GILBERT+SUTHERLAND
agriculture · water · environment

December 12, 2008

Winten Property Group
PO Box 2578
Southport Q 4215

Attention: Mr Dale Holt

Dear Dale,

RE: PRELIMINARY ASSESSMENT – SEA LEVEL RISE IMPACT ON GROUND WATER RELATIONSHIPS UNDER FILL ZONES, MOONEE GLADES DEVELOPMENT, MOONEE BEACH NORTH, COFFS HARBOUR, NEW SOUTH WALES

Further to your discussions on November 28, 2008 with Phil Matthew and Alan Genn of our Robina office, we have reviewed the 'key issues unresolved' put forward by the NSW Department of Planning in its October 30, 2008 correspondence. As you are aware, this correspondence identified a 0.91m sea level rise by 2100 and requested further consideration of this sea level rise on the water tables present on site.

In consideration of the issues relating to rising sea level and the impact on ground water we have prepared the following assessment. However, in summary our findings are:

- The water table detected by the test pits and bores is a perched water table lying over water flow constraining layers of clay and coffee rock.
- The water flow constraining layers are within 1.6 m of the soil surface.
- The estimated 2100 mean high water springs (MHWS) and mean high water (MHW) is lower in elevation (>0.6 m) than these constraining layers.
- Consequently, the estimated 0.91m rise in sea level by 2100 will not impede drainage from the perched water table.

Data sources

The information used for this response was obtained from the following reports:

- WBM Oceanics 2005, *Moonee Creek Estuary Process Study Final Report,* February 2005.
- Coffey Geosciences Pty Ltd 2005, *Resource Design and management proposed subdivision at North Moonee Beach Pacific Hwy Moonee Beach NSW, Geo-technical Assessment,* Report No. CH1173/1-AM, December 16, 2005.
- Coffey Geosciences Pty Ltd 2006, *Results of Groundwater Monitoring,* Ref No. CH1173/1AN, June 26, 2006.
- Gilbert & Sutherland 2007, *Revised Stormwater Assessment, The Glades Moonee Beach, Moonee Beach North, Coffs Harbour*, Report No. GJ0399-1_SWA_RFA7F.

Test pit and bore logs from prior investigations on site were provided by Winten Property group. Contour information was provided by Auspacific Engineers and meteorological data was accessed from the Commonwealth Bureau of Meteorology climate data web site.

Gilbert & Sutherland Pty Ltd
ABN 56 077 310 840
Eastside 5/232 Robina Town Centre Drive
PO Box 4115, Robina, Queensland 4230
T.07 5578 9944 F.07 5578 9945
gsrobina@groupgs.com

Method

To establish the probable impact of sea level rise we adopted the following procedure:

- Estimate the modelled seas level rise of 0.91m in relation to mean high water springs (MHWS) and mean high water (MHW).[1]
- Review the test pit and borehole bore logs of investigations undertaken in areas associated with the fill areas of the site.
- Identify constraining layers within the soil profiles that would act as an aquitard or aquiclude.
- Aquitard or aquiclude[2] type and water barrier layers were identified by;
    - layer characteristics that pose a significant impediment to saturated hydraulic conductivities such as the presence of coffee rock or significant amounts of plastic clays,
    - borelog water content assessments that indicate a slowing of water movement such as drier soil layers underlying water logged or very wet layers.
- Establish the water table location in relation to any constraining layers.
- Compare the resultant sea level height after sea level rise with the location of the groundwater and the constraining layers.

Outcomes

Sea level rise

The Moonee Creek Estuary processes study identified a MHWS near the proposed development site as 0.438m (AHD) and MHW of 0.396 m (AHD).[3] The study used a monitoring site adjacent to the confluence of Skinners and Moonee creeks to derive the estimates of the tide levels. As a conservative measure of the increase in tide level, a uniform 0.91m was added to the existing estimates of MHWS and MHW to give 1.348 and 1.306m AHD respectively.

Fill zone area groundwater

The test pit and bore logs used for the analysis is attached in addendum 1. The locations of the test pits and bores are shown in Drawing No GJ0793_2.1. A summary of the preliminary analysis is outlined in Table 1 (following page).

South-eastern fill zone

The data indicates there is a watertable that is close (< 1.0m NSL) to the soil surface throughout the south-eastern section of the fill zone. However, there is coffee rock and high clay layers beneath the water table that constrains the deeper percolation of the groundwater.

Typical cross-sections of the in-situ material are shown in Drawing GJ0793_2.2 and show a wide distribution low permeability coffee rock and clays. The nature of the material suggests there is a separation of the shallow water table detected during the construction of the test pits and bores and the deeper layers of the in-situ material on site.

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[1] MHWS and MHW levels establish the groundwater regime in the longer term rather than higher high water spring solstices (HHW(SS)) or highest astronomical tide (HAT) which are short term peaks. The DECC guideline on flood plain risk management does not specify a analysis height for groundwater assessment.

[2] Aquitard retards but does not arrest groundwater transfer; Aquiclude absorbs groundwater but impedes onwards transfer. Water barriers are materials such as coffee rock, hard rock or dry clays (etc) adjacent to wet or moist materials.

[3] WBM Oceanics 2005 *Moonee Creek Estuary Process Study Final Report* Feb 2005 Table 3.2 page 3-5.

Table 1 – Bores and test pits in fill zone, height (m AHD) of the ground surface, water tables and constraining layers

Log No.	Surface AHD (m)	Water level NSL (m)	Water level AHD (m)	Constraining layer NSL (m)	Constraining layer AHD (m)	Constraining layer material
South-east fill zone						
11 [4]	3 (2.0)[6]	dry	dry	0.8	2.2	heavy clay
13 [1]	3 (2.0)	0.2	2.8	1	2	coffee rock
15	3.2 (2.0)	0.8	2.4	1.2	2	coffee rock
16	3.2 (2.0)	0 [7]	3.2	1.5	1.7	heavy clay
18	3.3 (2.0)	0.4	2.9	1.2	2.1	sandy clay
19	3.1 (2.1)	0.4	2.7	1.6	1.5	clay
20	3.2 (2.4)	0	3.2	1.4	1.8	heavy clay
34	3.2 (2.0)	0	3.2	nil	nil	nil
40	3 (2.1)	0	3	1.2	1.8	silt clay
tp6 [5]	3		2.5 [2]	0.5	2.5	sandy clay -
BH5	3.1(5.0)		2.74 [3]	0.3	2.8	sandy clay
BH4	3.15 (4.4)		2.84 [3]	1.4	1.75	clay
BH3	3.35 (4.3)		3.05 [3]	1.5	1.85	clay
South-west fill zone						
11	3 (2.0)	dry	dry	0.8	2.2	heavy clay
9	3.5 (1.3)	dry	dry	0.4	3.1	heavy clay
3	3.1 (2.0)	dry	dry	0.5	2.6	heavy clay
5	3.7 (2.2)	dry	dry	0.5	3.2	clay
1	3 (2.0)	dry	dry	0.3	2.7	clay
33	3.9 (2.1)	dry	dry	0.2	3.7	heavy clay
BH1	3.65 (5.0)		3.59	1.5	2.05	clay (dry)
BH2	2.95 (5.0)		2.84			wet clay throughout
North-east fill zone						
21	4 (2.0)	dry	dry	0.2	3.8	heavy clay
23	3.5 (3.0)	dry	dry	0.2	3.3	silt clay
24	4.2 (2.0)	dry	dry	0.2	4	silt clay

Notes:
1 Error in record of RL AHD in EASystems log pit 13 and corrected using data from Coffey bore holes BH3 and 4 and contour data from Auspacific Engineers Pty Ltd.
2 TP 6 from original logs Coffey Report no. CH1173/1-AM.
3 Water level heights from monitoring program and report No. CH1173/1AN and correspond to highest recorded water table heights March 27, 2006.
4 Underlined log numbers are from EASystems test pit and bore logs, data collected May 27, 2008.
5 Italic log numbers are Coffey logs from Coffey Report no. CH1173/1-AM.
6 Number in brackets is the depth of excavation (m) NSL.
7 Water table at surface.

The identified shallow water table is related to the onsite localised recharge. The effluent zone for this shallow water table will be Moonee Creek at a similar level as the expression of the constraining layers in the creek bank.

The logs also identify a sandy pocket of material in the location of test pit 34. The sections shown in Drawing GJ0793_2.2 show that this sandy material appears to be surrounded by the low permeability clays and coffee rock and does not have a direct connection to the tidal waters of Moonee creek. The confining layers effectively separate the permeable surface and sand pocket layers from the influence of the creek.

The deep borehole (BH3) shows a sand to 1.5m (NSL) and high plasticity grey brown clay below to the termination of the hole at 4.3m (NSL). The colour and moisture content indicates the clay is at worst, suffering seasonal short-term waterlogging.[4] However the construction log of the bore shows the sand packing intercepting a wet sand layer (0.4 to 1.5m NSL). The recorded water level on the log coincides with the top of the wet sand layer. This strongly suggests the water table detected and measured in this bore is the shallow sand and not a deeper water-bearing material. Deep borehole (BH4) shows the same outcome.

Deep borehole (BH5) shows a dry grey clay with high plasticity starting at 1.5m (NSL) to a depth of 4.5m (NSL). At depth this layer changes colour to red/purple. The dryness and the colour indicates a high oxidation state and no or very infrequent waterlogging. The origin of the water measured in the borehole is unknown. Nevertheless if the water comes from the layer at the termination point of the borehole, the dry clay forms an effective barrier to the progress of the water table higher in the soil profile. In an undisturbed state the water table will be held at depth and not affect the development. Alternatively, If the water is gaining ingress to the borehole from the zone above the dry layer, the water is part of a shallow groundwater table perched above the dry clay and reflects the situation shown by the other test pits and boreholes.

The relationship between a 0.91m sea level rise and the shallow water table and constraining layers is shown in Table 2 (next page). The new sea level is significantly lower than both the constraining layers and the water table height. The expectation is that the shallow groundwater will not be affected by the sea level rise as the effluent zone for these ground waters is above the 2100 MHWS.

Irrespective of the shallow water table and constraining layers, the logs indicate sandy layers in the surface 0.5 to 1.2m of the in-situ soils that will be retained under the fill platform. This will ensure an effective drainage layer separating the low permeability clays and the fill platform. This separation will impede the movement of any ground waters into the fill platform (lateral drainage in the sand will be greater than vertical percolation in the compacted fill platform).

Groundwater that emerges at the soil surface outside of the fill platform area will drain to the creek. The land surface will have an elevation (>1.6m) above the estimated 2100 MHWS and MHW, (i.e. the site will drain).

[4] Seasonal water logging is normally associated with shallow perched water tables over clays or some other similar constraining layer and is a function of the poor internal drainage of the constraining layer.

Table 2 – South east fill zone height difference (m) between estimated 2100 MHWS and MHW and the constraining layer, water table and ground surface levels (positive values indicates higher than 2100 sea level and negative values lower than 2100 sea level)

Log No.	Constraining layer (m)		Water table ht (m)		Ground surface (m)	
	MHW	MHWS	MHW	MHWS	MHW	MHWS
11 [1]	0.894	0.852	dry	dry	1.694	1.652
13[5]	0.694	0.652	1.494	1.452	1.694	1.652
15	0.694	0.652	1.094	1.052	1.894	1.852
16	0.394	0.352	1.894	1.852	1.894	1.852
18	0.794	0.752	1.594	1.552	1.994	1.952
19	0.194	0.152	1.394	1.352	1.794	1.752
20	0.494	0.452	1.894	1.852	1.894	1.852
34	ID	ID	1.894	1.852	1.894	1.852
40	0.494	0.452	1.694	1.652	1.694	1.652
tp6 [2]	1.194	1.152	1.194	1.152	1.694	1.652
BH5	1.494	1.452	1.434	1.392	1.794	1.752
BH4	0.444	0.402	1.534	1.492	1.844	1.802
BH3	0.544	0.502	1.744	1.702	2.044	2.002

Notes:
1 Underlined log numbers are from EASystems - data collected May 27, 2008.
2 Italic log numbers are Coffey logs from Coffey Report no. CH1173/1-AM.
ID = indeterminate level – no constraining layers found, however, site may have sampled a sand infill that is separated from the creek by the surrounding clay layers and coffee rock.

Table 3 – South west fill zone height difference (m) between estimated 2100 MHWS and MHW and the constraining layer, water table and ground surface levels (positive values indicates higher than 2100 sea level and negative values lower than 2100 sea level)

Log No.	Constraining layer (m)		Water table ht (m)		Ground surface (m)	
	MHW	MHWS	MHW	MHWS	MHW	MHWS
11 [1]	0.894	0.852	dry	dry	1.694	1.652
9	1.794	1.752	dry	dry	2.194	2.152
3	1.294	1.252	dry	dry	1.794	1.752
5	1.894	1.852	dry	dry	2.394	2.352
1	1.394	1.352	dry	dry	1.694	1.652
33	2.394	2.352	dry	dry	2.594	2.552
BH1 [2]	0.744	0.702	2.284	2.242	2.344	2.302
BH2	ID	ID	1.534	1.492	1.644	1.602

Notes:
1 Underlined log numbers are from EASystems test pit and bore logs data collected May 27, 2008.
2 Italic log numbers are Coffey logs from Coffey Report no. CH1173/1-AM.
ID = indeterminate level (see text).

[5] Even though pit 13 surface RL AHD was estimated, the height estimation erred on the conservative by allocating a lower elevation than its most probable height.

South-west fill zone

The EASystem logs show soil profiles to 2m (NSL) that show high clay, low permeability materials with orange and red mottles indicating significant times of oxidising activity and short term seasonal waterlogging. Logs 1 and 5 show dry clay material at depth further reinforcing this conclusion. Log 33 also shows weathered rock and Log 9 records backhoe refusal at 1.3m (NSL). No water table of any consequence is identified by the EASystems logs.

Deep borehole (BH1) shows a dry grey to pale brown clay of high plasticity. This layer has similar characteristics to those shown in BH3 and BH4 and suggests a barrier to the movement of water (either from the surface to deeper into the profile or rise of water to the surface from deep in the profile).

BH2 is located less than 10m from a drain and standing water body. It is located outside of the fill zone and the water table associated with this borehole will have no impact on the fill. In addition, the location of BH2 being adjacent to the drain and pond indicates it may be detecting seepage from these features.

Table 3 (previous page) shows the relative height difference between the bore log features (constraining layer, water table and ground surface) and the estimated 2100 MHWS and MHW. The constraining layers water table and land surface are all significantly higher than the estimated sea level rise. Sea level change will have no impact on the subsurface water flows in the fill zone.

North-east fill zone

The logs of the test pits and boreholes in this area do not indicate a water table of any consequence to the fill zone. Heavy clays of high plasticity with many red and yellow mottles indicate significant times of high oxidation with short periods of seasonal waterlogging. This is reflective of seasonal water logging of short duration due to the impeded drainage (low saturated conductivity) of the clay materials.

Table 4 shows the water constraining layers and ground surface are significantly higher (>1.9m) than the estimated 2100 MHWS and MHW. The water movement processed for the site will be dominated by quick flow or surface flow and subsurface water movement will be of no impact to the fill zone.

Table 4 – North east fill zone height difference (m) between estimated 2100 MHWS and MHW and the constraining layer, water table and ground surface levels (positive values indicates higher than 2100 sea level and negative values lower than 2100 sea level)

Log No.	Constraining layer (m)		Water table ht (m)		Ground surface (m)	
	MHW	MHWS	MHW	MHWS	MHW	MHWS
21 [1]	2.494	2.452	dry	dry	2.694	2.652
23	1.994	1.952	dry	dry	2.194	2.152
24	2.694	2.652	dry	dry	2.894	2.852
24	2.694	2.652	dry	dry	2.894	2.852

Notes:
1 Underlined log numbers are from EASystems test pit and bore log data collected May 27, 2008.

Conclusions

The preliminary analysis suggests the estimated 0.91m sea level rise by 2100 will have little or no impact on the groundwater regime of the land under the fill zones described by the development proposal. This outcome is because the expected effluent zones for the shallow groundwater (as indicated by the water constraining layers) are above the estimated sea level. In addition the water tables at their highest levels (and closest although not within the fill material) are significantly higher than the estimated sea level.

The fill activity will not interfere with the existing regime and no detrimental changes are expected. Where water tables are evident, such as in the area of the south eastern fill zone, surface sand layers should be retained to maintain the existing drainage regime and provide a drainage separation layer between the in-situ material and the proposed compacted fill.

We trust this is acceptable. Please do not hesitate to contact this office if you require any further details or elaboration.

Yours faithfully,
Gilbert & Sutherland Pty Ltd

fa **Allan Genn**
Principal Engineer

Phil Matthew
Principal Agricultural Scientist

Base plan source: Auspacific Engineers Pty Ltd.

GILBERT+SUTHERLAND
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Eastside
5/232 Robina Town Centre Drive, Robina, Qld. 4226
Phone 55789944 Mobile 0418 760919 Fax 55789945

PROJECT

WINTEN PROPERTY GROUP

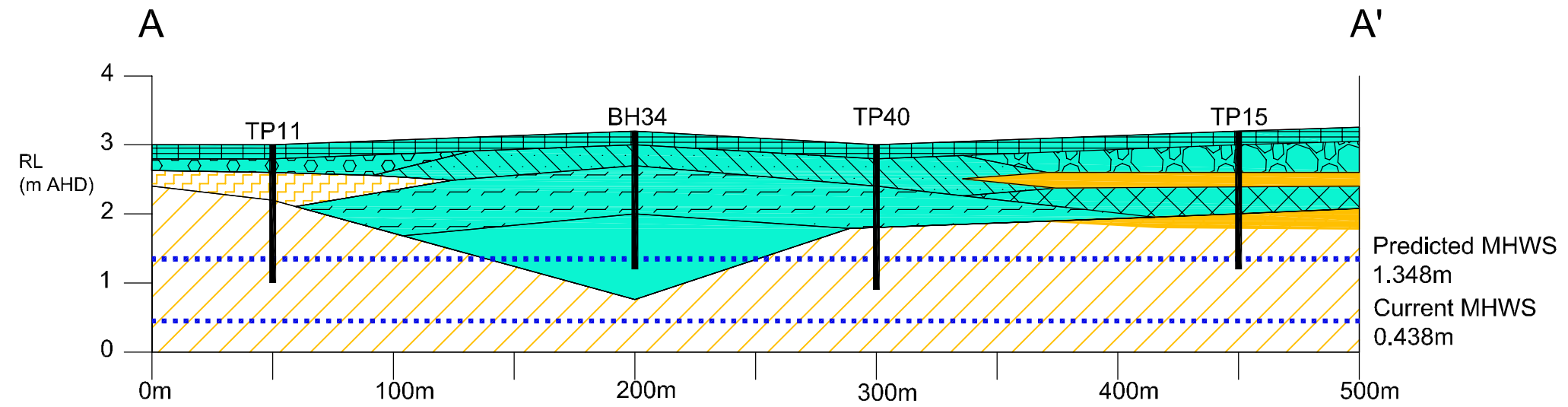
THE GLADES

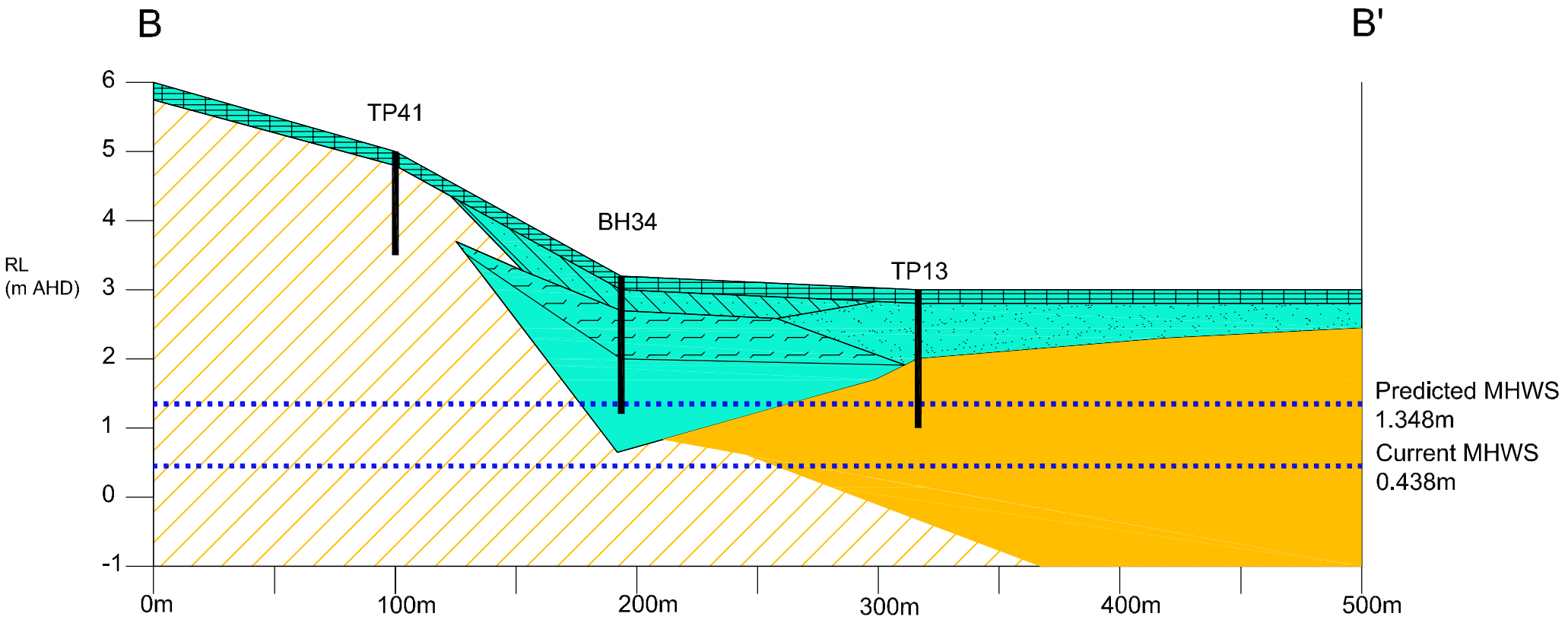
MOONEE BEACH, COFFS HARBOUR

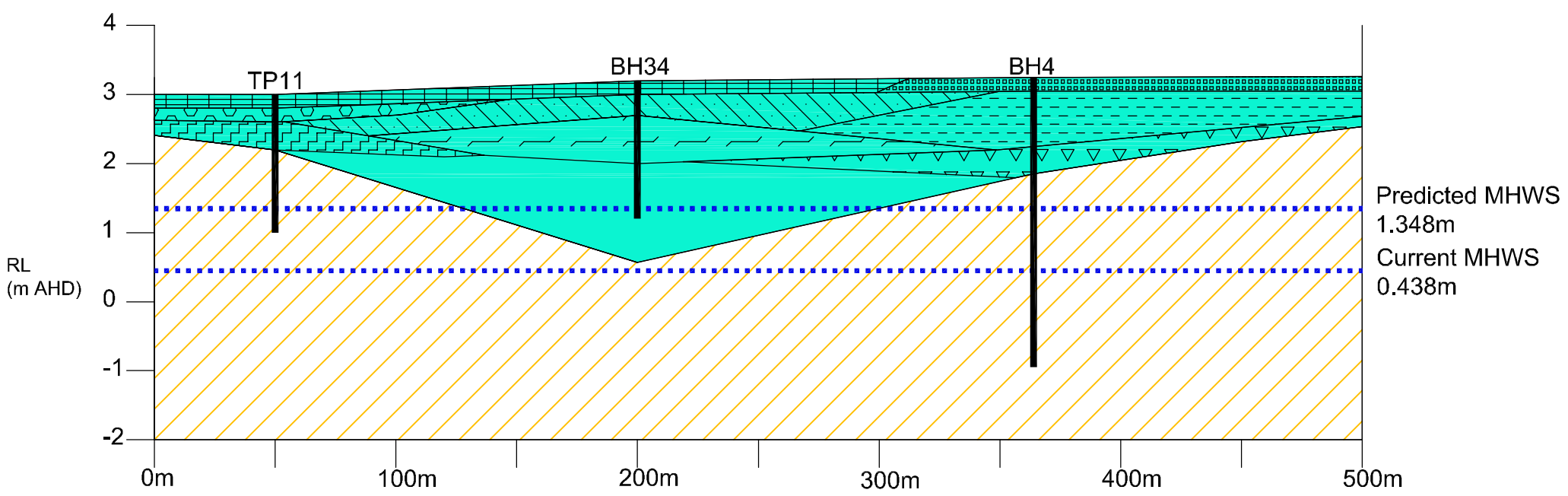
BOREHOLE, TEST PIT AND CROSS SECTION LOCATIONS

FIGURED DIMENSIONS TO BE READ IN PREFERENCE TO SCALING.	APPROVED	SCALE AS SHOWN	DRAWN K.T.
		DATE 11/12/08	CHECKED

DRAWING No. GJ0793_2.1







Low Permeability Layer

- Constraining Layer of Plastic Clays
- Grey Silty Clay
- Coffee Rock

High Permeability Layer

- Brown Fine Sand
- Dark Brown Sandy Loam
- Yellow Clayey Sand
- Dark Brown Clayey Sand
- Yellow Brown Silty Sand
- Light Brown Silty Sand
- Grey Yellow Sand
- Grey Sand
- Yellow Silty Sand
- White Silty Sand
- Pale Brown Sand

MHWS- Mean High Water Springs

Data Source: EASystem's logs (May 2008)
Coffey geotechnics (April 2004)

(Note: Representations are indicative, based on the available data.)

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Eastside
5/232 Robina Town Centre Drive, Robina, Qld. 4226
Phone 55789944 Mobile 0418 760919 Fax 55789945

PROJECT

WINTEN PROPERTY GROUP

THE GLADES

MOONEE BEACH, COFFS HARBOUR

INDICATIVE STRATIGRAPHIC SECTIONS A-A', B-B' AND C-C'

FIGURED DIMENSIONS TO BE READ IN PREFERENCE TO SCALING.	APPROVED	SCALE AS SHOWN	DRAWN K.T.
		DATE 10/12/08	CHECKED

DRAWING No. GJ0793_2.2

Addendum 1
EASystems test pit and bore logs

Profile ID: **TP11**

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G&S Job No.: GJ0793
Project: Moonee Glades ASS
Client: Rothwell Boys Pty Ltd
Northing: 6659507 Easting: 514773
Aspect: South Facing
Vegetation: Grass (Slashed)
Current Land Use: Grazing/Unused
Sampling Method: Backhoe

Depth (m): 2
Logged by: EASystems
Drilled by: EASystems
Date Started: 27/05/2008
Date Completed: 27/05/2008
Slope: Flats
Surface Drainage: Low drainage
R.L. at Surface: 3.0m AHD
Datum: GDA94(MGA Zone56)

Depth NSL(m)	Drilling: Method	Drilling: Graphic log	Soil Description: Material- soil type: plasticity or particle characteristics, colour, secondary or minor components	Soil Description: Moisture condition	Soil Description: Structure and additional observations (ie. odour, models, presence of roots, etc.)	Depth NSL(m)
			CSL , Dark brown clay sand loam (Topsoil)	M	Thick vegetation (grass) and roots	
			CLAYEY SAND , Yellow clayey sand	M	Roots	
.5			SILTY CLAY , Grey silty clay	M	Red mottling	.5
1.0						1.0
			HEAVY CLAY , Grey heavy clay	M	High plasticity	
1.5						1.5
2.0						2.0
2.5						2.5

Profile ID: **TP13**

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G&S Job No.: GJ0793
Project: Moonee Glades ASS
Client: Rothwell Boys Pty Ltd
Northing: 6659437 Easting: 514971
Aspect: South Facing
Vegetation: Grass (Slashed)
Current Land Use: Grazing/Unused
Sampling Method: Backhoe

Depth (m): 2
Logged by: EASystems
Drilled by: EASystems
Date Started: 27/05/2008
Date Completed: 27/05/2008
Slope: Flats
Surface Drainage: Low drainage
R.L. at Surface: 3.0m AHD
Datum: GDA94(MGA Zone56)

Depth NSL(m)	Drilling: Method	Drilling: Graphic log	Soil Description: Material- soil type: plasticity or particle characteristics, colour, secondary or minor components	Soil Description: Moisture condition	Soil Description: Structure and additional observations (ie. odour, models, presence of roots, etc.)	Depth NSL(m)
			SANDY LOAM , Dark brown sand loam (Topsoil)	M	Thick vegetation (sedge) and roots	
.5			SAND , Grey sand (fine)	W	Saturated and poor wet strength. Water moving through sand layer impeded at cemented Coffee Rock below. Wall collapse.	.5
1.0			CEMENTED SAND , Black Indurated cemented sand (Coffee Rock)	D	Poor strength, crumbly.	1.0
1.5			CEMENTED SAND , Dark brown cemented sand (Coffee Rock)	D	Poor strength, crumbly.	1.5
2.0						2.0
2.5						2.5

Profile ID: **TP15**

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G&S Job No.: GJ0793
Project: Moonee Glades ASS
Client: Rothwell Boys Pty Ltd
Northing: 6659626 Easting: 515136
Aspect: East Facing
Vegetation: Grass (Slashed)
Current Land Use: Grazing/Unused
Sampling Method: Backhoe

Depth (m): 2
Logged by: EASystems
Drilled by: EASystems
Date Started: 27/05/2008
Date Completed: 27/05/2008
Slope: Flats
Surface Drainage: Low drainage
R.L. at Surface: 3.2m AHD
Datum: GDA94(MGA Zone56)

Depth NSL(m)	Drilling: Method	Drilling: Graphic log	Soil Description: Material- soil type: plasticity or particle characteristics, colour, secondary or minor components	Soil Description: Moisture condition	Soil Description: Structure and additional observations (ie. odour, models, presence of roots, etc.)	Depth NSL(m)
			CSL , Dark brown clay sand loam (Topsoil)	M	Thick vegetation (sedge) and roots	
.5			SAND , Grey yellow sand	M	Roots	.5
			COMPACTED SAND , Black compacted sand (Coffee Rock)	D	Low strength, crumbly	
1.0			SILTY SAND , Light brown silty sand	W	Slightly yellow mottling, Saturated layer. Wall collapse	1.0
			COMPACTED SILTY SAND , Black compacted silty sand (Coffee Rock)	W	Low strength, crumbly	
1.5			HEAVY CLAY , Grey heavy clay	M	Micropores, yellow and orange mottling	1.5
2.0						2.0
2.5						2.5

Profile ID: **BH34**

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G&S Job No.: GJ0793
Project: Moonee Glades ASS
Client: Rothwell Boys Pty Ltd
Northing: 6659559 Easting: 514930
Aspect: East Facing
Vegetation: Grass (Slashed)
Current Land Use: Grazing/Unused
Sampling Method: Backhoe

Depth (m): 2
Logged by: EASystems
Drilled by: Coffee Geo
Date Started: 27/05/2008
Date Completed: 27/05/2008
Slope: Lower Slope
Surface Drainage: Moderate
R.L. at Surface: 3.2m AHD
Datum: GDA94(MGA Zone56)

Depth NSL(m)	Drilling: Method	Drilling: Graphic log	Soil Description: Material- soil type: plasticity or particle characteristics, colour, secondary or minor components	Soil Description: Moisture condition	Soil Description: Structure and additional observations (ie. odour, models, presence of roots, etc.)	Depth NSL(m)
			SANDY LOAM , Dark brown sandy loam (Topsoil)	W	Water on surface. Thick veg. (sedge) and roots	
			SILTY SAND , Brown silty sand	W	Saturated. Very low wet strength. Strong rotten egg smell	
.5						.5
			SILTY SAND , Yellow silty sand	W	Saturated. Very low wet strength. Yellow mottling. Strong rotten egg smell	
1.0						1.0
			SILTY SAND , White silty sand	W	Saturated . Very low wet strength.	
1.5						1.5
2.0						2.0
2.5						2.5

Profile ID: **TP40**

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G&S Job No.:	GJ0793	Depth (m):	2.1
Project:	Moonee Glades ASS	Logged by:	EASystems
Client:	Rothwell Boys Pty Ltd	Drilled by:	EASystems
Northing:	6659623 Easting: 514991	Date Started:	27/05/2008
Aspect:	East Facing	Date Completed:	27/05/2008
Vegetation:	Grass (Slashed)	Slope:	Lower Slope
Current Land Use:	Grazing/Unused	Surface Drainage:	Moderate
Sampling Method:	Backhoe	R.L. at Surface:	3.0m AHD
		Datum:	GDA94(MGA Zone56)

Depth NSL(m)	Drilling: Method	Drilling: Graphic log	Soil Description: Material- soil type: plasticity or particle characteristics, colour, secondary or minor components	Soil Description: Moisture condition	Soil Description: Structure and additional observations (ie. odour, models, presence of roots, etc.)	Depth NSL(m)
			SANDY CLAY LOAM , Dark brown sandy clay loam (Topsoil)	W	Water on surface. Thick veg. (sedge) and roots	
.5			SILTY SAND , Light yellow brown silty sand	MW	Saturated. Very low wet strength.	.5
1.0			SILTY SAND , Light yellow silty sand	W	Saturated. Orange mottling. Strong rotten egg smell. Wall collapse	1.0
1.5			SILTY CLAY , Grey silty clay	M	Orange mottles. Strong rotten egg smell.	1.5
2.0			SILTY CLAY , Grey silty clay	M	Large orange and red mottles. Strong rotten egg smell.	2.0
2.5						2.5

Profile ID: **TP41**

GILBERT+SUTHERLAND
agriculture - water - environment

G&S Job No.: GJ0793
Project: Moonee Glades ASS
Client: Rothwell Boys Pty Ltd
Northing: 6659642 Easting: 514889
Aspect: East Facing
Vegetation: Grass (Slashed)
Current Land Use: Grazing/Unused
Sampling Method: Backhoe

Depth (m): 1.6
Logged by: EASystems
Drilled by: EASystems
Date Started: 27/05/2008
Date Completed: 27/05/2008
Slope: Upper Slope
Surface Drainage: Well drained
R.L. at Surface: 5.0m AHD
Datum: GDA94(MGA Zone56)

Depth NSL(m)	Drilling: Method	Drilling: Graphic log	Soil Description: Material- soil type: plasticity or particle characteristics, colour, secondary or minor components	Soil Description: Moisture condition	Soil Description: Structure and additional observations (ie. odour, models, presence of roots, etc.)	Depth NSL(m)
			SILTY CLAY LOAM , Dark brown silty clay loam (Topsoil)	M	Thick vegetation (grass) and roots	
.5			MEDIUM CLAY , Yellow brown moderate clay	M	Well structured with 2% gravel (quartz, chert)	.5
1.0			HEAVY CLAY , Light brown heavy clay	M	Red mottles esp. adjacent to obvious micropores	1.0
			SILTY CLAY , Light grey silty clay	M	25% gravel (quartz & chert) and coloured mottles	
1.5			PARENT ROCK - MUDSTONE			1.5
2.0						2.0
2.5						2.5

Addendum 2
Coffey Geosciences test pit and bore logs

Engineering Log - Piezometer

Borehole No. **BH4**

Sheet 1 of 1

Office Job No.: **CH1173/1**

Client: **WINTEN PROPERTY GROUP**

Date started: **5.4.2004**

Principal:

Date completed: **5.4.2004**

Project: **PROPOSED DEVELOPMENT**

Logged by: **AGG/ELC**

Borehole Location: **REFER TO FIGURE 1**

Checked by:

Coffey

drill model & mounting:MD200 | Easting: | slope: -90° | R.L. Surface:

hole diameter: | Northing: | bearing: | datum:

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
ADV		C					1		CH	**CLAYEY SAND:** fine to medium grained, dark brown.	M		TOPSOIL
									SP	**SAND:** fine to medium grained, brown/orange			ALLUVIAL
									SP	**SAND:** fine to medium grained, brown.	M-W		
									SP	**SAND:** fine to medium grained, pale brown, some clay.	W		
							2		CH	**CLAY:** high plasticity, grey, some fine to medium grained sand.	M	St	RESIDUAL?
							3						Water level at time of drilling about 2m.
							4			Borehole terminated at 4.4m			
							5						
							6						
							7						
							8						

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

PIEZOMETER CH1173-1.GPJ COFFEY.GDT 12.16.05

Form GEO 5.10 Issue 3 Rev.0