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# Dewatering Management Plan

*Location:*

Lot 7 DP 875447
Tweed Coast Road
Kings Forest

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*Prepared for:*

LEDA Group Project 28 Pty Ltd

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*Report:*

HMC 2015.046

May 2015

## Document Control Summary

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**Title:** **Dewatering Management Plan**
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**Limitations**

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# 1 INTRODUCTION

A S75W Modification to MP06_0318 and MP08_0194 was prepared to facilitate a proposed Service Station to be located within Kings Forest Precinct 1 on land identified as Lot 7 DP875447, Tweed Coast Road, Kings Forest. The proposed service station would 'replace' the rural supplies development currently approved under MP08_0194.

The service centre construction would require excavation for the installation of the underground fuel storage tanks (USTs). The site is located on low-lying land in the vicinity of Cudgen Creek and it is likely groundwater depth is shallow in this location. To assess the need to undertake dewatering and provide details on treatment required to achieve discharge criteria, a groundwater investigation including installing a monitoring bore and collecting samples for laboratory analysis was completed.

The site is proposed to be filled to achieve final flood protection levels and any dewatering operation would be generally be confined to the north-western part of the site where the USTs would be installed. The operation would be temporary and the excavation would be open for less than 2 weeks.

## *1.1 Site Description*

Although part of the larger Kings Forest holding, the subject allotment which will accommodate the service station is legally described as Lot 7 DP875447. The allotment currently has no common or street address reference. The allotment has frontage to Tweed Coast Road; is irregular in shape and provides for a total area of 7.6 hectares. The allotment is identified on **Figure 1 – Aerial Image**.

The proposed Service Station is to be located on part of the lot only. This part is Precinct 1 as identified within approved Kings Forest Concept Plan (MP06_0318). The proposed Service Station is to be located within the footprint of the currently approved Rural Supplies Development issued under Project Approval (MP08_0194)

That part of the allotment which is to house the Service Station is identified in **Figure 2 – Kings Forest Precinct Plan**.


**Figure 1 Aerial Image. Source: NSW SIX Viewer.**

For the purposes of this report, a reference to the 'site' is considered a reference to precinct 1 and the footprint established by the current approved rural supplies development.

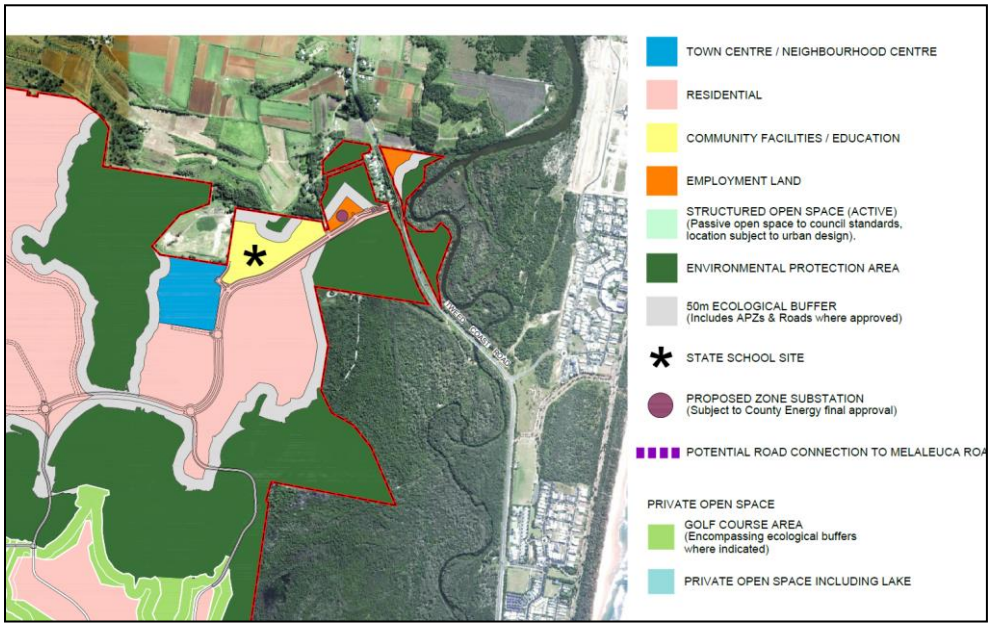



**Figure 2 Kings Forest Precinct Plan (Source: Planit)**

## 2 SITE INFORMATION

| | |
|---|---|
| **Property description** | Lot 7 DP DP875447 |
| **Report commissioned by** | LEDA Group Project 28 Pty Ltd |
| **Proposed development** | Service Station |
| **Site Elevation** | |
| **Maximum depth of excavation** | |
| **Groundwater depth** | 0.76mBGL (24.04.2015) |
| **Investigator** | Mark Tunks |
| **Local Government Authority** | Tweed Shire Council |
| **Soil investigation date (Mazlab)** | 24 April 2015 |

## 3 PROJECT DESCRIPTION

The project comprises a service station including shop with food outlets, car wash and dog washing facilities. Both car and truck bowsers are provided with extensive carparking (73 bays) and other hardstand areas. The service station would be located east of the Tweed Coast Road.

## 4 MAXIMUM EXCAVATION DEPTH AND EXPECTED GROUNDWATER DRAWDOWN

With the elevated water table and the sandy sediments on site, it is likely the perimeter of the excavation would be shored. General discussions with Gilbarco and ECL Fuelquip indicate that the excavation would be initially shored providing a 5m buffer outside the final USTs location. A review of the site plan indicates that an excavation of approximately 30m x 25m would be required.

The maximum depth of excavation would be associated with the installation of the 4 USTs (includes an LPG tank). The 3m diameter Envirotank would require an excavation of approximately 4.5m depth to provide

minimum cover and bedding requirements. Assuming 0.5m depth fill the final depth would be approximately 4m.

Assuming a groundwater depth (existing ground surface) of 0.75m and imported fill depth 0.5m, to achieve a minimum 1m buffer to the groundwater to provide a dry base to the excavation, the groundwater drawdown would be 3.75m.

The standing water level in the groundwater monitoring bore was measured on 24 April 2015 as 0.76mBGL.

The estimated excavation depth and measured groundwater depth are summarised in the following table.

**Table 1 – Dewatering Summary**

| Estimated USTs invert (mBGL) | Estimated Imported fill depth (m) | Adjusted UST invert (mBGL) | Measured Groundwater Depth (mBGL)[(2)] | Adjusted Groundwater Depth (mBGL) | Required groundwater buffer to excavation invert | Required Groundwater Depth (mBGL)[)] | Estimated groundwater drawdown (m) |
|---|---|---|---|---|---|---|---|
| 4.5 | 0.5 | 4.0 | 0.75 | 1.25m | 1.0m | 5.0 | 3.75 |

## 5 TWEED LOCAL ENVIRONMENT PLAN 2014

The NSW Department of Land & Water Conservation 1:25 000 Acid Sulfate Soil Planning Maps – *Cudgen* indicates the site is located within a Class 3 area. Table 2.1 in the Assessment Guidelines of the Acid Sulfate Soil Manual (ASSMAC, 1998) and Clause 7.1 of Tweed Shire Council's LEP 2014 indicate for each class of land the types of works likely to present an environmental risk if undertaken in the particular class of land. The maps do not describe the actual severity of ASS in a particular area but provide a first indication that ASS **may** be present (see Figure 3).

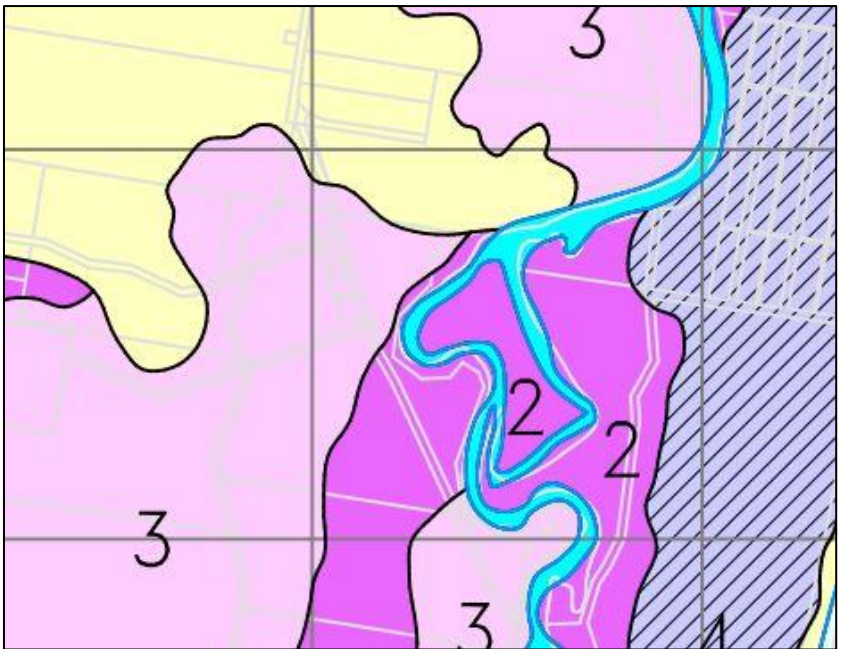



**Figure 3 NSW DNR ASS Planning Map – *Tweed Heads***

Clause 7.1 of the Tweed LEP 2014 requires that works beyond 1m below the ground surface (Class 3) require a preliminary acid sulfate soil assessment prior to consent. A management plan is required should it be confirmed that acid sulfate soil is present above action criteria and likely to be disturbed. If a management plan is required it must be prepared in accordance with the Acid Sulfate Soil Manual produced by the Acid Sulfate Soil Management Advisory Committee (ASSMAC).

## 6 GEOLOGY & SOIL LANDSCAPE

It is noted that the area has been previously filled during construction of the adjacent canals and drainage easement.

The Coastal Quaternary Tweed Heads Area 1:100000 mapping (Troedson,A.L & Hashimoto,T.R. et al, 2008) shows the site within a coastal plain system quaternary unit comprising pleistocene ridge and associated strandplain: marine sand, indurated sand, gravel. This geology unit extends west over much of the Kings Forest area.

The NSW Department of Land & Water Conservation Soil Landscape Map "Murwillumbah-Tweed Heads 1:100 000 Sheet" (Morand, 1996) show the subject site lies within a "kingscliff" aeolian soil landscape (ki) which is characterised by extremely low, level to gently undulating Pleistocene sand sheets> Soils are expected to be deep (>200cm) generally well-drained podzols.

## 7 SOIL INVESTIGATION

A borehole (BH1) was drilled on site by Mazlab on 24 April 2015 to 4.75m depth on the north-western part of the site as shown in Appendix 7.

The borelog shows 4.0m of grey brown to grey sand over a dark brown, dense, indurated sand to 4.75m depth where the borehole was terminated.

Groundwater was intercepted at approximately 0.95m depth.

## 8 DEWATERING

### *8.1 Groundwater Quality*

To determine groundwater quality a 50mm UPVC monitoring bore with 1.5m screen was installed by Mazlab Pty Ltd on 21 April 2015. The bore was developed and purged with a 12V submersible pump following installation. HMC returned to the site on 24 April 2015 and following purging, a Hydrolab Quanta multi-parameter meter was used to record the pH, electrical conductivity, dissolved oxygen and temperature. A sample and duplicate of the groundwater was collected in 1L plastic bottles for chemical and physical parameters (colour, total suspended solids, turbidity, alkalinity, acidity, chloride and sulfate) and 50mL plastic bottles (acidified and field filtered) were used for soluble metals (iron and aluminium). The samples were stored at <5°C and delivered to the NATA-registered Tweed Laboratory Centre (see Appendix 10).

Results recorded are summarised in Table 1:

**Table 4 Groundwater Quality Summary**

| Parameter | KS1 | KS1 DUP | Discharge Off-Site | Irrigation to bunded recharge area |
|---|---|---|---|---|
| | | | EPA Tweed River Water Quality Objectives (Estuaries) | ANZECC ARMCANZ 2000 |
| Depth (mBGL) | 0.76 | 0.76 | | |
| pH (pH units) | 4.12 | 4.12 | 7.0-8.5 | > 6 (limited corrosion to pumps) |
| Electrical Conductivity (uS/cm) | 94 | 94 | | <95 (sensitive crops) |
| Dissolved Oxygen (mg/L) | 0.87 (8.3% sat) | 0.87 (8.3% sat) | 80-110 %sat'n | |
| Temperature (°C) | 24.6 | 24.6 | | |
| Soluble Iron (mg/L) | 0.83 | 0.82 | 1 (NHMRC, recreational water) | 10 (<20 years) |
| Soluble Aluminium (mg/L) | 0.57 | 0.55 | 0.055 (ANZECC, 2004) | 20 (<20 years) |
| Suspended solids (mg/L) | 233 | 231 | 50 (typical EPA lic. cond.) | |
| Turbidity ntu | 632 | 406 | 0.5-10 | |
| Chloride (mg/L) | 16 | 15 | | <175 (sensitive crops) |
| Sulphate (mg/L) | 9.4 | 9.0 | | |
| Chloride:Sulfate ratio | 1.7 | 1.6 | | |
| Total acidity mg/L $CaCO_3$ | 270 | 340 | 40 (total titratable acidity) | |
| Alkalinity as $CaCO_3$ | <1 | <1 | | |

These results indicate that the groundwater is fresh (<1500uS/cm), acidic with elevated suspended solids. Dissolved oxygen levels were low which is typical of groundwater. The soluble iron levels complied with recreational water quality guidelines and were low for these coastal sands where elevated levels (>10mg/L) have been recorded in groundwater along the Tweed Coast. Aluminium was elevated and did not meet discharge criteria.

The chloride:sulphate ratio was <7 indicating an excess of sulphate, potentially from previously oxidised sulphidic sediments. There was no buffering capacity (alkalinity) and the total actual acidity exceeded recommended concentrations for discharge.

The groundwater quality meets the ANZECC (2000) irrigation water quality. However to protect groundwater and surface water pH adjustment with alkaline amendments would be recommended for irrigation on the site.

It is likely that suspended solids and turbidity would decrease once steady state conditions are achieved and, with treatment including pH adjustment and aeration, it is likely the groundwater would meet discharge criteria should discharge off-site be required.

### *8.2 Zone of Influence & Discharge*

Two scenarios were run using the WA DEC *Cone of Depression Calculator* (http://www.dec.wa.gov.au/apps/cone_depression.htm) varying the soil profile.
The discharge and zone of influence would be affected by the hydraulic conductivity and the soil profile shows fine-medium sand over indurated (dense) sand material. An hydraulic conductivity of 8.2m/day is

assumed for fine-medium sand as per the WA DEC calculator. Research on Bribie Island has shown an average hydraulic conductivity of 0.4m/day for indurated material (similar to clay).

The zone of influence and the discharge flow would be within the range of these 2 estimates. For the purposes of this investigation the worst case has been adopted.

| Input | Assumption |
|---|---|
| Excavation Length m | 30 |
| Excavation Width m | 25 |
| Soil hydraulic conductivity m/day | Fine-medium sand -8.2. (0.0000949 L/s) |
| | Indurated sand – 0.4. (0.00000463 L/s) |
| Groundwater drawdown m | 3.75 |
| Saturated aquifer depth m | 10 |

The calculator results are shown in Appendix

| Output | Scenario 1 (Fine-medium sand) | Scenario 2 (indurated sand) |
|---|---|---|
| Zone of influence m | 24 | 110 |
| Discharge L/s | 2 | 9 |
| Discharge/day ML | 0.17 | 0.78 |

The borehole shows the indurated material at 4m depth. Assuming the groundwater is to be lowered 3.75m to 5m below the current ground level only approximately 25% of the seepage depth would be within the denser indurated material.

Using the maximum estimated discharge rate (9L/s) the hourly discharge would be 32400L. If off-site discharge was proposed, to achieve a 1 hour detention, 2 x 20000L tanks would be required. Alternatively a 10m x 5m excavation 1m deep would also provide approximately 40000L storage.

This flow would be confirmed following installation of the wellpoints.

The best outcome would be to recharge the site with the extracted groundwater and have minimal discharge from the site.

### *8.3 Discharge Point*

If irrigation on site after ph adjustment is adopted no discharge would occur. Should treatment for potential discharge following treatment be adopted, the receiving water would eventually be Cudgen Creek. It is likely that with surface controls including contour drains and other restrictions on overland flow, discharge may be prevented.

Two treatment/disposal options are proposed:

1. Treatment to minimise acid generation/export (pH adjustment) for irrigation on site
2. Treatment to achieve minimise acid generation/export and sediment export (pH adjustment and removal of suspended solids/turbidity)

### *8.4 Treatment Options*

#### *8.4.1 Discharge off-site*

The extracted groundwater would be treated via a commercial dosing and sedimentation system provided by the dewatering contractor to achieve a pH range 6.5-8.5, Total Titratable Acidity <40mg/L and suspended solids <50mg/L. It may also be an option to provide a lime dosing plant then discharge to sedimentation ponds for controlled discharge to the sandy soil for overland flow across the site. It is expected this arrangement would result in criteria being achieved prior to discharge off-site.

#### *8.4.2 Irrigation on site*

The extracted groundwater would be discharged to a lime dosing facility then to either a storage tank or sedimentation pond to balance flows prior to irrigation over a defined irrigation area. Assuming a flow of 6-9L/s and an irrigation rate of 0.1m/day (<5mm/hr) the irrigation area would need to be 5000-7000m2. The final area would depend on the flow.

## 9 DISCUSSION

To install the underground fuel storage tanks on the north-western part of the site it is estimated that excavation depth would extend approximately 4m below the existing ground level. The groundwater depth was measured at approximately 0.75m BGL in this area. Temporary dewatering would be required however this is likely to be a temporary operation during the placement of the USTs. Discussions with Gilbarco representatives indicate that the excavation would extend approximately 5m outside the perimeter of the USTs and that shoring would be required with the shallow groundwater and sandy sediments. A typical installation would include metal shoring and single-sided wellpoints. Shoring would help minimise lateral seepage but would not prevent vertical groundwater movement into the bottom of the excavation.

The groundwater quality in the collected sample meets irrigation criteria. However, as the extracted groundwater is very acidic, pH adjustment is recommended. lime dosing treatment would be either via a commercial dewatering system or a dosing chamber followed by a detention pond prior to irrigation. An area has been nominated for irrigation on the sandy soil, however, the final configuration would be subject to site constraints and project scheduling.

To achieve criteria for discharge off-site pH adjustment and removal of suspended solids/turbidity would be required. The pH adjustment would also remove slightly elevated soluble aluminium concentrations. Treatment would be either via a dewatering treatment system incorporating lime dosing, coagulation, flocculation and filtration. A minimum 1 hour detention would be required for 9L/s this would be 32000L. 2 x 20000L tanks would suffice. Alternatively a detention pond could be provided.

It is likely suspended solids concentrations would reduce significantly once steady state conditions have been achieved.

Monitoring for pH and Total Titratable Acidity would be required for irrigation and these parameters plus dissolved oxygen ad suspended solids/turbidity would be required for discharge off-site.

Depending on the overland flow path and final flow volumes, discharge off site might not occur. Catch dams and contour drains could also be used to control overland flow paths to prevent discharge off-site.

Should discharge off-site be adopted, a monitoring schedule has been developed to prevent acidic, sediment-laden water with low dissolved oxygen concentrations being discharged.

## 10 CONCLUSION

Groundwater would be intercepted during excavation associated with the installation of the underground fuel storage tanks on 7 DP875447, Tweed Coast Road, Kings Forest. Extracted groundwater quality would generally meet irrigation criteria. Two treatment options are proposed for extracted groundwater:

1. Irrigation on site with alkaline treatment to minimise acid generation/export.
2. Potential discharge off-site following treatment including alkaline treatment, removal of sediment and increased aeration. Discharge off-site may be minimised or prevented with contour drains and other surface controls to reduce overland flow on the site permeable sandy soil.

## 11 REFERENCES


- Acid Sulfate Soil Management Advisory Committee, "Acid Sulfate Soil Manual", Wollongbar, 1998.
- Ahern CR, McElnea A E, Sullivan L A,. (2004). *Acid Sulfate Soils Laboratory Methods Guidelines. In Queensland Acid Sulfate Soils Manual 2004*. Department of Natural Resources, Mines and Energy. Inddoorapilly, Queensland, Australia
- Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*
- White, I. et al, "Fixing Problems Caused By Acid Sulphate Estuarine Soils", *In* C. Copeland, C. (Ed.) Ecosystem Management: the Legacy of Science, Halstead Press, Sydney 1995.
- Naylor,S.D., Chapman,G.A., Atkinson,G., Murphy,C.l., Tulau,M.J., Flewin,T.C., Milford,H.B., Morand,D.T.1998 *Guidelines for the Use of Acid Sulfate Soil Risk Maps*. 2nd ed. Department of Natural
- White, I., Melville, M.D., Wilson, B.P., and Sammut, J. 1997 *Reducing Acidic Discharges from Coastal Wetlands in Eastern Australia.* Wetlands Ecology and Management 5 : 55-72


SIGNATURE
This report has been prepared by Mark Tunks of HMC Environmental Consulting Pty Ltd

Mark Tunks
Principal

8th May 2015
Completion Date

## 12 APPENDICES

### *Appendix 1 Groundwater Monitoring Schedule (Discharge Off-Site Only)*

- NAME(S) OF PERSON(S) RESPONSIBLE FOR MONITORING TO BE FORWARDED TO TWEED SHIRE COUNCIL PRIOR TO COMMENCEMENT OF DEWATERING OPERATIONS
- SITE MANAGER CONTACT DETAILS TO BE FORWARDED TO TWEED SHIRE COUNCIL PRIOR TO COMMENCEMENT OF DEWATERING OPERATIONS
- GROUNDWATER TREATMENT SYSTEM TO BE INSTALLED TO COLLECT/TREAT GROUNDWATER PRIOR TO DISCHARGE TO THE STORMWATER SYSTEM (IF MEASURED GROUNDWATER QUALITY FAILS DISCARGE CRITERIA)
- ALL MONITORING TO BE CARRIED OUT AT THE POINTOF DISCHARGE TO THE COUNCIL STORMWATER SYSTEM OR OTHER AGREED LOCATIONS

| Parameter | Objective | Frequency(during irrigation/discharge) | Action Threshold (median) | Action (2) |
|---|---|---|---|---|
| pH | pH 6.5 – 8.5 | Daily | pH < 6.5 or > 8.5 | ▫ Inform site manager<br>▫ Investigate cause<br>▫ Apply hydrated lime to holding tank or other facility at appropriate rate to maintain pH 6.5 – 8.5<br>▫ If problem persists temporarily cease discharge until rectified<br>▫ Record monitoring results and any actions |
| Total Titratable Acidity | <40mg/L | Daily | >40mg/L | ▫ Inform site manager<br>▫ Investigate cause<br>▫ Apply hydrated lime to holding tank or other facility at appropriate rate to maintain pH 6.5 – 8.5<br>▫ If problem persists temporarily cease discharge until rectified<br>▫ Record monitoring results and any actions |
| Suspended Solids | < 50 mg/L | Weekly (1) | > 50 mg/L | ▫ Inform site manager<br>▫ Investigate cause<br>▫ Apply flocculent to holding tank and/or modify sedimentation/ filtration process<br>▫ If problem persists temporarily cease discharge until rectified<br>▫ Record monitoring results and any actions |
| Turbidity | <50NTU | Daily | >50 NTU | ▫ Inform site manager<br>▫ Investigate cause<br>▫ Apply flocculent to holding tank and/or modify sedimentation/ filtration process<br>▫ If problem persists temporarily cease discharge until rectified<br>▫ Record monitoring results and any actions |
| Dissolved oxygen | >6 mg/L<br><br>80-110% sat'n | Daily (1) | <6mg/L<br><br><80% sat'n | ▫ Inform site manager<br>▫ Investigate cause<br>▫ Check equipment configuration to maximise turbulence<br>▫ Increase aeration via flowforms or mechanical aerators<br>▫ Check dissolved metal concentration as Fe & Al oxidation may reduce DO levels<br>▫ If problem persists temporarily cease discharge until rectified<br>▫ Record monitoring results and any actions |
| Oil and Grease | No residue/film visible | Daily | Visible residue/film | ▫ Inform site manager<br>▫ Investigate cause including spills/equipment leak<br>▫ Remove source<br>▫ Contain and clean up<br>▫ Record monitoring results and action |
| Dissolved metals<br><br>Iron<br><br>Aluminium | <br><br><1 mg/L<br><br><0.055mg/L | <br><br>Weekly (1)<br><br>Weekly (1) | <br><br>>1 mg/L<br><br>>0.055mg/L | ▫ Inform site manager<br>▫ Provide additional treatment aeration, pH adjustment or flocculation/coagulation as required<br>▫ If problem persists temporarily cease discharge until rectified<br>▫ Record monitoring results and action |

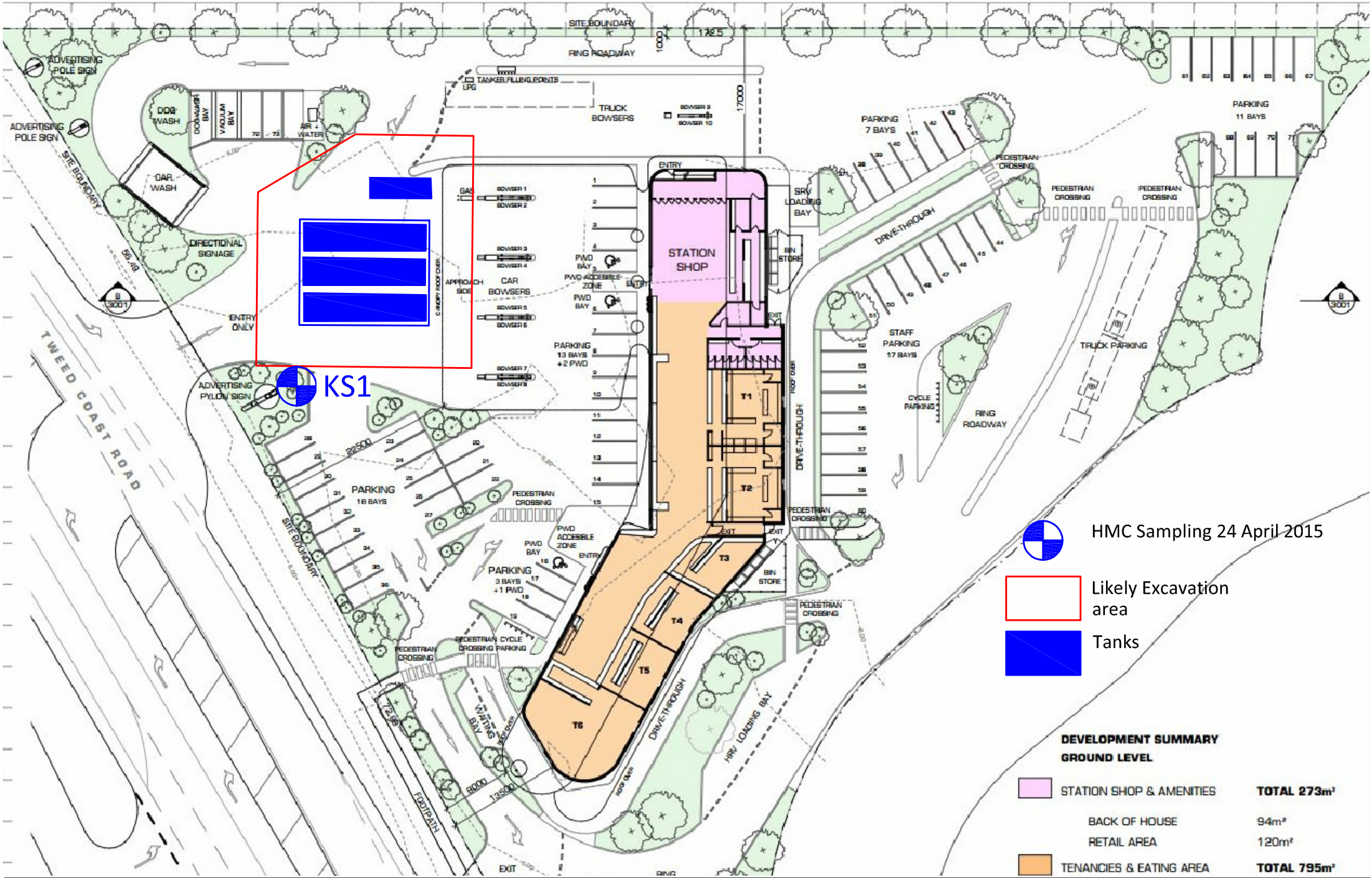
(1) Frequency may be reduced after steady state conditions and 2 weeks monitoring confirm ongoing compliance with discharge criteria
(2) A suitable electronic monitoring device to detect a failure in the dewatering system is to be provided. This device would include a facility to report any failure automatically back to a nominated person

***Appendix 2 Locality Map***

## *Appendix 3 Site Boundary & Layout*

***Appendix 4 Site Plan - Estimated Excavation Area & Monitoring Bore Location***

See following page

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# Groundwater Investigation - Borehole Location

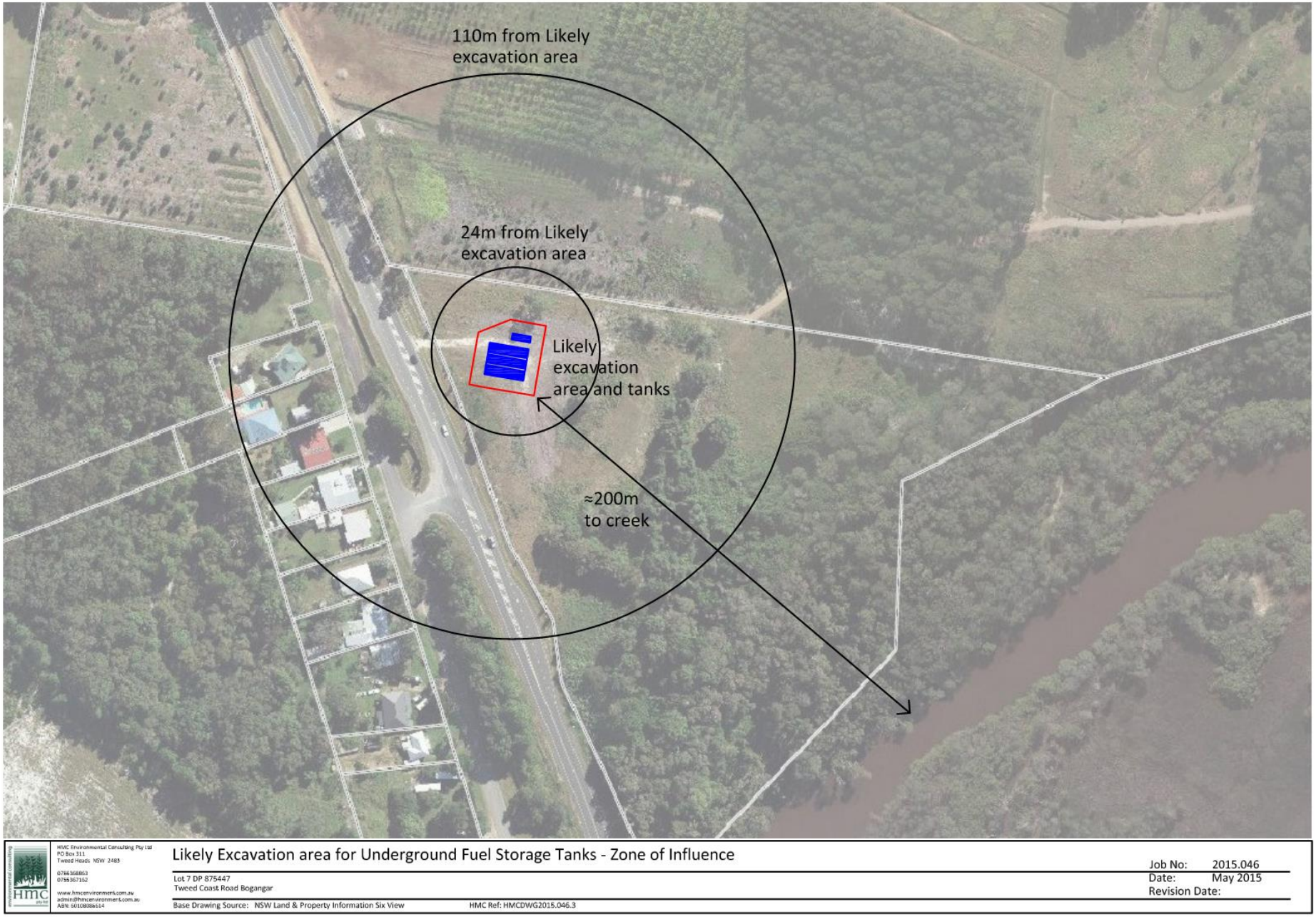
Lot 7 DP 875447
Tweed Coast Road Bogangar

Base Drawing Source: PUSH job: 738.12 DWG: 1000

HMC Ref: HMCDWG2015.046.5

Job No: 2015.046
Date: May 2015
Revision Date:

## *Appendix 5 Site Plan – Zone of Influence*



## *Appendix 6 Site Plan – Potential Irrigation Zone*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## *Appendix 7 Geology & Soil Landscape Maps*

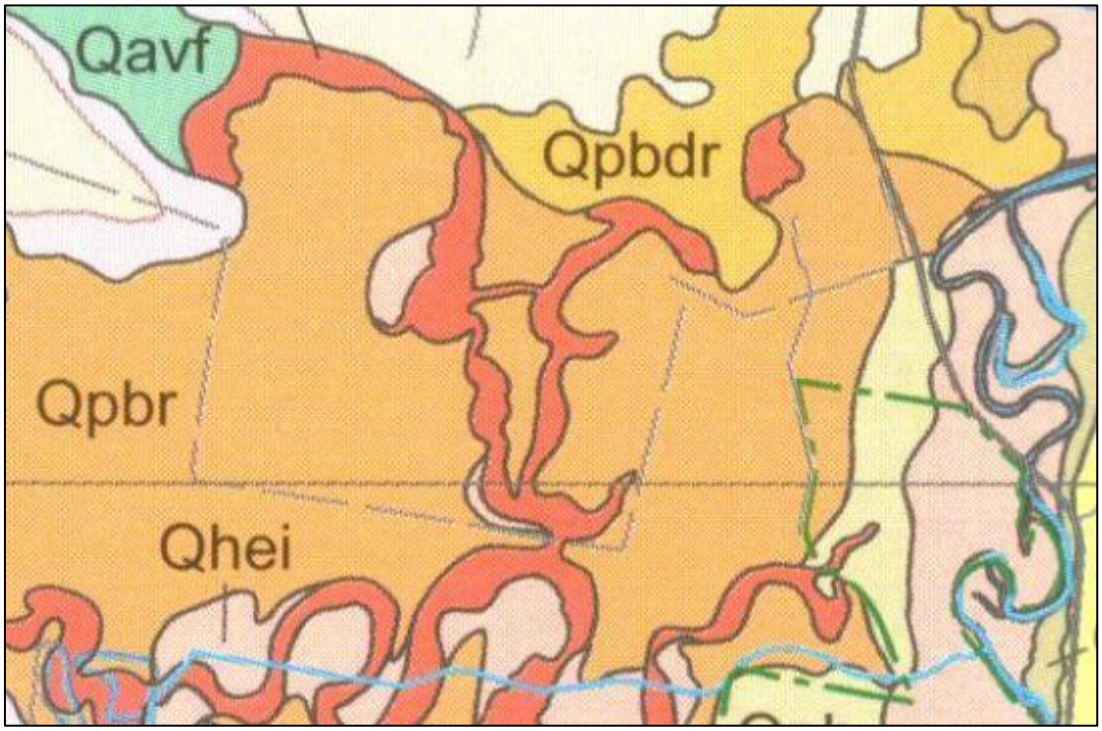



**Figure 4 - Geology (Source: Australian Geoscience)**

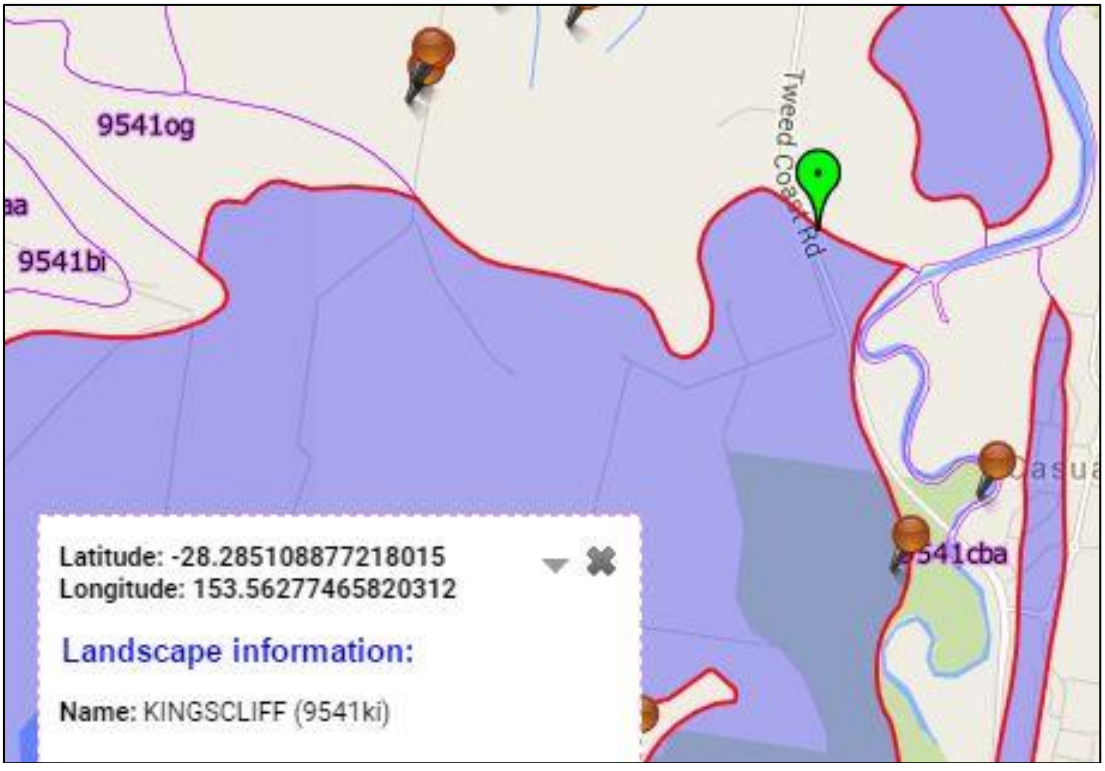



**Figure 5 - Soil Landscape (Source: http://www.environment.nsw.gov.au/eSpadeWebApp/)**

## *Appendix 8 Registered Groundwater Bores*


**Figure 6 - Groundwater (Source: http://allwaterdata.water.nsw.gov.au/water.stm)**

## *Appendix 9 Monitoring Bore Borelog*

MAZLAB Pty Ltd
Environmental Testing, Sampling and Drilling (Vibracore)
ABN 90 151 684 436 ACN 151 684 436

*U1/ 33 MACHINERY DR., TWEED HEADS SOUTH, 2486*
*PO BOX 6879 TWEED HEADS SOUTH, 2486*
*PHONE: (07) 55239922 FAX: (07) 55239822*
*EMAIL: mazlab@bigpond.com*

| **CLIENT:** HMC Environmental | **DATE:** 22/04/2015 | **BH#:** 1 |
|---|---|---|
| **MAZLAB JOB NO:** HMC2544 | **PROJECT:** Tweed Coast Rd., Cudgen | |

| **DEPTH** | **DESCRIPTION** | **TEST** | **DEPTH / RESULT** |
|---|---|---|---|
| 0.00 | Silty SAND(SM) dark grey brown, fine grained, moist | | |
| 0.20 | SAND(SP) light grey brown, fine grained, moist | | |
| 0.70 | SAND(SP) grey brown, fine grained, v/moist becoming wet | | |
| 1.00 | As above – only wet | | |
| 2.50 | SAND(SP) light grey brown, fine grained, wet | | |
| 3.70 | SAND(SP) grey, fine to medium grained, wet | | |
| 4.00 | Indurated SAND(SM) weakly cemented, dark brown, wet | | |
| 4.75 | Hole Terminated – Water/Hole Collapse @ 0.95 metres | | |

| **JACMAZ 500 :** | **DRILLER :** |
|---|---|

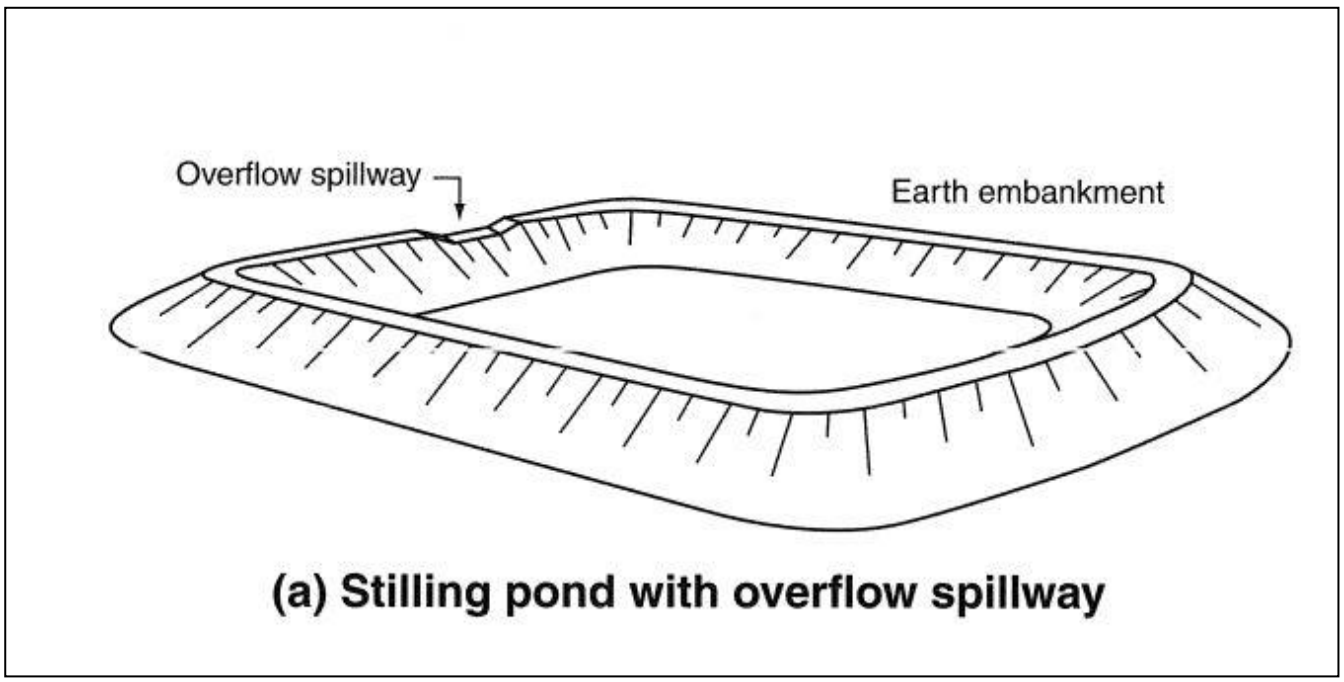
## *Appendix 10 Typical Envirotank installation*

## *Appendix 11 Site Photos*

**Photo 1 – View NE across excavation site**

**Photo 2 – Potential irrigation site**

***Appendix 12 Typical bunded treatment or sedimentation pond***



## *Appendix 13 Zone of influence calculator*

http://www.der.wa.gov.au/your-environment/acid-sulfate-soils/66-cone-of-depression

### Calculator

#### Input

| | | |
|---|---|---|
| Length of excavation (metres): | 30 | m |
| Width of excavation (metres): | 25 | m |
| Required groundwater drawdown (metres): | 3.75 | m |
| Saturated thickness of the unconfined aquifer[A] (metres): | 10 | m |
| Hydraulic conductivity of the aquifer (K) (metres per second): | 0.0000949 | m/sec |

Calculate

#### Results

| | |
|---|---|
| Effective radius of pumping well , $R_e$ (metres): | 15m |
| Radius of influence of dewatering, $R_0$ (metres): (i.e. radius of the cone of depression) | 110m |
| Total pumping rate (litres per second): | 9l/sec |
| Time taken to establish the cone of depression (hours): | 250hrs |

## Calculator

### Input

| | | |
|---|---|---|
| Length of excavation (metres): | 30 | m |
| Width of excavation (metres): | 25 | m |
| Required groundwater drawdown (metres): | 3.75 | m |
| Saturated thickness of the unconfined aquifer[(A)] (metres): | 10 | m |
| Hydraulic conductivity of the aquifer (K) (metres per second): | 0.00000463 | m/sec |

Calculate

### Results

| | |
|---|---|
| Effective radius of pumping well , $R_e$ (metres): | 15m |
| Radius of influence of dewatering, $R_0$ (metres): (i.e. radius of the cone of depression) | 24m |
| Total pumping rate (litres per second): | 2l/sec |
| Time taken to establish the cone of depression (hours): | 250hrs |

## *Appendix 14 Laboratory Results*

**Tweed Laboratory Centre**

TWEED SHIRE COUNCIL

Tweed Laboratory Centre, 46 Enterprise Avenue, Tweed Heads South NSW 2486 Australia
Phone: 07 5569 3103 Fax: 07 5524 2676 Email: samplereception@tweed.nsw.gov.au ABN: 90 178 732 496
(All correspondence: Tweed Shire Council PO Box 816 Murwillumbah NSW 2484)
www.tweed.nsw.gov.au/tweedlab/

**FINAL CERTIFICATE OF ANALYSIS**

| | | | |
|---|---|---|---|
| **Client:** | HMC Environmental Consulting Pty Ltd | | Page 1 of 2 |
| **Address:** | PO Box 311<br>TWEED HEADS<br>**NSW 2485** | | |
| | | **Lims1 Report No:** | 15/0988-C |
| **Attention:** | Mark Tunks | **Client Reference:** | |
| **Copy To:** | Fax: 07 5536 7162 | **Date of Report:** | 06/05/2015 |

All pages of this Report have been checked and approved.
This document may not be reproduced except in full.

| | | | |
|---|---|---|---|
| **Taken By:** | Client | **No of Samples:** | 3 |
| **Date Taken:** | 24/04/2015 | **Date Testing Commenced:** | 24/04/2015 |
| **Date Received:** | 24/04/2015 | **Date Testing Completed:** | 06/05/2015 |

**Sample Description:** 2015.046 Kings Forest Service Station

| Sample/Site Identification | Sample/Site Description |
|---|---|
| 1 | KS1 |
| 2 | KS1 Dup |
| 3 | KSRS1 |

**COMMENTS:**

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025

**Accreditation No: 12754 & 13538**

Dr Paul J Wright
(Laboratory Coordinator)
paulw@tweed.nsw.gov.au

TWEED SHIRE COUNCIL

## Tweed Laboratory Centre



**Client:** HMC Environmental Consulting Pty Ltd

**Address:** PO Box 311

TWEED HEADS
NSW 2485

**Attention:** Mark Tunks

**Lims1 Report No:** 15/0988-C
**Date Testing Completed:** 06/05/2015
**Date of Report:** 06/05/2015

**Sample Description:** 2015.046 Kings Forest Service Station

| Sample Identification: | | | KS1 | KS1 Dup | KSRS1 |
|---|---|---|---|---|---|
| Date Taken: | | | 24/04/2015 | 24/04/2015 | 24/04/2015 |
| Date Received: | | | 24/04/2015 | 24/04/2015 | 24/04/2015 |
| Date Testing Commenced: | | | 24/04/2015 | 24/04/2015 | 24/04/2015 |
| Test | Method | Units | 15/0988-C-1 | 15/0988-C-2 | 15/0988-C-3 |
| Colour True | P10 | Colour Units | 570 | 580 | ----- |
| Alkalinity as $CaCO_3$ | C10 | mg/L | <1 | <1 | ----- |
| *Total Acidity | APHA 2310 | mg/L $CaCO_3$ | 270 | 340 | ----- |
| Suspended Solids | P4 | mg/L | 233 | 231 | ----- |
| Chloride | C20 | mg/L | 16 | 15 | <3 |
| Iron (Soluble) | M8 | mg/L | 0.83 | 0.82 | <0.01 |
| Sulphur as Sulphate | M8 | mg/L | 9.4 | 9.0 | <0.1 |
| Aluminium (Soluble) | M8 | mg/L | 0.57 | 0.55 | <0.01 |
| Turbidity | P8 | NTU | 632 | 406 | ----- |

## *Appendix 15 Chain of Custody*

**HMC Environmental Consulting**

Page 1 of 1

Unit 29, Wharf Central
75-77 Wharft Street
Tweed Heads NSW 2485
PO Box 311, Tweed Heads, NSW 2485 Ph (07) 5536 8863 Fax (07) 5536 7162 Email: admin@hmcenvironment.com.au

### ENVIRONMENTAL ANALYSIS REQUEST – CHAIN OF CUSTODY RECORD

| | | | |
|---|---|---|---|
| Company: | HMC Environmental | Project Name: | Kings forest Service Station |
| Address: | PO Box 311 | Project Number: | 2015.046 |
| | Tweed Heads NSW 2485 | Quote Reference: | 2015.046 |
| | | Purchase Order No: | |
| Contact: | | Results Required by: | 24 hours ☐ 48 hours ☐ 3 – 5 Day X Other ☐ |
| Telephone: | 07 55368863 Fax: 07 55367162 | Send Results to: | admin@hmcenvironment.com.au |
| Email: | admin@hmcenvironment.com.au | Results to be provided by: | Mail: ☐ Fax: ☐ Email: X |

| SAMPLE DESCRIPTION | | | | | | ANALYSIS REQUIRED | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Date Sampled | Time | Lab No | Soil / Water Other | Comments# | COMPOSITE | COMPOSITE | Reactive P | TP | TKN | Oxidised N | Ammonia | PAHs | BOD | (OCs | (OPs | Speciated Phenols | Calcium | Metals 8 | Magnesium | Potassium | Alkalinity | ~~TSS~~ Total Acidity | Sodium | TSS | Chloride | Soluble Iron | Sulfate | Fluoride | Soluble Aluminium | COD | Turbidity |
| KS1 | 24/4/15 | | | W | Groundwater | X | | | | | | | | | | | | | | | X | X | | X | X | X | X | | X | | X |
| KS1DUP | " | | | W | Duplicate | X | | | | | | | | | | | | | | | X | X | | X | X | X | X | | X | | X |
| KSRS1 | | | | W | Rinsate | | | | | | | | | | | | | | | | ~~X~~ | ~~X~~ | | ~~X~~ | X | X | X | | X | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| # Please Provide Field PID Readings where possible | | | | | Totals | 2 | | | | | | | | | | | | | | | 2 | 2 | | 2 | 3 | 3 | 3 | | 3 | | 2 |

Relinquished by: [signature] Date/Time: 24/4/15 1415

Received by: Date/Time:

Relinquished by: Date/Time: 24/4/15

Received by: JOHN LAWSON Date/Time: 1415

Special Requirements (eg. OHS issues etc.)

** METALS (Please circle):
Ag, Al, As, B, Ba, Be, Bi, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn

Sample Receipt Advice (Lab Use Only)
All Samples Received in Good Condition ☑
All Documentation in Proper Order ☑
Samples Received Properly Chilled ☑ 10.6
Samples Received Within Recommended Holding Times ☑
For Enquires please quote Batch No.