Douglas Partners
Geotechnics • Environment • Groundwater

Integrated Practical Solutions

ACID SULPHATE SOIL MANAGEMENT PLAN

PROPOSED TRINITY POINT MARINA AND TOURIST DEVELOPMENT
49 LAKEVIEW ROAD, MORISSET PARK

Prepared for
JOHNSON PROPERTY GROUP PTY LTD

Project 39823A
DECEMBER 2007

Douglas Partners
Geotechnics • Environment • Groundwater

ACID SULPHATE SOIL MANAGEMENT PLAN

PROPOSED TRINITY POINT MARINA AND TOURIST DEVELOPMENT
49 LAKEVIEW ROAD, MORISSET PARK

Prepared for

JOHNSON PROPERTY GROUP PTY LTD

Project 39823A

DECEMBER 2007

Douglas Partners Pty Ltd
ABN 75 053 980 117

Box 324
Hunter Region Mail Centre
NSW 2310 Australia

15 Callistemon Close
Warabrook, NEWCASTLE

Phone: 02 4960 9600
Fax: 02 4960 9601
newcastle@douglaspartners.com.au

TABLE OF CONTENTS

ATTACHMENTS

JAW:kd

Project No: 39823A

P:\39823A\Docs\39823A - ASSMP.doc

4 December 2007

ACID SULPHATE SOIL MANAGEMENT PLAN
PROPOSED TRINITY POINT MARINA AND TOURIST DEVELOPMENT
49 LAKEVIEW ROAD, MORISSET PARK

1. INTRODUCTION

This Acid Sulphate Soil Management Plan (ASSMP) has been prepared for the proposed Trinity Point Marina and Tourist Development. The work was undertaken for Johnson Property Group Pty Ltd.

The ASSMP was prepared to provide the following information:

- acid sulphate soil management strategies;
- monitoring program for soil and water quality; and
- contingency procedure.

The results of the acid sulphate soil assessment undertaken at the site (Ref 1) have been used in formulating this Acid Sulphate Soil Management Plan (ASSMP). Reference has also been made to the NSW Acid Sulphate Soil Management Advisory Committee (ASSMAC), August 1998 (Ref 2) and the Queensland Acid Sulphate Soil Technical Manual, Soil Management Guidelines (QASSIT), November 2002 (Ref 3), and recent experience with similar works in acid sulphate soils.

A plan showing the location of the site is shown on Drawing 1, attached.

2. PROPOSED DEVELOPMENT

2.1 General

The Trinity Point Marina and Tourist Resort comprises a number of features, including the Marina, Marina Village and clusters of multi-storey accommodation buildings (Blocks A to G).

The Marina and Marina Village development will include an approximately 300 berth marina, along with an associated breakwater, boat maintenance facilities (travel lift, hardstand and workshop), and other related commercial infrastructure such as café, restaurant and function facilities.

Immediately south of the Marina Village will be a cluster of multi storey buildings, up to six stories in height for short to medium term tourist accommodation. These areas are shown as Blocks A, B, C and D on the attached Drawing 2. These buildings will include under-croft car parking beneath.

Another three clusters of multi-storey accommodation buildings are located further to the south (shown as Blocks E, F and G on attached Drawing 2). These three clusters comprise apartment style accommodation, in two to five storey buildings, associated car parking (underground parking), access roadways, footpaths, boardwalks, jetties and landscaping.

2.2 Proposed Marina Village Centre and Floating Marina Berths

The proposed marina and village centre will include a 308 berth marina consisting of up to four arms of floating pontoons, a floating helipad pontoon, marina administration offices, a breakwater, a travel lift with associated hardstand area for boat repairs and maintenance, and a workshop. It is understood that the marina has been configured to avoid dredging.

The marina will comprise a system of floating walkways, and associated berths. The floating walkways would be located between vertical piles driven into the lake bed. It is understood that the preferred pile type is driven tubular steel piles.

The marina will incorporate a breakwater around the southern and eastern boundaries. The proposed breakwater will consist of two rows of parallel tubular steel piles driven in to the lake bed, with timber slats supported on outer side of each row of piles. The breakwater will also have a timber walkway, allowing access around the perimeter of the marina, and for access to the helipad.

The helipad will be an approximately 25 m by 25 m floating steel pontoon anchored to the lake bed, with an access gangway directly from the breakwater walkway. The current preference is that the anchors would be steel piles driven into the lake bed similar to piles for the breakwater and pontoons; however the piles would be cut off at the lake bed level.

In addition to the marina, there will be an associated on-shore village centre incorporating a café, restaurant, function centres, chandlery, general store and commercial offices.

2.3 Proposed Tourist/Accommodation Development

The southern portion of the site will incorporate apartment style accommodation (serviced tourist and permanent residential) with two to five storey buildings arranged in a series of three building clusters (Blocks E, F and G).

2.4 Pavements

Proposed pavement areas for the site include access roads and parking areas. It is understood that the majority of parking for Blocks A to D will be offered via under-croft parking beneath the proposed multi-storey buildings. It is understood that the under-croft parking in this area of the site will be at about RL 1.2 (AHD).

Blocks E to G will include basement car parking with preliminary basement floor levels ranging from 0.35 m to 4.85 m AHD.

2.5 Cut/Fill

Preliminary levels for under-croft car parking and basement car parking floor levels suggest approximate cut and fill depths could be in the order of the following:

Building Cluster	Approximate Ground Surface Level (AHD)	Preliminary Under-croft/Basement Floor Level (AHD)	Preliminary Approx Fill Depth (m)	Preliminary Approx Excavation Depth (m)
A	0.8	1.2	0.4	-
B	0.9	1.2	0.3	-
C	0.9	1.2	0.3	-
D	0.9 – 1.9	1.2	0.3	0.7
E	1.6 – 3.4	0.35	-	1.25 – 3.05
F	2.6 – 6.8	1.65 to 3.53	-	0.95 – 3.29
G	4.0 – 8.5	4.85	0.85	3.65

It is anticipated that excavations could also be required for installation of utilities, and also for swimming pool construction, although the final locations of these features are unknown at this time.

3. SUMMARY OF ACID SULPHATE SOIL CONDITIONS

An acid sulphate soil assessment for the site has been undertaken by Douglas Partners Pty Ltd (DP) (Ref 1). The results of detailed laboratory testing indicate the presence of actual and potential acid sulphate soils at the site, and therefore the proposed development will need to consider the presence of acid sulphate soils, particularly in the low-lying portions of the on-land marina development.

All excavations within the portion of the site that includes the Marina, Marina Village and Blocks A, B, C and D should be considered as having the potential to disturb acid sulphate soils, and should be undertaken with specific reference to this Acid Sulphate Soil Management Plan.

It is understood that dredging is not proposed in the marina area, and that driven piles will be utilised. Therefore, the current project proposal does not indicate that lake bed sediments will be exposed to oxidising conditions during construction.

Dewatering of excavations, if required, also have the potential to oxidise acid sulphate soils, and will also need to be undertaken with reference to this Acid Sulphate Management Plan.

Some excavations within other areas of the site could also encounter acid sulphate soils, eg. the excavation to RL 0.15 for the basement of the Block E building. The risk is likely to diminish as surface elevations increase to the south. Additional targeted acid sulphate soil investigations has been recommended to be undertaken during the design stage of the project to further delineate the presence of acid sulphate soils (Ref 1). The additional work will assist in assessing which portions of the site around Blocks E, F and G will require consideration of acid sulphate soils, and hence an acid sulphate soil management plan for proposed excavations.

The acid sulphate soil assessment (Ref 1) found subsurface conditions beneath the water table generally comprised sands with varying proportions of gravel and clay.

Details of the acid sulphate soil assessment undertaken, along with copies of borehole logs are found in Reference 1. A copy of the test location plan from Reference 1 is attached.

4. POTENTIAL FOR OXIDISING ACID SULPHATE SOILS

The following activities may expose acid sulphate soils to oxidising conditions during construction:

- installation of underground services;
- construction of shallow foundations;

- bored pile installation;
- construction of swimming pools;
- dewatering of excavations, if required during the construction works.
- general excavation;

It is understood that excavation or dredging of the lake bed sediments are not proposed, and hence these soils have not been considered further.

5. MANAGEMENT STRATEGY

5.1 Soil Treatment

Neutralisation of PASS should be undertaken in accordance with the ASSMAC and QASSIT guidelines, as discussed below.

The excavated material should be contained within a suitable bunded area with an impermeable base and appropriately neutralised prior to backfilling.

The location of the bunded area should be selected in order to minimise the potential for impact on nearby sensitive receptors, such as the adjacent Lake Macquarie. Any leachate produced in the bunded area should be contained for monitoring and treatment as discussed below.

Suitable neutralising agents for acid sulphate or potential acid sulphate soils include agricultural lime ($CaCO_3$), calcined magnesia (MgO or $Mg(OH)_2$), and dolomite ($MgCO_3.CaCO_3$).

An assessment of the dosing rate for lime treatment can be calculated from the results of detailed laboratory testing, using the following equation, which includes a factor of safety.

Alkali Material Required (kg)

$$\textit{per unit volume of soil } (m^3) = \left(\frac{\%\,S \times 623.7}{19.98} \right) \times \frac{100}{ENV(\%)} \times D \times FOS$$

Where: *%S = net acidity (% S units);*

623.7 = % S to mol H^+/t;

19.98 = mol H^+/t to kg $CaCO_3$/t;

D = Bulk density of soil (t/m^3);

FOS = safety factor (usually 1.5);

ENV = Effective Neutralising Value (eg. 80% for Grade 1 Agricultural lime).

Note: *The ENV is calculated based on the molecular weight, particle size and purity of the neutralising agent and should be assessed for proposed materials in accordance with QASSIT (Ref 5).*

It is recommended that Grade 1 agricultural lime is used for the neutralisation of potential acid sulphate soils excavated during the construction.

The following liming/monitoring procedures for the treatment of PASS are recommended:

- all excavated soil should be contained within a suitably bunded area and kept moist to minimise oxidation, prior to treatment with lime. Progressive neutralisation will minimise the area required for bunding;
- the base of the excavation should be treated with approximately 1 kg/m^2 of agricultural lime;
- stockpiled soil should be limed at an average rate of about 55 kg/m^3 of soil (30 kg lime/tonne of soil) for neutralisation as soon as practicable following excavation. Lime treatment rates based on the detailed laboratory testing undertaken in Reference 1 ranged from 10 kg/m^3 of soil to 75 kg/m^3 of soil for Grade 1 agricultural lime. The average value should be used initially and refined based on monitoring results as construction proceeds;
- the neutralising agent and acid sulphate soils should be thoroughly mixed and aerated using, for example, an agricultural lime spreader and excavator. The soil should be treated in layers up to 300 mm thick to encourage aeration (ie. incorporate treatment with progressive reuse of soil or disposal at a suitably licensed landfill);

- it should be noted that the actual lime rate required will also depend on the results of monitoring during neutralisation. Additional lime will be required if monitoring results indicate that appropriate neutralisation has not been achieved. Conversely the liming rate may decrease if monitoring suggests over liming is occurring;
- sampling and testing should be undertaken in accordance with Section 6.1 to verify the neutralisation treatment. The acceptance criteria are discussed in Section 6.2. Depending on the results of testing, reapplication of lime may be necessary to gain adequate neutralisation;
- upon verification of treatment, the neutralised acid sulphate soils should be either progressively reused on site or disposed of at a licensed landfill following confirmation of the waste classification by an appropriately qualified consultant.

5.2 Neutralising Leachate

Leachate water collected from the bunded area (in a multi stage sedimentation tank, if required) should be neutralised as necessary before release. Calcined magnesia (magnesium hydroxide, burnt magnesite, or magnesia) is the recommended neutralising agent as it produces a two-step reaction, which proceeds rapidly at acidic pH and slows down as higher pH is approached, and hence reduces the potential for over neutralisation to occur.

The amount of neutraliser required to be added to the leachate can be calculated from the equation below:

$$\textit{Alkali Material Required (kg)} = \frac{M_{Alkali} \times 10^{-pH\ initial}}{2 \times 10^{3}} \times V$$

Where: *pH initial = initial pH of leachate*

V = volume of leachate (litres)

M_{Alkali} = molecular weight of alkali material (g/mole)

Note: *molecular weight of calcined magnesia (M_{MgO}) = 40 g/mole.*

The alkali should be added to the leachate as a slurry. Mixing of the slurry is best achieved using an agitator.

Notwithstanding regulatory authority requirements, the leachate should meet the water quality criteria presented in Section 6.2 prior to discharge.

5.3 Dewatering

Based on previous experience, the following procedure is recommended in order to minimise potential adverse impacts resulting from excavation and dewatering of acid sulphate soils during construction:

- minimise the dewatering depth required for installation (ie. as close as practicable to the invert level of the excavation);
- minimise the time and volume of exposed acid sulphate soils (ie. stage excavation and dewatering);
- collection of extracted groundwater in a multi stage sedimentation tank and neutralise as necessary prior to release;
- the extracted groundwater could then be discharged to a bunded area away from the dewatering site (ie. evaporation/infiltration), or discharged to stormwater/sewer, subject to regulatory requirements;
- the pH of the extracted water should be monitored prior to discharge. Neutralisation should be undertaken, as discussed in Section 5.2, if discharge water pH falls below natural groundwater levels (evaporation/infiltration) or regulatory requirements (stormwater disposal);
- dose the base of the excavation at a rate of approximately 1 kg/m^2 of Agricultural lime in order to counteract the generation of acidic leachate following groundwater recovery;
- treat acid sulphate soils excavated during construction as discussed in Section 5.1;
- undertake monitoring as recommended in Section 6 below.

6. MONITORING STRATEGIES

6.1 Procedures

Monitoring programs for the various construction and treatment methods discussed are outlined below.

6.1.1 Soil Neutralisation/Management

It is recommended that the following inspections and monitoring be undertaken when excavating acid sulphate soil materials, based on guidelines presented in the ASSMAC and QASSIT manuals:

- daily inspection of liming operations during excavation;
- sampling and testing after lime treatment (ie. measurements of soil pH in distilled water and pH in peroxide) should be undertaken at a frequency of at least one sample per 50 m^3 excavated soil, or daily, to verify the neutralisation treatment and confirm oxidation of acid sulphate soils is not occurring.

6.1.2 Leachate Management

Leachate collected within the bunded area should be temporarily stored (in a multi stage sedimentation tank, if required) and neutralised as necessary. The pH of the leachate should be monitored daily, and prior to discharge. The leachate could be discharged overland (ie. evaporation/infiltration), or discharged to stormwater/sewer, subject to regulatory requirements and licences.

Neutralisation should be undertaken if discharge water pH falls below natural background groundwater levels (evaporation/infiltration) or regulatory requirements (stormwater or sewer discharge).

A contingency procedure should be in place to allow lime dosing and monitoring to confirm neutralisation prior to discharge.

6.1.3 Dewatering

Extracted groundwater should be temporarily stored in a multi stage sedimentation tank, and neutralised as necessary. The pH of extracted water associated with areas of acid sulphate soils should be monitored twice daily (am, pm) prior to discharge. The groundwater could be discharged overland (ie. evaporation/infiltration), or discharged to stormwater/sewer subject to regulatory requirements and licences.

Neutralisation should be undertaken if discharge water pH falls below natural background groundwater levels (evaporation/infiltration) or regulatory requirements (stormwater or sewer discharge). Natural groundwater pH should be confirmed at the commencement of dewatering.

A contingency procedure should be in place to allow lime dosing and monitoring to confirm neutralisation prior to discharge. Similarly nearby creeks/drains should be periodically monitored for pH prior to and during construction.

6.1.4 Reporting

A record of treatment of acid sulphate soil and leachate should be maintained by the contractor and should include the following details:

- date;
- location;
- time of excavation and reuse or disposal (ie. time stockpile has been exposed);
- neutralisation process undertaken;
- lime rate utilised;
- results of monitoring of soil, leachate, and groundwater.

A record of dewatering activities should also include the following:

- groundwater pH at commencement of dewatering;
- daily pH monitoring of discharge water and surface waters in the vicinity of discharge (ie. upstream and downstream).

A record should also be maintained confirming contingency measures and additional treatment if undertaken.

A final report should be issued upon completion of the works presenting the monitoring regime and results, and confirming that no adverse environmental impact has occurred during the works.

6.2 Acceptance Criteria

Water

Notwithstanding regulatory requirements, it is recommended that the ANZECC Guidelines for Fresh and Marine Water Quality, 2000 (Ref 4) be met before discharging any leachate to the environment.

Table 4 – ANZECC – Water Discharge Criteria

Indicator	Marine Water Trigger Values
pH[1]	8.0 – 8.4
Turbidity[1]	0.5 - 10 NTU
Al (Total)[2]	55μg/L for pH>6.5
	NA for pH<6.5

Notes to Table 4:

Guidelines from ANZECC Guidelines for Fresh and Marine Water Quality (Ref 4)
NA – Not Applicable
NTU – Nephelometric Turbidity Units
1 – Trigger values for physical and chemical stressors for south-east Australia for slightly disturbed Ecosystems (Tables 3.3.2 and 3.3.3 in Ref 4)
2 – Trigger value for slightly to moderately disturbed system

Soil

Further treatment may be required if monitoring of the material reveals any of the following properties:

- pH of soil in water is less than background groundwater values (ie. between about pH 4 to 8 – Ref 1);
- pH in water minus pH in hydrogen peroxide is greater than 1 and pH in water is less than background values.

Depending on the results of testing, reapplication of lime may be necessary to gain adequate neutralisation. Care should be taken to ensure over liming does not occur.

7. CONTINGENCY PLAN

Remedial action will be required if the agreed standards or acceptance criteria are not being achieved. Remedial action shall comprise mixing of additional lime through the excavated material and neutralisation of leachate. The required mixing rate to remediate the soil or leachate should be confirmed by monitoring tests.

If overland discharge of groundwater is proposed, a contingency plan should be in place to allow neutralisation and confirmation monitoring prior to injection if pH levels are low or fall below natural background levels.

During periods of heavy or prolonged rainfall, stockpiling of acid sulphate soils should be appropriately contained/bunded to collect leachate for testing and neutralisation (if required) prior to disposal (see Section 5). Alternatively backfilling of acid sulphate soils could be undertaken to prevent the migration of leachate.

Sufficient lime should be stored on site during construction for the neutralisation of acid sulphate soils and contingency measures.

8. LIMITATIONS

Conditions on site different to those identified during this assessment may exist. Therefore DP cannot provide unqualified warranties nor does DP assume any liability for site conditions not recorded in the data available for this assessment.

This report and associated documentation and the information herein have been prepared solely for the use of Johnson Property Group Pty Ltd. Any reliance on this report assumed by other parties shall be at such party's own risk. Any ensuing liability resulting from use of the report by other parties cannot be transferred to DP.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

Julie Wharton
Associate

John Harvey
Principal

REFERENCES

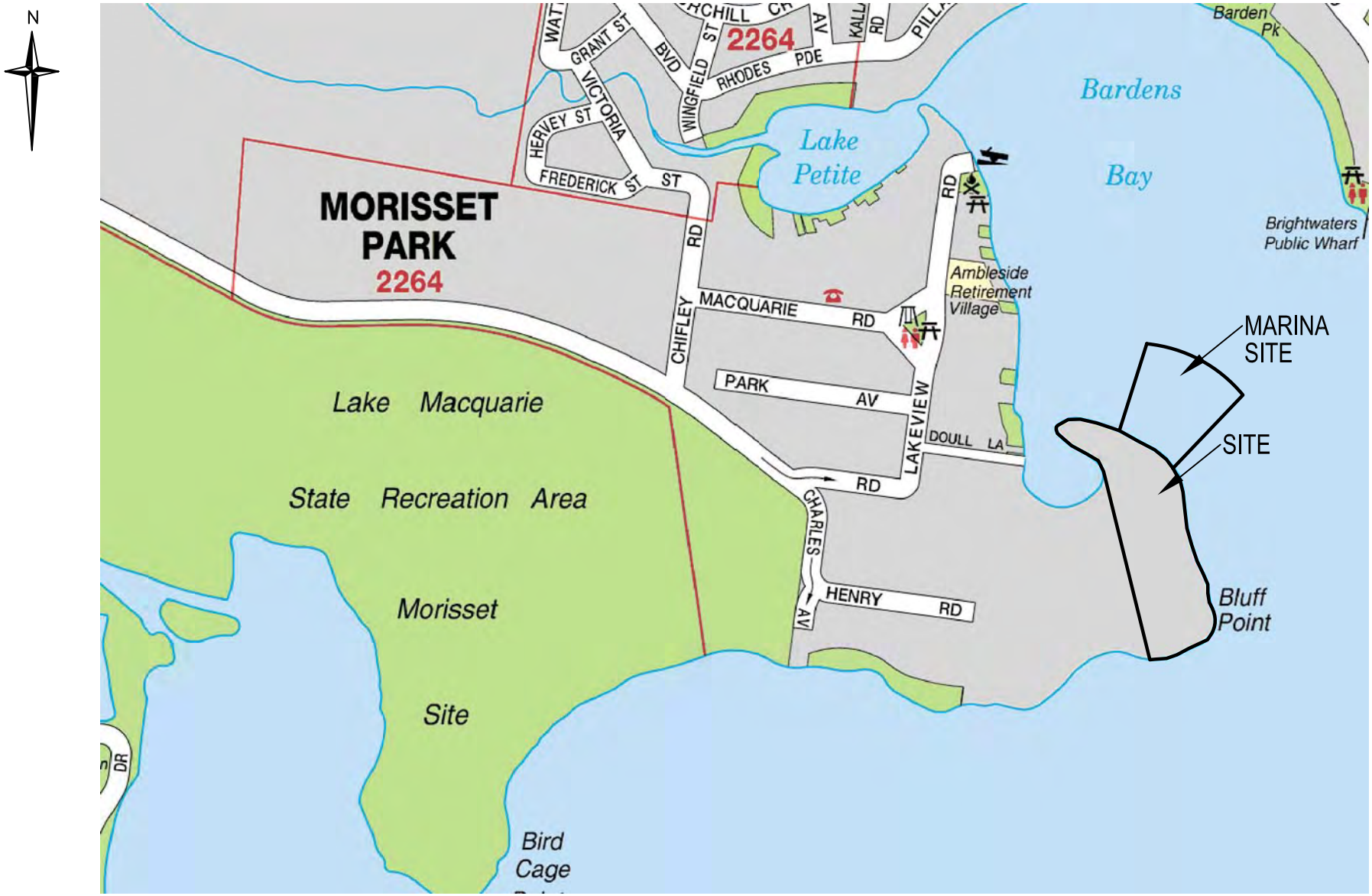
1. Douglas Partners Pty Ltd “Report on Acid Sulphate Soil Assessment, Proposed Trinity Point Marina and Tourist Development, 49 Lakeview Road, Morisset Park”, Project 39823A, December 2007.

2. ASSMAC “ASSMAC Acid Sulphate Soil Manual”, New South Wales Acid Sulphate Soil Management Advisory Committee, August 1998.

3. Dear SE, Moore NG, Dobos SK, Watling KM and Ahern CR “Soil Management Guidelines” in “Queensland Acid Sulphate Soil Technical Manual”, Department of Natural Resources and Mines, November 2002.

4. ANZECC (2000): Australian Water Quality Guidelines for Fresh and Marine Waters, November 2000.

5. Ahern CR, Sullivan LA and McElnea AE “Acid Sulphate Soils Laboratory Methods Guidelines” in “Queensland Acid Sulphate Soil Technical Manual”, Department of Natural Resources and Mines, June 2004.



Douglas Partners Geotechnics Environment Groundwater	Sydney, Newcastle, Brisbane, Melbourne, Perth, Wyong, Campbelltown, Townsville, Cairns, Wollongong, Darwin	TITLE: LOCALITY PLAN PROPOSED TRINITY POINT MARINA & TOURIST RESORT 49 LAKEVIEW ROAD, MORISSET PARK	CLIENT: JOHNSON PROPERTY GROUP PTY LTD	
			DRAWN BY: PLH / SCALE: NTS / PROJECT No: 39823A	OFFICE: NEWCASTLE
			APPROVED BY: / DATE:	DRAWING No: 1