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ACID SULFATE SOILS MANAGEMENT PLAN PROPOSED GP SUPER CLINIC/HEALTHONE RAYMOND TERRACE

JACARANDA AVENUE AND SWAN STREET RAYMOND TERRACE NSW

Prepared for

HUNTER NEW ENGLAND LOCAL HEALTH DISTRICT

Prepared by

RCA AUSTRALIA

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RCA AUSTRALIA
ABN 53 063 515 711

92 Hill Street, CARRINGTON NSW 2294

Telephone: +61 2 4902 9200
Facsimile: +61 2 4902 9299
Email: administrator@rca.com.au
Internet: www.rca.com.au

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CERTIFIED QUALITY MANAGEMENT SYSTEM ISO 9001

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RCA ref 7869a-202/1

23 January 2012

Hunter New England Local Health District
Locked Mail Bag 1
NEW LAMBTON NSW 2305

Attention: Scott Pascoe

ACID SULFATE SOIL MANAGEMENT PLAN
PROPOSED GP SUPER CLINIC/HEALTH-ONE RAYMOND TERRACE
CORNER OF JACARANDA AVENUE AND SWAN STREET, RAYMOND TERRACE

1 INTRODUCTION

This report presents a preliminary Acid Sulfate Soils Management Plan (ASSMP) for the proposed development of healthcare facilities at the corner of Jacaranda Avenue and Swan Street, Raymond Terrace, NSW.

This is a contingency document which will provide acid sulfate soil (ASS) management strategies for implementation during the construction phase of the development should suspected acid sulfate soils be encountered. The requirement for the ASSMP was identified in the RCA Australia (RCA) acid soils sulfate assessment, undertaken for the proposed development at site (RCA ref 7869a-201/1, January 2012).

Briefly, the assessment identified concentrations of hydrogen ions and percent sulfur (H^+/%S), in some samples, above the criteria set out in the ASSMAC guidelines (Ref [2]), indicating the potential for the presence of acid sulfate soils. Based on these results the guidelines recommend the preparation of an ASSMP.

The site is an approximately 5300m^2 property to the north of the intersection of Jacaranda Avenue, Swan Street and Sturgeon Street in Raymond Terrace. The area is relatively flat and undeveloped but was previously the site of the Raymond Terrace swimming pool complex. Cut and fill has historically been undertaken across the site.

The proposed GP Super Clinic/HealthOne Raymond Terrace development at the site is understood to include:

- a building with an area in the order of 2,500m^2;
- basement car parking beneath the proposed building;

- pavements, eg, access roads, carparks.

It is understood that excavations up to in the order of 2.5m depth will be required for the proposed secure carpark and that excavations up to about 1.5m depth will be required for the proposed multi deck/two level car parking. Localised excavations to a depth of about 4.2m will be required for the construction of a lift pit.

This management plan is required to manage and remediate any excavated soil to mitigate risks to the environment and human health. This management plan has been prepared in accordance with the ASSMAC Guidelines (Ref [2]).

2 BACKGROUND TO ASS AND TESTING

Estuarine sediments of coastal NSW from the Holocene geological age contain iron pyrite, the main constituent of acid sulfate soils. The Holocene sediment is found below and up to 5m Australian Height Datum (AHD) typically in coastal and floodplain areas. The sediment can be divided into classes based on its oxidised state. If the pyritic material above the water table is being oxidised and has a pH <4.0 it is called actual acid sulfate soil (AASS). If the pyrite material is below the water table and has not been oxidised, it is termed potential acid sulphide soil (PASS) and generally has a pH of >4.0. The pH has the potential to become much lower when the soil is exposed to oxygen. Sediment, which, after the addition of hydrogen peroxide, has a pH <2.5 strongly indicates the presence of ASS (Ref [2]).

The ASSMAC Guidelines outline an Action Criteria based on Acid Sulfate Soil analysis. These are based on three broad texture categories, and can be seen in **Table 1**.

Table 1 *Acid Sulfate Soils Action Criteria for Different Texture*

Type of Material		**Action Criteria if 1 to 1000 Tonnes of material is Disturbed**		**Action Criteria > 1000 Tonnes of material is Disturbed**	
Soil Texture	Approx. Clay Content (%)	Equivalent Sulphur (%S)	Equivalent Acidity (mol H^+/tonne)	Equivalent Sulphur (%S)	Equivalent Acidity (mol H^+/tonne)
Coarse (silty sand to sands)	≤5	0.03	18	0.03	18
Medium (sandy loam-light clay)	5-40	0.06	36	0.03	18
Fine (Medium to heavy clays and silty clays)	≥40	0.1	62	0.03	18

1. Taken from Reference 2.

3 SITE CONDITIONS

The site of the proposed development is in Raymond Terrace.

Geological maps indicate that the site is situated in the vicinity of the boundary between the Branxton Formation of the Maitland Group, which is noted to generally comprise conglomerate, sandstone and siltstone rock types, and an area of Quaternary alluvium associated with the Hunter River.

The site has been covered with sand and silty sand (sand fill and natural sands) with soil exposures noted across most of the site comprising sand and silty sand fill.

3.1 ACID SULFATE SOIL RISK MAP

The Beresfield Acid Sulfate Soil Risk Map (Ref [3]) indicated a low probability of the occurrence of acid sulfate soils at depths greater than 3m below the ground surface.

3.2 SUBSURFACE CONDITIONS - SOIL

The recent investigation at the site (Ref [1]) encountered the following subsurface conditions:

- FILL, Silty SAND with pieces of brick, concrete, steel reinforcement, tiles and plastic, of variable depth to depths up to in excess of 3.0m; overlying
- Natural SAND soils, fine to coarse grained, to depths up to in excess of 3.6m; overlying
- Natural Clayey SAND soils (encountered in test pit TP14 below a depth of 3.2m), fine to coarse grained.

Based on the subsurface profiles encountered in boreholes BH1 to BH3 drilled as part of geotechnical investigations previously undertaken at the site (RCA ref 7869-201/0, July 2010 – Ref [4]), the sand soils at the site are underlain by residual clay soils at a depth of about 4m, and weathered rock with siltstone/sandy siltstone encountered in boreholes BH1 and BH2 at depths of about 7.4m and 6.1m, respectively.

3.3 SUBSURFACE CONDITIONS - GROUNDWATER

Groundwater was noted at depths ranging from 2.4m to 2.9m.

Groundwater levels are likely to fluctuate with variations in climatic and site conditions. It was also noted that based on measured groundwater levels together with observations during the drilling of the boreholes for geotechnical investigations previously undertaken at the site (Ref [4]) it appears that there may be a couple of different aquifers at the site with different pressure heads.

4 ACID SULFATE SOIL ASSESSMENT

RCA conducted an acid sulfate soil assessment at the request of Mr Peter Kemp of Kemp Consulting Pty Ltd on behalf of the Hunter New England Local Health District, to further assess soil conditions, given the depth of excavations proposed at the site as noted in Section 1. The investigation was required to support a Development Application to Port Stephens Council for the proposed development at the site.

The acid sulfate soil assessment (RCA ref 7869a-201/1) included the following:

- Excavation of 7 test pits across the site to depths of up to 4.3m, comprising:
  - TP14 excavated to a depth of 4.3m in the vicinity of the proposed location of the lift pit;
  - TP15 and TP20 excavated to depths of 3.6m in the area of the proposed secure carpark;
  - TP16 and TP17 excavated to depths of 3.0-3.1m in the area of the proposed multi deck/two level car parking;
  - TP18 and TP19 excavated to depths of 3.0-3.1m at other locations across the site in areas where buildings and on-grade car parking is proposed.
- Collection of samples representative of the encountered soil profiles.
- Acid sulfate screening testing of a total of 26 samples; and
- Based on screening results, laboratory analysis of seven samples for acid sulfate parameters, SPOCAS and $S_{Cr.}$ (chromium reducible sulphur).

Test pit locations are shown on **Drawing 1**, which is attached in **Appendix A**.

The results of the investigation were compared to the soil action criteria for soils according to their texture and the combined existing and potential acidity of the material as per the ASSMAC Acid Sulfate Soil Manual 1998 (Ref [2]). Based on the subsurface conditions encountered in the test pits excavated at the site the action criteria for soils of coarse texture would be appropriate.

Results showed that of the seven samples on which further analysis by the $S_{Cr.}$ and SPOCAS methods were undertaken, one sample (of the natural clayey sand soils from test pit TP14) had concentrations of acidity and sulfur that exceed the ASSMAC action criteria for coarse soils such as sands.

The results did not indicate results in excess of the action criteria for the other samples of the natural sand soils or samples of the silty sand fill materials that were tested.

It was noted that while the net acidity of 18 mole H^+/tonne for the sample of natural clayey sand soils tested from test pit TP14 is borderline when compared with the ASSMAC action criteria, the potential oxidisable sulfur (S_{CR} or Spos) for this sample was relatively high and well over the ASSMAC action criteria. The borderline net acidity for this sample arises from the acid neutralising capacity (ANC) of the soil, which cannot always be relied upon.

Consequently, it was recommended that any disturbance and excavation of the natural clayey sand soils (encountered in test pit TP14 below a depth of 3.2m) be undertaken in accordance with an ASSMP. As such, if/where deeper excavations that may encounter the natural clayey sand soils (such as that for the construction of the lift pit) are proposed, then an ASSMP would be required for that proposed work.

An ASSMP for the proposed development at the site is presented in the following sections.

5 ACID SULFATE SOILS MANAGEMENT PLAN

The ASSMAC guidelines (Ref [2]) state that a management plan should include measures or procedures which:

- prevent the oxidation of pyrite (avoiding the disturbance of ASS or changes to groundwater levels) - parts of the proposed development that excavate natural material cannot be avoided;
- treat or manage ASS;
- prevent, control or minimise the discharge of ASS leachate to the surrounding environment;
- allow for neutralisation of acid leachate from ASS.

5.1 ACTIVITIES THAT WILL IMPACT ON ASS

The following outlines specific proposed activities that have the potential to disturb the ASS and thereby require the controls as detailed in this management plan. Whilst the following information relates to specific activities, all activities that disturb natural soils should be assessed for acid generating potential and treated accordingly.

5.1.1 SOIL EFFECTS

5.1.1.1 GENERAL EXCAVATIONS

The acid sulfate soil investigation assessment indicted that, with the exception of the clayey sands in TP14, other natural sands at the site within the depth of proposed excavations were not PASS/ASS.

Generally, based on assessment results, if excavations into the natural material are proposed to depths below three metres they should be considered to potentially encounter PASS/ASS. ASS/PASS were not encountered at depths above this.

These may include, but are not limited to, excavations for:

- major drains;
- major services;
- underground structures (specifically at the site, the proposed lift well);
- pavement construction; and
- footings.

Excavated soils and the excavation itself can result in the generation of ASS. The face of the excavation also has the potential to oxidise and become acid sulfate generating.

While most excavations are backfilled, therefore removing the potential for oxidation (such as footings and service trenches) other excavations such as major drains may remain open for a period of time before being filled with water, depending on rainfall and groundwater levels. Even when filled with water there is still potential for acid to be generated due to the oxygen content in the water. Therefore the water in the excavation could become acidic until the potential acid generation of the exposed soil is exhausted.

It is understood that, apart from the lift well (proposed depth of over four meters) generally no substantial/deep excavations are proposed for the site, with excavations generally less than about 2.5m depth.

Potential ASS impacts should be considered if the proposed lift well is developed and if cut and fill depths in other areas extend beyond those proposed.

5.1.2 WATER EFFECTS

Any activities (eg, excavation dewatering, use of groundwater) that have the potential to lower the water table may enhance the oxidation of sediments.

If dewatering is likely to be required for construction of the proposed development at the site, a suitably qualified professional should be consulted.

Uncontrolled discharge from drainage lines and stockpile areas can result in impact on sensitive environments.

5.1.2.1 GROUNDWATER DRAWDOWN

The installation or reconstruction of shallow drains below the water table can drawdown the surrounding groundwater table. This can result in exposure of previously saturated sediments allowing oxidation of PASS and acid generation. The potentially high permeability of the soil will allow an increased volume of acid generation.

If installation of drains below the water table is proposed as part of this development, the potential for acid generation should be reassessed.

5.1.2.2 CHANGES TO GROUNDWATER FLOW PATTERNS

The excavation and removal of natural material and placement of fill to adjacent locations can create changes in the groundwater table. These can result from consolidation of compressible strata from increased surface loading and from capillary action as a result of fill placement above a shallow water table, both of which result in water table increases.

It is considered that rises in the water table as a result of site works will not be significant and will remain within the seasonal variations expected at the site.

5.1.2.3 DISCHARGE OF ACIDIC RUN-OFF FROM SOILS

Acidic drainage generated from the excavation of ASS can impact on waterways and therefore requires minimisation, collection and treatment prior to discharge.

If ASS are identified and stockpiled, minimisation of acidic run-off should be undertaken by covering and bunding stockpiles to prevent surface water ingress.

Permission to allow drainage from treated stockpiles to water bodies must be sought from the NSW Office of Water and the DECCW and would require a licence in accordance with Chapter 3 (Environment Protection License) and Part S3 (Water Pollution) of the Protection of the Environment (Operations) Act (1999).

5.1.2.4 ACID GENERATION FROM EXCAVATION

If it is proposed to excavate below the water table, it is noted that acid generation in excavations can occur from excavation below the water table allowing soil oxidation. Acid generation impacts on groundwater can be minimised by sheet piling excavation sides and minimising exposure times. Where acidic conditions do occur, lime treatment of soils and waters will be required.

5.1.3 *EXPOSURE AND OXIDATION OF IMPORTED FILL MATERIAL*

If it is proposed to import fill as part of this development, it is noted that imported material from off site has the potential to be PASS/ASS. Importation of such material could allow acid generation where there may be no treatment available. Imported fill from low lying areas (<5m, AHD) should be tested prior to delivery on site.

In particular, any sand imported to the site for use in construction should be analysed.

5.2 ASS TREATMENT METHODS

The following are options that would be considered when the status of the acid sulfate potential has been determined in excavated soils.

5.2.1 *AVOIDANCE*

Disturbance of ASS should be minimised to avoid soil exposure. Minimisation measures can include the use of bridging layers and geo-fabric instead of removal of unsuitable soil, locating services in imported fills or above ground, shallow and wide drainage and sedimentation ponds.

RCA understands that the proposed lift well will be excavated below the depth of encountered ASS and thus, avoidance is not an applicable option.

5.2.2 *BURIAL (NO PRE-TREATMENT)*

This option requires the disposal of the excavated soil by burial within the site below the water table or from the depth from which the material was originally excavated.

Given the limited proposed deeper excavations in the area of the proposed lift well this is not considered applicable in this case.

5.2.3 *SEPARATION AND TREATMENT*

Separation and treatment of the residual pyrite has been used on a limited number of sites but is generally only considered a viable option for sandy soils. The contractor may have previous experience with this method and may consider this a viable option, however given the likely relatively small volumes this is not considered feasible for this site.

5.2.4 *NEUTRALISATION*

This option requires the application of lime, or other such neutralising agent, in a controlled manner. Lime is applied using a rotary hoe or similar which also acts to aerate and mix the soils. Application of lime and aeration is undertaken until a neutral pH is achieved. Once neutralised, soils can be re-used on site. This is considered the most appropriate method based on the available information.

Liming rates are based on total acid potential of the soils (both PASS and ASS).

For this project, based on the results of analysis from the acid sulfate assessment, the following liming rates have been estimated:

Based on Table 4.6 (Ref [2]) and the results of the ASS assessment (Ref [1]), a liming rate of 4.7 kg/tonne is suggested.

6 ASS MANAGEMENT AND MONITORING REQUIREMENTS

6.1 GENERAL EXCAVATIONS

6.1.1 RESPONSIBILITIES

The control of acid generation is the responsibility of the contractor.

Additional soil testing to assess the potential impacts of construction activities on ASS may be considered prior to activities taking place; otherwise the results of the current assessment may be used.

Management of ASS can then be undertaken concurrently with the activity, thereby minimising the risk of uncontrolled acid generation.

6.1.2 CONTROL

Whilst the recommended method of treatment is lime neutralisation, other treatment methods may be more feasible, including methods not considered within this document. In all treatment methods, appropriate occupational health and safety requirements are to be followed. Additionally, the potential off site impacts of the methods, for example run-off from lime stockpiles to rivers and streams, are to be controlled in the Environmental Management Plan for the site.

The control of acid generation from excavated soil can be achieved by neutralisation using lime. There are numerous types of suitable lime including agricultural lime, hydrated lime, calcined magnesia and dolomite. These vary in their neutralising requirements and the choice depends on cost and availability.

The following details the sequence of events that must be followed during excavation works that are below the water table, or where ASS soils are suspected, based on the existing assessment results (refer to Section 4), or, alternatively, additional testing can be undertaken where more extensive ASS is encountered.

1. Determine depth and extent of area requiring excavation in conjunction with design plans.
2. Use liming rates based on the assessment results (4.7kg/tonne) which incorporates a safety factor of 1.5.

Excavated soil should be placed in the containment area prior to the end of each day to prevent release of acid water into the environment. Excavated soil should be treated within one day of excavation. Containment areas must be bunded and have impermeable sides and bases to contain any leachate produced. Alternatively, a 0.5m thick base of granular limestone can be utilised instead of an impervious base.

The treatment and containment area should be divided into a minimum of two areas separated by a bund wall. One area is for treatment and one for stockpiling the treated soils. The rate of neutralisation is dependent on soil types and investigation should be undertaken to determine timeframes for neutralisation to occur. The treatment bund should at least be able to contain twice the amount of soil expected to be excavated during the neutralisation period.

Both the treatment and stockpile areas will require separate catch ponds to control the discharge of leachate. Monitoring of the leachate will be required as outlined in the next section. The catchpond volume (CPV) should be calculated as follows:

> CPV = plan area of the neutralisation area (m^2) x 10^{-3} (m/mm) x rainfall rate (1 in 10, mm/hour) x rainfall duration (1 in 10, hour).

The catchpond bund height is dependent on site specific details such as ground slope and available area. The catchpond should be designed for a one in 10 year, one hour storm duration capacity.

Leachate will require assessment prior to discharge. Leachate monitoring requirements are outlined in Section 6.1.3.2.

The catch-ponds will collect some fines and this material should be assessed and treated prior to disposal.

Excavated soil should be spread out in a maximum 0.3m deep layer and covered with the required amount of lime (nominally 4.7 kg/tonne or determined from additional testing from the %Scr test). Lime treatment is then undertaken by tyning lime and soil aeration with a rotary hoe or similar. Thorough mixing and aeration is essential and it is recommended that trials be conducted to assess the effectiveness of the mixing method. Treatment of soils delivered to the treatment area is to be undertaken within one day of delivery.

Monitoring and final validation sampling should be undertaken throughout treatment as described in Section 6.1.3.

Once treatment is satisfactorily complete, soils can be reused for the project or disposed of appropriately. Properly treated ASS can be disposed of as solid waste to landfill providing soils are spadeable. Treated soils should be used in areas away from sensitive water ways. Where treated soils are reused in areas where drainage occurs, run off should be collected and monitored.

The treatment area should be situated away from sensitive waterways and preferably in a flat area to ensure adequate containment within bunds and catch-ponds.

6.1.3 MONITORING

6.1.3.1 EXCAVATED SOILS

Monitoring of excavated soils is required at the completion of treatment to ensure successful neutralisation. Soil should be assessed by testing for pH, %Scr and TPA levels. pH should be between 6.5 and 8.5. The soil can be considered neutralised if the sulphur and acid trail requirements are met as described in **Table 2**.

A rate of testing of one sample per $50m^3$ (with a minimum of two samples) is recommended.

The criteria for this site will be 0.03 %S/18 moles H^+/tonne, as applicable for coarse textured soils such as sands (refer to **Table 2**).

Table 2 *Neutralisation Guidelines for Lime Treated Soils* [1]

Type of Material	Action Criteria 1-1000 tonnes disturbed		Action Criteria >1000 tonnes disturbed	
Texture	Sulfur trail % Scr oxidisable	Acid trail Mol H^+/tonne TPA	Sulfur trail %S oxidisable	Acid trail Mol H^+/tonne TPA
Coarse texture **Sands to loamy sands**	0.03	18	0.03	18
Medium texture **Sandy loams to light clays**	0.06	36	0.03	18
Fine Texture **Medium to heavy clays and silty clays**	0.1	62	0.03	18

1. Taken from Reference 2.

Soil meeting these criteria can be removed from the bunded treatment areas and either incorporated into the works, placed in the stockpile area or transported off site for appropriate disposal.

6.1.3.2 LEACHATE FROM TREATMENT AREAS

A licensed discharge point is required under Section 120 of the Protection of the Environment Operations Act (POEO Act) (1999).

Monitoring of leachate from the treatment and stockpile area should be undertaken to ensure that any run off that occurred prior to treatment or during dewatering of soils is not discharged prior to neutralisation. Testing is to be undertaken for pH and should be in the range of 6.5 to 8.5. Where pH is below 6.5, additional testing as follows should be undertaken:

- $Cl/S0_4$ ratio.
- Salinity.

Where pH is less than 5.0 and/or the $Cl/S0_4$ ratio is less than 2.0, lime treatment is required.

Monitoring should be undertaken prior to discharge from the treatment area.

6.1.4 CONTINGENCY

6.1.4.1 TREATED SOIL

If %Scr and TPA of treated soil exceeds the criteria set out in the ASSMAC guidelines (Ref [2]), then the soil must be re-dosed with the required extra amount of lime based on the TAA and %Scr result, or longer aeration/oxidation time allowed if there is sufficient ANC (due to added lime) present to treat the potential acidity.

6.1.4.2 LEACHATE

Leachate should be contained in catchponds and prevented from discharge. Lime treatment of the leachate will be required to achieve the target pH of between 6.5 and 8.5. This would best be achieved using a concrete agitator truck and concrete pump to mix and place a lime slurry. In large rainfall events, stormwater to catchponds is not expected to be significant as catchment ponds are protected from surface runoff outside the treatment area. In the event that discharge does occur, the high rainfall in the catchment would negate any impacts from acid run off.

6.2 CHANGES IN GROUNDWATER FLOW

Changes to groundwater flow direction are expected to be minimal and there is considered to be a low potential for acid transport. No further action is required.

6.3 SURFACE WATERS

6.3.1 LOCATION AND VOLUMES

Throughout the construction phase, surface water discharge from any surface drain or excavation area where ASS is encountered, should be discharged to sedimentation dams. When assessing the suitability of this water for discharge, assessment is to be undertaken for pH.

6.3.2 CONTROL

Discharge from the dam should not occur without prior testing to assess suitability. Discharge from the sediment ponds on the site must comply with Section S3 (Water Pollution) of the POEO Act (1999).

6.3.3 MONITORING

pH monitoring of the water in the sedimentation dam should be undertaken prior to discharge.

6.3.4 CONTINGENCY

If the monitoring programme shows that dam water pH has fallen to below pH 5 (Ref [2]), further assessment of Cl/SO_4 ratio, Iron and Aluminium is to be undertaken. If pH is less than pH 5.0 and/or the Cl/SO_4 ratio is less than 2.0, then dam water will require treatment by lime dosing to achieve a target pH of between 6.5 to 8.5 prior to release of water.

6.4 EXPOSURE AND OXIDATION OF IMPORTED FILL MATERIAL

6.4.1 LOCATION

If fill material from off-site is proposed to be used during construction of the proposed development at the site, the following controls and monitoring should be adhered to.

6.4.2 CONTROL

It must be verified, prior to delivery, that all imported soil derived from below 5m AHD is not ASS. In particular this is likely to be applicable to any imported sand materials.

6.4.3 MONITORING

All imported material derived from below 5m AHD used on the site should be assessed for acid sulfate potential (%Scr and TPA) and only those materials that meet the guidelines in **Table 2** should be used. Note additional contaminant monitoring may be required on soils that have not been assessed.

6.4.4 CONTINGENCY

Should testing indicate unacceptable %Scr and TPA results, alternative material should be sourced. Treatment of non-compliant soil may be required.

6.5 POST CONSTRUCTION

Due to the likely minimal excavation of ASS involved in the proposed development (from deep excavations for the proposed lift pit), it is not anticipated that post construction monitoring will be required. Where large open drains or sedimentation ponds are installed, monitoring of these water bodies should be considered. Monitoring should involve:

- Monthly monitoring of pH in all sedimentation dams and drains to ensure pH is maintained between 6.5 and 8.5.

Where pH falls below pH 5, management requirements presented in Section 6.3 of this management plan should be implemented.

6.6 REPORTING AND TIMING

Monthly monitoring reports during the construction phase are to be prepared for submission to the site supervisor and should include:

- volumes of excavated soils in ASS areas;
- laboratory testing results;
- lime dosing rates;
- location of treated soils including reuse locations;
- surface water and groundwater quality data;
- any non-conformance to the Contractor Construction Management Plan;
- rainfall records;
- incidents, including any non-conformance to licence requirements of the DECCW or breaches in the relevant requirements of the POEO Act;
- any reporting requirements of DECCW and NSW Office of Water licences.

7 SUMMARY

A summary of the management plan is presented in **Table 3**.

Table 3 *Summary of ASS Management Plan*

Activity	Impact	Control	Monitoring	Monitoring Timeframe	Contingency	Likelihood of Impact if detected and not treated
Excavation	Oxidation of ASS	Neutralisation	Soil and leachate	During Construction	Cease excavation, Increase lime dose	Moderate
Groundwater in excavations	Discharge of acid water	Neutralisation	pH	During Construction	Cease excavation, Increase lime dose	Moderate
Surface Water	Discharge of acid water	Neutralisation	pH	During Construction	Increase lime dose	Moderate
Imported fill material	Oxidation of ASS	Testing prior to delivery	Off site monitoring	During Construction	Source new material	Probably Low [1]

1. Will need to be assessed once the contractor nominates imported material sources.

A summary of the monitoring requirements is given in **Table 4**.

Table 4 *Summary of Monitoring Requirements*

Activity	Type of Monitoring	Testing Required	No of tests	Frequency
Excavations	Soil Pre-excavation	pH, %Scr, TPA ***NB already completed as per Ref [4]***	Volume dependent. As per (Ref [2])	Prior to excavation
	Soil Post treatment	pH, %Scr, TPA	One per 50m^3 (min 2 samples)	After mixing and aeration
	Leachate entering catchpond	pH	Two per sampling interval	Prior to discharge
Surface Water	Drainage water from treated soil reuse areas and from drains and sediment ponds	pH, sulfate and chloride ions, total dissolved solids, ferric iron, aluminium	1 per 50 Lm or 50m^2 of open excavation	Prior to discharge
Groundwater in excavations	Excavation water chemistry	pH, sulfate and chloride ions, total dissolved solids, ferric iron, aluminium	1 per 50 Lm of excavation or 50m^2 of open excavation	At time of excavation
Imported Materials	Imported soil from below 5m AHD	Off site pH, %Scr, TAA, TPA	One per 50m^3 (min 2 samples)	At material source

8 LIMITATIONS

This report has been prepared for Hunter New England Local Health District in accordance with the agreement with RCA. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of Hunter New England Local Health District for the specific purpose and the specific development described in the report. The report may not contain sufficient information for purposes or developments other than that described in the report or for parties other than Hunter New England Local Health District. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without permission.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. The conclusions drawn in the report are based on interpolation between boreholes or test pits. Conditions can vary between test locations that cannot be explicitly defined or inferred by investigation.

Yours faithfully

RCA AUSTRALIA

Steve Cadman
Associate Environmental Geologist

Robert Carr
Principal Geotechnical Engineer

REFERENCES

[1] RCA Australia, *Acid Sulfate Soil Assessment, Proposed GP Super Clinic/ HealthOne Raymond Terrace, Corner of Jacaranda Avenue and Swan Street, Raymond Terrace,* RCA ref: 7869a-201/1, January 2012.

[2] NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC), *Acid Sulfate Soil Manual*, August 1998.

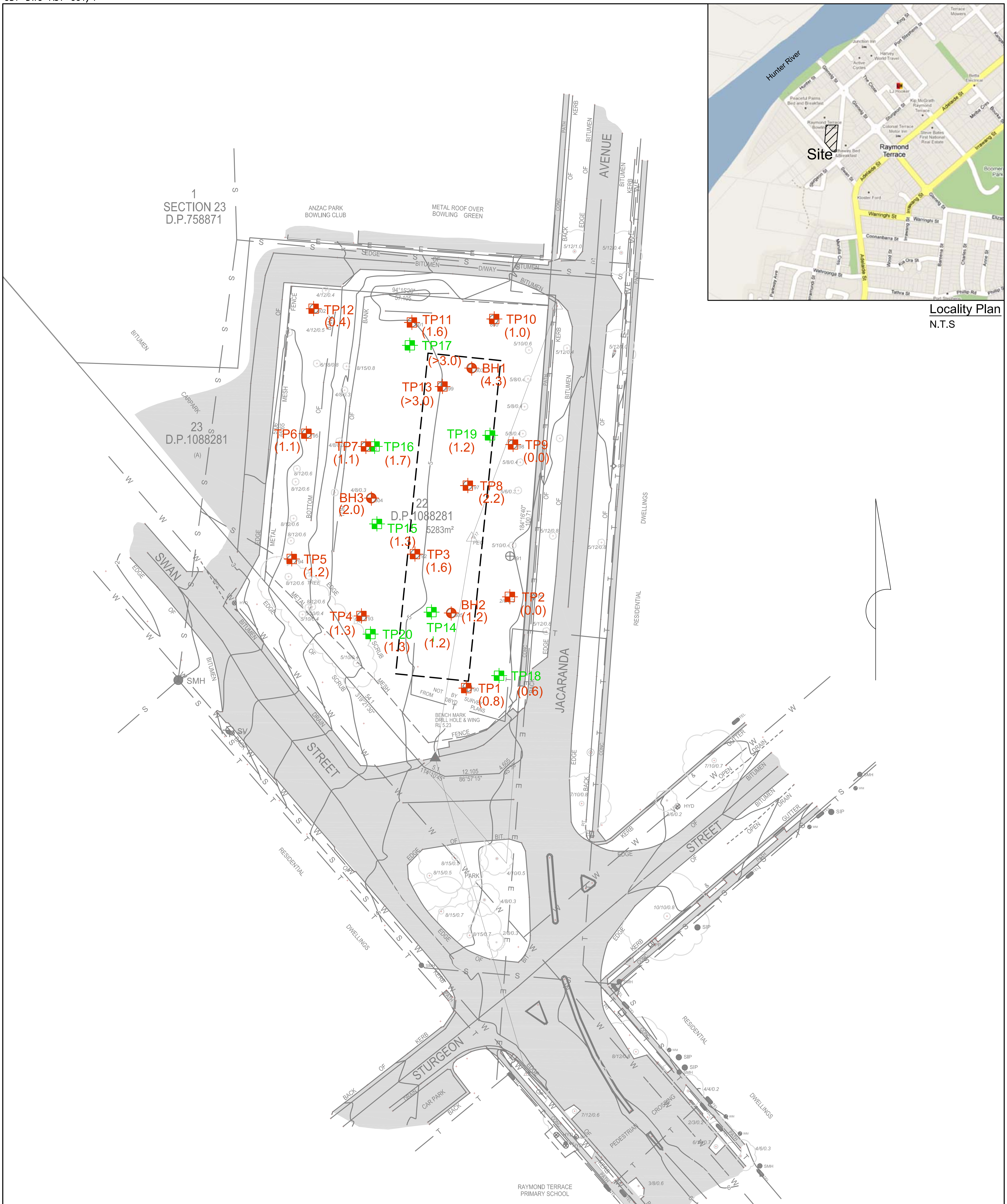
[3] Department of Land and Water Conservation, *Acid Sulfate Soils Risk Map, Beresfield 1:25,000,* Edition 2, December 1997.

[4] RCA Australia, *Geotechnical Investigation, Proposed HealthOne Facility, Corner of Jacaranda Avenue and Swan Street, Raymond Terrace, RCA* ref 7869-201/0, July 2010.

Appendix A

Drawing

CDT-DWG-A3V-001/1



Locality Plan
N.T.S

LEGEND

- Approximate test pit location, 23/6/2011
- Previous RCA test pit location (RCA Ref 7869-201/0)
- Previous RCA borehole location (RCA Ref 7869-201/0)
- (1.2) Depth of fill (m) encountered in test pit/borehole
- Approximate location of former pools

0 10 20 30 40 50
metres

NOTES: Drawing adapted from plan supplied by de Witt Consulting Dwg.No 2000-2-DET, Dated 24/6/2010

The locations of test pits TP1 to TP13 and boreholes BH1 to BH3 were surveyed by de Witt Consulting.

The locations of test pits TP14 to TP20 are approximate and were measured from existing site features, including the above mentioned test pit and borehole locations.

The location of the former pools should be regarded as indicative only and has been inferred from historical aerial photographs

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

TEST PIT AND BOREHOLE LOCATION PLAN
CORNER JACARANDA AVENUE AND
SWAN STREET
RAYMOND TERRACE

CLIENT	Hunter New England Local Health District			PROJECT No	7869a-202/1
DRAWN BY	CJM	SCALE	1 : 800 (A3)	DRAWING No	1 REV 0
APPROVED BY	RJC	DATE	20/1/2012	OFFICE	NEWCASTLE