14 Attachment E – Chain of Custody

martens
consulting engineers since 1989

SOIL ANALYSIS CHAIN OF CUSTODY FORM

Additional Testing									
Name	Engineering Services: Settlement City, Port Macquarie								
Martens Contact Officer	Gray Taylor			**Contact Email**	gtaylor@martens.com.au				
Sampling and Shipping	**Sample Date**	04.05.09 and 05.05.09	**Dispatch Date**	07.05.09	**Turnaround Time**	Normal			
	Our Reference	P0902316JC02_v1 COC		**Shipping Method (X)**	**Hand**		**Post**		**Courier** X
	On Ice (X)	X	**No Ice (X)**		**Other (X)**				
Laboratory									
Name	EnviroLab								
Sample Delivery Address	12 Ashley Street, Chatswood								
Delivery Contact	**Name**	Aileen	**Phone**	9910 6200	**Fax**		**Email**		
Please Send Report By (X)	**Post**		**Fax**		**Email**	X	**Reporting Email Address**	gtaylor@martens.com.au	

	Sample ID	Composite	8HM	OCP	OPP	PCB	Combination 6	EC	SPOCAS					
1	2316/11/0.4						X							
2	2316/9/0.25						X							
3	2316/19/0.2						X							
4	2316/23/0.2						X							
5	2316/29/0.3						X							
6	2316/22/3.0						X							
7	2316/13/2.8						X	X						
8	2316/13/4.2						X	X						
9	2316/16/3.0						X							
10	2316/24/2.8						X							
11	2316/4/0.5	-14 Y	X	X	X									
12	2316/12/0.4		X	X	X									
13	2316/13/0.5		X	X	X									

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 28732
Date received: 7/5/9
Time received: 3
Received by: SS
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Head Office
Unit 6 / 37 Leighton Place
Hornsby NSW 2077, Australia
Ph 02 9476 9999 **Fax** 02 9476 8767

> mail@martens.com.au
> www.martens.com.au
MARTENS & ASSOCIATES P/L
ABN 85 070 240 890 ACN 070 240 890

SOIL ANALYSIS CHAIN OF CUSTODY

	Sample ID	Composite	8HM	OCP	OPP	PCB	Combination 6	EC	SPOCAS					
14	2316/9/2.7	75	X	X	X									
15	2316/18/3.0	Y	X	X	X									
16	2316/16/02	76	X	X	X									
17	2316/21/0.2	Y	X	X	X									
18	2316/25/0.2		X	X	X									
19	2316/17/0.2	77	X	X	X									
20	2316/18/0.2	Y	X	X	X									
21	2316/10/0.2		X	X	X									
22	2316/19/0.5	78	X	X	X									
23	2316/20/0.5	Y	X	X	X									
24	2316/26/0.5		X	X	X									
25	2316/15/0.5	79	X	X	X									
26	2316/22/0.5	Y	X	X	X									
27	2316/23/0.5		X	X	X									
28	2316/11/0.2	80	X	X	X									
29	2316/12/0.2	Y	X	X	X									
30	2316/15/0.25		X	X	X									
31	2316/1/2.5								X					
32	2316/1/3.3							X	X					
33	2316/1/4.5							X						
34	2316/1/7.5							X						
35	2316/1/9.0							X	X					
36	2316/5/2.0							X						
37	2316/5/2.5							X						
38	2316/5/4.0								X					
39	2316/5/4.5							X						
40	2316/5/5.5							X						
41	2316/5/6.0							X						
42	2316/8/2.0							X						

SOIL ANALYSIS CHAIN OF CUSTODY

	Sample ID	Composite	8HM	OCP	OPP	PCB	Combination 6	EC	SPOCAS				
43	2316/8/4.0							x	x				
44	2316/8/6.0							x					
45	2316/8/7.5							x	x				
46	2316/13/4.2 [illegible]							x					
47	2316/14/0.5							x					
48	2316/14/1.5							x					
49	2316/14/3.0								x				
50	2316/14/9.0							x					
51	2316/16/0.5							x					
52	2316/16/1.0								x				
53	2316/16/5.0							x					
54	2316/16/6.0								x				
55	2316/18/2.0							x					
56	2316/18/4.5								x				
57	2316/24/0.5								x				
58	2316/24/1.4							x	x				
59	2316/24/4.5							x					
60	2316/25/1.0							x					
61	2316/27/1.0							x					
62	2316/27/4.0							x					
63	2316/27/5.5								x				
64	2316/28/1.0							x					
65	2316/28/2.9								x				
66	2316/28/5.0								x				
67	2316/28/6.0							x					
68	2316/28/7.5							x					
69	2316/z3		x										
70	2316/z10		x										
71	2316/z11		x										
72	2316/z12		x										

73 2316/28/45

SOIL ANALYSIS CHAIN OF CUSTODY

Notes	Combination 6 = TPH, BTEX, PAH, OC, OP, PCB, and 8 Heavy Metals

martens
consulting engineers since 1989

SOIL ANALYSIS CHAIN OF CUSTODY FORM

Additional Testing									
Name	Engineering Services: Settlement City, Port Macquarie								
Martens Contact Officer	Megan Bowling / Gray Taylor			Contact Email	mbowling@martens.com.au				
Sampling and Shipping	Sample Date	04.05.09 and 05.05.09	Dispatch Date	28.05.09	Turnaround Time	Normal			
	Our Reference	P0902316JC06_v1 COC		Shipping Method (X)	Hand		Post		Courier X
	On Ice (X)	X	No Ice (X)		Other (X)				

Laboratory								
Name	EnviroLab							
Sample Delivery Address	12 Ashley Street, Chatswood							
Delivery Contact	Name	Aileen	Phone	9910 6200	Fax		Email	
Please Send Report By (X)	Post		Fax		Email	X	Reporting Email Address	mbowling@martens.com.au

	Sample ID	Composite	8HM	OCP	OPP	PCB	Combination 6	EC	SPOCAS					
1	2316/2/1.0								X					
2	2316/6/1.4								X					
3	2316/9/1.0								X					
4	2316/14/1.5								X					
5	2316/16/1.5								X					
6	2316/18/1.0								X					
7	2316/18/1.5								X					
8	2316/27/1.0								X					
9	2316/29/1.0								X					
10	2316/29/1.4								X					

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 28273
Date received: 28/5/9
Time received: 11
Received by: SS
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Notes	

Head Office
Unit 6 / 37 Leighton Place
Hornsby NSW 2077, Australia
Ph 02 9476 9999 **Fax** 02 9476 8767

> mail@martens.com.au
> www.martens.com.au
MARTENS & ASSOCIATES P/L
ABN 85 070 240 890 ACN 070 240 890

15 Attachment F – DECC Correspondence, ASS

Our reference :
Contact : Glenn Atkinson 65614969

Ms M Bowling
Martens and Associates
6/37 Leighton Place
Hornsby NSW 2077

Dear Megan,

Re DECC Consultation, ASS Investigation, Settlement City, Port Macquarie

Thank you for the opportunity to review your Preliminary Assessment of acid sulfate soils issues at this site dated 25th May 2009.

I note that you have drilled 12 deep boreholes on the site and 18 to a depth of about 1.4 m. Fifteen samples were laboratory tested for ASS but of these only 3 were from the overlying fill material above the watertable. These samples showed no acid sulfate soil material. Acid Sulfate soil was confirmed in all samples from below the watertable at about 2 m depth.

Untested bore logs showed a consistent layer of fill generally consisting of silty sands with some shell present in all samples to a depth of approximately 2 m. Three Laboratory pH and TAA results on this material suggests that it is not acidic and has some available buffering capacity. There is no field evidence of this fill causing acidification problems in the past.

You indicate that the proposed development will only have shallow excavations for concrete slabs and services. By that I assume you mean less than 1.0 m. Therefore it is necessary to establish that there is no ASS material above 1.5 m to confirm a Preliminary Assessment and determine that an ASS Management plan is not required.

Although existing data indicates that this is probably the case, there are only the 3 samples to support it. I would recommend that you conduct pH and TAA tests on 10 additional samples from depths of 1.0 and 1.5 confirm that acid sulphate soils are not present in this fill material. If these results are negative then it will not be necessary to proceed to a full ASS Management Plan.

I recommend that you test the following samples in this way: 2/1.0, 6/1.4, 9/1.0, 14/1.5, 16/1.5, 18/1.0, 18/1.5, 27/1.0, 29/1, and 29/14.

Yours sincerely

GLENN ATKINSON
Scientific Services Kempsey

PO Box 195 Kempsey NSW 2440
Ph 65614969
ABN 30 841 387 271
www.environment.nsw.gov.au

Department of **Environment & Climate Change** NSW

16 Attachment G – Notes About This Report

Information

Important Information About Your Report

martens consulting engineers

Subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Martens to help you interpret and understand the limitations of your report. Not all of course, are necessarily relevant to all reports, but are included as general reference.

Engineering Reports - Limitations

Geotechnical reports are based on information gained from limited sub-surface site testing and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Engineering Reports – Project Specific Criteria

Engineering reports are prepared by qualified personnel and are based on the information obtained, on current engineering standards of interpretation and analysis, and on the basis of your unique project specific requirements as understood by Martens. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the Client.

Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relative if the design proposal is changed (eg. to a twenty storey building). Your report should not be relied upon if there are changes to the project without first asking Martens to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Martens will not accept responsibility for problems that may occur due to design changes if they are not consulted.

Engineering Reports – Recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption often cannot be substantiated until project implementation has commenced and therefore your site investigation report recommendations should only be regarded as preliminary.

Only Martens, who prepared the report, are fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Martens cannot be held responsible for such misinterpretation.

Engineering Reports – Use For Tendering Purposes

Where information obtained from this investigation is provided for tendering purposes, Martens recommend that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. Attention is drawn to the document 'Guidelines for the Provision of Geotechnical Information in Tender Documents', published by the Institution of Engineers, Australia.

The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Engineering Reports – Data

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings *etc* are customarily included in a Martens report and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Engineering Reports – Other Projects

To avoid misuse of the information contained in your report it is recommended that you confer with Martens before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Subsurface Conditions - General

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects, relevant standards and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions - the potential for will depend partly on test point (eg. excavation or borehole) spacing and sampling frequency which are often limited by project imposed budgetary constraints.
- Changes in guidelines, standards and policy or interpretation of guidelines, standards and

policy by statutory authorities.

- The actions of contractors responding to commercial pressures.
- Actual conditions differing somewhat from those inferred to exist, because no professional, no matter how qualified, can reveal precisely what is hidden by earth, rock and time.

  The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions

If these conditions occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Subsurface Conditions - Changes

Natural processes and the activity of man create subsurface conditions. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Reports are based on conditions which existed at the time of the subsurface exploration.

Decisions should not be based on a report whose adequacy may have been affected by time. If an extended period of time has elapsed since the report was prepared, consult Martens to be advised how time may have impacted on the project.

Subsurface Conditions - Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those that were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved at the time when conditions are exposed, rather than at some later stage well after the event.

Report Use By Other Design Professionals

To avoid potentially costly misinterpretations when other design professionals develop their plans based on a report, retain Martens to work with other project professionals who are affected by the report. This may involve Martens explaining the report design implications and then reviewing plans and specifications produced to see how they have incorporated the report findings.

Subsurface Conditions - Geoenvironmental Issues

Your report generally does not relate to any findings, conclusions, or recommendations about the potential for hazardous or contaminated materials existing at the site unless specifically required to do so as part of the Company's proposal for works.

Specific sampling guidelines and specialist equipment, techniques and personnel are typically used to perform geoenvironmental or site contamination assessments. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Martens for information relating to such matters.

Responsibility

Geotechnical reporting relies on interpretation of factual information based on professional judgment and opinion and has an inherent level of uncertainty attached to it and is typically far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded.

To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Martens to other parties but are included to identify where Martens' responsibilities begin and end. Their use is intended to help all parties involved to recognize their individual responsibilities. Read all documents from Martens closely and do not hesitate to ask any questions you may have.

Site Inspections

Martens will always be pleased to provide engineering inspection services for aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site. Martens is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction.

Definitions

In engineering terms, soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material does not exhibit any visible rock properties and can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726 and the S.A.A Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

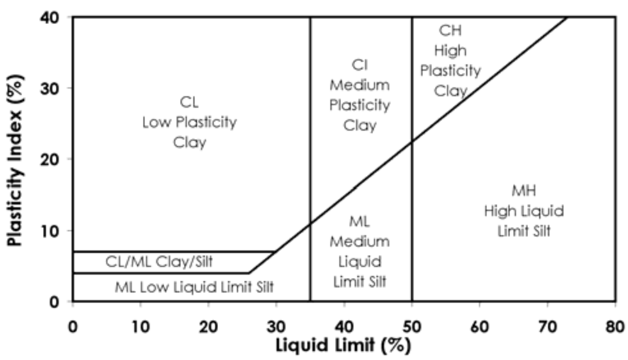
Particle Size

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay). Unless otherwise stated, particle size is described in accordance with the following table.

Division	Subdivision	Size
BOULDERS		>200 mm
COBBLES		60 to 200 mm
GRAVEL	Coarse	20 to 60 mm
	Medium	6 to 20 mm
	Fine	2 to 6 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties

Plasticity properties can be assessed either in the field by tactile properties, or by laboratory procedures.



Moisture Condition

Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and damp and is darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

Consistency of Cohesive Soils

Cohesive soils refer to predominantly clay materials.

Term	C_u (kPa)	Approx SPT "N"	Field Guide
Very Soft	<12	2	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	2 to 4	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	4 – 8	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	8 – 15	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	15 – 30	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	> 200	> 30	The surface of the soil can be marked only with the thumbnail.
Friable	-		Crumbles or powders when scraped by thumbnail

Density of Granular Soils

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration test (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	%	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c Mpa)
Very loose	< 15	< 5	< 2
Loose	15 – 35	5 - 10	2 -5
Medium dense	35 – 65	10 - 30	5 - 15
Dense	65- 85	30 - 50	15 - 25
Very dense	> 85	> 50	> 25

Minor Components

Minor components in soils may be present and readily detectable, but have little bearing on general geotechnical classification. Terms include:

Term	Assessment	Proportion of Minor component In:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: < 5 % Fine grained soils: < 15 %
With some	Presence easily detectable by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 – 12 % Fine grained soils: 15 – 30 %

Soil Agricultural Classification Scheme

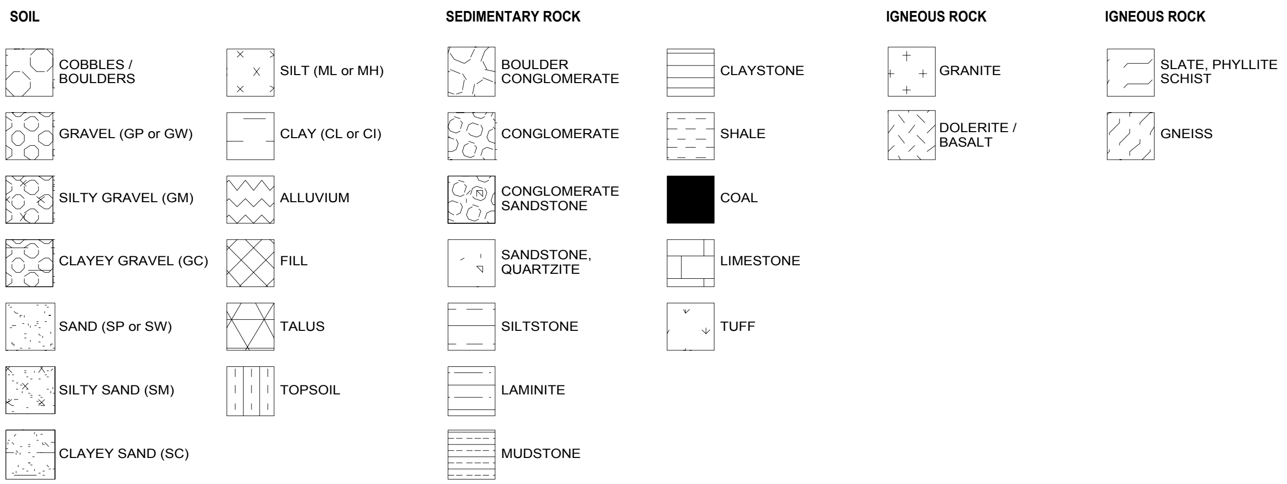
In some situations, such as where soils are to be used for effluent disposal purposes, soils are often more appropriately classified in terms of traditional agricultural classification schemes. Where a Martens report provides agricultural classifications, these are undertaken in accordance with descriptions by Northcote, K.H. (1979) *The factual key for the recognition of Australian Soils*, Rellim Technical Publications, NSW, p 26 - 28.

Symbol	Field Texture Grade	Behaviour of moist bolus	Ribbon length	Clay content (%)
S	Sand	Coherence nil to very slight; cannot be moulded; single grains adhere to fingers	0 mm	< 5
LS	Loamy sand	Slight coherence; discolours fingers with dark organic stain	6.35 mm	5
CLS	Clayey sand	Slight coherence; sticky when wet; many sand grains stick to fingers; discolours fingers with clay stain	6.35mm - 1.3cm	5 - 10
SL	Sandy loam	Bolus just coherent but very sandy to touch; dominant sand grains are of medium size and are readily visible	1.3 - 2.5	10 - 15
FSL	Fine sandy loam	Bolus coherent; fine sand can be felt and heard	1.3 - 2.5	10 - 20
SCL^{-}	Light sandy clay loam	Bolus strongly coherent but sandy to touch, sand grains dominantly medium size and easily visible	2.0	15 - 20
L	Loam	Bolus coherent and rather spongy; smooth feel when manipulated but no obvious sandiness or silkiness; may be somewhat greasy to the touch if much organic matter present	2.5	25
Lfsy	Loam, fine sandy	Bolus coherent and slightly spongy; fine sand can be felt and heard when manipulated	2.5	25
SiL	Silt loam	Coherent bolus, very smooth to silky when manipulated	2.5	25 + > 25 silt
SCL	Sandy clay loam	Strongly coherent bolus sandy to touch; medium size sand grains visible in a finer matrix	2.5 - 3.8	20 - 30
CL	Clay loam	Coherent plastic bolus; smooth to manipulate	3.8 - 5.0	30 - 35
SiCL	Silty clay loam	Coherent smooth bolus; plastic and silky to touch	3.8 - 5.0	30- 35 + > 25 silt
FSCL	Fine sandy clay loam	Coherent bolus; fine sand can be felt and heard	3.8 - 5.0	30 - 35
SC	Sandy clay	Plastic bolus; fine to medium sized sands can be seen, felt or heard in a clayey matrix	5.0 - 7.5	35 - 40
SiC	Silty clay	Plastic bolus; smooth and silky	5.0 - 7.5	35 - 40 + > 25 silt
LC	Light clay	Plastic bolus; smooth to touch; slight resistance to shearing	5.0 - 7.5	35 - 40
LMC	Light medium clay	Plastic bolus; smooth to touch, slightly greater resistance to shearing than LC	7.5	40 - 45
MC	Medium clay	Smooth plastic bolus, handles like plasticine and can be moulded into rods without fracture, some resistance to shearing	> 7.5	45 - 55
HC	Heavy clay	Smooth plastic bolus; handles like stiff plasticine; can be moulded into rods without fracture; firm resistance to shearing	> 7.5	> 50

Soil Data

Explanation of Terms (3 of 3)

Symbols for Soil and Rock



Unified Soil Classification Scheme (USCS)

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 63 mm and basing fractions on estimated mass)					USCS	Primary Name
COARSE GRAINED SOILS More than 50 % of material less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm.	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Gravel
				Predominantly one size or a range of sizes with more intermediate sizes missing	GP	Gravel
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	GM	Silty Gravel
				Plastic fines (for identification procedures see CL below)	GC	Clayey Gravel
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of intermediate sizes missing.	SW	Sand
				Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Sand
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	SM	Silty Sand
				Plastic fines (for identification procedures see CL below)	SC	Clayey Sand

IDENTIFICATION PROCEDURES ON FRACTIONS < 0.2 MM							
		DRY STRENGTH (Crushing Characteristics)	DILATANCY	TOUGHNESS	DESCRIPTION	USCS	Primary Name
FINE GRAINED SOILS More than 50 % of material less than 63 mm is smaller than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	None to Low	Quick to Slow	None	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	ML	Silt
		Medium to High	None	Medium	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays	CL	Clay
		Low to Medium	Slow to Very Slow	Low	Organic slits and organic silty clays of low plasticity	OL	Organic Silt
		Low to Medium	Slow to Very Slow	Low to Medium	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	MH	Silt
		High	None	High	Inorganic clays of high plasticity, fat clays	CH	Clay
		Medium to High	None	Low to Medium	Organic clays of medium to high plasticity	OH	Organic Silt
HIGHLY ORGANIC SOILS		Readily identified by colour, odour, spongy feel and frequently by fibrous texture				Pt	Peat

Low Plasticity – Liquid Limit W_L < 35 % Medium Plasticity – Liquid limit W_L 35 to 60 % High Plasticity - Liquid limit W_L > 60 %

Rock Data

martens consulting engineers

Definitions

Descriptive terms used for Rock by Martens are given below and include rock substance, rock defects and rock mass.

Rock Substance — In geotechnical engineering terms, rock substance is any naturally occurring aggregate of minerals and organic matter which cannot, unless extremely weathered, be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Rock substance is effectively homogeneous and may be isotropic or anisotropic.

Rock Defect — Discontinuity or break in the continuity of a substance or substances.

Rock Mass — Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

Degree of Weathering

Rock weathering is defined as the degree in rock structure and grain property decline and can be readily determined in the field.

Term	Symbol	Definition
Residual Soil	Rs	Soil derived from the weathering of rock. The mass structure and substance fabric are no longer evident. There is a large change in volume but the soil has not been significantly transported.
Extremely weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - ie. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decrease compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original rock substance is no longer recognisable.
Moderately weathered	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh	Fr	Rock substance unaffected by weathering

Rock Strength

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance is the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics.

Term	Is (50) MPa	Field Guide	Symbol
Extremely weak	< 0.03	Easily remoulded by hand to a material with soil properties.	EW
Very weak	0.03 - 0.1	May be crumbled in the hand. Sandstone is ‘sugary’ and friable.	VW
Weak	0.1 - 0.3	A piece of core 150mm long x 50mm diameter may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	W
Medium strong	0.3 - 1	A piece of core 150mm long x 50mm diameter can be broken by hand with considerable difficulty. Readily scored with a knife.	MS
Strong	1 - 3	A piece of core 150mm long x 50mm diameter cannot be broken by unaided hands, can be slightly scratched or scored with a knife.	S
Very Strong	3 - 10	A piece of core 150mm long x 50mm diameter may be broken readily with hand held hammer. Cannot be scratched with pen knife.	VS
Extremely strong	> 10	A piece of core 150mm long x 50mm diameter is difficult to break with hand held hammer. Rings when struck with a hammer.	ES

Rock Data

martens consulting engineers

Degree of Fracturing

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but excludes fractures such as drilling breaks.

Term	Description
Fragmented	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than core diameter.
Highly fractured	Core lengths are generally less than 20mm-40mm with occasional fragments.
Fractured	Core lengths are mainly 30mm-100mm with occasional shorter and longer sections.
Slightly fractured	Core lengths are generally 300mm-1000mm with occasional longer sections and occasional sections of 100mm-300mm.
Unbroken	The core does not contain any fractures.

Rock Core Recovery

TCR = Total Core Recovery

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100\%$$

SCR = Solid Core Recovery

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100\%$$

RQD = Rock Quality Designation

$$= \frac{\sum \text{Axial lengths of core} > 100\,\text{mm long}}{\text{Length of core run}} \times 100\%$$

Rock Strength Tests

▼ Point load strength Index (Is50) - axial test (MPa)

▶ Point load strength Index (Is50) - diametrall test (MPa)

● Unconfined compressive strength (UCS) (MPa)

Defect Type Abbreviations and Descriptions

Defect Type (with inclination given)

BP	Bedding plane parting
X	Foliation
L	Cleavage
JT	Joint
F	Fracture
SZ	Sheared zone (Fault)
CS	Crushed seam
DS	Decomposed seam
IS	Infilled seam
V	Vein

Coating or Filling

Cn	Clean
Sn	Stain
Ct	Coating
Fe	Iron Oxide

Planarity

Cu	Curved
Ir	Irregular
Pl	Planar
St	Stepped
Un	Undulating

Roughness

Po	Polished
Ro	Rough
Sl	Slickensided
Sm	Smooth
Vr	Very rough

Inclination

The inclination of defects are measured from perpendicular to the core axis.

Sampling

Sampling is carried out during drilling or excavation to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples may be taken by pushing a thin-walled sample tube into the soils and withdrawing a soil sample in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Other sampling methods may be used. Details of the type and method of sampling are given in the report.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Hand Excavation – in some situations, excavation using hand tools such as mattock and spade may be required due to limited site access or shallow soil profiles.

Hand Auger - the hole is advanced by pushing and rotating either a sand or clay auger generally 75-100mm in diameter into the ground. The depth of penetration is usually limited to the length of the auger pole, however extender pieces can be added to lengthen this.

Test Pits - these are excavated with a backhoe or a tracked excavator, allowing close examination of the *in-situ* soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) - the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling - the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength *etc.* is only marginally affected.

Continuous Spiral Flight Augers - the hole is advanced using 90 - 115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or *in-situ* testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface or, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling - similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling - a continuous core sample is obtained using a diamond tipped core barrel, usually 50mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in AS 1289 Methods of Testing Soils for Engineering Purposes - Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

(i) In the case where full penetration is obtained with successive blow counts for each 150mm of say 4, 6 and 7 blows:

as 4, 6, 7
N = 13
(ii) In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm

as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally, the test method is used to obtain samples in 50mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

CONE PENETROMETER TESTING AND INTERPRETATION

Cone penetrometer testing (sometimes referred to as Dutch Cone - abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in AS 1289 - Test F4.1.

In the test, a 35mm diameter rod with a cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on separate 130mm long sleeve, immediately behind the cone. Tranducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been traced from the original records.

The information provided on the charts comprises:
Cone resistance - the actual end bearing force divided by the cross sectional area of the cone - expressed in MPA.
Sleeve friction - the frictional force of the sleeve divided by the surface area - expressed in kPa.
Friction ratio - the ratio of sleeve friction to cone resistance - expressed in percent.

There are two scales available for measurement of cone resistance. The lower (A) scale (0 - 5 Mpa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main (B) scale (0 - 50 Mpa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%-2% are commonly encountered in sands and very soft clays rising to 4%-10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

q_c (Mpa) = (0.4 to 0.6) N (blows/300mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:

$q_c = (12 \text{ to } 18)\ c_u$

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes *etc*. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

DYNAMIC CONE (HAND) PENETROMETERS
Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods. Two relatively similar tests are used.

Perth sand penetrometer - a 16 mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS 1289 - Test F 3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
Cone penetrometer (sometimes known as the Scala Penetrometer) - a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289 - Test F 3.2). The test was developed initially for pavement sub-grade investigations, with correlations of the test results with California bearing ratio published by various Road Authorities.

LABORATORY TESTING
Laboratory testing is carried out in accordance with AS 1289 Methods of Testing Soil for Engineering Purposes. Details of the test procedure used are given on the individual report forms.

TEST PIT / BORE LOGS
The test pit / bore log(s) presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of excavation / drilling. Ideally, continuous undisturbed sampling or excavation / core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variation between the boreholes.

GROUND WATER
Where ground water levels are measured in boreholes, there are several potential problems:

In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all during the time it is left open.
A localised perched water table may lead to an erroneous indication of the true water table.
Water table levels will vary from time to time with seasons or recent prior weather changes. They may not be the same at the time of construction as are indicated in the report.
The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Manidis Roberts C/-
ING Real Estate

martens
consulting engineers

Engineering Advice
Proposed Settlement City Re-development, Port Macquarie

ENVIRONMENTAL

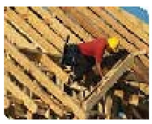
WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT
MANAGEMENT



P0902316JR01_v2
February 2009

Copyright Statement

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to provide concept advice regarding engineering services in accordance with the scope of services set out in the contract / quotation between Martens & Associates Pty Ltd and Manidis Roberts c/ ING Real Estate (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

Martens & Associates Pty Ltd derived the data in this report primarily from a number of sources including site inspections, correspondence regarding the proposal, examination of records in the public domain and interviews with individuals with information about the site or the project. The passage of time, manifestation of latent conditions or impacts of future events may require further examination / exploration of the site and subsequent data analyses, together with a re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, Martens & Associates Pty Ltd may have relied upon and presumed accurate certain information (or absence thereof) relative to the site. Except as otherwise stated in the report, Martens & Associates Pty Ltd has not attempted to verify the accuracy of completeness of any such information (including for example survey data supplied by others).

The findings, observations and conclusions expressed by Martens & Associates Pty Ltd in this report are not, and should not be considered an opinion concerning the completeness and accuracy of information supplied by others. No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings and conclusions are based solely upon site conditions, information and drawings supplied by the Client *etc*. in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between Martens & Associates Pty Ltd and the Client. Martens & Associates Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Head Office
6/37 Leighton Place
Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
Phone: +61-2-9476-9999
Fax: +61-2-9476-8767
Email: mail@martens.com.au
Web: www.martens.com.au

Document and Distribution Status

Author(s)	Reviewer(s)	Project Manager	Signature
Matthew Butler/Megan Bowling	Andrew Norris	Andrew Norris	

Revision No.	Status	Release Date	Document Location					
			File Copy	MA Library	Client	Void	Void	Void
1	Draft	4/11/05	1E	-	1P			
2	Draft	13/02/09	1E, 1H	-	1P			
3	Final	20/02/09	1E, 1H	1H	1P			

Distribution Types: F = Fax, H = hard copy, P = PDF document, E = Other electronic format. Digits indicate number of document copies.

All enquiries regarding this project are to be directed to the Project Manager.

Executive Summary

Overview

This report is prepared to support a project application for a proposed expansion and partial redevelopment to the Settlement City Shopping Centre at the corner of Park and Bay St, Port Macquarie. The report addresses a range of issues covering:

- Stormwater management, re-use and water quality implications.
- Geotechnical site constraints including acid sulfate soil constraints.

Site Description

The existing Settlement City Shopping Centre is located on Lots 4 and 5 DP 1018087 and Lot 2 DP 702484. T he site is approximately 7.4 ha in area and is understood to have been previous filled with material likely to have been derived from dredging of the Hasting River.

The site is generally level at an elevation of 3.0 – 4.0 mAHD. Drainage is through a series of surface and piped drainage ways discharging to the Hastings River and associated canals. No sub-surface investigations have been completed, however, it is inferred that Groundwater levels shall be approximately equivalent to levels in adjacent tidal inlets.

Results

A range of geotechnical constraints have been identified on the site. Issues identified include potential for differential settlements due to compaction of underlying clay, peat and silt layers; groundwater impacts and settlement if dewatering occurs; salinity impacts on foundations; and acid sulfate soils. Each of the identified geotechnical constraints on the site are considered to be manageable through standard engineering design.

The existing site stormwater system provides drainage of the site to the receiving waters without treatment. Following the proposed site redevelopment much of the site drainage shall be treated through new stormwater treatment systems. The proposed redevelopment reduces the surface area of bitumen carparks (potential source of PAH from bitumen and pollutants from vehicles) and replaces it with concrete carparks and new roof areas.

The incorporation of 'HumeCeptor', 'HumeGard' or similar gross pollutant and grease and oil capture systems within the piped site discharge to the west shall allow for further stormwater renovation ensuring that the proposed site redevelopment shall have a significant beneficial impact on the overall site discharge water quality.

DRAINS modelling was used to compare pre-development (existing) and post-development flow rates from the site. The site was divided into 3 catchments according to discharge points (i.e. Hastings River, the canal system or beneath Park Street).

It was found that the northern and western catchments (draining to the Hastings River and canal system respectively) remained unchanged in terms of their pre- vs post-development impervious area. The south eastern catchment (draining to Park Street) has an increased pervious area resulting in a slight decrease in discharge flow rates. The post-developed site therefore achieves policy objectives of no net increase in site discharge.

Stormwater management recommendations are as follows;

1) Renewed stormwater system as part of building and road construction on the eastern area of the site replacing existing Panthers club and car park drainage systems.

2) Collection of stormwater from the existing metal roof areas and / or new roof top parking area and the capture of this water on-site for reuse through non-potable site uses such as toilet flushing and irrigation.

3) A 3m wide pervious pavement 'strip' with vegetation planting is to be provided allowing either side of Entertainment Street to maximise infiltration of overland flow in this area. Paving product such as Borals 'Hydrapave' are to be used.

4) The use of stormwater for toilet flushing in new amenities, site irrigation and external washdown is recommended.

The sandy nature of site soils and gentle site grades means that sediment and erosion control measures such as sediment fences, shake down areas and (possibly) sedimentation basins shall be readily incorporated in to the construction plan to ensure no construction phase impacts on receiving water.

Review of available acid sulfate soil information indicates that acid sulfate soil material may be present on site at a depth of approximately 3 – 5 m below ground level. Further investigations at construction certificate stage shall be undertaken to confirm the presence and nature of this underlying material. The proposed expansion and redevelopment has only minor sub-grade components and few to extend beyond the inferred depth of ASS material. Standard engineering responses (spoil lime treatment) are expected to be sufficient to appropriately manage inferred site acid sulfate soil conditions.

Conclusions

Identified site geotechnical constraints are considered to be comparatively minor and shall be readily overcome using conventional engineering practices and methods.

The proposed expansion and redevelopment of the site shall result in a net beneficial impact on the local hydrology and water quality impacts of the site. The reclamation of clean stormwater and beneficial re-use shall minimise the redevelopment's demand for additional town water as well as reducing discharge volumes. The proposed water quality control measures shall ensure that post-development water quality outcomes are considerably better than the existing case.

Site acid sulfate soil conditions are not expected to be significant and shall not limit the ability of the site to be redeveloped as proposed. Conventional management strategies shall be sufficient to manage any possible disturbance of acid sulfate soil material through foundation excavation works.

Contents

Figures

Tables

1 Overview

1.1 Report Background

This report has been prepared by Martens and Associates Pty Ltd to assess a range of water management and geotechnical engineering related site constraints related to the proposed re-development of the existing Settlement City Shopping Centre expansion and partial redevelopment at Port Macquarie. SEPP 71 does not apply to this project application. However since it provides a thorough list of issues to be considered, it has been used as a guideline for reporting on the site.

Investigations completed have been of a preliminary nature and are largely based on desktop reviews of available information. Such an investigation is appropriate for a 'project plan' submission. Additional analysis is required following approval and prior to lodgement of the site construction certificate (CC). Specifically, this report addresses the following issues associated with the proposed development:

1. Stormwater management requirements based on available site information, results of DRAINS (stormwater quantity) modelling and relevant state and local government policy, including advice on collection, re-use and disposal.

2. Appraisal of options for stormwater storage and non-potable re-use including toilet flushing, irrigation and commercial cleaning.

3. Identification of likely site geotechnical constraints.

4. Identification of likely site acid sulfate soil constraints.

5. Management recommendations for site soils.

1.2 Development Background

It is understood that the proposed site development comprises an expansion and partial redevelopment of the Settlement City Shopping Centre at Port Macquarie, including the construction of new commercial structures and demolition of structures as follows:

- Expansion of retailers area (including large format and specialty stores.
- Inclusion of cinemas and bowling and commercial offices.
- A new multi-deck carpark.

The remainder of the site is to be used for loading areas, landscaping and ancillary purposes such as outdoor dining and access roads.

1.3 Report Structure

This report is set out as follows:

- Section 2: Site Characterisation
- Section 3: Stormwater Management
- Section 4: Sediment and Erosion Control
- Section 6: Acid Sulfate Soil Assessment

2 Site Characterisation

2.1 Location and Site Description

The development site comprises Settlement City Shopping Centre and is located 1.3km east of Port Macquarie business area. Together with the Panthers club, they occupy a site area of 6.4 hectares, with water frontage to the north (the lower Hastings River) and west (canal systems) and road frontage to the east (Park Street) and South (Bay Street). The site is in the Port Macquarie-Hastings Local Government Area on the mid north coast of NSW.

The town centre of Port Macquarie is located approximately 1.0 – 1.5 kilometres to the south-east. The site is bounded by Bay Street to the south, Park Street to the east and canal systems off the Hastings River to the north and west (Figure 1).

The site is identified as Lot 2 in DP 702484 and Lots 4 and 5 in DP 1018087, covering an area of approximately 7.4 ha.

Source: Kempsey 1:25 000 Aerial photo (Dept of Lands) (2003)

Figure 1: The proposed redevelopment site within the local environmental context, Port Macquarie, NSW.

2.2 Land-use Practices

Settlement City Shopping Centre comprises a large discount department store, supermarket, mini major store, specialty stores, food and beverage outlets and open car parking area. Landscaped areas are generally confined to the boundary fringes. Urban, commercial and recreational land-uses dominate the local area.

Figure 2: Photograph of subject site taken on 11/10/05, viewed to east, Settlement City, Port Macquarie, NSW.

2.3 Climate

The nearest rainfall station is located at Hill Street (St No. 060026), 3.0 km to the south-east of the site. Rainfall data indicate that the local area experiences a mean annual rainfall of 1540 mm. Rainfall is generally highest during the period from December to June [i.e. summer and autumn dominated], with mean monthly totals ranging from 127 to 177 mm per month over this period.

2.4 Topography and Slopes

The site is gently sloped with local relief of less than 0.5 m. It is located on the lower Hastings River floodplain. Surrounding land is described as a near level coastal floodplain with elevations of less than 5 mAHD, with slopes of less than 5%.

Available site development history indicates that the site was filled between 1979 and 1983 prior to its development. Original site levels appear to have been approximately 1.7 – 2.1 mAHD (based on Dept of Lands orthophoto, 1975). The current elevation of the site is between approximately 3.0 and 4.0 mAHD (based on site survey by Frank O'Rourke & Associates, Aug 2005).

A review of the Port Macquarie 1 : 25 000 topographic map indicates that surrounding lands comprise predominantly coastal flats that have been developed to create the urban centres of Port Macquarie and 'Settlement Shores'.

2.5 Geology

Review of the 1 : 250 000 Geology Map (Hastings, Sheet SH 56-14, 1970), indicates that the site is underlain by Quaternary deposits of alluvium including sand, silt, mud and gravel. Total depth of these deposits is expected to be in excess of 4 m and may be up to 20 m or more. Subsequent to preparation of the Hastings geology map a number of canal systems have been constructed on surrounding lands and the site has been filled.

2.6 Soil Profiles

A walk-over site inspection was undertaken by Martens and Associates on October 11, 2005. Sub-surface soil and groundwater investigations were not undertaken.

Investigations regarding site soils included a review of soil landscape mapping as well as a review of the history of site development. The Kempsey 1:100 000 Soil Landscape Map indicates that the site is located in an area of disturbed terrain. Such areas have been extensively disturbed by human activity. It is inferred that the site has been filled by approximately 1.0 – 2.0 m. A possible source of this fill may have been marine sand dredged from the lower Hastings River.

Natural site soils underlying the fill are most likely of the 'Limeburners' soil landscape, comprising deep siliceous sands to depths greater than 3.0 m developed on barrier or Pleistocene sand deposits. These soils are typically well drained although are likely to be highly acidic and saline.

2.7 Surface Waters

The site is a developed surface with a roof drainage system and pavement drainage system. Natural grades allow discharge through a pipe and drainage network to the east to the Hastings River and also to the north and west towards the canal systems off the Hastings River.

2.8 Flood Control Weir

A flood control weir structure (crest RL – 1.44 mAHD) is located directly to the north of the site in the canal system. The purpose of this structure is to prevent flood flows from upstream passing directly through the canal system and potentially causing damage to developments adjoining the canal. Rather, it ensures that flood flows continue in the Hastings River around Settlement Point.

2.9 Tidal and Flood Inundation

The site is located adjacent to a system of canals known as Dolphin Keys which join the Hastings River approximately 1 km to the north west of the site. With regard to tidal flow influence the canals adjacent to the western site boundary are approximately 7.0 km upstream from the river mouth, although the northern site boundary is only 2.0-2.5 km directly west of the river mouth. Settlement Point separates the canal system from the lower reach of the river.

Discussions with Council (22.01.2009) and review of *Hastings Flood Study* (Patterson Britton and Partners Pty Ltd, 2006) indicate that the flood planning levels for the site are influenced by the differing effects of flood on the canal system and the Hastings River. Flood planning levels are provided in Table 1.

Table 1: Flood Levels for the site (Port Macquarie Hastings Council, 2009)

Boundary	Influence	Design 100 yr ARI Flood level (mAHD)	20 yr ARI flood level (mAHD)
North	Canals	2.85	2.40
West	Canals	2.85	2.40
East	Hastings River	2.55	2.30

Available information indicates that existing site levels would be a minimum of approximately 0.15 m above the design 100 yr ARI flood level (assuming a worst case scenario of 2.85 mAHD) and proposed ground floor levels are approximately 0.71 m above this height. Council mapping shows the site as being outside of the 100 yr ARI flood event.

2.10 Climate Change and Predicted Sea Level Rise

The potential impacts of climate change induced sea level rise are considered in this assessment. According to DECC (2007) sea level rise on the NSW coast is expected to be in the range of 0.18 to 0.91m by 2100.

Assuming a worst case scenario of 0.91m of sea level rise and an existing mean high water summer solstice level of 0.986 mAHD, the post climate-change mean high water summer solstice water level at the mouth of the Hastings River would be 1.9 mAHD. Given the distance from the mouth of the river to the site and the height of the Park Street bridge (4.65 mAHD), it is not expected that tidal influence would be attenuated significantly. We therefore consider the possible site impacts of this post-climate change water level to the site.

Given design ground floor levels are 3.56m, approximately 1.66m above this height, it is concluded that climate induced sea level rise poses minimal additional risk to the proposed development.

Another possible outcome of climate change could be increased frequencies and magnitude of flood events due to increased rainfall intensities (DECC, 2007). Review of DECC (2007) indicates that increased rainfall intensity of the order of 5 – 10% is possible for the Northern Rivers area. While this may lead to increased flood levels, such change will be readily accommodated with the provided 710mm freeboard between the current 1% AEP level (2.85m) and the adopted site finished floor levels of 3.56m. The site is considered to have sufficient adaptive capacity to accommodate the possible impacts of sea level rise.

2.11 Groundwater

No sub-surface investigations were carried out on site, therefore groundwater information has been inferred from local hydrology and topography. Given the site's close proximity to the lower Hastings River and the expected permeable nature of site soils, groundwater would be expected to be at a level approximately equivalent to water levels in the adjacent canal systems and river. It is also likely that the water table beneath the site would be highly variable in response to tidal movements and local weather. We estimate that groundwater would be located at a depth of approximately 2.5 m below existing ground level or 0.5 – 1.0 m AHD.

2.12 Geotechnical Constraints

Given the site's coastal location and history of filling, a number of potential geotechnical constraints have been identified:

- Settlement: The potential presence of layers of readily compressible silt, clay or peat or poorly compacted fill may result in differential settlement of structures. This is particularly the case where heavy masonry or concrete structures are used.

- Groundwater: As groundwater is estimated to be at a depth of approximately 2.5 m below the ground surface, any construction works near this depth may require dewatering. This may lead to potential acid sulfate soil, differential settlement and saltwater ingress issues.

- Salinity and Acidity: As natural site soils are of marine or estuarine origins there is a likelihood of high salinity and acidity in the soil which may impact foundation materials. Furthermore, the risk of acid generation from actual or potential acid sulfate soils being excavated shall need to be investigated prior to excavation. This issue is further considered in Section 6;

- Contamination: Past uses of the site, including filling and commercial use and possible agriculture, raise the possibility of the introduction of contamination to the site soils. This issue is further investigated in Martens Report No. P0501226JR02_v1.

The constraints identified above will require further investigation prior to finalisation of the site development design. Standard engineering strategic remedies for management of identified geotechnical constraints are readily available. None of the identified site geotechnical constraints are considered to be sufficient to overly restrict the proposed site development.

3 Stormwater Management

3.1 Overview

Implications of the proposed site development with regard to site stormwater management have been assessed through a review of available site information and relevant state and local government policies. Options for collection, re-use and disposal of stormwater have been investigated.

Site hydraulic modelling was carried out for the existing and post-development site using the DRAINS modelling package. From these results, advice has been provided with regard to flow regimes and requirements for site stormwater infrastructure to achieve stated objectives.

3.2 Relevant Controls and Policy Objectives

A number of specific planning controls and policy objectives have been considered in the development of the site stormwater management plan. These include:

- Part 3A – Environmental Planning and Assessment Act 1979, Major Infrastructure and Other Projects
- State Environmental Planning Policy (Major Projects) 2005
- State Environmental Planning Policy No. 71 – Coastal Protection
- North Coast Regional Environmental Plan (REP)
- Hastings Local Environment Plan (LEP) 2001
- Port Macquarie – Hastings Shire Council Development Design Specification No. 5 (2003) for Stormwater Drainage Design
- Port Macquarie – Hastings Shire Council Development Design Specification No. 7 (2003) for Stormwater Management

In summary, the above planning controls and policies require there to be no increase in peak stormwater discharges from the site and no added impacts on local water quality such as any increase in release of stormwater pollutants from the site.

3.3 Stormwater Quantity

3.3.1 Existing

The site is highly developed with the majority of the land surface being covered by impervious surfaces such as buildings, roads and car parking areas. Only a minor proportion of the site is covered with pervious landscaping; in the form of boundary planting and along internal roads and in carpark areas.

Drainage of impervious areas is currently provided by a pit and pipe network which drain to the canal system (north and west) or to a mangrove inlet on the Hastings River beyond the eastern site boundary and Park Street. Landscaped fringes drain directly to the canal system by overland flow. No formal stormwater treatment devices were observed in the site drainage system.

For the purposes of assessment, the site was separated into 3 different catchments according to existing stormwater discharge points;

1. A 'western' catchment; consisting of the existing supermarket, carpark and smaller retailers, draining to the canal system,

2. A 'northern' catchment; consisting of the existing Panthers club and loading bay, draining to the Hastings River, and

3. A 'south eastern' catchment'; primarily consisting of the existing carpark and site entrance off Park Street, draining to Park Street.

Each of these catchments was represented in DRAINS modelling as a separate node. A site plan showing discharge points is provided in Attachment A, while DRAINS catchment boundaries are provided in Attachment B.

3.3.2 Proposed

The current project plan for the site re-development primarily involves;

1. Expansion of the existing south-eastern carpark area to a multi-story facility,

2. An expansion and partial redevelopment of shopping and retail facilities; and

3. An increase in internal landscaped and pervious areas.

In terms of changes within the identified catchments; there is no net increase in impervious area within the northern and western catchments – only a change in the nature of these surfaces. Within the south-eastern catchment, a 3m wide pervious landscape 'strip' is recommended on either side of the main entry/exit road ('Entertainment Street'). This has been provided to compensate for some loss of landscaping throughout the parking area. It is proposed to increase pervious area within the catchment. Table 2 summarises DRAINS input catchment details.

Table 2: DRAINS catchment details

Scenario	Catchment ID	Total Area (ha)	Impervious Area (%)	Pervious Area (%)
Existing	Northern	1.393	98	2
	Western	4.257	98	2
	Existing South Eastern	1.596	96	4
Proposed	Western	4.257	98	2
	Northern	1.393	98	2
	Post Dev South Eastern	1.596	92	8

A 'proposed development' scenario in DRAINS was created to reflect these changes. The 5yr, 20yr and 100yr ARI events were considered for all standard durations up to and including the 12 hour event for both the pre-development (existing) and post-development scenarios. Discharges from each catchment under each scenario were then compared.

3.3.3 *Results*

DRAINS results are summarised in the following tables:

Table 3: 5yr ARI DRAINS results.

	WESTERN CATCHMENT			NORTHERN CATCHMENT			SOUTH EASTERN CATCHMENT		
DURATION (MINS)	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE
5	0.713	0.713	0	0.337	0.337	0	0.36	0.35	-0.01
10	1.14	1.14	0	0.5	0.5	0	0.556	0.541	-0.015
30	1.48	1.48	0	0.548	0.548	0	0.616	0.603	-0.013
60	1.37	1.37	0	0.47	0.47	0	0.525	0.517	-0.008
90	1.3	1.3	0	0.497	0.497	0	0.555	0.547	-0.008
120	1.35	1.35	0	0.528	0.528	0	0.584	0.576	-0.008
180	1.01	1.01	0	0.331	0.331	0	0.376	0.37	-0.006
360	0.651	0.651	0	0.213	0.213	0	0.242	0.239	-0.003
540	0.576	0.576	0	0.189	0.189	0	0.215	0.212	-0.003
720	0.576	0.576	0	0.188	0.188	0	0.215	0.212	-0.003

Table 4: 20yr ARI DRAINS results

	WESTERN CATCHMENT			NORTHERN CATCHMENT			SOUTH EASTERN CATCHMENT		
DURATION (MINS)	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE
5	0.954	0.954	0	0.451	0.451	0	0.484	0.473	-0.011
10	1.53	1.53	0	0.665	0.665	0	0.746	0.731	-0.015
30	2.01	2.01	0	0.748	0.748	0	0.844	0.833	-0.011
60	1.92	1.92	0	0.657	0.657	0	0.735	0.726	-0.009
90	1.77	1.77	0	0.678	0.678	0	0.758	0.75	-0.008
120	1.84	1.84	0	0.718	0.718	0	0.795	0.79	-0.005
180	1.38	1.38	0	0.451	0.451	0	0.514	0.508	-0.006
360	0.883	0.883	0	0.289	0.289	0	0.329	0.326	-0.003
540	0.773	0.773	0	0.253	0.253	0	0.289	0.286	-0.003
720	0.774	0.774	0	0.253	0.253	0	0.289	0.287	-0.002

Table 5: 100yr ARI DRAINS results

	WESTERN CATCHMENT			NORTHERN CATCHMENT			SOUTH EASTERN CATCHMENT		
DURATION (MINS)	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE
5	1.27	1.27	0	0.601	0.601	0	0.647	0.636	-0.011
10	2.05	2.05	0	0.888	0.888	0	1	0.985	-0.015
30	2.55	2.55	0	0.935	0.935	0	1.06	1.05	-0.01
60	2.48	2.48	0	0.844	0.844	0	0.946	0.938	-0.008
90	2.29	2.29	0	0.87	0.87	0	0.974	0.967	-0.007
120	2.39	2.39	0	0.931	0.931	0	1.04	1.03	-0.01
180	1.75	1.75	0	0.574	0.574	0	0.654	0.649	-0.005
360	1.11	1.11	0	0.362	0.362	0	0.414	0.411	-0.003
540	0.967	0.967	0	0.316	0.316	0	0.361	0.359	-0.002
720	0.961	0.961	0	0.314	0.314	0	0.359	0.357	-0.002

DRAINS results confirm that for the 'western' and 'northern' catchments, given that there is to be no net change in the total site impervious area, the proposed expansion and partial redevelopment shall not impact on site hydraulics. The net increase in pervious area in the south eastern catchment has resulted in a slight decrease (by an average of 1.4%) in 'maximum flow discharge' across each ARI event.

Thus, in accordance with relevant planning controls and policies, the proposed expansion and partial redevelopment of the site is expected to result in no net increase in peak stormwater discharges.

3.3.4 Preliminary Stormwater Management Recommendations

Through the redevelopment of the site a range of improvements to the stormwater system are recommended to achieve both efficient site drainage and to achieve objectives of Ecologically Sustainable Design (ESD). For the purpose of the concept plan it has been assumed that all site areas to the north and west may be adequately drained to the canal system or Hastings River as is the current situation. Recommendations for inclusion in the development include:

1. Renewed stormwater system on the eastern area of the site with replacing existing Panthers club and car park drainage systems. System is to be designed to Council's specification. In-line stormwater quality controls are to be included on these new pipe systems.

2. Collection of stormwater from the existing metal roof areas and / or new roof top parking area and the temporary storage of this water on-site for non-potable uses would be a positive water management outcome. Significant town water savings may be possible in the long term if stormwater reclamation is included in the site's re-development.

3. A 3m wide pervious pavement 'strip' with vegetation planting is recommended on either side of Entertainment Street to maximise infiltration of overland flow in this area. Materials such as Boral's 'Hydrapave' are considered suitable for this area.

4. Site layout and grading should be designed to maximise infiltration of overland flow through pervious areas, with excess runoff conveyed by the road stormwater system. Along the northern and western site boundaries, landscaped fringes would allow excess runoff to drain directly to the canal system by overland flow.

5. The use of stormwater for toilet flushing in new amenities, site irrigation and external washdown is recommended. This shall achieve a reduction in site discharges as well as a reduced town water demand. Infrastructure required would be limited to storage tanks, which could be provided below the ground floor level, and pumping and reticulation systems. Sizing of tanks, pumps and reticulation would be determined subsequent to finalisation of landscaping plans and water demand analysis at construction certificate stage. It is anticipated that a reservoir of the order of 100 kL with town water backup would be sufficient for the site.

6. No specific requirements are given in Council policy for on-site stormwater detention. As there is no major proposed

change in the proportion of impervious surfaces there shall be no increase in site stormwater discharge. The inclusion of stormwater reclamation tanks in the design would provide some degree of integrated on-site retention capacity, thus achieving a small reduction in overall stormwater flows from the site.

A plan showing the proposed drainage concept for site re-development and suggested locations for stormwater storages and infrastructure is provided in Attachment A.

3.4 Stormwater Quality

The proposed expansion and partial redevelopment is expected to result in an improvement to the quality of stormwater discharged from the site. Improved water quality shall be achieved in three ways:

1. Reduction of overall flows through stormwater reclamation and re-use.

2. Inclusion of new and effective stormwater treatment devices.

3. Improvement in stormwater quality through reduced contaminant generation rates as a result of modifications to land surfaces (as detailed in Table 6).

Table 6: Comparison of land surface types and stormwater quality for proposed Settlement City Re-development, Port Macquarie, NSW.

Land Surface Type	Stormwater quality based on contaminant generation from surface	Modifications due to proposed re-development	Overall effect on site stormwater quality
Steel roofs of commercial buildings	Good	Increase	Improved
Concrete roof top car parking areas	Average	Increase	Unchanged
Bitumen road pavements and car parking areas	Poor	Decrease	Improved
Soft landscaping and associated footpaths along canal frontage	Very good	Negligible	Unchanged

The overall result of the expansion and partial redevelopment shall be an increase in the area occupied by steel roofs and concrete roof top car parking areas by a decrease in bitumen paved areas. This shall provide improved stormwater quality through a decrease in the generation of contaminants such as sediments, oil and grease.

Proposed in-line stormwater quality control system for the development include:

1. Humeceptor treatment systems, and

2. Storage/re-use tanks for collection and retention of runoff from impervious surfaces.

These water quality control measures and their likely beneficial input are briefly discussed below.

'Humeceptor' and 'HumeGard' (litter only) treatment systems function as advanced gross pollutant traps, significantly reducing sediment, nutrient, oil and grease and litter loads in stormwater. They should be appropriately sized at the construction certificate stage, to achieve greater than 70% retention of annual litter load (larger than 5 mm) and 90% retention of annual coarse sediment load (>0.125 mm diameter).

The collection and detention of water from roof and paved areas in the proposed stormwater reclamation tanks will provide additional water quality benefits through physical filtration and sedimentation.

3.5 Summary

The proposed expansion and partial redevelopment shall intrinsically improve stormwater quality through a reduction in bitumen car park areas and replacement with roofed areas and concrete car parks. It also provides an opportunity for improved stormwater treatment technology to be incorporated. Overall we conclude that the expansion and partial redevelopment will result in an improved local environmental outcome through reduction of stormwater discharges, improvement of local water quality and reducing demand on local water supply.

4 Water Supply and Sewage

4.1 Overview

A brief review has been undertaken with regard to the current water supply and sewage infrastructure servicing the Settlement City Shopping Centre and Panthers Club. The capability of existing infrastructure to support the proposed expansion and partial redevelopment has been assessed in light of estimated water demands and wastewater generation.

4.2 Water Demand for Proposed Re-development

Current water supply to the site is from a 450 mm diameter trunk mains along the south side of Bay Street. A 200 mm diameter connection runs into the site. On the basis that the existing commercial development occupies an area of 19,240 m^2, it is estimated that the current peak water demand is approximately 1.73 L/s (based on a typical peak hourly demand rate of 0.9 L/s/ha for commercial developments, from the WSA Water Supply manual).

The proposed new Stage 1 development with a total of 35,918 m^2 (15,915 m^2 of additional area) of commercial space will therefore add a peak hourly demand of approximately 1.50 L/s. The existing 200 mm connection is considered adequate for this supply, although detailed analysis to confirm this is to be completed at detailed design stage.

Preliminary discussions with Port Macquarie-Hastings Council (28.01.2009) indicate that the proposed expansion and partial redevelopment will not place undue strain on the existing 450mm water main. An upgrade to the 200mm connection is also unlikely; however this will need to be confirmed at CC stage. It should be noted that detailed analysis shall be completed at CC stage to determine if any system augmentation will be required.

Importantly, the proposed stormwater reclamation strategy shall reduce the demand on town water supply by replacing some use with stormwater.

4.3 Sewage Management for Proposed Re-development

Site wastewater reticulation is currently provided by gravity drainage to one of two site pump stations with transfer to the town sewage treatment plant by 100 mm rising mains which connect to the town sewer mains on Bay Street. The site has a third private pump station and 50 mm rising main servicing the petrol station.

Based on site area, current peak wastewater flows for the site are 1.92 L/s (from on an estimated 75 EP/ha and d-factor of 6.36 according to the WSA Sewage Code).

It is estimated that the proposed re-development will add a further 1.17 L/s to this peak flow rate (based on a total re-developed area of 3.59 ha and a d-factor of 5.46 from the WSA Sewerage Code). The existing rising mains should be adequate for this flow rate, however, detailed assessment and possible upgrade or reconfiguration of pump systems may be required.

Where feasible the proposed expansion and partial redevelopment will be connected to the existing site sewage pumping stations (SPS). If necessary an additional SPS shall be constructed on the site and connected similarly to the town reticulation system. Site sewage reticulation requirements shall be confirmed by detailed analysis to be completed at construction certificate stage.

Discussions with Council staff (19.02.2009) indicate that the expansion and partial redevelopment of Settlement City Shopping Centre is unlikely to impact adversely on Council's sewerage system, external to the site.

5 Sediment and Erosion Control

5.1 Overview

During the construction stage of the proposed expansion and partial redevelopment there will be a potential for soil erosion and sedimentation impacts on adjacent waters. These have potential to cause detrimental impacts on downstream aquatic ecosystems. It is therefore necessary for an appropriate sediment and erosion control plan to be prepared and implemented.

5.2 Key Control Measures

Key control measures to be included in the sediment and erosion control plan are:

- Sediment fences to be installed down slope of significant excavation and construction works and along the canal boundaries prior to commencement of construction.

- Vehicle shake down grid(s) and wheel wash facility to be placed at the site construction exit(s).

- Placement of stabilising fabric in areas to be re-vegetated and landscaped immediately following final grading.

- Implementation of hay bale or filter fence check dams during the construction of major drainage infrastructure including pits and swale drains.

Sediment fences are to be placed along the down slope edge of disturbed areas and constructed according to standard design SD 6-7 (Figure 3). Sediment fences are to be checked weekly and following significant (>10 mm) rainfall events. Sediment is to be removed when 30 % of the storage capacity is filled. Removed sediment is to be placed in site stockpiles or on land up-slope of fences.

Depending on the scale and staging of the construction, a sedimentation basin may also be required on site during construction. If site soils are found to comprise coarse sands these may provide adequate infiltration capacity for site runoff and a sedimentation basin would not be required. If the soils contain significant fines, however, it is likely that a sedimentation basin shall be required. In this case the size and location of the basin should be determined at construction certificate stage.

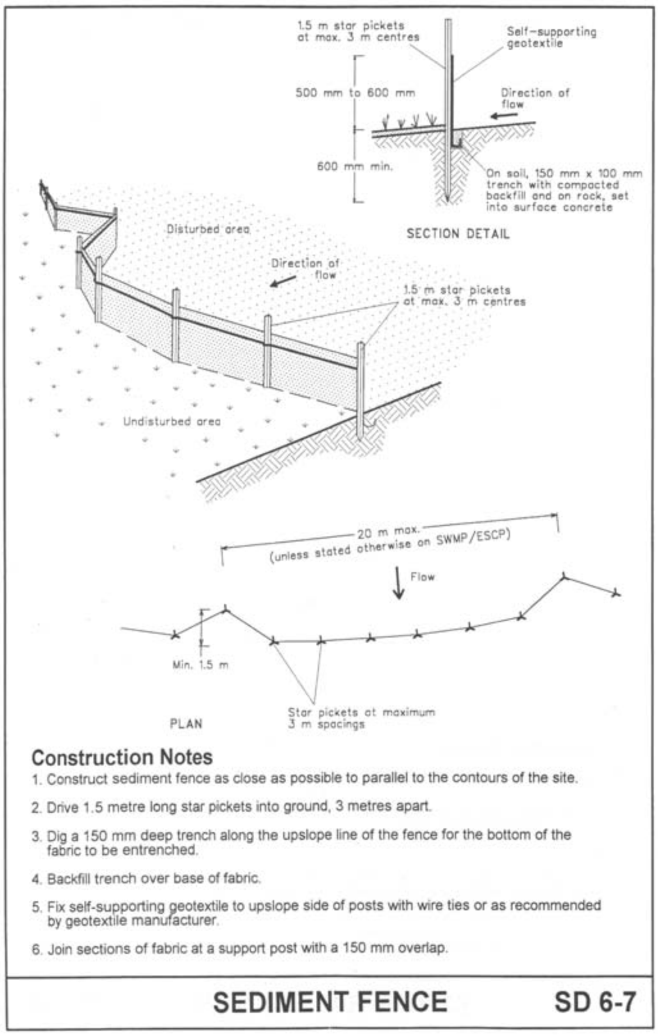


Figure 3: Department of Housing (1998) standard design 6-7: Sediment Fence.

5.3 Detailed Sediment and Erosion Control Plan

A detailed plan indicating proposed sediment and erosion control works should be provided at the construction certificate stage. The plan should be designed in accordance with Council document *"Development Design Specification D7 – Stormwater Management"* and should provide the specific location, construction details and management measures for the proposed works. In addition, a contingency strategy should be provided for large rainfall events during the construction works in areas where flows shall naturally concentrate.

With an appropriately designed and implemented sediment and erosion control strategy the proposed expansion and partial redevelopment will not have excessive detrimental impacts on the local aquatic environment.

6 Acid Sulfate Soil Assessment

6.1 Overview

A preliminary acid sulfate soil assessment has been undertaken on the site. This assessment has been completed to provide an indication of the likely nature and extent of any acid sulfate soil (ASS) material that may be present on the site and, if identified, provide a preliminary management strategy should this material be disturbed during the proposed development.

6.2 Risk Assessment Strategy

The completed preliminary ASS assessment is based on a review of the geomorphic site setting, evaluation of site acid sulfate soils risk classification from DLWC risk maps and review of limited site development and filling history.

6.3 ASS Risk Classification Mapping

The Wauchope/Port Macquarie Acid Sulfate Soil Risk Map (1997) identifies the site as disturbed terrain at elevations of 2-4 m ('X2'). This classification reflects past site filling. Surrounding areas are mapped as Aeolian sandplains at elevations of 2-4 m (Wa2) with a 'low' probability of acid sulfate soil material being found at 1-3 m below ground surface. These soils are likely to be beneath the placed fill material and would now be located at a depth of approximately 2-5 m. Acid sulfate soil risk mapping for the site is shown in Figure 4.

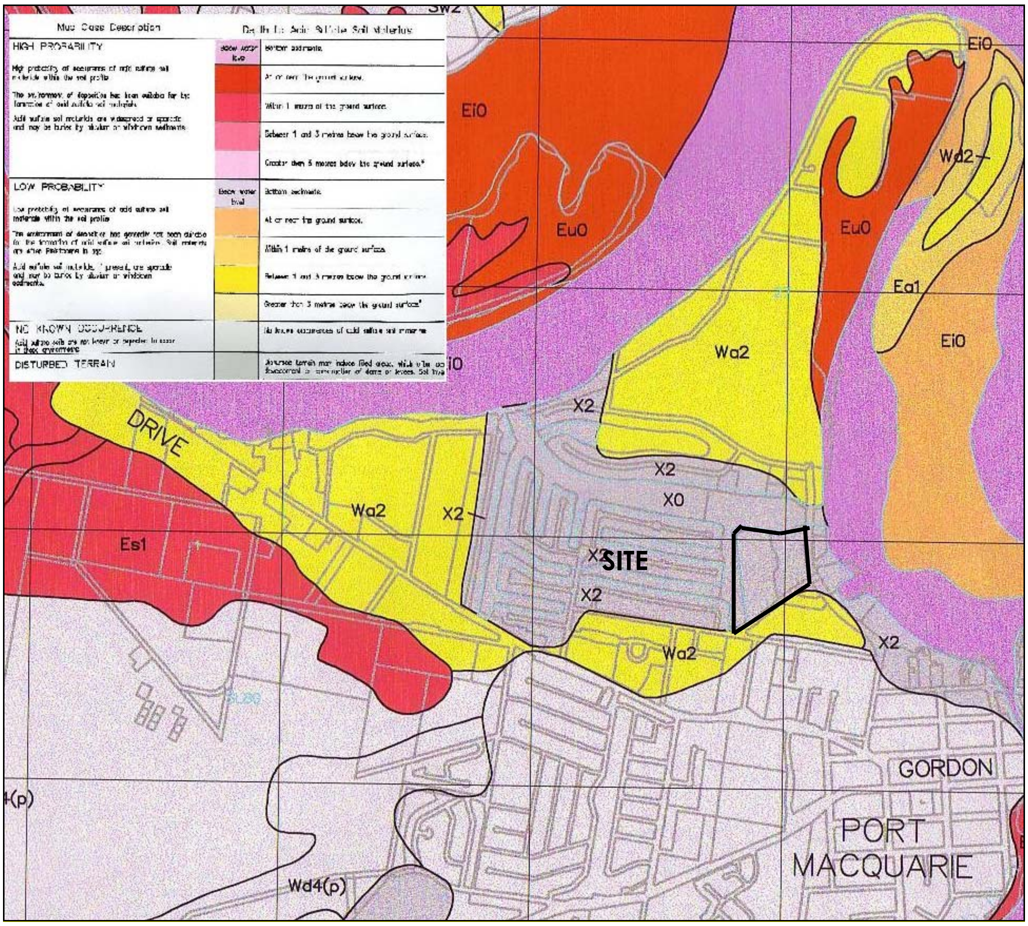


Figure 4: Acid Sulfate Soil Risk Mapping. Settlement City, Port Macquarie, NSW.

6.4 Geomorphic Setting

The likelihood of acid sulfate soils being present on a site is dependent on a range of geomorphic parameters (ASSMAC, 1998, Assessment Guidelines p10), which are summarised and assessed for the site in Table 7.

Table 7: Geomorphic site features indicative of acid sulfate soils and their presence or absence. Settlement City, Port Macquarie, NSW.

Geomorphic Feature	Present on site?
Holocene sediments	Yes[1]
Soil horizons less than 5 mAHD	Yes
Marine / estuarine sediments or tidal lakes	Yes
Coastal wetland; backwater swamps; waterlogged or scaled areas; interdune swales or coastal sand dunes.	Yes[2]
Dominant vegetation is mangroves, reeds, rushes and other swamp or marine tolerant species.	Yes[2]
Geologies containing sulphide bearing material	Unknown
Deep older (Pleistocene) estuarine sediments	Possible

Note: [1] Holocene sediments are likely to be present in site fill and underlying *in-situ* soils beneath the site. [2] Prior to development of site and surrounding areas, it is likely that the site was a coastal wetland or swamp area with a dominant vegetation of marine tolerant species as indicated by historical aerial photography.

Five (5) of the seven (7) geomorphic conditions are satisfied by the site indicating a likelihood of there being acid sulfate soils material on the site.

A review of historical aerial photography of the site indicates that the site was most likely a coastal wetland or swamp prior to its development in the early 1980s which most likely included layers of actual and potential acid sulfate soils. The site was also most likely filled with material of marine / estuarine origin. This material may have included acid sulfate or potentially acid sulfate soil. It is noted that the length of time over which the fill has been placed on site (approximately 25 years); the likely location of the fill above the local water table ; and the likely coarse-grained nature of material should have provided opportunity for oxidation of any potential acid sulfate soil material. Therefore it is unlikely that the fill material is potential acid sulfate soil material. Underlying original site soils, particularly below the ground water table may well be acid sulfate soil or potential acid sulfate soil material.

6.5 Summary and Findings and Preliminary Recommendations

Any aspects of the proposed development which have the potential for lowering the local groundwater table may have significant local impacts through acid sulfate soil processes. Acid sulfate soils impacts would require careful consideration if any groundwater lowering was to result from the development. It is recommended that such works be avoided wherever possible.

The combination of the geomorphic setting and past management activities result in a significant risk of acid sulfate soils issues. Further investigation of the characteristics of underlying soil materials and required management measures for any affected spoil from deep site excavation (foundations and service trenches in particular) will therefore be necessary. These should be conducted in accordance with ASSMAC (1998) guidelines and Port Macquarie-Hastings Council DCP 34 *Acid Sulfate Soils* (2006).

Management of any excavated acid sulfate soil on the site would most likely comprise of the separate stockpiling of the material; incorporation of lime at rates determined through laboratory testing; and then use of the material as site fill or removed from the site as fill for off-site purposes. These conventional engineering solutions are frequently applied in similar situations and any acid sulfate material that may be located beneath the site is not considered to present any limitation in light of the proposed expansion and partial redevelopment.

7 References

Acid Sulfate Soil Management Advisory Committee (ASSMAC, 1998). *Acid Sulfate Soil Manual*.

Department of Minerals and Energy. Geological Survey of NSW (1970). Hastings 1 : 250 000 Geological Series Sheet SH 56-3 (Edition 1).

NSW Department of Environment and Climate Change (DECC) (2007). *Practical Consideration of Climate Change*.

NSW Department of Housing (1998). *Managing Urban Stormwater – Soils and Construction.* (3rd edition).

NSW Government, 2001. *Floodplain Management Manual: the management of flood liable land.*

Patterson Britton and Partners Pty Ltd (2006) *Hastings River Flood Study*

Water Services Association of Australia (2002) *Water Supply Code of Australia; Second Edition*

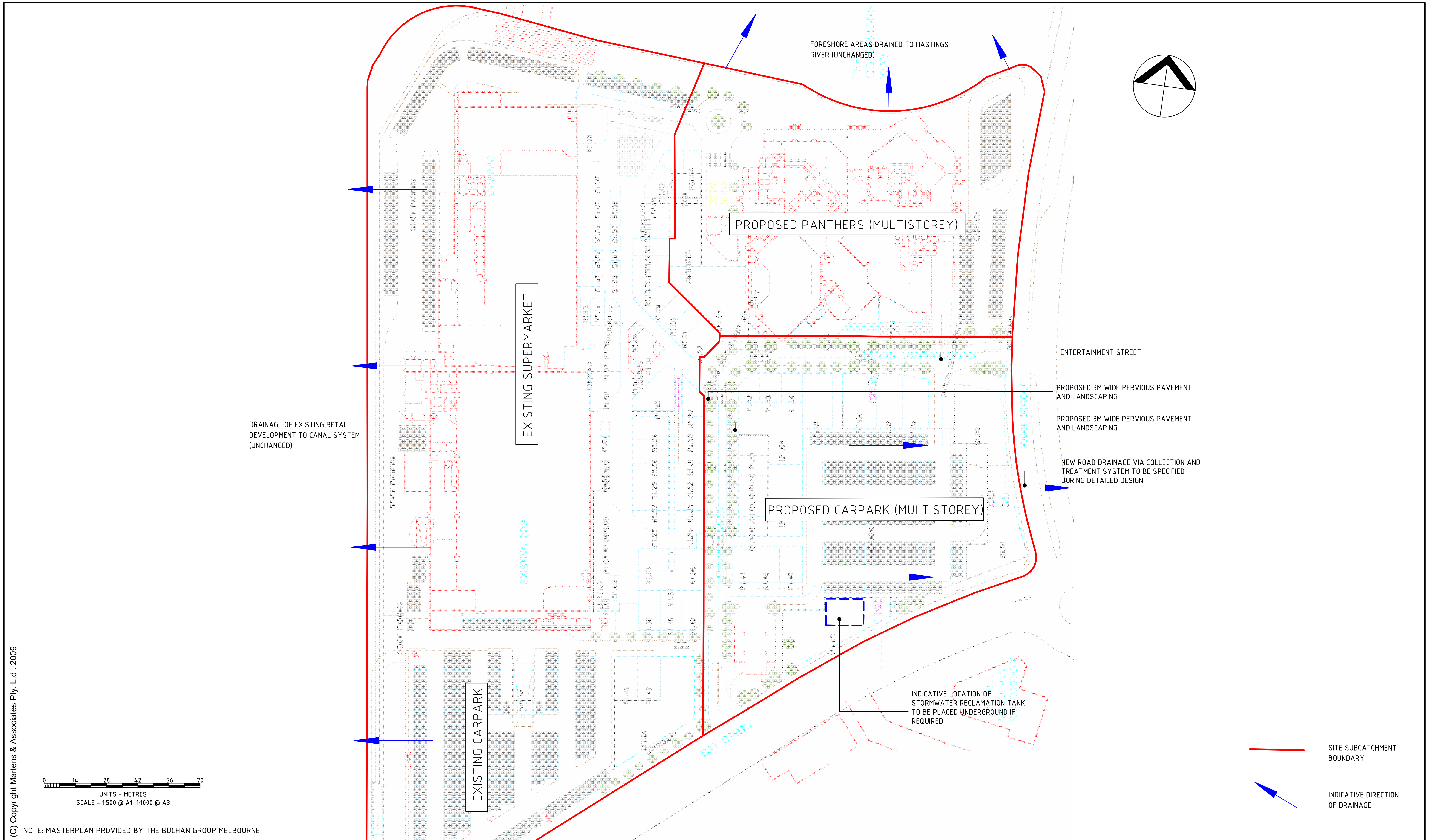
Water Services Association of Australia (2002) *Sewerage Code of Australia; Second Edition*

Attachments

Attachment A: Stormwater Management Concept Plan

Attachment B: Hydraulic Modelling Results

8 Attachment A – Stormwater Management Concept Plan



martens

6/37 Leighton Place
Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999
Fax: (02) 9476 8767
Email: mail@martens.com.au
Internet: http://www.martens.com.au

MARTENS & ASSOCIATES PTY LTD

Sustainable Solutions

Environmental - Geotechnical - Civil
Hydraulic - Wastewater Engineers

CLIENT/ PROJECT: MANIDIS ROBERTS

THIS PLAN MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED BY PRINCIPAL CERTIFYING AUTHORITY
All measurements in mm unless otherwise specified.

TITLE: HYDRAULIC MODELLING RESULTS; SETTLEMENT CITY SHOPPING CENTRE; PORT MACQUARIE

PROJECT MANAGER: ANDREW NORRIS

DRAWING NUMBER: P0902316JD02_v1

DESIGNED:	DATUM:	SHEET
MLB	mAHD	1
DRAWN: MLB	HORIZONTAL RATIO: 1:500 @ A1 1:1000 @ A3	OF 1 SHEETS
REVIEWED: AN	VERTICAL RATIO: 1:500 @ A1 1:1000 @ A3	PAPER SIZE: A1 / A3

REV.	DESCRIPTION	DATE	ISSUED
1	DRAFT	13.02.2009	AN

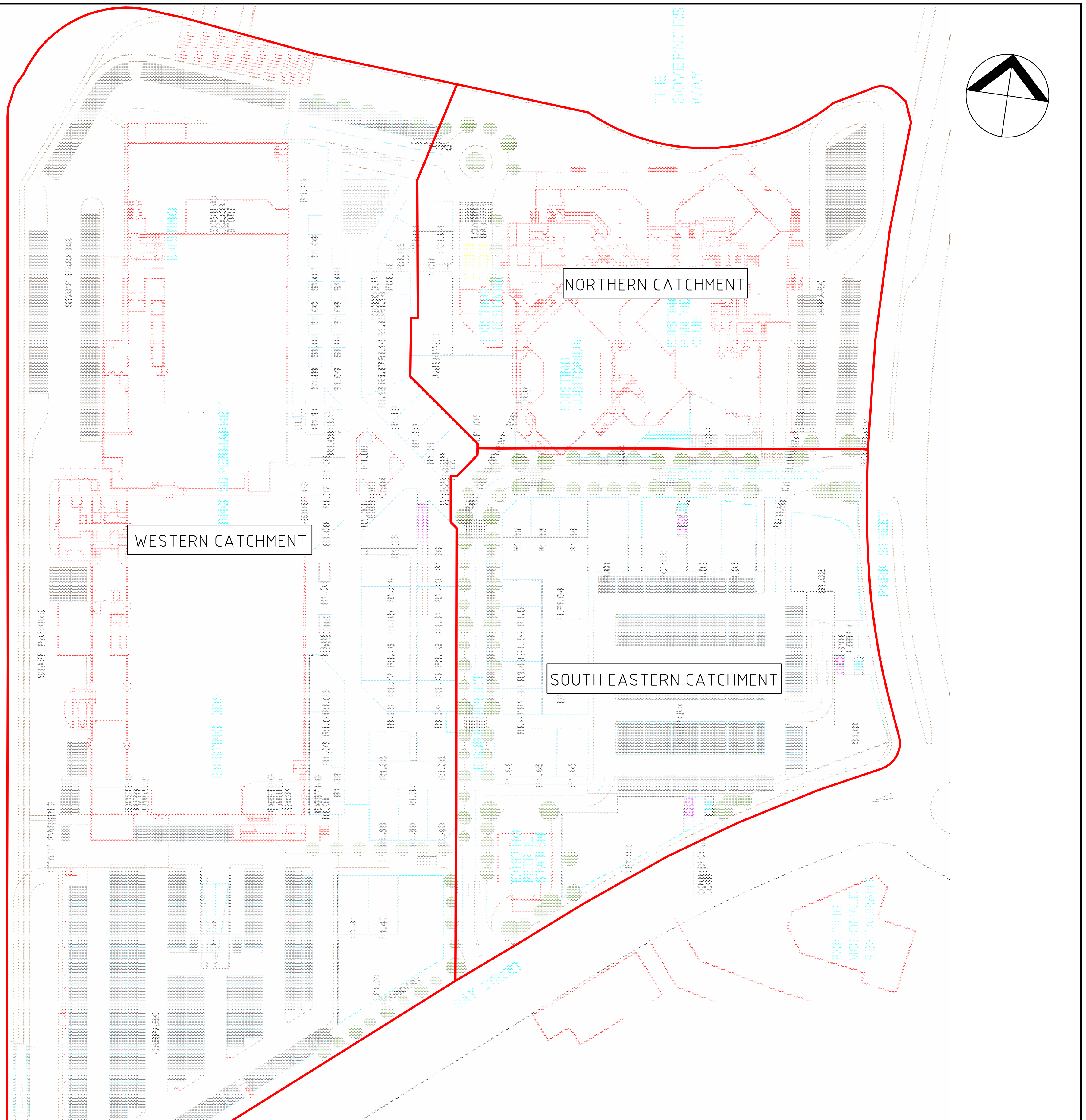
9 Attachment B – Hydraulic Modelling Results

CATCHMENT DETAILS					TIME OF CONCENTRATION	
SCENARIO	CATCHMENT NAME	CATCHMENT AREA	IMPERVIOUS AREA	PERVIOUS AREA	IMPERVIOUS	PERVIOUS
		(ha)	%	%	(min)	(min)
EXISTING	Nothern Catchment	1.393	98	2	9	9
	Western Catchment	4.257	98	2	13	13
	Existing Sth Eastern	1.596	96	4	9.5	9.5
PROPOSED	Western Catchment	4.257	98	2	13	13
	Northern Catchment	1.393	98	2	9	9
	Post Dev Sth Eastern	1.596	92	8	9.5	9.5

HYDRAULIC MODELLING RESULTS - 5 YR ARI					
SCENARIO	CATCHMENT NAME	MAX FLOW Q	MAX FLOW IMPERVIOUS	MAX FLOW PERVIOUS	SIGNIFICANT STORM
		(cu.m/s)	(cu.m/s)	(cu.m/s)	
EXISTING	Nothern Catchment	0.548	0.543	0.006	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Western Catchment	1.477	1.464	0.013	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Existing Sth Eastern	0.616	0.604	0.012	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
PROPOSED	Western Catchment	1.477	1.464	0.013	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Northern Catchment	0.548	0.543	0.006	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Post Dev Sth Eastern	0.603	0.579	0.024	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1

HYDRAULIC MODELLING RESULTS - 20 YR ARI					
SCENARIO	CATCHMENT NAME	MAX FLOW Q	MAX FLOW IMPERVIOUS	MAX FLOW PERVIOUS	SIGNIFICANT STORM
		(cu.m/s)	(cu.m/s)	(cu.m/s)	
EXISTING	Nothern Catchment	0.748	0.737	0.011	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Western Catchment	2.013	1.989	0.025	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Existing Sth Eastern	0.844	0.821	0.023	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
PROPOSED	Western Catchment	2.013	1.989	0.025	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Northern Catchment	0.748	0.737	0.011	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Post Dev Sth Eastern	0.833	0.786	0.047	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1

HYDRAULIC MODELLING RESULTS - 100 YR ARI					
SCENARIO	CATCHMENT NAME	MAX FLOW Q	MAX FLOW IMPERVIOUS	MAX FLOW PERVIOUS	SIGNIFICANT STORM
		(cu.m/s)	(cu.m/s)	(cu.m/s)	
EXISTING	Nothern Catchment	0.935	0.92	0.015	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Western Catchment	2.553	2.517	0.037	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Existing Sth Eastern	1.06	1.026	0.033	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
PROPOSED	Western Catchment	2.553	2.517	0.037	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Northern Catchment	0.935	0.92	0.015	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Post Dev Sth Eastern	1.05	0.984	0.067	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1



0 14 28 42 56 70

UNITS - METRES

SCALE - 1:500 @ A1 1:1000 @ A3

NOTE: MASTERPLAN PROVIDED BY THE BUCHAN GROUP MELBOURNE

martens

6/37 Leighton Place
Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999
Fax: (02) 9476 8767
Email: mail@martens.com.au
Internet: http://www.martens.com.au

MARTENS & ASSOCIATES PTY LTD

Sustainable Solutions

Environmental - Geotechnical - Civil
Hydraulic - Wastewater Engineers

CLIENT/ PROJECT: MANIDIS ROBERTS

THIS PLAN MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED BY PRINCIPAL CERTIFYING AUTHORITY
All measurements in mm unless otherwise specified.

TITLE: HYDRAULIC MODELLING RESULTS; SETTLEMENT CITY SHOPPING CENTRE; PORT MACQUARIE

PROJECT MANAGER: ANDREW NORRIS

DRAWING NUMBER: P0902316JD01_v1

DESIGNED: MLB | DRAWN: MLB | REVIEWED: AN

DATUM: mAHD | HORIZONTAL RATIO: 1:500 @ A1 1:1000 @ A3 | VERTICAL RATIO: 1:500 @ A1 1:1000 @ A3

SHEET 1 OF 1 SHEETS | PAPER SIZE: A1 / A3

REV.	DESCRIPTION	DATE	ISSUED
1	DRAFT	13.02.2009	AN