : Summary of Monitoring Plan Objectives

Monitoring Plan Objective	Relevant Section(s)
Location for undertaking flow and water quality monitoring activities	Section 4.1.1, Section 4.1.2
Flow and water quality monitoring methodology	Section 4, Section 4.1.3
Sampling, testing and analysis procedures	Section 4.2
Trigger value for water quality exceedances	Section 4.2.1, Table 4-3
Sediment load determination methodology	Section 4.2, Section 4.2.2
Annual reporting requirements	Section 5, Table 5-1, Section 5.1
Quarterly reporting requirements	Section 5, Table 5-1
Use of telemetry data and investigations into identified exceedances	Table 5-1
Future monitoring requirements for SB2	Section 4.1.2
Turbidity sensor obstruction and fouling mitigation strategies	Section 4.2
Standardisation of water quality exceedance reporting.	Section 5, Table 5-1, Section 5.1

.

3. Background Information

Hanson are one of the largest producers of aggregates (crushed rock, sand and gravel) and one of the largest producers of concrete products and concrete in the world. Hanson operate a number of sites across the Adelaide Region including the White Rock Quarry located at Horsnell Gully.

Primary site activities at Hanson's White Rock Quarry include drilling, blasting, extraction, loading, crushing and processing of rock materials and transportation of processed product from the site.

White Rock Quarry is situated within the Horsnell Gully Catchment – A major tributary to Third Creek. The quarry is adjacent to the Horsnell Gully Conservation Park and below Giles Conservation Park.

Streamflow from Giles Conservation Park enters a large dam upstream of the Quarry and proceeds to flow through a section of modified swales before entering a closed pipe system. A series of continuous bunds have been installed along the full alignment of the modified swale section meaning that surface runoff from all operational surfaces and haul roads throughout the quarry are isolated from the clean runoff sources originating from the Giles Conservation Park. The clean runoff from the Horsnell Gully Conservation Park is also diverted into the closed pipe system in similar manner. Clean surface water runoff from both upstream conservation parks exits the close pipe system on the western boundary of the quarry where it flows through to a concrete weir downstream of the silt dam before finally discharging into Third Creek.

Sediment-laden runoff from haul roads and operational surfaces is diverted through a series of collection, storage and treatment systems. A large sedimentation basin (SB1) which was designed and installed as a major element of the EIP, captures and stores runoff from the majority of the site's operational surfaces. Runoff from operational surfaces west of SB1 including overflow from the concrete washout area is captured by a grid trench at the main gate where it is diverted into a series of sedimentation basins approximately 200m downstream of the main gate. Overflow from these sedimentation basins can enter a grated overflow pit where it discharges into the weir pool upstream of the concrete weir.

4. Monitoring Methodology

Water Data Services has installed and currently operates a flow and water quality monitoring station downstream of the silt dam at the point where over-flow from the silt dam converges with clean water from the Giles and Horsnell Gully Conservation Parks.

The station comprises the following components:

- Stepped concrete weir (installed by Hanson)
- Campbell Scientific Pressure Sensor
- Observator Analyte NEP5000 Turbidity Sensor
- Campbell Scientific CR850 data logger with custom WDS programming
- NextG Telemetry system
- Push data telemetry uploading to www.waterdata.com.au

The station collects data in real-time for the following parameters:

- Turbidity (NTU)
- Water Level (m)
- Flow Rate (m^3/s)
- Flow Volume (ML)

In addition to real-time monitoring, operation also includes the collection of routine grab samples that are analysed for the following parameters:

- Turbidity (NTU)
- Suspended Solids

The following chapters outline current monitoring methodologies and procedures in reference to Monitoring Plan requirements recommended by the EPA.

4.1 Sampling Location, Frequency and Analytes

4.1.1 Established Flow and Water Quality Monitoring Location

The primary monitoring and telemetry station for flow and water quality monitoring is to be undertaken at the established monitoring station located at the following coordinates:

Zone: 54
Easting: 289756 m E
Northing: 61325945 m S

A photograph of the weir is shown in Figure 5-1 below.

Figure 5-1 : Concrete Step Weir

When the operational surfaces of the quarry were not effectively isolated from the clean conservation park runoff, monitoring at the concrete step weir (installed by Hanson to improve monitoring accuracy) was the only way to measure the total sediment load from the site. As a result, flow and water quality monitoring has been undertaken at the concrete step weir since March 2011, meaning that a mature dataset is available for non-parametric trend analyses capable of removing seasonality from the dataset and revealing the underlying flow and water quality trends at the site.

4.1.2 Future Monitoring Locations

Although long-term flow and water quality monitoring has traditionally only been undertaken at the concrete step weir, the isolation of the clean water sources from the Giles and Horsnell Gully Conservations Parks means that the water arriving at the weir via the natural channel is now largely unaffected by Quarry operations.

This means that lower-quality stormwater discharge from the adjacent SB2 (during periods of overflow) can be diluted by the clean water which bypasses the quarry.

To address this, a secondary turbidity monitoring location is to be established at the outfall of SB2, to measure the undiluted turbidity at the point of discharge of the basin.

The outfall structure of the existing silt dam is not currently suitable for the installation of monitoring instrumentation, however the upgrade of SB2 which will replace the existing silt dams at this location presents an opportunity to design and integrate an outfall structure suitable for turbidity (and potentially flow) monitoring at this location.

Hanson has already purchased instrumentation for installation at this location, and the additional sensors will be integrated into the existing datalogger and telemetry system upon completion of the SB2 upgrade works.

It is recommended that flow and water quality monitoring continue to be undertaken at the concrete step weir in conjunction with the new SB2 outfall monitoring for the medium-term, until the dataset available for the outfall of SB2 matures enough to facilitate meaningful non-parametric trend analysis (typically 4-6 years).

4.1.3 Analytes and Frequency

The frequency and methodology for analysis of real-time parameters is described in Table 4-1 below.

Defined recording frequencies are to be achieved using the Campbell Scientific CR800 data logger, and data should be uploaded in real-time to the WDS website (www.waterdata.com.au) .

Table 4-1 : Real-time Data Parameters and Recording Frequency

Parameter	Units	Frequency	Method
Water Level	m (Gauge Datum)	10 minutes	Direct measurement via Pressure Sensor
Flow Rate	m^3/s	10 minutes	Derived from water level using calibrated stage-discharge relationship
Flow Volume	ML	As-required	Derived from 10-minute flow rate data
Turbidity	NTU	10 minutes	Direct measurement using Observator Analyte NEP 5000 Turbidity Sensor
Suspended Solids	mg/L	10 minutes	Derived via site-specific, calibrated relationship between Turbidity and Suspended Solids
Total Suspended Solids Load	kg	As-required	Derived using real-time suspended solids time series and flow volume.

In addition to the real-time data collection, the parameters and frequencies for collection of calibration and verification data collection are outlined in Table 4-2.

Table 4-2 : Calibration Parameters

Parameter	Units	Frequency	Method
Flow Rate	m^3/s	Opportunistic	Direct measurement of flow using a suitable flow gauging method to be undertaken opportunistically during periods of high flow (low to medium flows are well calibrated).
Turbidity	NTU	12 times per year during comprehensive site visits with flow.	Grab sample of stormwater at concrete step weir with laboratory testing undertaken in a NATA accredited laboratory. Used to verify calibration of NTU-Suspended Solids relationship.
Suspended Solids	mg/L	12 times per year during comprehensive site visits with flow.	Grab sample of stormwater at concrete step weir with laboratory testing undertaken in a NATA accredited laboratory. Used to verify calibration of NTU-Suspended Solids relationship.

4.2 Sampling and Testing Procedures

All data collection, sampling and analysis should be undertaken within the framework of the following specifications:

- Comprehensive site visits shall be undertaken 12 times per year on a monthly basis. These comprehensive visits shall ensure all instruments are serviced, tested and calibrated and to undertake general site maintenance.
- Out-of-cycle maintenance visits shall be undertaken by suitably trained Hanson operators on an as-required basis (determined via daily telemetry assessments) to address sensor bio-fouling detected via telemetry. The date, time and photographic evidence of bio-fouling at the time of cleaning shall be recorded for data verification purposes.
- Comprehensive Visits and in-situ instrument calibration verification shall be undertaken in accordance with Water Data Services' Field Work and Instrument Calibration work instructions. These documents are part of the Water Data Services Quality Management System (QMS) which is BSI certified to ISO9001:2015.

- Grab samples shall be collected at each of the 12 Comprehensive Visits but only if the site is flowing through the concrete step weir. These samples shall be collected in accordance with the Water Data Services work instruction for Sample Collection, which is ISO9001:2015 certified.
- Grab samples shall be analysed by a NATA accredited laboratory for Turbidity and Suspended Solids.
- Flow gaugings shall be undertaken on an opportunistic basis during periods of high flow in accordance with the Water Data Services ISO9001:2015 work instructions for Flow Gauging.
- Flow gaugings should be processed upon completion and reviewed within the context of the calibrated stage-discharge relationship for derivation of flow from water level. A rating review shall be undertaken if a new gauging is outside of the confidence interval of the rating. Any calibration changes shall be discussed and presented into the annual report.
- Grab sample data shall be collated and reviewed within the context of the calibrated NTU-SS relationship derived using historical data. The statistical correlation (R^2) of the relationship shall be calculated annually and incorporated into the annual report (See Section 4.2.1).
- If the statistical correlation (R^2) of the Turbidity-Suspended Solids relationship for the site drops below 0.8, a review of the Monitoring Plan shall be triggered.
- Flow and Water Quality data shall be processed, archived and stored in accordance with the Water Data Services Data Processing work instructions which are also certified to ISO9001:2015.

4.2.1 Water Quality Trigger Values

Table 4-3 below summarises the water quality trigger values which shall be adopted for determination of water quality exceedances.

Table 4-3 : Water Quality Trigger Values

Parameter	Units	Aggregation	Trigger Value
Turbidity	NTU	24-hour average	**50**

4.2.2 Calibrated Turbidity – Suspended Solids Relationship

Historical laboratory data collected at the site since 2011 has been used to derive a relationship between recorded (in-situ) Turbidity and the concentration of Suspended Solids.

Additional regression analyses should be undertaken on an annual basis as part of the Annual Reporting process which uses all available laboratory results for the monitoring station, which allows for the derivation of a calibrated relationship.

Regression analysis undertaken on the existing data set prior to the development of this monitoring plan allowed for the derivation of the following formula, which has a statistical correlation (R2) of 0.9416 (indicating a high degree of certainty) (WDS 2021).

$$\text{TSS} = 0.7831 \times \text{NTU}$$

The regression curve is shown in Figure 5-2.

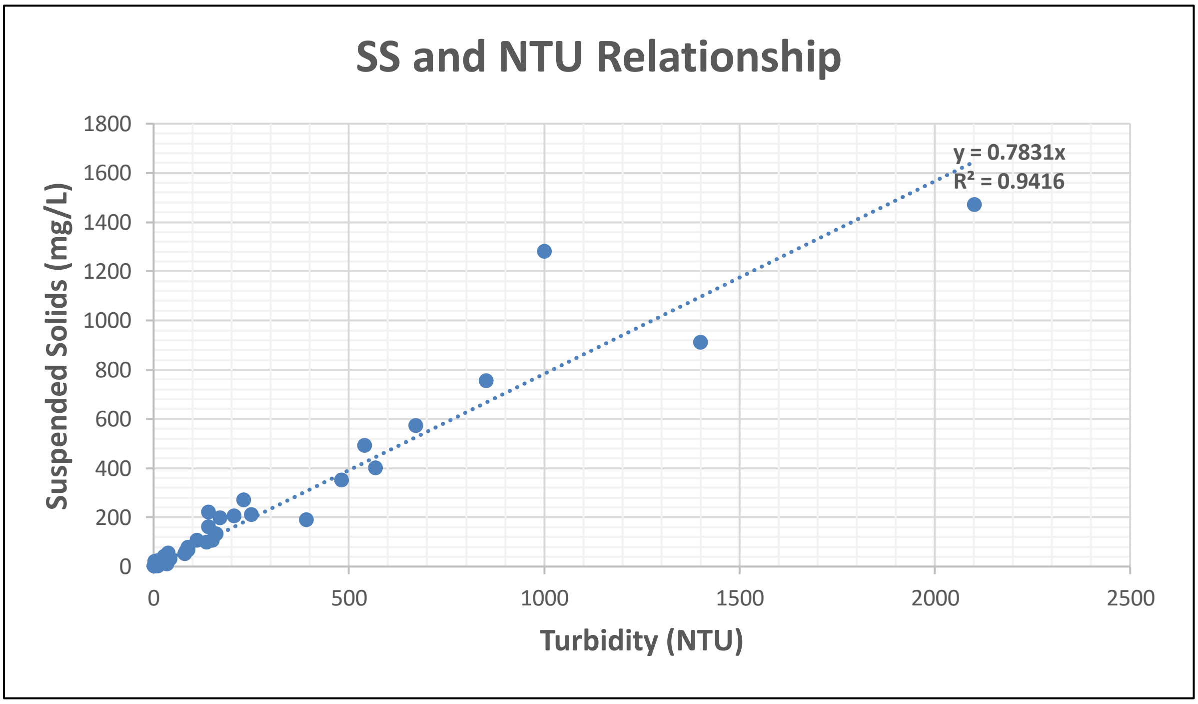


Figure 5-2 : Turbidity - Suspended Solids Regression Analysis

This relationship should be adopted upon implementation of this Monitoring Plan and should be used to derive suspended solids using real-time data until the next annual report.

The regression analysis should be reviewed annually as part of the annual reporting process and should incorporate all available (historical and new) data.

If the R^2 value of the regression analysis is observed to drop below 0.8 at the completion of a regression analysis review, this should trigger a review of the Monitoring Plan.

5. Reporting

Internal and External reporting should be undertaken in accordance with the requirements specified in Table 5-1.

Table 5-1 : Reporting Frequency

Reporting Component	Reporting Frequency	Method	Comment
Real-time Data	Hourly	www.waterdata.com.au Secure data provision portal	Real-time (unverified) data displayed on the website as it arrives. This data shall be used by Hanson operators to track and respond to discharge events and water quality exceedances in real-time.
Verified/Processed Data	Within 2 weeks of Comprehensive Visits	www.waterdata.com.au Secure data provision portal	Processed, verified and archived data which has all instrument errors removed representing the long-term site record.
Quarterly Reports	Quarterly	Submission via email to EPA	Verified data should be used to summarise the total number of days in a reporting period where the 24-hour average turbidity has exceeded 50 NTU.

Reporting Component	Reporting Frequency	Method	Comment
Annual Report	Annually by 31st March	PDF provided to Hanson for review, and submitted to EPA by Hanson	Annual report provided by Water Data Services which summarises all monitoring undertaken in accordance with this Monitoring Plan and associated monitoring objectives as specified in Section 5.1.

5.1 Annual Reporting Requirements

The annual report should contain the following minimum information:

- Assessment of the total number of days where the 24-hour average turbidity exceeds ANZECC Fresh and Marine Water Quality Guidelines (50 NTU)
- Comparison of continuous turbidity sensor measurements with turbidity measurements obtained from grab samples.
- The suspended solids-turbidity calibration curve with associated R^2 value.
- Assessment of the recorded data for isolation of discrete flow events.
- A summary table with data on the discrete stormwater events showing:
    - Event discharge volume.
    - Event average, median, maximum and 80th percentile turbidity.
    - Classification of events relative to applicable trigger levels (24-hour average turbidity).
    - Event suspended solids load
- The annual suspended solids load discharged from the quarry
- Further analysis and/or comments applicable to reporting criteria.

6. References

- EPA 2006, *Regulatory monitoring and testing – Monitoring plans requirements*, Issued December 2006, Updated August 2013
- EPA 2015, *Environment Protection (Water Quality) Policy,* Issued 2015, Version 1.7.2020
- Hanson 2017, White Rock Quarry Environment Improvement Programme, 29 September 2017
- Water Data Services 2015, *White Rock Quarry Water Quality Monitoring Plan 2016, Issued December 2015*
- Water Data Services 2021, *2020 White Rock Quarry Water Quality Verification Report*, 5th March 2021

Attachment 15

Groundwater Assessment

GROUNDWATER
SCIENCE

James Rowe
SA Manager
Groundwork Plus

16 October 2020

Dear James

RE: Groundwater Assessment to Support Mining Operations Plan – White Rock Quarry.

Please find the following report that details findings from a groundwater assessment at White Rock Quarry, Private Mine (PM) 188, Horsnell Gully Road ("the Site" – Figure 1). Groundwater Science (GWS) were engaged to conduct a groundwater desktop assessment and to conduct water level monitoring at resource drillholes constructed in 2019. Outcomes from the work will be used to support the Mining Operations Plan (MOP) review.

1 Scope of work

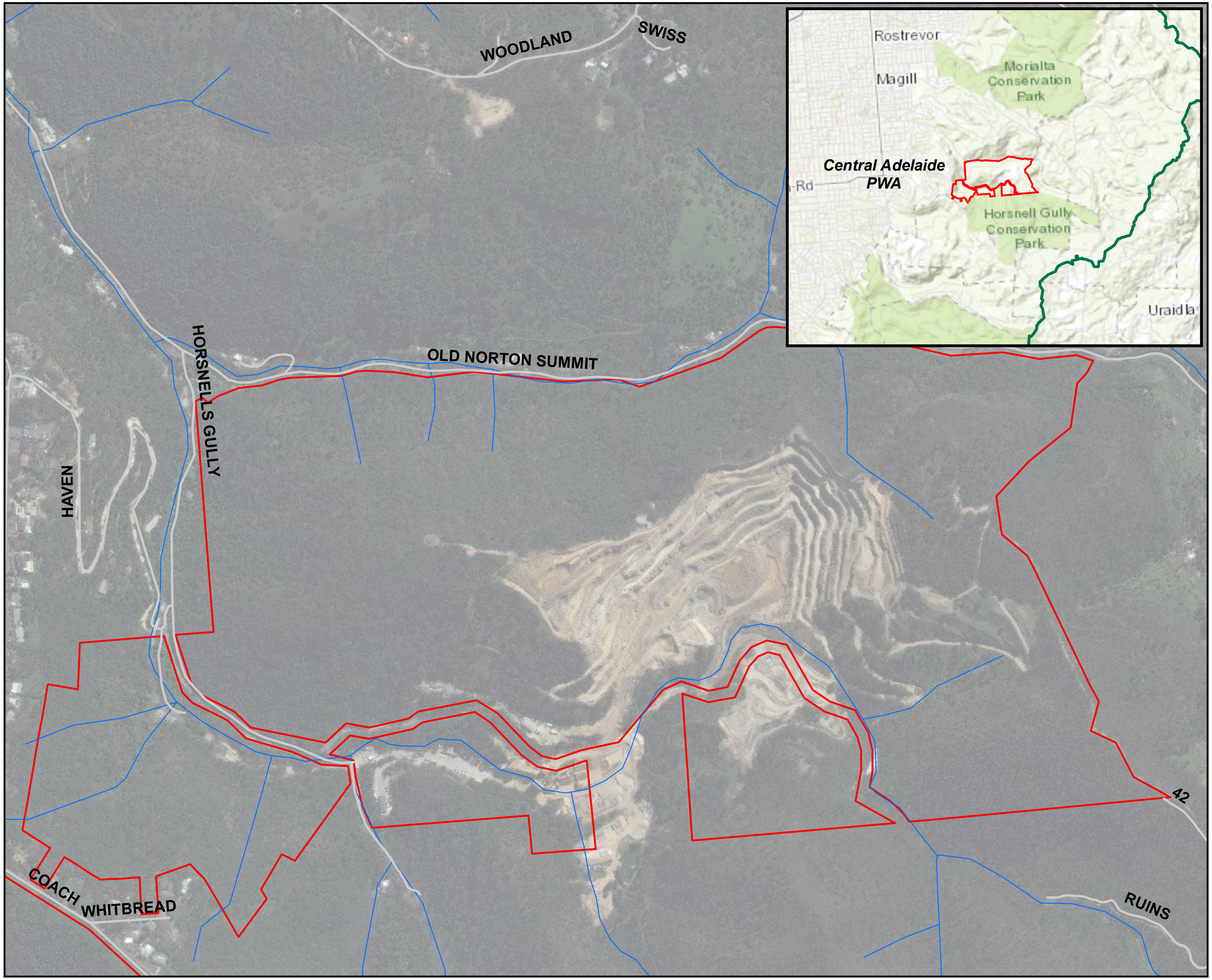
As detailed in the project proposal, the scope of work was to:

- Review and summarise geological and hydrogeological data from public data sources.
- Measure groundwater levels and salinity at exploration drillholes constructed in August 2019.
- Present a hydrogeological cross section displaying present day groundwater levels and interpreted water table contours across the Site.
- Provide recommendations for pit designs to remain a minimum of 3 m above regional groundwater.

2 Findings

Findings from the assessment include the following:

- The Site is located in the Central Adelaide Prescribed Wells Area (PWA). Any groundwater extraction requires a license. Hanson have confirmed they applied as an existing groundwater user in 2007 and are understood to have an existing groundwater authorisation of 15,000 kilolitres (kL).
- The geology of the site comprise rocks of the Adelaide Geosyncline (Adelaide Rift). Groundwater in these rock types occurs in fractures i.e. fractured rock aquifer. Groundwater in the area is fresh and is consistently below 1,200 milligrams / litre total dissolved solids (mg/L TDS).
- Groundwater elevations from on-site wells report between 289 and 323 metres Australian Height Datum (mAHD). Highest groundwater elevations were observed at topographic high points whilst lowest groundwater elevations were reported at drainage lines. Groundwater gradient is interpreted to be steep owning to rapid topographic changes across the Site and surrounding area.
- A number of water wells exist to the north of the Site along existing drainage lines. The existing users are not expected to be impacted provided the quarry is designed to remain above groundwater.
- There are no aquatic groundwater dependent ecosystems mapped at the Site (BoM, 2020) with potential GDE's described as terrestrial woodland. This vegetation is likely dependent on incident rainfall.
- For quarry planning it is recommended to remain a minimum of 3 m above the inferred groundwater table as illustrated in Figure 12. This will reduce the likelihood of pit seepages, avoid detailed impact assessments and groundwater licensing.



Legend

— Streams

— Roads (major)

🟩 Prescribed Well Area

🟥 Private Mine 188

GROUNDWATER SCIENCE

Job Number: HAN-19-6

Client: Hanson

Version: 1 Date: 28/09/2020

Drawn by: PM

N

0 100 200 400
Meters

Coordinate System: GDA 1994 MGA Zone 54

Location Map - White Rock Quarry

Figure 1

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Report for MOP\Fig 1. Location Map.mxd
Document Name: Fig 1. Location Map

3 Background

The White Rock Quarry is located approximately 10 km east of the City of Adelaide (Figure 1). The quarry has been in operation for many years (extraction starting in 1940's) and extracts quartzite and sandstone for the construction industry.

Hanson Construction Materials Pty Ltd ("Hanson") are reviewing their existing Mine Operations Plan (MOP) on Private Mine (PM) 188. To support this review GWS have been engaged to conduct a groundwater desktop study and undertake groundwater monitoring at resource drillholes.

The aim of the work is to outline baseline groundwater conditions in proximity to the Site and to recommend quarry floor levels to remain a minimum of 3 m above regional aquifers. This will reduce the risk of groundwater interception, pit inflows and additional licensing requirements.

The following report provides a summary of the desktop assessment and fieldwork.

4 Hydrogeological Setting

4.1 Rainfall

Rainfall for the area is of Mediterranean climate, with cool wet winters and warm drier summers. Average monthly rainfall for nearby suburbs is presented in Table 1, including Burnside, Rosslyn Park and Ashton. The data demonstrates a west-east increase in average annual rainfall, ranging from 608 mm at Burnside to 1026 mm at Ashton. This increase correlates to orographic uplift towards the higher parts of the Mt Lofty Ranges.

Based on topographic position White Rock Quarry is expected to receive annual rainfall between 700 and 850 mm/annum.

Table 1. Average annual rainfall (mm) at nearby suburbs.

Month	Burnside	Rosslyn Park	Ashton
January	20.2	26.8	40.3
February	20.1	19.3	32.5
March	27.7	24	42.3
April	44.7	45.6	74.9
May	75.6	67.3	120.5
June	94.5	84.1	142.4
July	78.8	84.9	158.6
August	75.4	82.3	131.5
September	56.6	58.3	112.7
October	41.2	33.2	69.5
November	34.4	34.1	48.8
December	29.3	34.4	49.8
Annual	**608.7**	**601.3**	**1026.8**

Source: Bureau of Meteorology (BoM).

4.2 Physiography

The Site is located in hilly terrain in western part of the Mt Lofty Ranges. Topography varies across the Site and ranges from 242 metres Australian Height Datum (mAHD) at the entrance gate, 295mAHD in the current pit location (Propeller, 2018) and up to 450 mAHD in the south east.

The Site was surveyed via an unmanned aerial vehicle (UAV) in 2018 and 2019 which has provided ground elevations to a precision of approximately 5 cm (Groundwork Plus, 2019). A *hillshade* plan of the existing quarry footprint with selected spot heights is displayed in Figure 2. Results from the survey confirm that:

- Maximum ground elevation occurs in the south-east and north-east of the Site, and ranges between 425 and 450 mAHD.
- Topography falls rapidly towards creek lines to the north (along Old Norton Summit Road) and along Horsnell Gully Road (the quarry access road).
- Maximum ground elevations to the west of working pits are reported at 414 mAHD. This is the highest elevation in the central pit area with topography dropping abruptly in all directions.

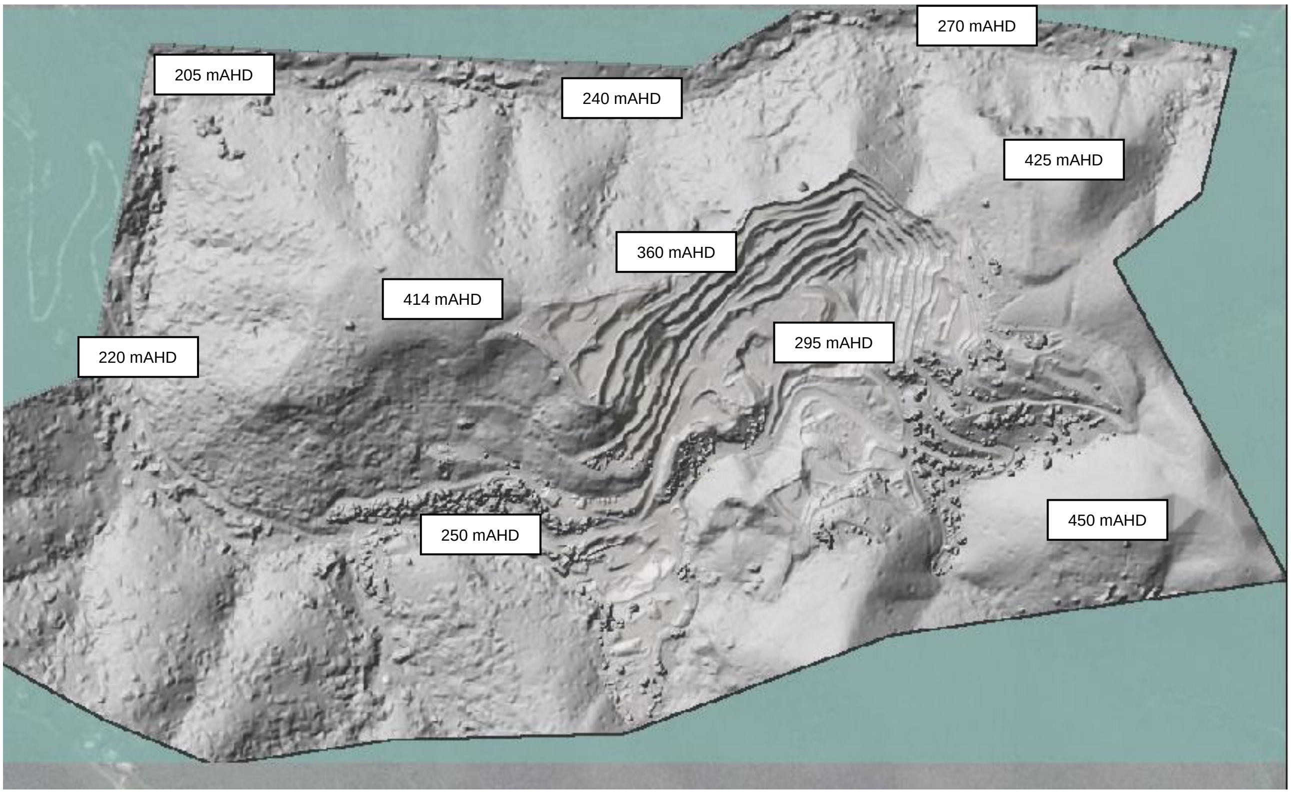


Figure 2. Hillshade image of the Site labelled with selected spot heights (mAHD).

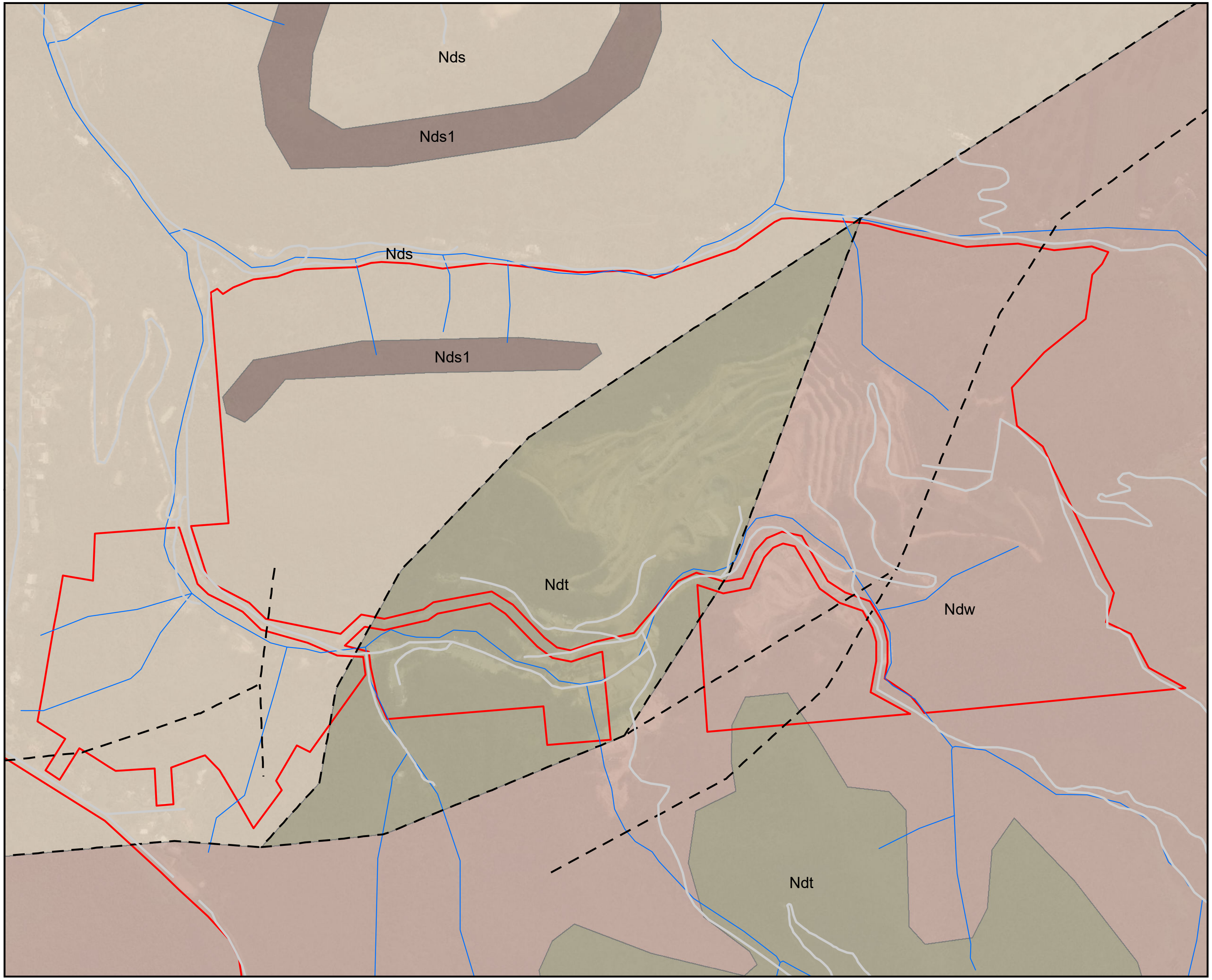
4.3 Geology

The quarry targets rocks of the Adelaide Geosyncline. The surface geology as mapped by the Geological Survey of South Australia is displayed in Figure 3. The most prominent outcropping units across the Site include the Saddleworth Formation, Woolshed Flat Shale and Stonyfell Quartzite, with the Stonyfell Quartzite located in the central part of the tenement at the active pit workings. Details of geological units displayed in Figure 3 are summarised in Table 2. The map also indicates the presence of faults striking through the quarry in a general north-east to south-west orientation.

Based on the geology of the area groundwater is expected to be found in fractured rock aquifers (no Quaternary or Tertiary sediments are mapped in the area).

Table 2. Geological Units at the Study Site.

Geological Unit	Map Symbol	Age	Geological Terrain	Description*
Saddleworth Formation	Nds	Cryogenian	Adelaide Geosyncline	Laminated siltstone with variable carbonate content and lenticular thin sandy interbeds.
Stonyfell Quartzite	Ndt	Neoproterozoic	Adelaide Geosyncline	Quartzite, feldspathic, with shale interbeds; silty sandstone, in part calcareous; Dark pyritic shales, quartzitic and sandy at base;
Woolshed Flat Shale	Ndw	Neoproterozoic	Adelaide Geosyncline	Shale, black; dolomitic siltstone; dolomite; grey laminated siltstone.



Legend

- - - Faults (mapped)
— Streams
— Roads
🟥 Private Mine 188

Surface Geology

▨ Saddleworth Formation - Nds
▨ Saddleworth Formation - Nds1
▨ Beaumont Dolomite Member - Ndsb
▨ Stonyfell Quartzite - Ndt
▨ Woodshed Flat Shale - Ndw

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White Rock Quarry - 1:100,000 surface geology (Data Source: SARIG, 2020)

Figure 3

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Report for MOP\Fig 3. Geology.mxd
Document Name: Fig 3. Geology

4.4 Well Data

To investigate the hydrogeology of the immediate project area, water well information was downloaded from the Department for Environment and Water's (DEW) Groundwater Data application (WaterConnect, 2020). A spatial search was conducted to identify wells within 2 km of the Site.

The data was manipulated in a geographic information system (GIS) to display well attributes including well locations, aquifer monitored, well yield, depth to water and groundwater salinity. Results are presented in the following sub-sections.

4.4.1 Nearby Wells

Figure 4 displays nearby wells labelled by unit number, filtered to exclude wells with a latest depth of '0'. These wells were removed from the search as they have either:

- Reduced data integrity, as no depth is available; or
- Have been backfilled and are no longer in use.

The figure indicates that a number of wells are located north of the Site along an east-west drainage line. The intensity of wells along this drainage line correlates with homesteads and low intensity horticulture.

Three wells are marked at White Rock Quarry (6628-6232, 6628-6231, 6628-6892), however only one well is known to exist (6628-6231). This well is the previously used production well which is currently not operational. It was previously monitored by DEW for standing water levels (observation well ADE068). The remaining two wells 6628-3232 and 6628-6892 are either out of position or are unlikely to have existed (M. Harvey pers comm., 2016). Due to their uncertainty in location they have been discounted from the analysis.

4.4.2 Aquifer Monitored

Figure 5 displays water wells labelled by aquifer monitored. All wells target a fractured rock aquifer labelled as 'Nds', 'Nnt', 'Ndw' and 'N'. These map symbols correspond to Saddleworth Formation, Stonyfell Quartzite, Woodshed Flat Shale and a general term for Neoproterozoic rocks (N).

A review of water well data and geological information confirms that Tertiary or Quaternary Aquifers do not exist in the area.

4.4.3 Depth to water

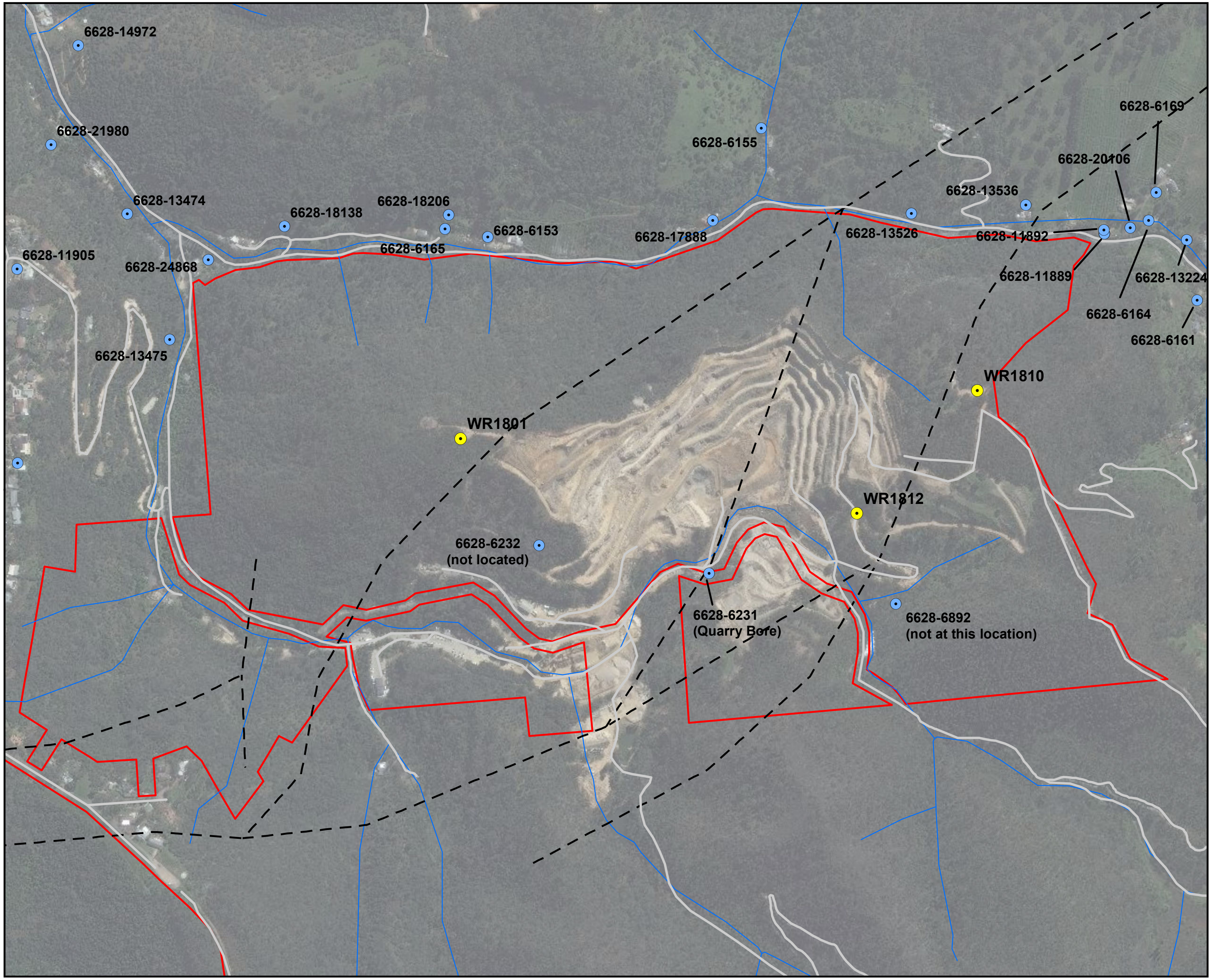
Figure 6 displays nearby wells labelled by depth to water (metres below ground). Most wells are constructed near the valley floors with water levels generally reporting less than 15 m below ground. Fewer wells are drilled in hilltop locations, most likely reflecting the steep topography and difficulty accessing with a drilling rig. The best available information at hilltop locations are from resource drillholes utilised for this study. This is discussed further in Section 5.

4.4.4 Well Yield (L/s)

Figure 7 presents well yields in litres per second (L/s). Well yields in the area are generally low and report at less than 2 L/s. Low report yields may relate to the low permeability nature of the fractured rock aquifer, however in some locations drill hole depth may be a limitation.

4.4.5 Groundwater Salinity

Groundwater salinity at nearby water wells is presented in Figure 8. All wells report fresh groundwater with the majority of wells falling within a range typically considered as 'potable' (e.g., 0 – 1,200 milligrams per litre total dissolved solids (mg/L TDS) as defined by NHMRC (2011).



Legend

- ● Water wells
- ● Vertical Drillhole - 2019
- - - - Faults (mapped)
- — Streams
- — Roads
- ☐ Private Mine 188

GROUNDWATER
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Job Number: HAN-19-6

Client: Hanson

Version: 1 Date: 28/09/2020

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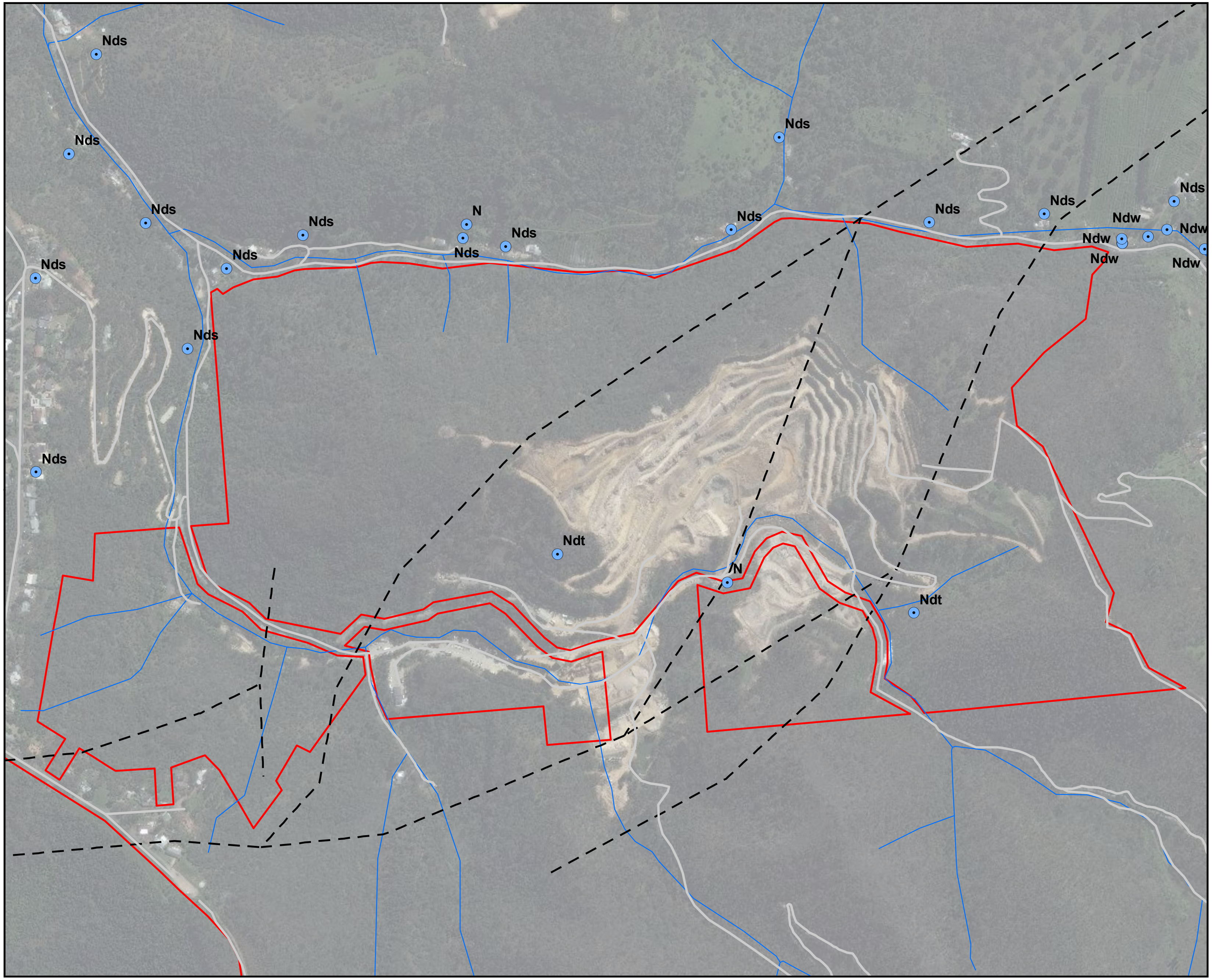
N

0 100 200 400
Meters

Coordinate System: GDA 1994 MGA Zone 54

White Rock Quarry - nearby water wells labelled by unit number

Figure 4



Legend

● Aquifer monitored

- - - - Faults (mapped)

—— Streams

—— Roads

🟥 Private Mine 188

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Job Number: HAN-19-6

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Coordinate System: GDA 1994 MGA Zone 54

Aquifer monitored as reported on WaterConnect (2020).

Figure 5

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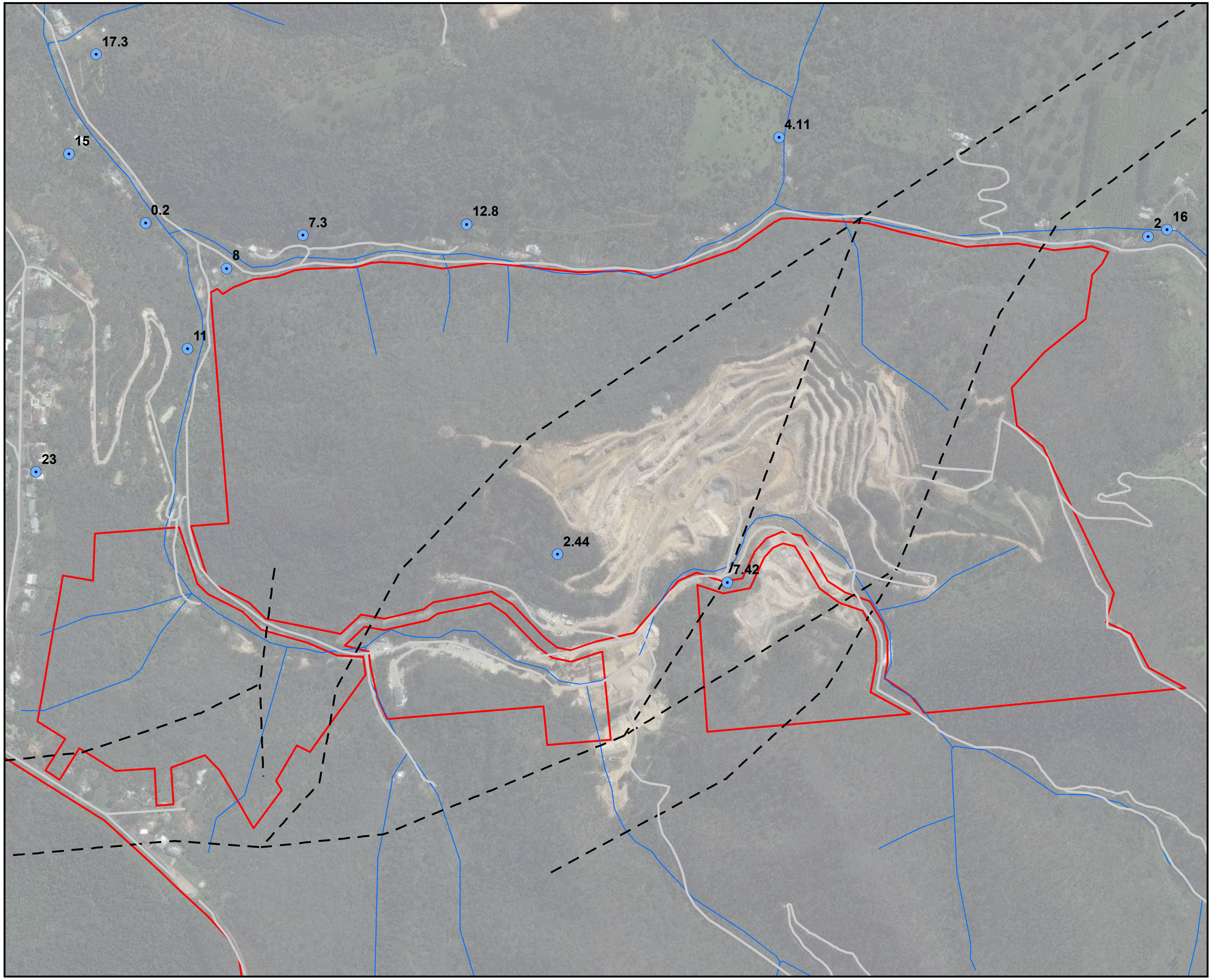
Document Name: Fig 5. Aquifer Monitored



Legend

● Depth to water (m below ground)

- - - Faults (mapped)

— Streams

— Roads

🟥 Private Mine 188

GROUNDWATER SCIENCE

Job Number: HAN-19-6

Client: Hanson

Version: 1

Date: 28/09/2020

Drawn by: PM

N

0 100 200 400

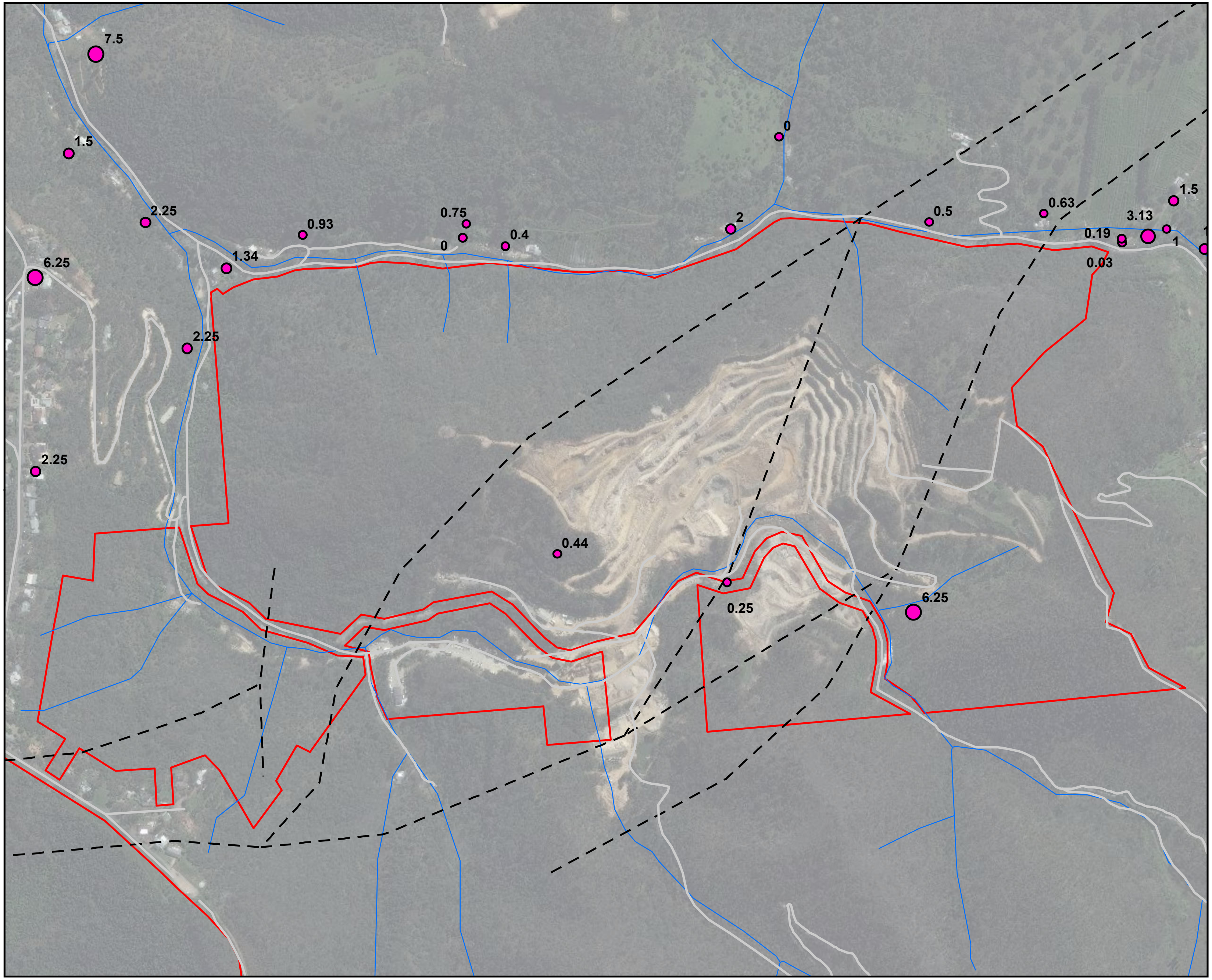
Meters

Coordinate System: GDA 1994 MGA Zone 54

Nearby water wells labelled by depth to water (m below ground)

Figure 6

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Report for MOP\Fig 7. Depth to water.mxd
Document Name: Fig 7. Depth to water



Legend

Well Yield (L/s)

- ● 0 - 1
- ● 1 - 3
- ● 3 - 5
- ● 5 - 10
- ● 10 - 31.25
- Faults (mapped)
- Streams
- Roads
- 🟥 Private Mine 188

GROUNDWATER SCIENCE

Job Number: HAN-19-6

Client: Hanson

Version: 1 Date: 28/09/2020

Drawn by: PM

N

0 100 200 400

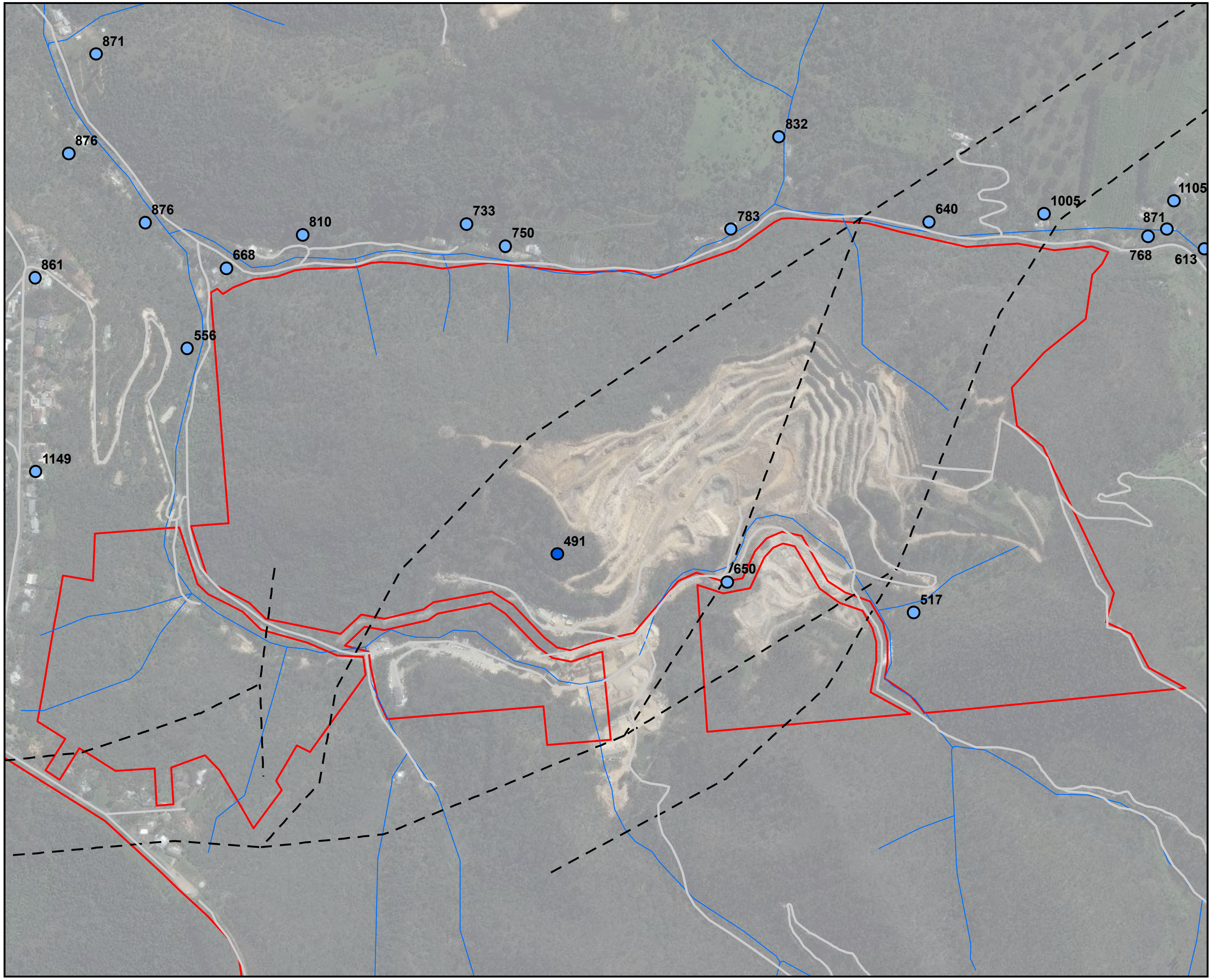
Meters

Coordinate System: GDA 1994 MGA Zone 54

Nearby water wells labelled by well yield (litres/second)

Figure 7

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Report for MOP\Fig 6. Well Yield.mxd
Document Name: Fig 6. Well Yield



Legend

Well salinity (mg/L)

● 0 - 500

● 501 - 1200

● 1201 - 3000

● 3001 - 5000

● 5001 - 5000

- - - Faults (mapped)

— Streams

— Roads

▭ Private Mine 188

GROUNDWATER
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Job Number: HAN-19-6

Client: Hanson

Version: 1 Date: 28/09/2020

Drawn by: PM

N

0 100 200 400
Meters

Coordinate System: GDA 1994 MGA Zone 54

Nearby water wells labelled by salinity (milligrams / litre total dissolved solids).

Figure 8

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Report for MOP\Fig 8. Salinity.mxd
Document Name: Fig 8. Salinity

4.5 Seasonal Groundwater Variation

To investigate seasonal groundwater variation a search was conducted for Government monitoring wells in the nearby area. One well was identified in proximity to the Site which corresponds to well 6628-6231 (DEWNR observation well ADE068). This well is the previously used production well which is located in a creek bed immediately to the south of the existing working pit (see Figure 4 for location and photos in Appendix 1). The well was monitored consistently over the period 1981 to 2002. The well provides a good representation of seasonal groundwater variation at the immediate project area. A hydrograph for the well is presented in Figure 9.

The temporal trends in Figure 9 (seasonal fluctuations and long-term variability) demonstrate that seasonal groundwater variability is in the order of 1.5 m, with maximum groundwater elevations generally residing around 289 mAHD (but no higher than 290.2 mAHD). This corresponds to a depth to water greater than 6.3 m below ground.

Please note the above assessment excludes variation attributed to pumping, which is observed to occur from 1982 to 1995. Further discussion on near site groundwater conditions is presented in Section 5.

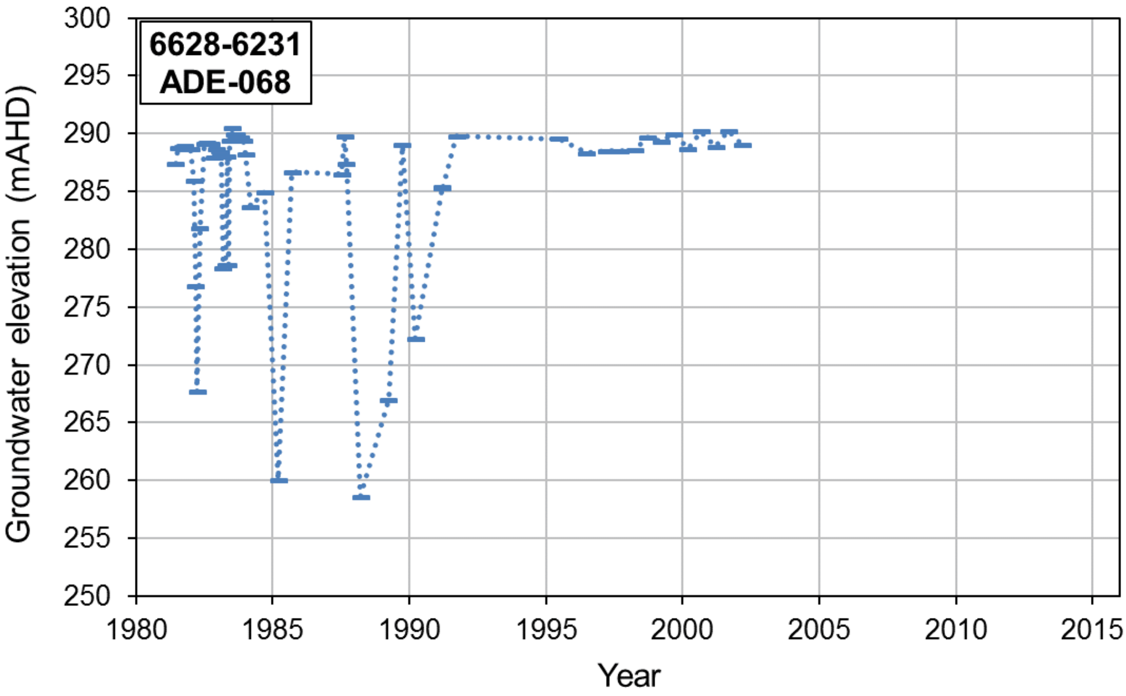


Figure 9. Water level variation at well 6628-6231 (Quarry production well – ADE068).

4.6 Potential for Groundwater Dependent Ecosystems.

The potential for groundwater dependent ecosystems was assessed by reviewing the Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE). This information can be found at the following link while a map of the potential GDE's displayed in Figure 10.

http://www.bom.gov.au/water/groundwater/gde/map.shtml

As detailed in the map, there are no ecosystems at the Site with a classification as an aquatic ecosystem with *high potential* for groundwater interaction. The 'potential GDE' is eucalyptus woodland which is described as having *low* to *moderate* potential for groundwater interaction (BoM, 2020). This indicates that woodland vegetation is likely to be rainfall or surface water dependent rather than groundwater dependent.

Irrespective, assuming creek line vegetation was groundwater dependent the following is noted:

- Water level information from the on-site production well (6628-6231; ADE068) demonstrates that standing water levels are more than 6 m below the creek bed during all seasons. This indicates that the stream is losing at that location, and that significant dependence on groundwater is unlikely.
- No baseflow is observed in the stream during summer with stream flows commencing in early to mid winter after the on-set of rainfall (M. Harvey, pers comm., 2020). This suggests that groundwater is consistently below the creek bed during all seasons.

It should be noted that as pit floors will be designed to remain above groundwater there is a low likelihood of impacting any ecosystem materially reliant on groundwater.

4.7 Groundwater Licensing

The Site resides within the Central Adelaide Prescribed Wells Area (PWA) and licenses are required for groundwater extraction.

The Central Adelaide PWA has been under moratorium since 2007, however as of October 2020 the moratorium has been removed. This enables drilling of new wells for stock and domestic purposes (without a license), however no new licenses are available for industrial or commercial supplies until a Water Allocation Plan (WAP) is adopted. The date for this is currently not known. Thus, based on the lack of a WAP there is no possibility of increasing allocations either via a new allocation or transfer of an allocation from an existing groundwater user.

4.7.1 Existing user registration

As part of prescription of the Central Adelaide PWA, groundwater users were invited to register as "existing groundwater user". This registration entitles proponents to continue extracting groundwater at historical volumes, provided proponents can demonstrate financial commitment for the taking of the groundwater water during the 'establishment period' (in the case of the Central Adelaide PWA this was over the period 2002 to 2005).

Information provided by Hanson has confirmed that the quarry registered as an existing groundwater user in 2007 (Harvey, written communications, 2016). This entitles Hanson to continue using groundwater as per their existing arrangement with their current application confirmed at approximately 15,000 kL/annum (M. Harvey pers comm., 2016).

It should be noted however that if Hanson intends to increase groundwater extraction from their on-site production well or quarry below the water table additional allocations will be needed. Obtaining these will be problematic until the WAP is adopted.

Legend

— Streams

🟥 Private Mine 188

🟦 Potential GDE - Stream

🟩 Potential GDE - Woodland

GROUNDWATER
SCIENCE

Job Number: HAN-19-6

Client: Hanson

Version: 1

Date: 28/09/2020

Drawn by: PM

Coordinate System: GDA 1994 MGA Zone 54

Potential for Groundwater Water Dependent Ecosystems (GDE's). Source: BoM, 2020

Figure 10

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Report for MOP\Fig 7. Potential GDEs.mxd
Document Name: Fig 7. Potential GDEs

5 Fieldwork

5.1 Exploratory Drilling

In August 2019 a drilling program was conducted to evaluate quarry resources. The program included the drilling of 10 diamond drillholes to depths varying between 50 and 150 m. Six (6) drillholes were completed as angled holes (approximately 60 degrees) while four (4) drillholes were drilled vertically (90 degrees, WR1801, WR1810, WR1812, WR1815 – Figure 11). The drillholes intersected a combination of sandstone, quartzite, shale and siltstone.

Appendix 2 provides a summary of lithology logs recorded by the supervising geologist at vertical drillholes, while Figure 11 displays their locations.

Groundwater Science attended Site in February and March 2020 to undertake groundwater monitoring and salinity sampling at open drillholes. Results of the fieldwork are presented below.

5.2 Groundwater Levels and Salinity

Each exploration hole was inspected and monitored on 25th of February 2020. Three vertical drillholes were found to have access for groundwater level monitoring (WR1801, WR1810, WR1812) whilst all angled drillholes were blocked or had collapsed.

Table 3 provides results from monitoring of the open vertical drillholes during March, including latest depths, water levels and salinity. Figure 12 presents measured groundwater elevations in mAHD.

A summary of site observations includes the following:

- Vertical drillholes WR1801, 1810 and 1812 were found to be open, however each of the drillholes were shallower than their original drilling depth (Table 1).
- Depth to water at the vertical drillholes ranged from 44.9 m below ground at WR1812 to 112.1 m at WR1810 (Table 3). The greatest depth to water was recorded at drillholes in topographic elevated positions i.e. WR1801 and WR1812.
- Drillhole water levels were reported between 302.75 and 323.09 mAHD (Figure 12), with highest water level at WR1801. This is higher than the water level reported at well 6628-6231 (ADE068) in the valley floor (approximately 289 mAHD).
- Drillhole salinity was reported at 1,257 and 821 micro siemens per centimetre (us/cm) at drillholes WR1801 and WR1812. These salinities are fresh and are consistent with qualities reported at the on-site production well / nearby 3rd party wells (Figure 8).
- pH was in the range of 7.29 to 7.9 which is slightly alkaline.
- No sample could be retrieved from drillhole WR1810 as the grab sampler (hydrasleeve) could not penetrate past 95 m.

5.3 Inferred Water Table Elevation and Hydrogeological Cross Sections.

Information from the data review (Section 4), site survey and fieldwork has been used to develop an inferred groundwater contour map for the Site (Figure 12). The contour map can be used to inform quarry planning to ensure that pits are designed to remain above groundwater. The approach to contour development is described as follows:

1. Generate point data set as described in Table 4.
2. Interpolation of the water table surface by triangulation.

The water table is inferred and is based on the 3 investigation holes drilled in 2019 and the quarry production well located to the south of the site (Figure 12). The remaining controls are the current topography which include:

- Water table set at creek bed elevations. This assumption is conservative given water levels at the on-site production well are consistently more than 6 m below ground and creek lines do not report summer baseflow (which implies that water levels are consistently below the creek bed).
- The assumption that the water table is 3 m below the ground surface in the deepest parts of the quarry (see dummy points in Figure 12). This is consistent with levels at the nearby observation well (6628-6231, ADE068) and observations from the quarry operator – no seepages have been reported to the pits at the deepest floor levels which extend to 295 mAHD (M. Harvey pers comm., 2020).

The results of the contouring demonstrate the following:

- Groundwater elevation is highest at topographic highpoints in the central and eastern parts of the Site. Groundwater elevations are lower along drainage lines to the north and south of the active pit areas. These drainage lines provide a constraint on the water table elevation near to the Site.
- In the eastern part of the tenement groundwater is interpreted to flow from the east to the north-west in the direction of a major drainage line near Old Norton Summit Road.
- In the central part of the tenement groundwater is interpreted to flow radially from the topographic high point (WR1801) toward topographic low points including drainage lines.
- Groundwater levels below the pit workings are interpreted to reside below 295 mAHD.

5.4 Implications for Pit Designs

Information from the inferred water table elevation (Figure 12) can be used to inform pit designs for the Site.

Based on the map the following is recommended:

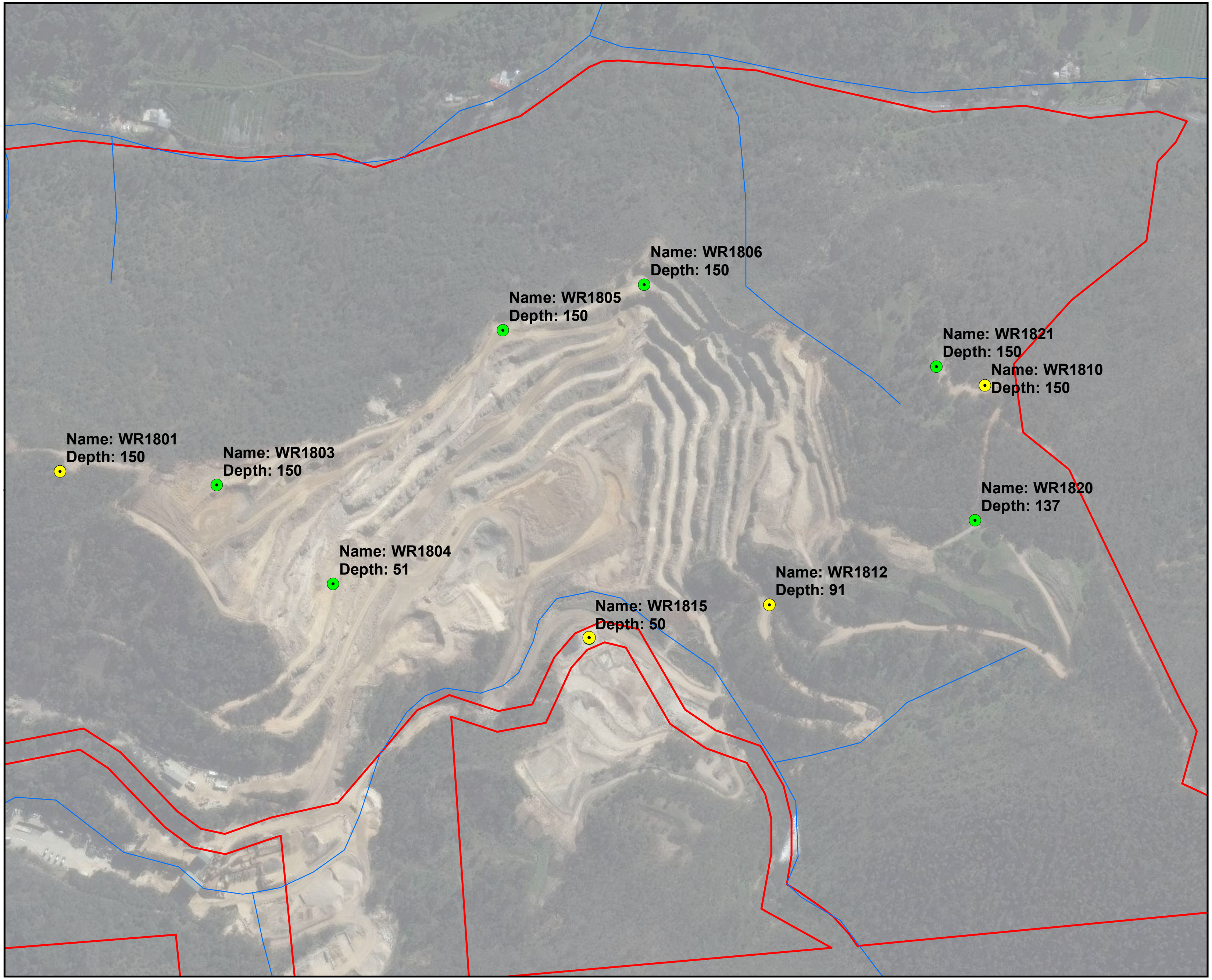
- Pits should remain a minimum of 3 m above the table elevation as presented in Figure 12. This would require pits to bench upward to the east toward WR1810 and upward to the west toward WR1801. The above will reduce the likelihood of groundwater interception and avoid detailed impact assessments / groundwater license applications.

Table 3. Results from February and March Fieldwork – White Rock Quarry.

Drillhole ID	Drillhole diameter (mm)	Easting	Northing	Z (mAHD)	Original Depth (m)	Latest Depth (m)	Latest Depth date	Depth to water (m)	Depth to water date	Groundwater Elevation (mAHD)	Salinity (us/cm)	pH	Comments
WR1801	75	290208	6132903	414.51	150	109	20/03/2020	91.42	25/02/2020	323.09	1257	7.9	Water strike noted by driller from 110 to 118 m. Bailer retrieved small quantity of water during sampling.
WR1810	75	291138	6132989	424.98	150	114.5	20/03/2020	112.09	25/02/2020	312.89	NA - see comments		Water strike noted by driller from 111 to 113 m. No sample retrieved with hydrasleeve or bailer.
WR1812	75	290922	6132768	347.64	90	46	20/03/2020	44.89	25/02/2020	302.75	851	7.29	Water strike noted by driller from 78 to 81 m. Bailer retrieved small quantity of drillhole water.

Table 4. Inferred Water Table Data Points.

Data	Treatment
Nearby Wells	Downloaded from DEWNR WaterConnect. Reference Elevation from UAV survey
	6628-6231 was Hanson's Production bore. Reference Elevation from UAV survey
Resource Drillholes	3 vertical drillholes measured water depth (WR1801, WR1810, WR1812). Reference Elevation from UAV. Refer Table 3.
Creek line Dummy Point	Water Table set at Creek bed elevation. Reference elevation from UAV survey. Methodology provides a conservative (maximum) water level elevation at creek bed locations.
In Pit Dummy Points	Water table set to 3 m below existing pit floor elevation from UAV survey. Rationale is that the operator does not report groundwater seepage to the existing pit.



Legend

● Vertical Drillhole - 2019

● Angled Drillhole 2019

— Streams

▭ Private Mine 188

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Version: 1 Date: 28/09/2020

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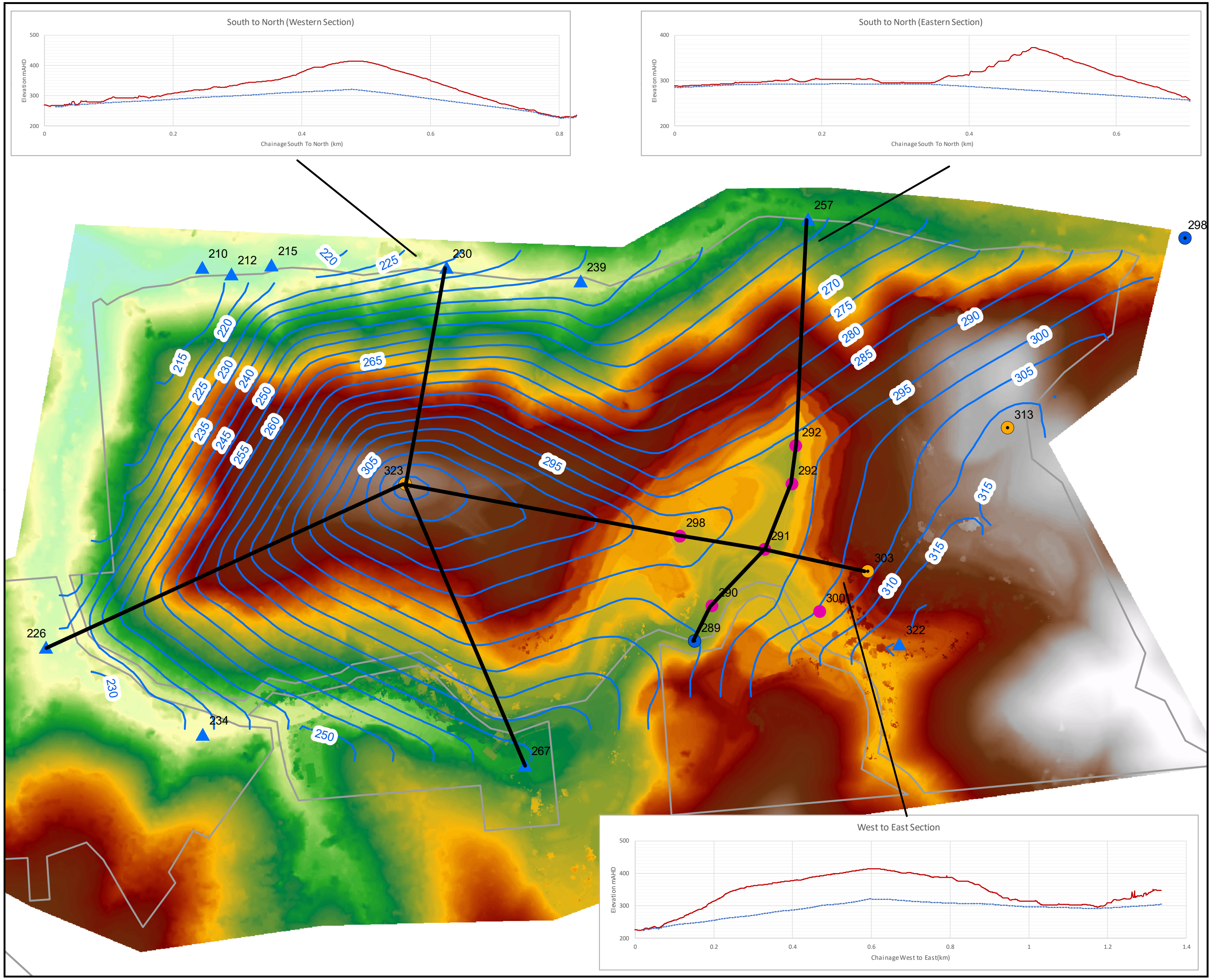
0 50 100 200
Meters

Coordinate System: GDA 1994 MGA Zone 54

Location of resource investigation drillholes constructed in 2019

Figure 11

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Report for MOP\Fig 11. Resource Drillholes.mxd
Document Name: Fig 11. Resource Drillholes



Legend

Data Points

● Bore

▲ Creekline Dummy Point

● HAN Drillhole

● In Pit Dummy Point

Inferred Water Table Contours

― mAHD

DEM

mAHD

High : 472.65

Low : 196.618

☐ Private Mine 188

GROUNDWATER
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Job Number: HAN-19-6

Client: Hanson

Version: 1

Date: 1/04/2020

Drawn by: BJ

N

0 70 140 280

Meters

Coordinate System: GDA 1994 MGA Zone 54

Inferred Water Table Elevation

Figure 12

Document Path: C:\Users\Ben Jeuken\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-19-6-White Rock Investigations\GIS\Maps\Water Table Elevation.mxd
Document Name: Water Table Elevation

6 Discussion

This report summarises groundwater conditions in proximity to White Rock Quarry. The results from the review confirm the following:

- The Site is located within the Central Adelaide PWA. Any groundwater extraction requires a license and authorisation from DEW.
- Hanson applied as an existing groundwater user in 2007 for an allocation volume of 15,000 kL/ annum.
- A number of water wells are located to the north of the Site along Old Norton Summit Road. Wells in this area are positioned in flatter terrain in proximity to drainage lines. Given pits will be designed to remain above groundwater there is very limited potential for impacts to these users.
- Groundwater elevations vary between 289 to 323 mAHD based on on-site wells, whilst water tables are inferred to remain below creek beds across the Site.
- Groundwater flow paths are interpreted to move from the east to the north-west, and radially from a topographic high point near WR1801.
- Groundwater salinity is reported as fresh at less than 1,200 mg/L us/cm.
- The BoM Atlas did not identify any GDE's related to aquatic ecosystems. The GDE identified terrestrial woodland which is described as having a 'low potential' for groundwater reliance (BoM, 2020).

7 Recommendations

The water table developed for this Site is inferred based on available drillhole data and topographic inference. Future quarry development may benefit from the drilling of additional wells in the western and central portions of the Site. This has potential to increase the quarry resource base at specific locations.

8 Closing

Thank you for the opportunity to undertake this assessment. If you have any queries' please contact Paul Magarey on 0438 856 442.

Regards

Paul Magarey
Senior Hydrogeologist

9 References

BoM (2020). Atlas of Groundwater Dependent Ecosystems. Accessed on-line 2016 and 2020.

DEWNR, 2020. Groundwater Data application, accessed February 2020. https://www.waterconnect.sa.gov.au

Harvey, M., (2020). Personal communications to Paul Magarey, March and September 2020.

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NHMRC, NRMMC (2011) Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra

.

Appendix 1. Photo of historical production well (6628-6231; ADE068).

Appendix 2. Generalised geology logs at WR1801, WR1810 and WR1812.

The following logs have been interpreted from lithology logs provided from diamond drilling and logged by Hanson geologists. Water strike was obtained from daily drilling reports from Underdale Drillers.

Drillhole Name	Depth from (m)	Depth to (m)	Geology Description	Water Strike noted by Driller
WR1801	0	30	Siltstone	
	30	37	Sandstone	
	37	105	Siltstone	
	105	117	Quartzite	Water struck between 110 and 118 m
	117	122	Sandstone	
	122	129	Siltstone	
	129	132	Sandstone	
	132	150	Siltstone	
WR1810	0	26	Siltstone	
	26	55	Sandstone	
	55	66	Quartzite	
	66	81	Siltstone	
	81	96	Sandstone	
	96	110	Siltstone	
	110	120	Sandstone	Water struck between 111 and 113 m
	120	127	Quartzite	
	127	138	Siltstone	
	138	150	Siltstone	
WR1812	0	7	Siltstone	
	7	11	Sandstone	
	11	19	Quartzite	
	19	22	Sandstone	
	22	26	Quartzite	
	26	28	Siltstone	
	28	43	Sandstone	
	43	45	Quartzite	
	45	47	Sandstone	
	47	49	Siltstone	
	49	60	Sandstone	
	60	72	Siltstone	
	72	79	Sandstone / quartzite	Water struck between 78 and 81 m
	79	90	Siltstone	

Attachment 16

Request for Alterations - Groundwater Related Tasks

GROUNDWATER
SCIENCE

WHITE ROCK QUARRY

Mining Operations Plan Review – Request For Information – Groundwater Related Tasks

Document number:	HAN-21-3-R0001	
Prepared for:	Groundwork Plus	March 2022

Document Title

Mining Operations Plan Review – Request for Information – Groundwater Related Tasks

Author

Paul Magarey and Matt Williams

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Revision History

Revision	Issue date	Revision description	Author	Reviewed by	Approved by
Version 1	22/3/2021	Draft Report	M. Williams	P. Magarey	P. Magarey

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Contents

List of Figures

List of Tables

List of Appendices

1 Introduction

Groundwater Science Pty Ltd (GWS) were engaged by Groundwork Plus Pty Ltd (GWP) to respond to a request for information (RFI) issued by the Department for Energy and Mining (DEM). The request for information relates to quarry expansion activities at White Rock Quarry, Private Mine (PM) 188 “the Site”.

DEM have requested additional groundwater information be provided to support the Mine Operations Plan (MOP) Review, submitted by Groundwork Plus in 2020. DEM have raised specific queries as provided in Appendix A. A summary of specific request is outlined below:

Item 17.

Provide evidence to support the interpretation of groundwater elevations, including:

- Drilling of observation well/s to confirm groundwater elevations in the Stage 1 to 3(a) mining areas.
    - Provide updated groundwater contour maps for the inferred difference between the proposed pit base and seasonally high water table for each quarry stage.
    - Highlight uncertainties and assumptions in the data and appropriate buffer distances between the inferred pit base and water table position.

Item 37

- Provide clear monitoring and measurement parameters to measure groundwater quality and quantity. Justify the frequency.

To address the above fieldwork was conducted including the drilling of observation wells, groundwater monitoring and sampling. Groundwater contours were developed that incorporate a degree of conservatism with respect to the water table position. Further discussion on the methodology and results is contained in the following report and includes implications for pit designs.

2 Fieldwork – Drilling and Monitoring

2.1 Approach

A fieldwork program was implemented to obtain additional groundwater level and salinity information across the Site.

The aims of the fieldwork were to design a drilling program that would be capable of intercepting the water table and confirm the depth to groundwater in the Stage 1 to 3 mining areas. Previous interpretations of groundwater elevation across the Site had utilised a combination of water well and diamond drillhole data available at that time. This was reported previously in GWS, (2020).

In design of the drilling program consideration was given to:

- Targeting locations that were sensitive for quarry expansion during Stages 1, particularly the eastern part of the Site where quarry pits approach the water table.
- Drill at locations that were accessible, noting the Site is extremely steep and not suitable for a drilling rig in some locations.
- Placing permanent groundwater monitoring wells at locations that were unlikely to be removed by quarrying over the short to medium term. This would enable ongoing monitoring to be conducted for water levels and quality and gauge seasonal groundwater level variation from dedicated wells.

2.2 Drilling and Well Construction

Drilling and well construction was conducted over two periods in September and November 2021. The initial drilling campaign (September 2021) comprised the drilling of 3 monitoring wells (GW-3, GW-4, GW-5) and two open drillholes (GW-5, northwest wall). Drilling utilised the on-site percussion rig to depths of ~27 m. Locations of the new wells and existing drillholes are presented in Figure 2.1. Construction details for the wells and drillholes are presented in Table 2.1.

The wells were completed as observation wells (50 mm) with Class 18 PVC casing. The wells were gravel packed across the screened interval, sealed with bentonite and cemented to the surface. Drilling returns comprised of quartzite consistent with the material quarried at the Site.

Table 2.1: Construction details for new wells and drillholes – White Rock Quarry.

Drillhole	Unit No	Drill Date	Max Drill Depth (m)	Easting	Northing	Well Type	Status	Surface Elevation (mAHD)	Casing Screen interval (m)
GW-3	6628-31591	6/09/2021	27.7	290563	6132739	Monitoring	Cased	306.31	17 - 26
GW-4	6628-31589	6/09/2021	27.1	290040	6132588	Monitoring	Cased	258.92	15 - 27
GW-5	NA	6/09/2021	27.5	290812	6133029	Drillhole	Open	319.32	
GW-6	6628-31590	6/09/2021	27.5	290724	6132651	Monitoring	Cased	320.61	21.5 - 27.5
Northwest wall	NA	6/09/2021	27	290723	6132978	Drillhole	Open	309.29	
Northeast wall	NA	2/11/2021	27	290865	6132983	Drillhole	Open	316.56	

Note: All wells target the Stonyfell Quartzite which is Neoproterozoic in Age.

Legend

- 🔵 Groundwater Wells - 2021
- 🟢 Historic Monitoring / Production Bore
- 🔴 Vertical Drillholes - 2019
- ☐ Private Mine 188
- — Drainage lines

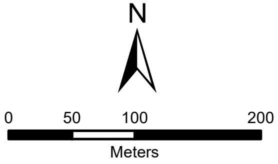
GROUNDWATER
SCIENCE

Job Number: HAN-21-3

Client: Hanson

Version: 1 Date: 20/02/2022

Drawn by: PM



Coordinate System: GDA 1994 MGA Zone 54

White Rock Quarry - Wells and Drillholes used for monitoring

Figure 2.1

2.3 Monitoring for Standing Water Level and Salinity

The new wells and drillholes were monitored for depth to water at least 7 days after the drillholes were completed. In addition to wells completed in 2021, monitoring was undertaken at an old well identified on site, referred to as 'Old Bore' in Table 2.2 and Figure 2.1. This well does not appear on the Government Database Water Connect and its depth and construction details are not known.

Attempts were made to measure water levels at the diamond drillholes completed in 2019. Two of the drillholes were found to have collapsed (WR1801, WR1810) while the 3rd drillhole, WR1812, had been covered by an access road. Additional monitoring of these drillholes was not possible.

Results from the monitoring are presented in Table 2.2 and include measurements for depth to water, electrical conductivity (EC) and pH. Samples collected for EC were obtained via the hydra-sleeve method.

Table 2.2: Wells monitored during 2021 fieldwork.

Drillhole	Unit No	Surface Elevation (mAHD)	DTW (m bTOC)	Monitoring Date	Stick up (m)	Groundwater Elevation (m AHD)	EC (us/cm)	pH	ORP	Temp
GW-3	6628-31591	306.31	16.93	14/09/2021	0.86	290.24	810	7.73	-35	17.6
GW-4	6628-31589	258.92	21.19	14/09/2021	0	237.73	1220	7.43	-24.2	17.32
GW-5	NA	319.32	17.07	14/09/2021		302.25	562	7.97	-55.8	17.63
GW-6	6628-31590	320.61	20.85	14/09/2021	0.7	300.46	815	6.98	67.3	
Northwest wall	NA	309.29	12.26	5/11/2021		297.03				
Northeast wall	NA	316.56	13.46	5/11/2021		303.1				
Old Bore	Not known	296.93	7.00	14/09/2021		289.93				

2.3.1 Standing Water Level

Results of standing water levels (SWL's) are presented as Table 2.2. Results from the monitoring confirm that water levels range from 7.00 to 20.85 m below ground for the new wells drilled. The shallowest water level was measured at 'Old Bore', while the deepest water level was reported at GW 6. This is displayed visually in Figure 2.2.

Figure 2.2 also includes water levels from diamond drillholes constructed in 2019. Water levels were monitored in January 2020 prior to their collapse. Water levels at these drillholes are significantly deeper, ranging from 44.81 to 112.03 m below ground. The deeper water levels reflect their position in the landscape in topographically elevated positions i.e. higher parts of the Private Mine.

The map also includes a water level from the on-site production well (6628-6231 / ADE068) which is now abandoned. This well was monitored extensively by DEW from 1981 to 2002 but is now in disrepair. The latest water level was reported at 7.42 m below ground (6/03/2002). The shallowest water level at this well over its period of record was 6 m below ground (7/07/1983).

2.3.2 Groundwater Salinity and pH

Groundwater salinity was measured at selected wells during the 2021 fieldwork. The results confirm that groundwater is fresh, ranging from 562 to 1,220 micro siemens per cm (µs/cm). This corresponds salinity that approximates 485 to 730 milligrams per litre total dissolved solids (mg/L TDS). Groundwater of these salinities has a beneficial use for irrigation, stock, domestic and industrial purposes. pH was reported from 6.98 to 7.97 which is neutral to slightly alkaline. It is suitable for most purposes including groundwater dependent ecosystems.

Legend

- 🔵 Groundwater Wells - 2021
- 🔴 Vertical Drillholes - 2019
- 🟢 Historic Monitoring / Production Well
- ― Drainage lines
- ▭ Private Mine 188

GROUNDWATER SCIENCE

Job Number: HAN-21-3

Client: Hanson

Version: 1 Date: 20/02/2022

Drawn by: PM

N

0 50 100 200
Meters

Coordinate System: GDA 1994 MGA Zone 54

White Rock Quarry - Depth to water at available Wells & Drillholes.

Figure 2.1

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-21-3-White Rock MOP_Response Doc\GIS\Maps\10.5\Fig 2.2_Depth to water.mxd
Document Name: Fig 2.2_Depth to water

2.4 Groundwater Elevation (mAHD)

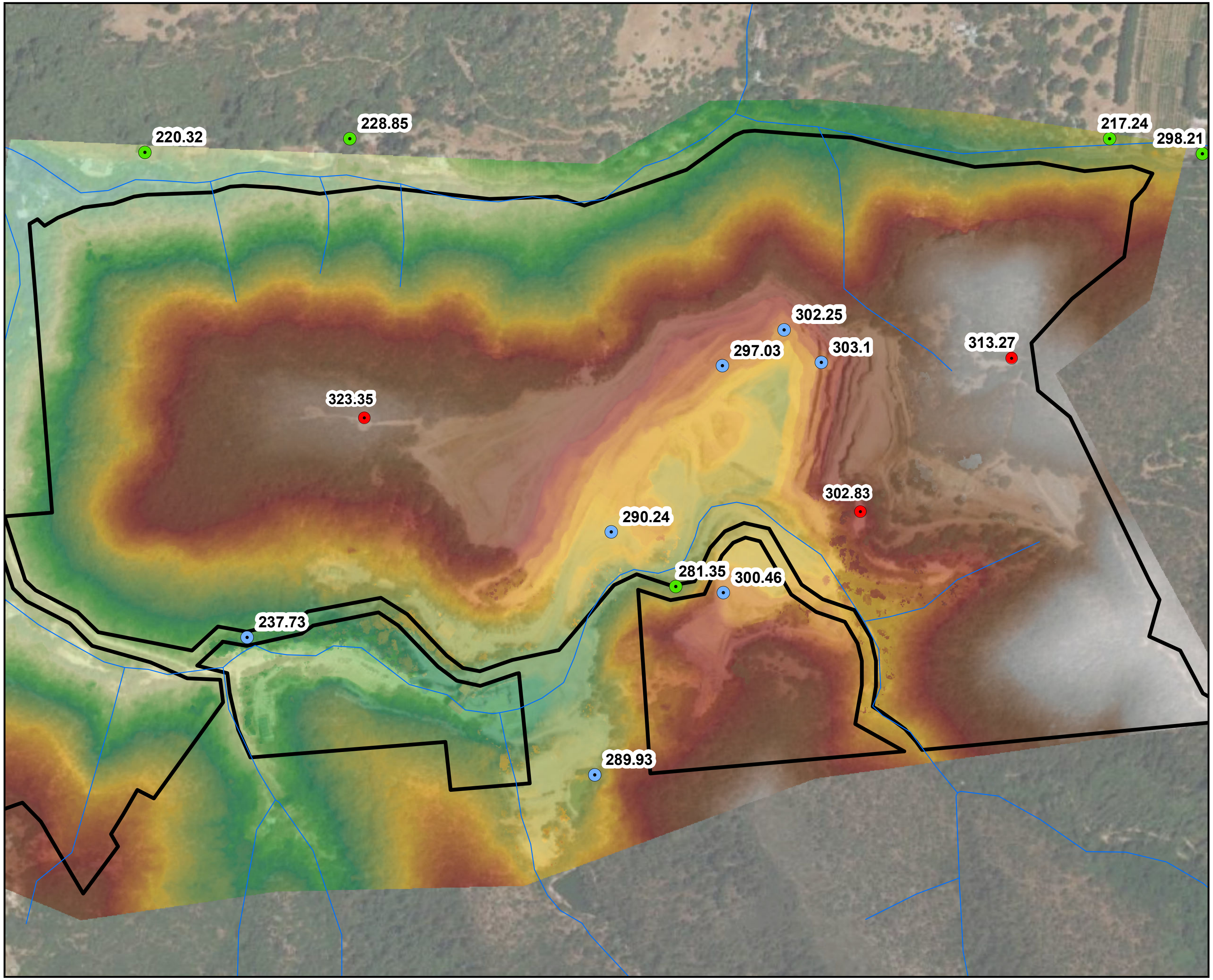
New data from monitoring (Section 2.2 and 2.3) was combined with previous information collected during groundwater studies in 2020 (Groundwater Science, 2020). The data was used to create a map displaying measured groundwater elevations in metres Australian Height Datum (mAHD). This is illustrated in Figure 2.3.

In collation of the data the following is noted:

- Coordinates (x, y) and reference elevations (z) for 2019 and 2021 drillholes were taken from drone surveys provided by Groundwork Plus (2019) and Hanson (2021).
- Survey data for ADE068 was originally taken from WaterConnect. However, close inspection of the DEW survey elevation shows a discrepancy of approximately 8 m from the Site surveys collected by the UAV compared with the DEW survey height. For this reason the UAV reference elevation was adopted as it is more accurate and matches another independent survey conducted by Hanson.
- Other 3rd party well data was taken from WaterConnect, with ground survey information taken from the 1-second Digital Elevation Model (GA, 2011).

Results from the groundwater elevation map include the following:

- Groundwater elevations vary across Site, ranging from 237 mAHD at GW-3 to 323 mAHD at WR1801. Groundwater elevations are highest at topographic high points and lower near drainage lines.
- Groundwater elevations in current pit workings range from 290.2 to 303.1 mAHD. Current pit floors extend to approximately 304 mAHD in these locations, which suggests that the workings are approaching the top of the water table in the eastern part of the quarry.
- Historically, a small area of the pit was quarried to 295 mAHD over the period 2016 to 2018. This area is displayed in Figure 2.4 and is near drillholes GW-5, north-east wall and north-west wall (Figure 2.1). Based on 2021 data it is likely that groundwater was intercepted in the low point of the quarry during this time. The bench has since been backfilled to a level of approximately 304 mAHD.
- The new data confirms that pit floors to 295 mAHD will intercept groundwater in some areas of the proposed expansion areas, particularly the eastern part of the pit near the drillholes *north-east wall*, GW-5 and the *north-west wall*. As Hanson intend to remain above the water table pits will need to be raised at this location. Additional implications for pit designs are discussed in Section 2.4, per below.



Legend

- ● Groundwater Wells - 2021
- ● Vertical Drillholes - 2019
- ● Water well (WaterConnect)
- Drainage lines
- ▭ Private Mine 188

DEM - Drone Survey 2019

mAHD

High : 472.65

Low : 196.618

GROUNDWATER
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Job Number: HAN-21-3

Client: Hanson

Version: 1 Date: 10/01/2022

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N

0 70 140 280

Meters

Coordinate System: GDA 1994 MGA Zone 54

White Rock Quarry - Measured Groundwater Elevations mAHD.

Figure 2.3

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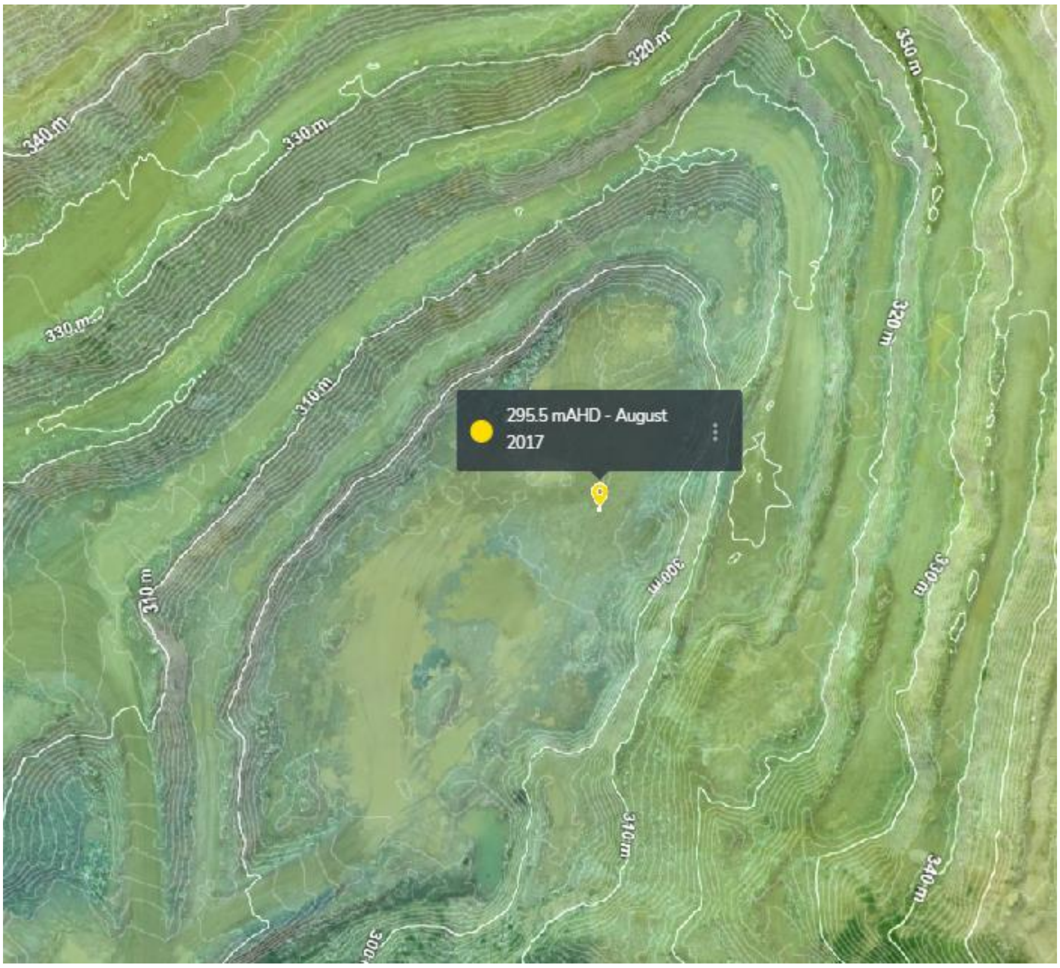


Figure 2.4: Historical pit floor elevations – August 2017 (Source: Groundwork Plus, 2017).

2.5 Groundwater Contours to Support Quarry Planning

New information has highlighted that groundwater will be intercepted at eastern portions of the pit per quarry development plans proposed in 2020 (Groundwork Plus, 2020). Whilst Hanson have an existing groundwater allocation which is currently not utilised (15 megalitres per annum), the preference is to design pits to remain above groundwater (M. Dupree, pers comm., 2021). This will avoid groundwater inflows and more detailed assessments including groundwater modelling and sourcing of additional groundwater allocations.

2.5.1 Seasonal High Groundwater Levels

The new monitoring wells have been monitored for depth to water during the spring of 2021, a relatively high rainfall year for the Adelaide region. It is expected that groundwater elevations at the time of monitoring are close to the seasonally high groundwater elevation available for the Site.

In addition to data collected in 2021, groundwater elevations were measured at vertical drillholes completed via diamond drilling in 2019 (WR1801, WR1810 and WR1812). Measured water levels were collected in February 2020 as reported in Groundwater Science, 2020. As the monitoring was conducted in summer, they are likely to represent seasonally low water table position. To account for seasonal variation time series water levels were inspected from the nearby monitoring well ADE068. Review of its hydrograph confirms that seasonal variation (without pumping) is in the order of 2 m. Thus, an additional 2 m should be added to the water levels of WR1801, WR1810 and WR1812 to account for this seasonal variation.

2.5.2 Data Gaps

In review of the data (Figure 2.1 and Figure 2.3) it is evident that there are data gaps across the Site where no groundwater level information is available. This is notable at the following locations:

- The eastern part of the Site between drillholes north-east wall and WR1810.
- On the pit crest at the northern extent of the current quarry workings. This ridgeline is a local highpoint before the topography descends rapidly into the Valley to the north (Old Norton Summit Road).
- In the south-east portion of the Site in the direction of Mt Lofty.
- In a radial area surrounding drillhole WR1801. This area is a topographic high point in the western area of the Site.

Obtaining access to the above locations is problematic due to the very steep terrain and thick vegetation.

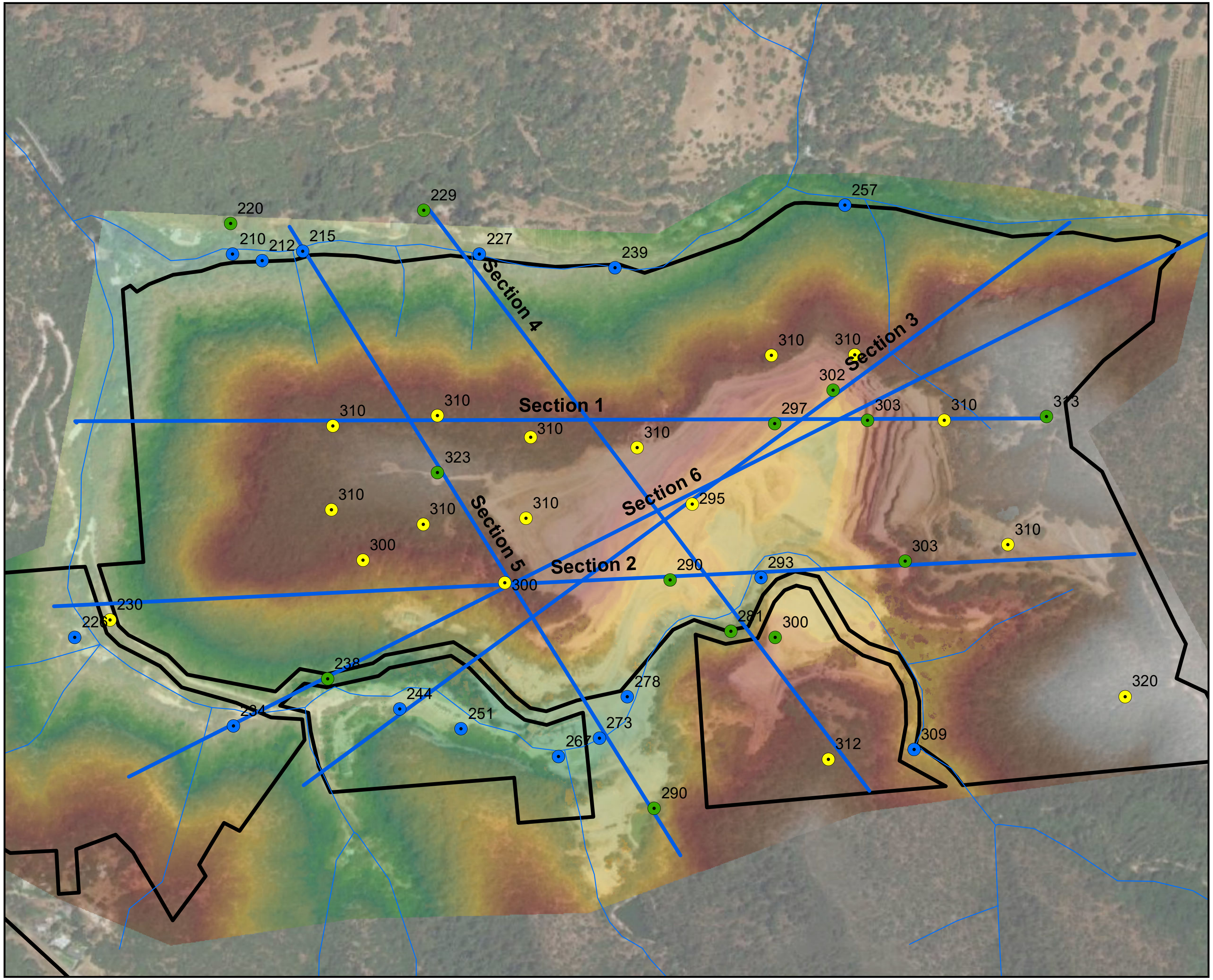
2.5.3 Groundwater Elevations – Creek Lines and Dummy Points

To enable construction of a realistic groundwater contour map, two additional data sets were incorporated into the measured water level data set:

- **Creek line elevations:** Creek line groundwater levels were incorporated into the data set at topographic low points along drainage lines. Inspection of water levels along creek lines along Old Norton Summit Road and within the quarry (6628-6231) indicate that groundwater levels reside between 2 and 6 m below the ground. For this reason placing the groundwater table at the stream bed provides a conservative estimate of the seasonally high water table. This is supported by stream flow observations within the quarry - the creek is typically dry over the period October to mid-Winter, and only starts flowing after sustained rainfall in the upstream catchment (M Harvey, pers comm., 2020). Thus, the stream reach at the quarry is expected to be a losing stream with groundwater residing below the creek bed on a semi-permanent basis
- **Dummy Points to account for topographic highs**: Dummy points were incorporated at topographic highs where there was no coverage with measured groundwater data. The process for selecting appropriate dummy elevations considered the following:
    - Inspection of ground elevation data from the Sites digital terrain model (Groundwork Plus, 2019).
    - Inspection of measured groundwater level monitoring data as displayed in Figure 2.3.
    - Proximity to valleys or topographic features such as escarpments and ridgelines.
    - Selecting values that would result in a conservative water table position representing low risk.

Groundwater contours were developed using GIS software and cross sections were developed to evaluate interpolated groundwater elevations with respect to topography. The cross sections served as a ‘reality check’ to ensure that the selected dummy points were conceptually consistent with the expected groundwater position. The final groundwater elevations for measured, creek line and dummy groundwater elevations is presented in Figure 2.5. This final surface is the outcome of a series of iterations in which the groundwater grid was progressively developed and updated with refined dummy points. Final groundwater contours are presented in Figure 2.6.

Hydrogeological cross sections developed from the groundwater level contours have been developed to illustrate the water table position vs ground surface at various locations across the Site. These are presented as Figure 2.7 and Figure 2.8. The cross section lines can be seen in Figure 2.5.



Legend

Groundwater Elevations (mAHD)

- ● Dummy Points
- ● Measured
- ● Stream
- Cross Section Lines
- Drainage lines
- ☐ Private Mine 188

DEM - Drone Survey 2019

mAHD

High : 472.65

Low : 196.618

GROUNDWATER SCIENCE

Job Number: HAN-21-3

Client: Hanson

Version: 1 Date: 22/03/2022

Drawn by: PM

N

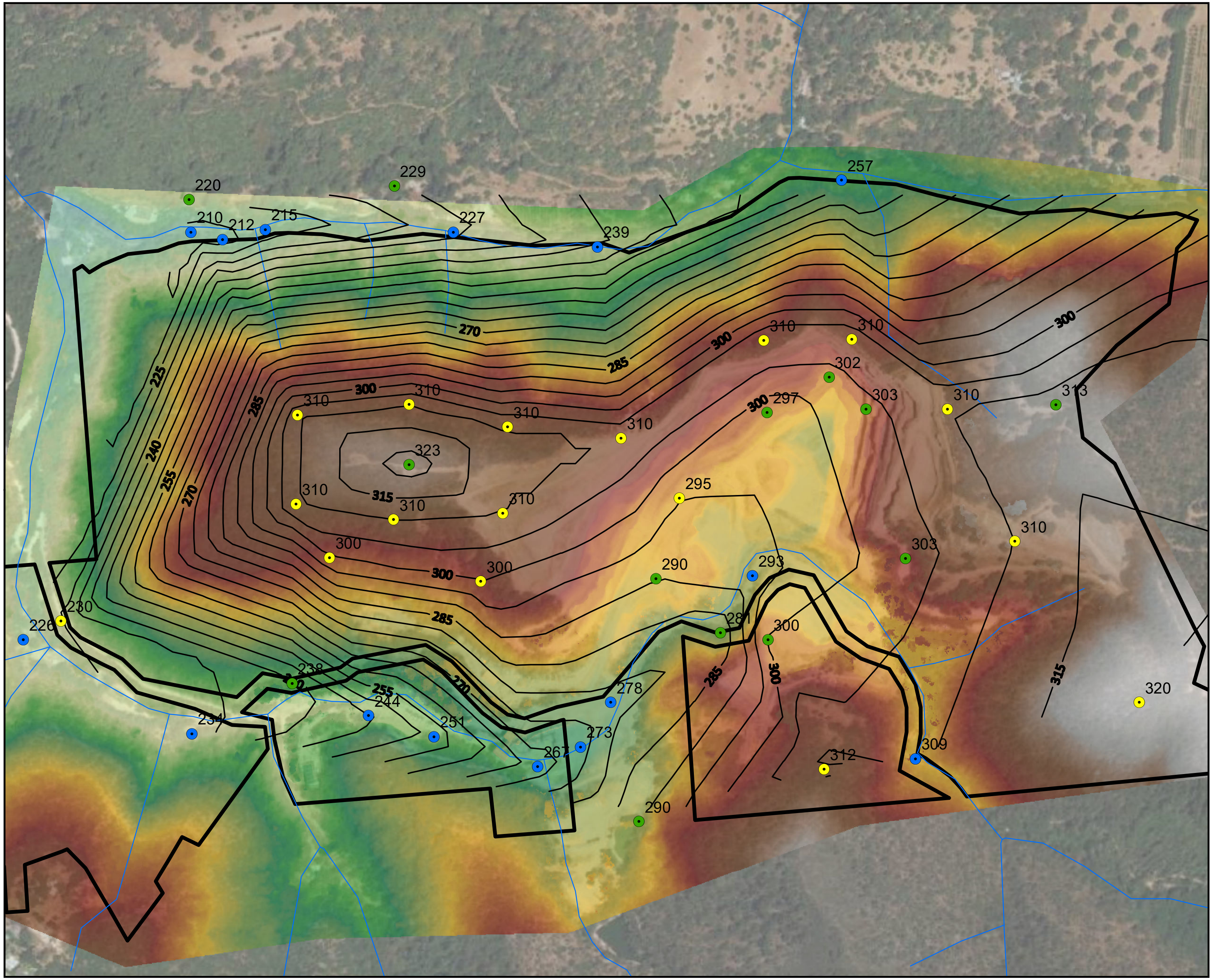
0 87.5 175 350

Meters

Coordinate System: GDA 1994 MGA Zone 54

White Rock Quarry - Measured and Inferred Groundwater Levels (mAHD)

Figure 2.5



Legend

Groundwater Elevations (mAHD)

- ● Dummy Points
- ● Measured
- ● Stream
- — Groundwater Contours (mAHD)
- — Drainage lines
- ▭ Private Mine 188

DEM - Drone Survey 2019

mAHD

High : 472.65

Low : 196.618

GROUNDWATER
SCIENCE

Job Number: HAN-21-3

Client: Hanson

Version: 1 Date: 22/03/2022

Drawn by: PM

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0 80 160 320
Meters

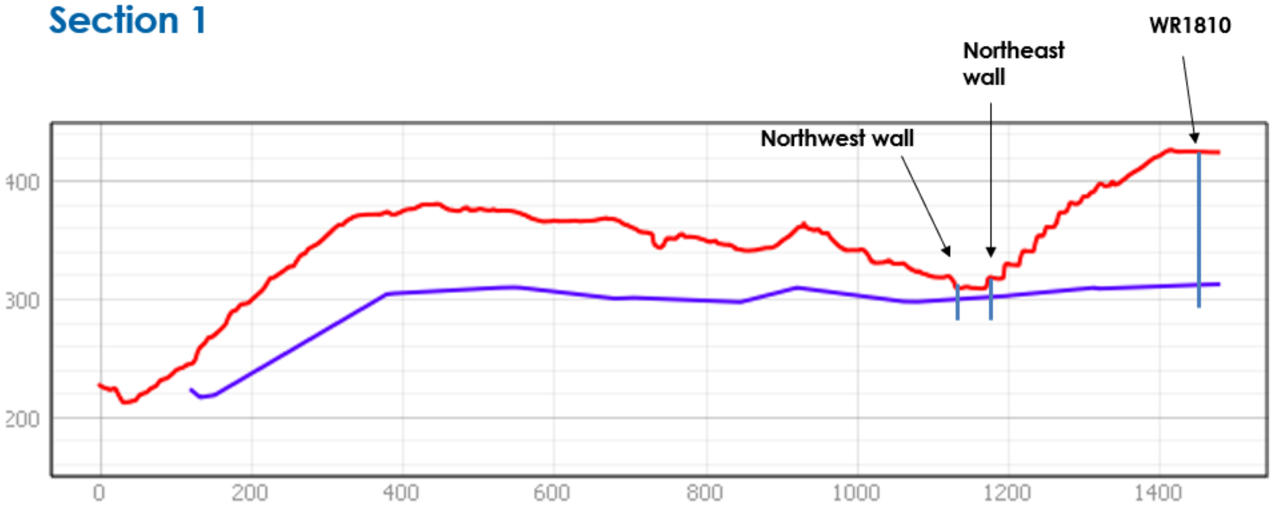
Coordinate System: GDA 1994 MGA Zone 54

White Rock Quarry - Measured and Inferred Groundwater Levels (mAHD)

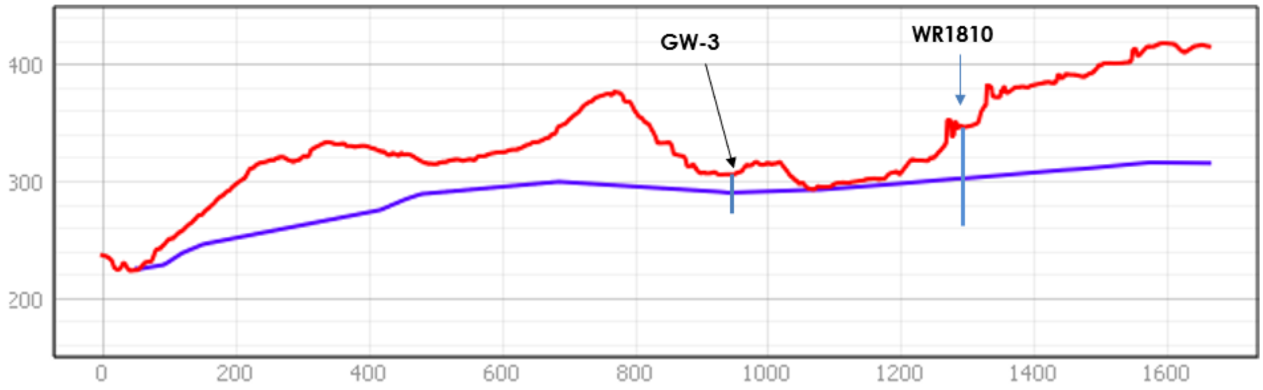
Figure 2.6

Document Path: C:\Users\Groundwater17\Dropbox (Groundwater Science)\Groundwater Science Team Folder\Project Files\HAN\HAN-21-3-White Rock MOP_Response Doc\GIS\Maps\10.5\Fig 2.6_Contours.mxd
Document Name: Fig 2.6_Contours

Section 1



Section 2



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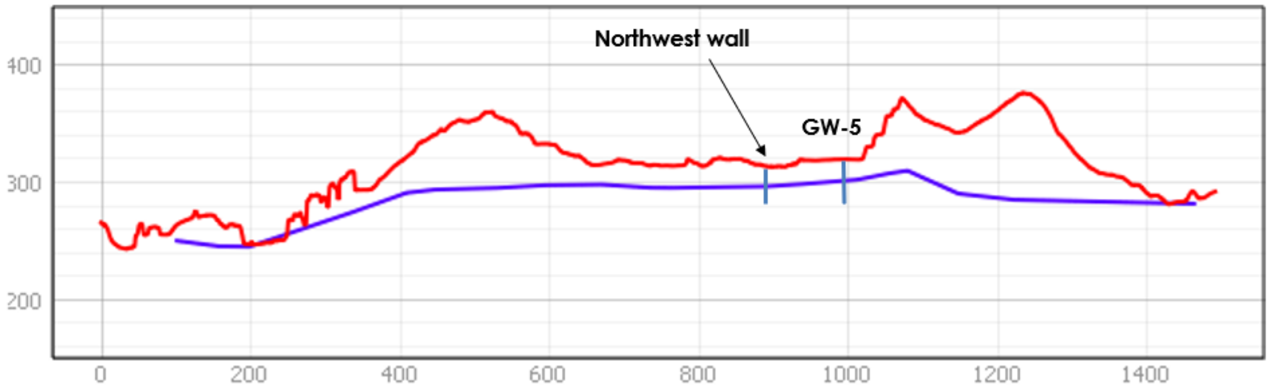
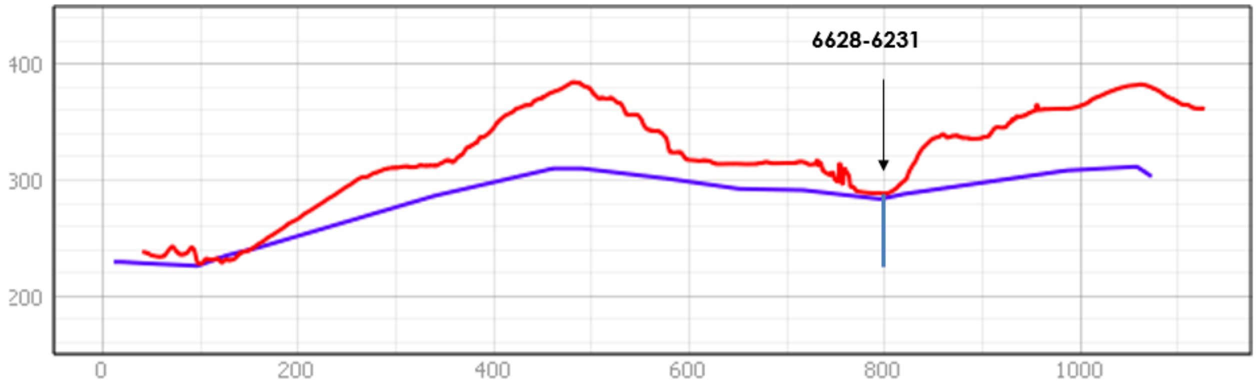
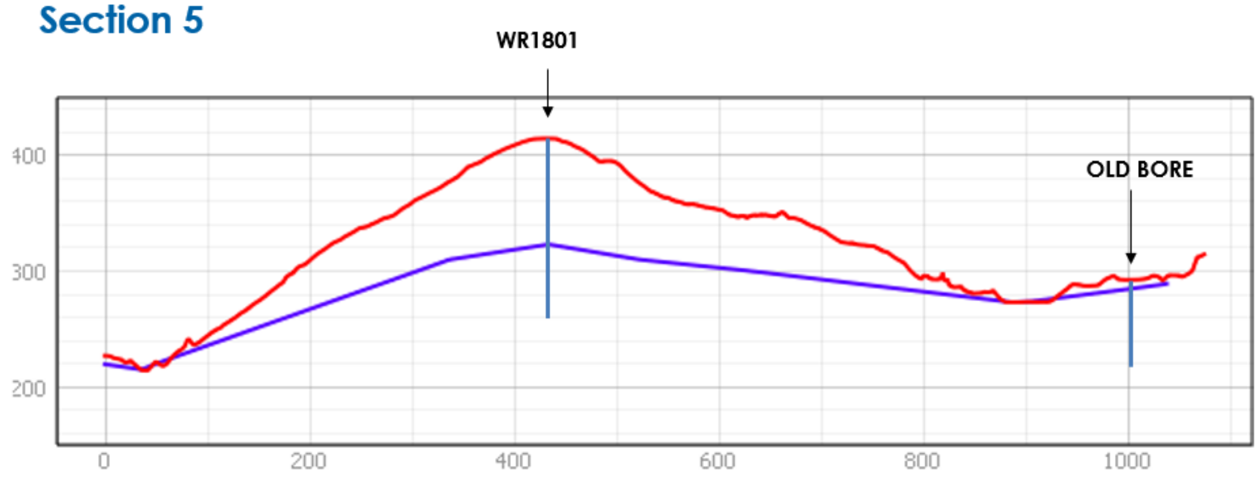


Figure 2.7: Cross Sections 1 to 3 illustrating groundwater surface with respect to topographic position (mAHD). Blue is groundwater table, red is topographic surface.

Section 4



Section 5



Section 6

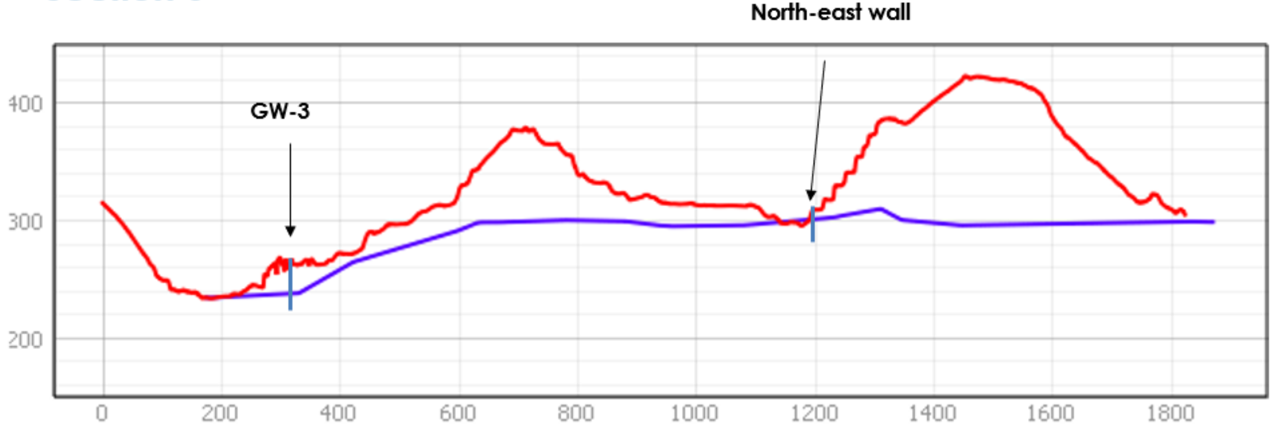


Figure 2.8: Cross Sections 4 to 6 illustrating groundwater surface with respect to topographic position (mAHD). Blue is groundwater table, red is topographic surface.

2.6 Quarry Development Planning

During quarry operations it will be important to maintain a sufficient buffer distance between pit floors and groundwater. This will limit the potential for groundwater intersection and potential impacts.

The spatial distribution of data across the Site is variable, being more concentrated in the topographic low points and sparser at topographic highs. Hence, there is more uncertainty at higher points in the landscape, particularly mid slope positions where terrain is steep.

The above indicates the need to incorporate some conservatism in pit designs to ensure that groundwater is not intersected as the quarry advances. Based on above the following is suggested with respect to pit designs:

- Areas of the Site in topographic highs should incorporate more conservative buffer distances to account for data variability and uncertainty surrounding seasonal groundwater variation. A buffer of 5 m is recommended above the inferred water table position per Figure 2.6. Areas where this apply would include:
    - In proximity to WR1801 and WR1810.
    - At dummy points at topographic highs.
- For areas at low points in the landscape (i.e. at measured monitoring points and near drainage lines) a buffer distance of 4 m is recommended. This buffer accounts for uncertainty in the seasonally high water table position.

2.6.1 Ongoing data validation

Future development of the quarry will present the opportunity to capture additional information as quarry benches lower and the Site becomes more accessible. This will enable Hanson to reduce uncertainties in topographic high points which may increase the quarry resource.

The following is recommended to validate groundwater information during future MOP reviews:

- Regular groundwater level monitoring should be undertaken to confirm the range in seasonal groundwater level variation. Monitoring should occur at all cased wells.
- Validation of groundwater elevations at selected dummy points once the Site becomes accessible. The locations would need to be considered at some point in the future.

Whilst the above is recommended, the suggested approach to quarry development incorporates a degree of conservatism which would limit the potential for groundwater intersection. However, should groundwater be intersected during quarry operations the following is noted:

- The depth of intersection would be relatively small. For this reason any inflows would be low and consequently, the potential effects are unlikely to reduce the quantity of groundwater available to GDE's or 3rd party groundwater users.
- The Quarry has an existing groundwater allocation of 15 ML/annum which is currently not utilised. This volume could potentially offset any pit losses should seepage occur.
- The water allocation plan for the Adelaide Plains Prescribed Wells Area (PWA) identifies the quarry as being in the Northern Fractured Rock *Consumptive Pool*. This Region has spare allocation should additional groundwater volumes be required (DEW, 2021).
- Hanson are employing progressive rehabilitation as pits are mined out. If required, overburden could be placed in low points of the quarry to seal groundwater and prevent exposure of the water table surface.

Further discussion with respect to groundwater monitoring is presented in Section 2.6

3 Risks

The risks of quarrying at the Site is interception of the water table which could result in pit seepages, groundwater lowering and possible salinity increase via evapotranspiration. These risks have been considered by recommending pits remain a conservative distance above the inferred water table position.

However, should pits intercept groundwater and seepages emerge the following is noted:

- The nearest 3rd party groundwater users are located along Old Norton Summit Road on the northern side of Third Creek. These users are located approximately 400 m north of the proposed pit perimeter. The wells target a bedrock aquifer at variable depths but typically extend more than 70 m below ground. The radial extent of groundwater seepages under small inflow volumes are not expected to impact the quality or quantity of groundwater to these users.

- The portion of the creek line south of the quarry is not specified as containing groundwater dependent ecosystems (BoM, 2020; DEW, 2021). This is consistent with groundwater measured at 6628-6231 (ADE068) which reports a water level from 6 to 7.8 m below ground. Hence, should groundwater be intercepted it is unlikely to impact any aquatic GDE’s reliant on baseflow, should these be present.

4 Groundwater Monitoring

The new wells present the opportunity to conduct regular groundwater level and quality monitoring. A proposed groundwater monitoring program is provided in Table 4.1. In development of the program the following is noted:

- Drillholes GW-5, North-west wall and North-east wall are in active pit areas. They are likely to be buried or removed in the short to medium term and hence have not been completed as observation wells.
- Diamond drillholes WR1801, WR1810 and WR1812 have collapsed or have been covered over, therefore monitoring of the wells is not possible.
- Remaining wells are located in areas that will not be quarried in the short to medium term and can be used for ongoing monitoring. 'Old Bore' is also accessible and can be utilised.

With respect to monitoring frequency bi-annual (6-monthly) is proposed for standing water levels. This will capture the maximum and minimum range in groundwater levels and is consistent with the frequency of the regional observation network for the Adelaide Plains (i.e. the DEW monitoring network). Salinity monitoring should be conducted annually in the spring time.

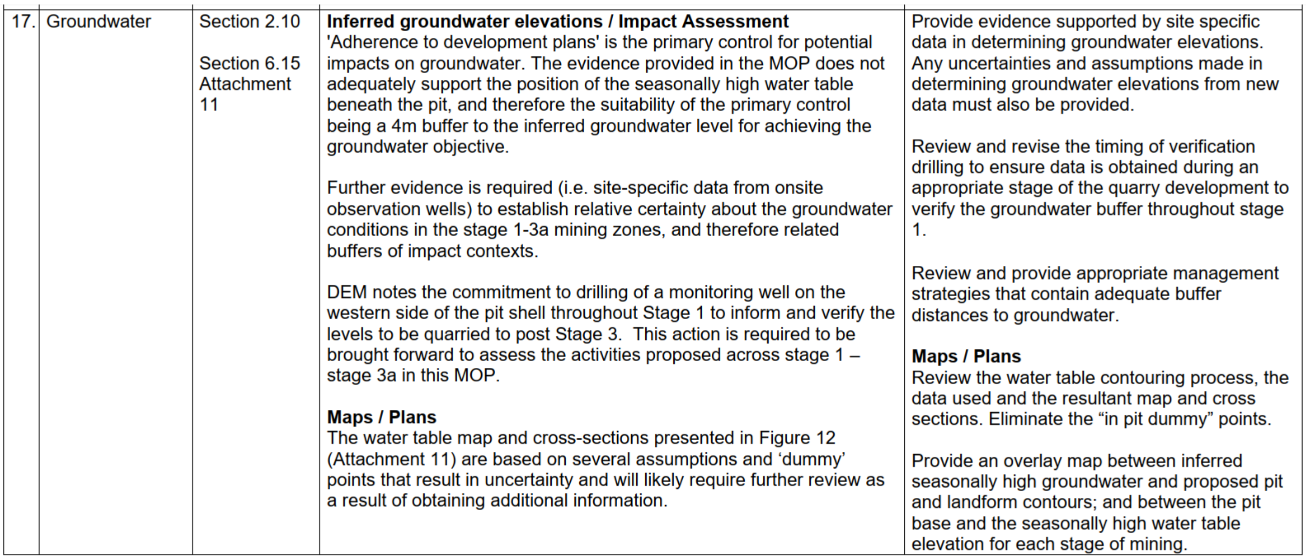
Table 4.1: Proposed Groundwater Monitoring Program.

Well Unit No	Name	Parameters	Frequency	Purpose
6628-31591 6628-31589 6628-31590 NA – not on Water Connect	GW-3 GW-4 GW-6 Old Bore	Water levels	6 monthly. Early October, mid-April	Measure seasonal low and high-water table elevations. Compare with data reported in 2021. Provide baseline information to assess groundwater response to rainfall events or other external factors.
		Electrical Conductivity pH	Annually. Early October	Measure annual variability in groundwater salinity and pH. Assess spatial water quality distribution and variability across Site Collect baseline data for future assessments.

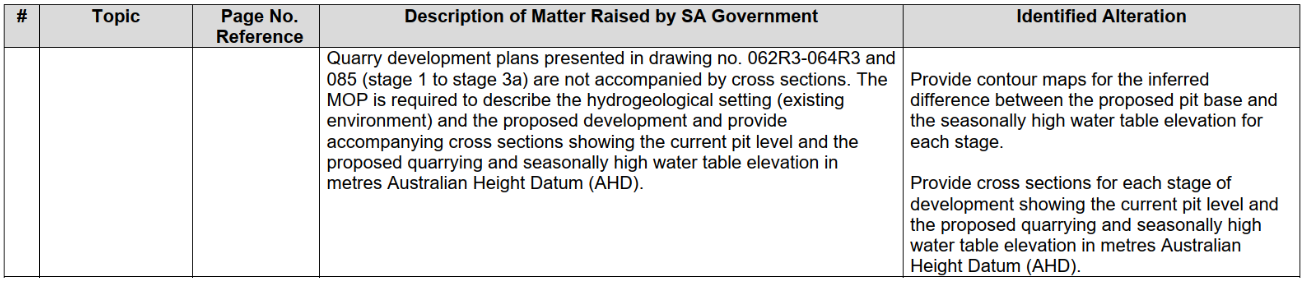
5 Closing

This report has been developed to support mining operations at White Rock Quarry. The results provide a greater resolution on groundwater elevations across the Site. Results can be used to inform quarry development plans while cased observation wells can be used for ongoing monitoring.

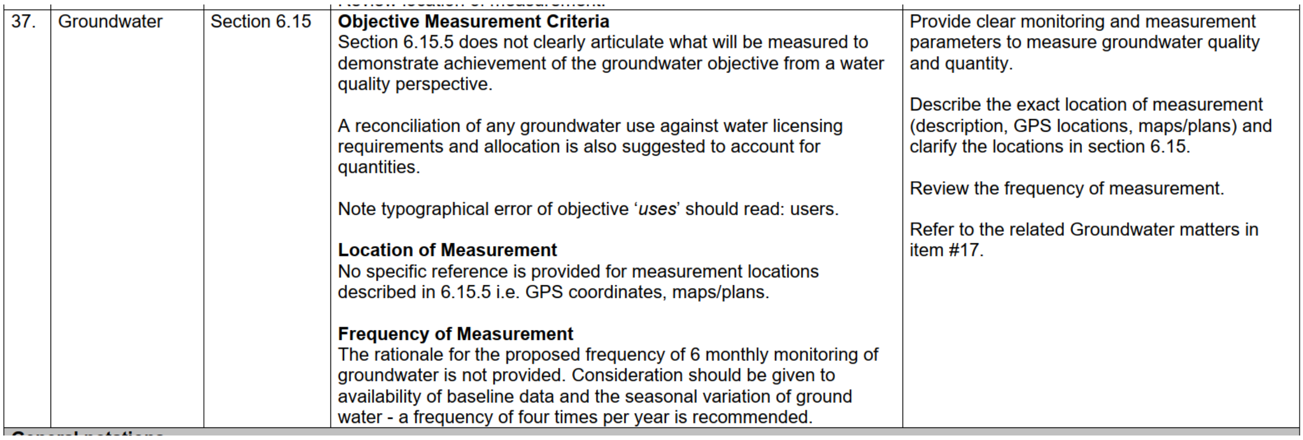
Appendix A Request for Information For Groundwater Related Items - White Rock MOP Review.



17.	Groundwater	Section 2.10 Section 6.15 Attachment 11	**Inferred groundwater elevations / Impact Assessment** 'Adherence to development plans' is the primary control for potential impacts on groundwater. The evidence provided in the MOP does not adequately support the position of the seasonally high water table beneath the pit, and therefore the suitability of the primary control being a 4m buffer to the inferred groundwater level for achieving the groundwater objective. Further evidence is required (i.e. site-specific data from onsite observation wells) to establish relative certainty about the groundwater conditions in the stage 1-3a mining zones, and therefore related buffers of impact contexts. DEM notes the commitment to drilling of a monitoring well on the western side of the pit shell throughout Stage 1 to inform and verify the levels to be quarried to post Stage 3. This action is required to be brought forward to assess the activities proposed across stage 1 – stage 3a in this MOP. **Maps / Plans** The water table map and cross-sections presented in Figure 12 (Attachment 11) are based on several assumptions and 'dummy' points that result in uncertainty and will likely require further review as a result of obtaining additional information.	Provide evidence supported by site specific data in determining groundwater elevations. Any uncertainties and assumptions made in determining groundwater elevations from new data must also be provided. Review and revise the timing of verification drilling to ensure data is obtained during an appropriate stage of the quarry development to verify the groundwater buffer throughout stage 1. Review and provide appropriate management strategies that contain adequate buffer distances to groundwater. **Maps / Plans** Review the water table contouring process, the data used and the resultant map and cross sections. Eliminate the "in pit dummy" points. Provide an overlay map between inferred seasonally high groundwater and proposed pit and landform contours; and between the pit base and the seasonally high water table elevation for each stage of mining.



#	Topic	Page No. Reference	Description of Matter Raised by SA Government	Identified Alteration
			Quarry development plans presented in drawing no. 062R3-064R3 and 085 (stage 1 to stage 3a) are not accompanied by cross sections. The MOP is required to describe the hydrogeological setting (existing environment) and the proposed development and provide accompanying cross sections showing the current pit level and the proposed quarrying and seasonally high water table elevation in metres Australian Height Datum (AHD).	Provide contour maps for the inferred difference between the proposed pit base and the seasonally high water table elevation for each stage. Provide cross sections for each stage of development showing the current pit level and the proposed quarrying and seasonally high water table elevation in metres Australian Height Datum (AHD).



37.	Groundwater	Section 6.15	**Objective Measurement Criteria** Section 6.15.5 does not clearly articulate what will be measured to demonstrate achievement of the groundwater objective from a water quality perspective. A reconciliation of any groundwater use against water licensing requirements and allocation is also suggested to account for quantities. Note typographical error of objective '*uses*' should read: users. **Location of Measurement** No specific reference is provided for measurement locations described in 6.15.5 i.e. GPS coordinates, maps/plans. **Frequency of Measurement** The rationale for the proposed frequency of 6 monthly monitoring of groundwater is not provided. Consideration should be given to availability of baseline data and the seasonal variation of ground water - a frequency of four times per year is recommended.	Provide clear monitoring and measurement parameters to measure groundwater quality and quantity. Describe the exact location of measurement (description, GPS locations, maps/plans) and clarify the locations in section 6.15. Review the frequency of measurement. Refer to the related Groundwater matters in item #17.

Attachment 17

White Rock Quarry - Water Interception During Construction of Onsite Sediment Basin

27 September 2022 Project No. PS133812-001-L-Rev0

Steve Seal
Hanson Construction Materials Pty Ltd
55 Galway Ave, Marleston SA 5033

WHITE ROCK QUARRY – WATER INTERCEPTION DURING CONSTRUCTION OF ON-SITE SEDIMENT BASIN

Dear Steve,

Please find the attached letter report detailing findings from a site investigation at White Rock Quarry. The site investigation was implemented to assess the source of water intercepted during construction of a new sediment basin, located a short distance downgradient from the quarry weigh bridge. A preliminary qualitative assessment of potential impacts to underground water (groundwater) is included in this report.

Context

Hanson Construction Materials Pty Ltd (Hanson) have been issued with a compliance order to manage surface water at White Rock Quarry, located at Horsnell Gully, South Australia. Hanson have designed a sediment basin near the entrance of the quarry to capture surface flows emanating from Site. Water captured in the sediment basin will be treated and released off-site. Construction commenced in May 2022.

Construction of the basin requires excavation of material to a depth of approximately 4 m below ground surface. The material intercepted comprises of transported fill and in-situ material including sediment and rock (broken and weathered shale). During construction, sub-surface water has been intercepted in the lower part of the basin. Attempts to purge the water from a sump have resulted in a continuous flow of water ingress to the sump. In one attempt the sump was fully dewatered over a period of 60 mins, however, the water level recovered to approximately 0.6 m below ground after 70 mins (Hanson, written comms., 2022). The dimensions of the sump are approximately 2 x 2 x 1.2 m (4.8 m^3).

As a response to the above Hanson stopped construction and notified the Department for Energy and Mining (DEM). The DEM have requested that Hanson provide further information to confirm:

- The likely source of the water reporting to the sump;
- The potential implications of the interception, including potential impacts to existing groundwater users such as pumping wells or groundwater dependent ecosystems (GDE's); and
- Implications for continuing construction at the sump.

Scope of work

Hanson engaged WSP Golder to conduct a groundwater assessment to investigation the source of water in the sump and potential impacts that may arise for continued construction. The scope of work included:

- A Site inspection comprising:
    - An inspection of the geology, including lithology encountered during excavation and in proximity to the construction site;
    - Assessment of topographic position of the sediment basin and relationship to other features including 3rd Creek.
    - Inspection of other works in 3rd Creek, including the v-notch weir and gabion rock walls. The v-notch weir is located a short distance downgradient from the sediment basin in the main drainage channel of 3rd Creek.
    - Sampling of the water intercepted by the sump and surface water flowing in 3rd Creek.
- Provide an opinion on the source of water ingress.
- Provide an assessment of the likely impacts to groundwater and 3rd party groundwater users (if any).
- Provide discussion on any implications for basin construction.

The results of the field investigation and assessment are provided below.

Hydrogeological Setting

The following section provides a brief overview of hydrogeological conditions at White Rock Quarry. The overview is intended to provide context to inform interpretations from the site investigation. For full background the reader is referred to Groundwater Science (2020), Groundwater Science (2022) and the Mining Operations Plan (MOP) Review developed by Groundwork Plus (2022).

Overview

White Rock Quarry is located in the Adelaide foothills approximately 9 km east of Adelaide. The quarry resides on Private Mine 188 (Figure 1) and targets bedrock of the Stonyfell Quartzite. These rocks are Neoproterozoic in age (>600 million years) and have been lithified, making the material hard rock in nature.

Groundwater investigations have been conducted across the Site throughout the period 2020 to 2022 (Groundwater Science, 2020; Groundwater Science, 2022) and include an assessment of groundwater conditions within the fractured rock aquifers within the Private Mine and immediate surrounds. Key results from the investigations are summarised as follows:

- Groundwater is encountered within a fractured rock aquifer of various lithologies. In current extraction areas groundwater resides in the Stonyfell Quartzite, while to the north and west groundwater resides in Saddleworth Formation Shale.
- Groundwater quality (inferred from total dissolved solids as a measure of salinity) from on-site monitoring wells is fresh, ranging between 350 and 800 mg/L. This is consistent with other 3rd party wells in the area within 1 km of Site.

- Depth to groundwater at the site are highly variable and depend on topographic position. Groundwater in deep drillholes in the high points of the quarry report groundwater > 100 m below ground. However, groundwater below creek lines is shallower and is expected less than 10 m below ground based on available data.
- Historical monitoring at the on-site production bore reports groundwater levels ranging from 6 to 10 m below ground. This bore (6628-6231) resides adjacent to 3rd Creek and suggests that groundwater in the bedrock is below the creek invert level at that location. This observation indicated groundwater was unlikely discharging to the creek in this location over the period of monitoring.
- WaterConnect (2022) identifies the nearest existing groundwater wells to the north of the Site, on Old Norton Summit Road. The nearest well (well unit no. 6628-17888) is located approximately 300 m north of active extraction areas and approximately 600 m north of the sediment basin.
- Third Creek bisects the Private Mine in an east-west orientation (Figure 1). The Creek originates from drainages within the Horsnell Gully Conservation Park, south and east of the site. Long term creek-flow observations confirm the Creek is ephemeral in nature. Creek flows are only observed during winter and early spring, with no flow during summer (M. Harvey, pers. comm., 2022).
- The Site more generally comprises of vegetation including terrestrial woodland which are not groundwater dependent ecosystems (GDE's). This concurs with information provided on the Atlas of Groundwater Dependent Ecosystems (BoM, 2022). However, the Adelaide Plains Prescribed Wells Area Water Allocation Plan (DEW, 2022) indicates that the location of the sediment basin is within a buffer zone of a groundwater dependent stream (fractured rock aquifer). This suggests that the stream that joins 3rd Creek from the south and just upstream of the sediment basin may have groundwater dependence.

Based on above it is inferred that groundwater across the Site resides in a fractured rock aquifer of low salinity. There are no existing pumping wells within 600 m of the sediment basin, however the sediment basin is located within a buffer zone of a groundwater dependent stream (DEW, 2022). This buffer zone will need to be considered if ongoing pumping of groundwater is required from the sediment basin, however we understand that this will not occur during the life of operations.

Field Observations

A site visit was conducted on Monday the 29th August. WSP Golder attended site with representatives from Hanson and Groundwork Plus. The inspection included:

- Reviewing the site of the sediment basin.
- Inspecting nearby hydrological features including the adjacent creek line (3rd Creek), Creek drainage channel and V-notch weir. The v-notch weir is located approximately 120 m downstream of the sediment basin.

Important features identified from the site visit are shown on Figure 1, whilst Figure 2 through Figure 6 show photographs of the sediment basin and surrounding area. Diagram 1 presents an illustrative cross section of the sediment basin, Creek line and nearby access track.

The following features were noted during the Site inspection:

- The centre of the sediment basin was found to be located approximately 35 m south of 3rd Creek. Inspection of the material underlying the basin identified floodplain sediments comprising of clay, silts and shale boulders. It is inferred that the sediments result from a meandering creek channel that has eroded into and deposited a thin veneer of sediments over the underlying bedrock. The sediments contain sufficient permeability to hold and transmit water.
- The ground elevation rises south of the sediment basin and to the north of 3rd Creek. No surface water runoff was observed flowing from the bedrock areas into the sediment basin at the time of the inspection. This suggests that water reporting to the sediment basin sump was from upward flow from below or laterally from floodplain sediments within the excavation.
- The perimeter of the sediment basin is at a similar ground elevation to the adjacent access track, however, the base of the sediment basin is approximately 1200 mm below the track ground level and lower than the drainage channel within 3rd Creek. This indicates that water from the Creek has potential to move towards the base of the sediment basin when the Creek channel is saturated (flowing).
- The creek was found to be flowing strongly after recent rainfall. Flow recordings on the day of the inspection report an average flow rate of 70 litres per second (L/s) (Hanson internal records from v-notch weir, 29th August 2022). The water was clear and reported low turbidity.
- The sump is constructed approximately 1200 mm below ground surface and below the level of the Creek Channel (Diagram 1). The specific conductance (electrical conductivity – us/cm) of the sump water was reported at 737 us/cm whilst the creek water reported a conductance of 453 us/cm. Groundwater conductivity from on-site monitoring wells (targeting fractured bedrock) range from 560 to 1220 us/cm (Groundwater Science, 2022). This confirms that the sump water quality is within the range of groundwater collected from other parts of the Site, and higher than the observed creek water quality at the time of observation.
- The Creek channel within 3rd Creek was found to be heavily modified by on-site works. This included:
  - V-notch weir constructed within the Creek Channel approximately 120 m downstream of the sediment basin (Figure 5).
  - Gabion rock wall above the V-notch weir (Figure 6) which has raised the Creek channel immediately upstream and adjacent to the sediment basin.

Key features described above are presented in plan view per Figure 1 while a cross section of the sediment basin (current landform) is provided in Diagram 1. It is inferred from the cross section that:

- Surface water in 3rd Creek drainage line has a higher elevation than the sediment basin. This suggests that recharge could occur from the stream to the adjacent floodplain sediments when the creek is flowing.
- The sump water salinity is approximately double the salinity of 3rd Creek. This suggests that that the water has undergone evapo-concentration prior to recharge or in-situ whilst the water is present sub-surface (given the water is within 2 m of the ground surface some evapo-transpiration is possible under natural conditions).
- It is inferred that sump water is shallow groundwater of recent age. Salinity is comparable to groundwater salinity of other on-site wells (but generally at the lower end of salinity levels).
- The water below the sediment basin is inferred to be seasonal in nature. This is on the basis that:

- No water was noted / intercepted in the sediment basin position drilling of geotechnical holes in December 2021 (M. Dupree, pers comm., 2022). This suggests that the site was not saturated during the dry summer months.
- Topographically, the site falls to the west in the direction of surface water drainage. It is inferred that the underground water would percolate down gradient during the drier / non-flow periods and thus shallows sediments would become unsaturated in the drier summer months.
- Seasonal variation of groundwater levels at the on-site monitoring well (6628-6231) reports seasonal fluctuations of 1.5 to 2 m (WaterConnect, 2022; Figure 7). This suggests that groundwater levels will drop below the base of the sump and sediment basin during late summer / early Autumn.

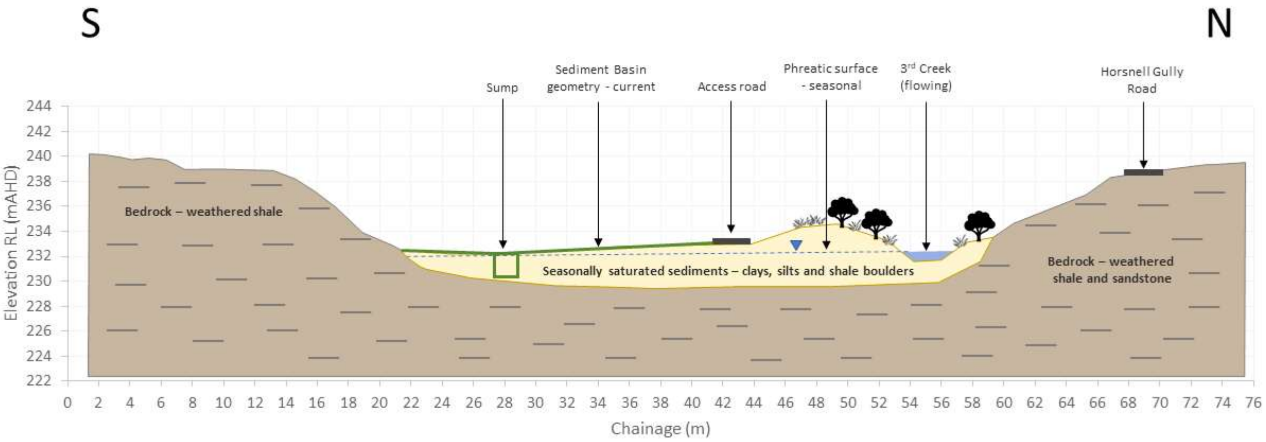


Diagram 1. Cross Section of current sediment basin – August 2022.

Discussion

The site of the sediment basin is in a topographical low point of PM 188, and a short distance from 3rd Creek. It is inferred from the Site inspection and water quality sampling that shallow groundwater has been intercepted at the base of the sediment basin. Inflows are relatively low but high enough to warrant delay of construction until the dry summer months. Based on the site investigation and consideration of the site hydrogeological conditions, we infer that the source of the water is likely from:

- Recharge to localised groundwater flow systems, particularly Creek water recharging the adjacent sediments / weathered material during high flow periods. This would predominantly occur over the period July through November (when creek flow is consistently observed).
- Lateral through flow from the bedrock aquifer, originating from rainfall recharge (infiltration). However, this is less certain as there are no wells targeting the bedrock in the immediate location of the sediment basin.

Based on the salinity of the sump water it is inferred that the water is groundwater of recent age. However, current impacts to the groundwater system are assessed as low. The basis for this assessment is as follows:

- No material discharge is occurring from the sediment basin, either in the form of pumped discharge or via seepage outflow.
- The Creek is flowing strongly and is continuously replenishing the adjacent sediments. Hence, any water removed from the sump is replaced from the Creek via lateral throughflow.

Based on above it is likely that the groundwater levels will rise above the sediment basin invert level during the wetter periods and potentially during extended periods of creek flow. Whilst in summer, there is a high probability that the sediments will dry when creek flows cease. During this period underground water is expected to drain from floodplain sediments (down gradient) and be removed via evapo-transpiration. During this period sediments are expected to become unsaturated.

A key aspect to consider as part of the construction is whether the design needs to change due to periodic saturation at the base of the basin. With the instream modifications a short distance downstream (V-notch weir, Gabion rock walls) there is ongoing potential for lateral throughflow from the Creek channel while the Creek is flowing. Shallow groundwater is likely to saturate the base of the sediment basin during winter and early Spring.

Based on above it is recommended that the base of the sediment basin be appropriately lined to prevent vertical / lateral ingress of shallow groundwater from the adjacent Creek. Based on discussions with Hanson we understand that the basin design can be modified to ensure the basin is lined with an appropriate low permeability material. This should be designed to ensure that the base / sides of the sediment basin can withstand any upward pressures induced from groundwater.

Practically we understand that the basin will be full on a semi-permanent basis. Thus, any upward / lateral pressure gradients from groundwater can be balanced by the head of water retained in the basin. It is recommended to adopt a minimum water level in the basin (if lined), during winter and spring months, to overcome any potential upward pressures. Additionally, there is merit confirming the saturation levels below the basin prior to commencement of construction, which may include the construction of a shallow monitoring well.

Risk Assessment

The key risk events to groundwater from the sediment basin construction are:

- Interception and removal of groundwater during the construction phase.
- Interaction with groundwater during operations.

Both aspects are assessed as low to negligible risk given:

- Construction of the basin will be completed during Summer (e.g. February) when groundwater is expected to be 1.5 to 2 m lower than currently noted (August 2022). Hence, no groundwater removal will be required for completion of the basin.
- Operations will not remove groundwater or materially alter groundwater flow gradients. Any groundwater movement through underlying floodplain sediments is expected to migrate downstream in line with natural River flow.
- The basin will be lined to avoid interaction with sediment laden surface waters and underlying groundwater. Hence, any potentially contaminants within the sediment basin will be poorly connected to sub-surface groundwater.
- There are no 3rd party pumping wells within 600 m of the sediment basin. Given the distance there is no plausible impact to these users from the sediment basin construction and operations.

- Potential risks to groundwater dependant ecosystems are considered negligible given:
    - Groundwater will not be removed during operations.
    - Stream flows are high and are expected to provide a significant component of water to instream vegetation.

Important Information

Your attention is drawn to the document – “Important Information”, which is included in Attachment 2 of this document. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Closing

Thank you for the opportunity to conduct this assessment. If you have any queries’ please contact Paul Magarey on 0438 856 442.

Golder Associates Pty Ltd

Paul Magarey
Principal Hydrogeologist

PM/PM/qn

CC: Maxim Dupree, Groundwork Plus.

Attachments: 1 – Figures
2 – Important Information

ATTACHMENT 1

Figures

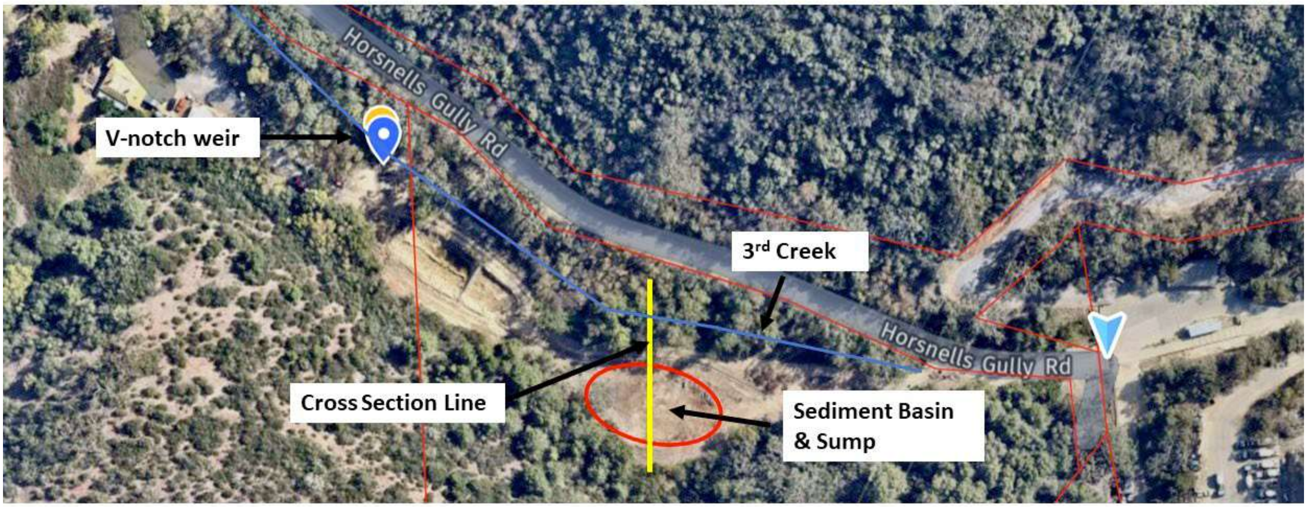


Figure 1. Site location map and key features noted during the Site inspection.

Figure 2. Location of detention basin with respect to 3rd Creek and the Site access Road. Key features denoted.

Figure 3. Current progress of the sediment basin (August 29 2022). Note the sump cordoned by flagging tape.

Figure 4. 3rd Creek at the time of inspection.

Figure 5. V-notch weir constructed in 3rd Creek, approximately 120 m downstream of the sediment basin.

Figure 6. Pool above V-notch weir and modification to upstream creek line (note gabion rock wall noted in foreground which has artificially raised the Creek channel elevation).

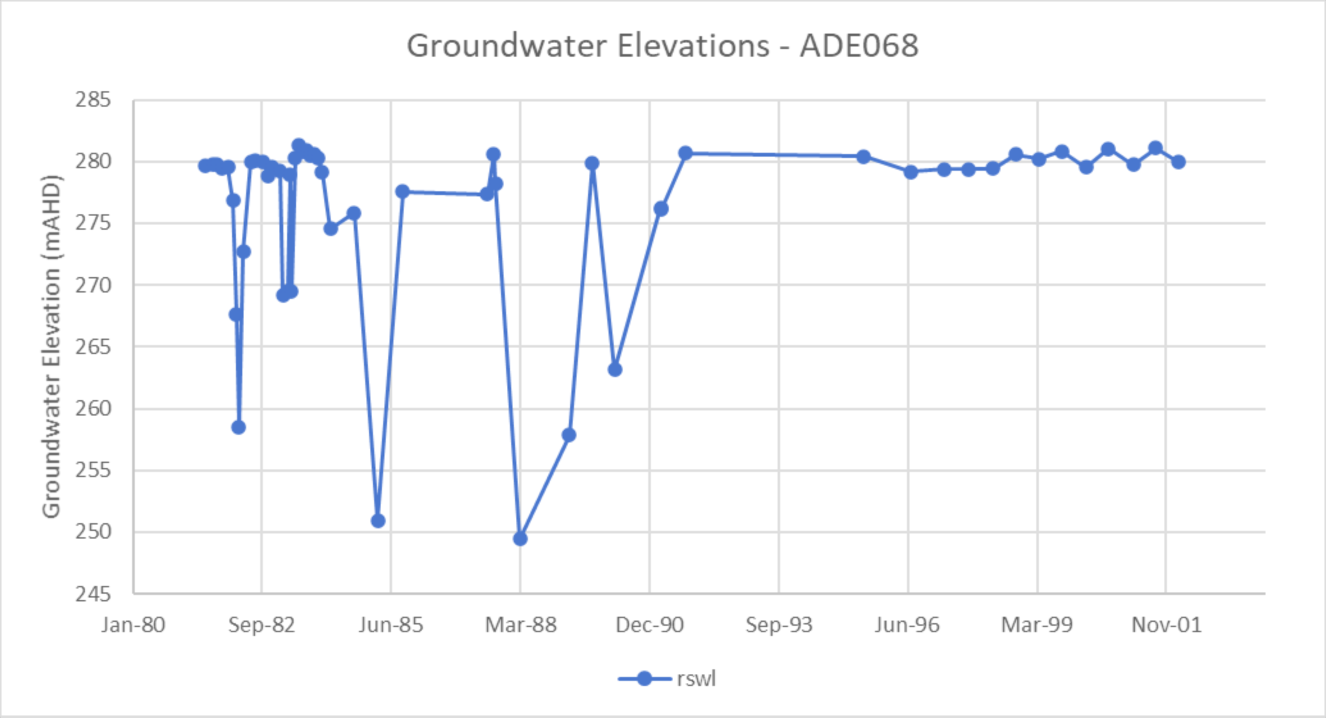


Figure 7. Seasonal groundwater levels reported at on-site monitoring well 6628-6231 (WaterConnect, 2022).

ATTACHMENT 2

Important Information

IMPORTANT INFORMATION RELATING TO THIS REPORT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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