

ECOAST HOMES PTY LTD

EASTMAN'S GREEN SUBDIVISION PENQUITE ROAD, NEWSTEAD

GEOTECHNICAL ASSESSMENT

ADDENDUM REPORT MAY 2011



Cover photo View looking towards the western slopes of the subdivision, on which three diamond drill holes were located and drilled in December 2010 and April 2011.

Refer to this report as

Cromer, W. C. (2008). Geotechnical Assessment Addendum Report, Eastman's Green subdivision, *Penquite Road, Newstead.* (Unpublished report for ECoast Homes Pty Ltd by William C. Cromer Pty. Ltd., 22 May 2011; 33 pages)

William C Cromer Pty Ltd may submit hard or electronic copies of this report to Mineral Resources Tasmania to enhance the geotechnical database of Tasmania.

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1 INTRODUCTION

1.1 BACKGROUND

ECoast Homes Pty Ltd is developing a 76-lot residential subdivision ("Eastman's Green") on about 6ha of land off Penquite Road in Newstead (Attachment 1).

In 2009, William C Cromer Pty Ltd was commissioned by the client via engineer M. van der Molen to prepare a geotechnical assessment of the property, with particular reference to the risk of slope instability in relation to residential dwellings. A geotechnical report was completed and recommended conditional development. Condition 16 on page 22 of the April 2009 report stated:

"Undertake a programme of diamond drilling on selected parts of the property. Its intent is to refine the geological model and slope stability assessment in relation to deep-seated slope instability. Further recommendations might arise as a result."

Accordingly, a three-hole diamond drilling programme was conducted in December 2010 and April 2011.

This is an addendum report to the April 2009 report, which describes the drilling programme, reviews its results, and offers recommendations for development of this part of the subdivision.

The reader is referred to the original report for a detailed presentation and discussion of the geology of the site, and its geotechnical (including slope stability) issues.

1.2 ATTACHMENTS TO THIS REPORT

Some of the following Attachments were included in the April 2009 report, and are repeated here with or without amendment.

- Attachment 1. Location of the proposed subdivision (1 page)
- Attachment 2. District and local geology (1 page)
- Attachment 3. Proposal plan and Google Earth imagery (1 page)
- Attachment 4. 1947 aerial photography of the area, showing 2010 2011 diamond drill hole locations (1 page)
- Attachment 5. Geotechnical sketch of the proposal showing topography, 2009 test pit locations, and 2010-2011 diamond drill hole locations (1 page)
- Attachment 6. Drill hole logs and site and core photograph (18 pages)
- Attachment 7. Interpreted geological map and cross sections cross sections (2 pages)





2 RESULTS

2.1 DIAMOND DRILLING

The diamond drill holes (Table 1) were located on the western slopes of the subdivision (Attachments 4 and 5), at elevations between about 35m and 41m, to investigate the evidence or potential for of deep-seated slope instability.

Details relating to each hole, including completion details, are presented in the engineering logs and core photographs in Attachment 6.

Each hole was completed as piezometers or monitoring bores using machine-slotted PVC screens, gravel pack and bentonite seals.

Table 1. Summary of diamond drill holes

	RL	Easting	Northing	Total depth (m)
DDH A	40.69	513916	5411014	20.0
DDH B	35.07	513962	5410874	18.5
DDH C	41.07	513945	5410939	20.0

2.2 STRATIGRAPHY

All three holes penetrated materials interpreted as Tertiary sediments – mainly sandstone and claystone, as follows:

DDH A

0 – 3m	Sandy clay (surface 0.6m is FILL; remainder is soil)
3 – 7m	Clay and Claystone
7 – 18m	Sandstone: weakly cemented
18 – 20m	Claystone

DDH B

0 – 0.8m	Sandy silt (soil)
0.8 – 10m	Clay
10 – 17m	Sandstone: weakly cemented
17 – 18.5m	Clavstone

DDH C

0 – 1.2m	Sandy silt (soil)
1.2 – 10.4m	Clay
10.4 – 13.3m	Sandstone: weakly cemented, and sand
13.3 – 16.2m	Claystone and sandstone
16.2 – 18.5	Sandstone

There is thus a rough correlation across the slope between the three holes (Attachment 7), with a near-surface clayey unit between 7 - 10m thick, overlying a sandstone unit of more variable thickness (about 3 - 11m) which in turn overlies claystone in DDH A and DDH B (but not DDH C which is located between them).





The sandstone and claystone may be correlated with similar materials exposed in test pits on lower slopes, but they could also simply be stratigraphic repetitions.

See Attachment 11 of the April 2009 report for a detailed discussion of the geology of the subdivision.

2.3 STRUCTURE

Sediments exposed in test pits in the subdivision exhibit variable dips (Attachment 5) and dip directions. Measured dips are in the range $5 - 30^{\circ}$, and dip directions range from SE to SW to W and NNE. The variability is unlikely to be due to original sedimentary angles, and is more likely to relate to basement form, folding, faulting and intraformational slumping rather than more recent slope instability.

The variability also suggested that angled diamond drilling to estimate true dip would add little to the overall structural picture. Core from the vertical diamond holes generally show low angle dips around 5° , but two instances of steep dips beneath subhorizontal dips were observed – at 14.4m in DDH B, and 10.5m in DDH C. Photographs of the cores near these depths are shown in Attachment 6.

In both instances the surface separating the two dip angles are interpreted as failure surfaces. In each instance, the failure surface and the materials above and below were of relatively high strength and weakly cemented, suggesting they are old features with no recent movement.

2.4 **G**ROUNDWATER

Groundwater was encountered in DDH A and DDH B. It is probably present also in DDH C, but the diamond hole was not completed. Instead, to test material type, strength and groundwater conditions without drilling with water, a hole was drilled with a solid auger next to DDH C to refusal at a depth of 14.5m. The driller reported very tight, dry clay from 10 - 14.5m, indicating the water table is deeper. This hole was cased, screened, gravel packed and bentonite-sealed.

During drilling DDH A, minor water losses occurred in sandstone in the interval 11.5 to 12.5m, and rapid losses were observed in sandstone in the interval 17.7 - 17.9m. Groundwater slowly entered the hole and three measurements between 2 December 2010 and 23 April 2011 showed a water table falling from 13.3m to 14.2m.

During drilling DDH B, water losses occurred in sandstone below about 12m. Groundwater slowly entered the hole and three readings between 2 December 2010 and 23 April 2011 showed a water table rising from the bottom of the hole at 18.5m, to 12.7m on 23 April 2011.

It appears a water table is present in the sediments at depths below about 12m or so.

2.5 MATERIAL STRENGTHS

Generally, the materials encountered in the diamond holes exhibited soil properties (remouldable in the hand, with or without adding water). Below the surface metre or so, clays and claystones were hard, and the sand and weakly cemented sandstone showed dense relative densities.

Standard penetration tests (SPTs) and pocket penetrometer readings were routinely conducted in each hole.





In DDH A, seven SPTs were done in the first 10.5m. N-values ranged from 10 near the surface, to 39 (bouncing) at 9m. The latter values in sand and weakly cemented sandstone indicate dense sand with relative densities in the 65 - 85% range. All values in clay indicate hard consistencies with undrained shear strengths above 200kPa. Pocket penetrometer readings on core were consistently above 400kPa below about 1.5m.

In DDH B, seven SPTs were done in the first 10.5m. N-values ranged from 9 near the surface, to 49 at 10.2m. The latter values in sand and weakly cemented sandstone indicate dense sand with relative densities in the 65 - 85% range. All values in clay indicate hard consistencies with undrained shear strengths above 200kPa. Pocket penetrometer readings on core were consistently above 300kPa below about 3m.

In DDH C, seven SPTs were done in the first 10.5m. N-values ranged from 20 near the surface, to 29 at 10.2m. The latter values in sand and weakly cemented sandstone indicate dense sand with relative densities in the 65 - 85% range. All values in clay indicate hard consistencies with undrained shear strengths above 200kPa. Pocket penetrometer readings on core were above 600kPa in the surface 4m or so, and mostly above 300kPa below about 4m.

3 **DISCUSSION**

In assessing the potential for deep seated slope instability on the western side of Eastman's Green subdivision, the following observations are relevant.

- Mineral Resources Tasmania (MRT) Landslide Hazard mapping shows that the higher, western parts of the proposal include both a fossil or old dormant landslide zone, and a fossil or old dormant landslide. The approximate locations of these features are shown here in Attachment 5, and were included in Attachment 5 of the April 2009 report.
- The same MRT maps show recent or active shallow landslides, and fossil or old dormant shallow landslides, near but not within the subdivision. Subsequent to the April 2009 report, land clearing on slopes below DDH A and DDH C exposed a topographic irregularity which appears to be a recent or dormant shallow landslide.
- There is no evidence of currently active deep-seated landsliding on or near the subdivision.
- Diamond drilling has revealed subsurface clay, claystone, sand and weakly cemented sandstone similar to materials exposed over the subdivision and in test pits. The materials are of relatively high strength.
- As discussed in the April 2009 report, examination of the dip directions and topographic slope directions over the subdivision indicate that there is no consistent relationship between them. Attachment 11 of the report stated: "This is significant from a slope stability viewpoint: if dip directions are similar to slope directions, it is possible the former are the result of slope failure. However, with the exception of pit N (where the dip and slope directions are effectively identical), dip directions on the Tertiary sediments differ by 45⁰ to 315⁰ from slope directions. This suggests their varied attitude is related to structural controls (basement form and post-depositional faulting, etc) rather than slope instability."
- Subhorizontal surfaces at around 14.4m in DDH B and 10.5m in DDH C separating disparate dip directions are interpreted as former failure surfaces. They are tight and sealed, suggesting ancient, not recent, deep seated movement.





4 **C**ONCLUSIONS

It is concluded that the diamond drilling programme conducted in accordance with Recommendation 16 of the April 2009 geotechnical report has revealed no significant geotechnical issues which would materially alter the potential for deep-seated slope instability on the western slopes of the subdivision.

5 **RECOMMENDATIONS**

Continued development of the subdivision should proceed in accordance with the recommendations of the April 2009 geotechnical report. In particular, recommendations 6 to 15 are particularly important on the steeper western slopes of the subdivision.

IN comment

W. C. Cromer Principal

22 May 2011

This report is and must remain accompanied by the following Attachments:

- Attachment 1. Location of the proposed subdivision (1 page)
- Attachment 2. District and local geology (1 page)
- Attachment 3. Original proposal plan and Google Earth imagery (1 page)
- Attachment 4. 1947 aerial photography of the area, showing 2010 2011 diamond drill hole locations (1 page)
- Attachment 5. Geotechnical sketch of the proposal showing topography, 2009 test pit locations, and 2010-2011 diamond drill hole locations (1 page)
- Attachment 6. Drill hole logs and site and core photograph (18 pages)
- Attachment 7. Interpreted geological map and cross sections (3 pages)





(1 page) Location of the proposed subdivision



Sources: Location: www.thelist.tas.gov.au; Satellite imagery: Google Earth





Attachment 2 (1 page) District and local geology



<u>Source</u>: Calver, C. R. and Forsyth, S. M (compilers) (2005). Map 3, Launceston – Geology. Tasmanian Landslide Hazard Series. Mineral Resources Tasmania. <u>Key to rock types</u> – Orange = Jurassic dolerite; Brown: Tertiary partly consolidated clay, silt, sand, clayey sand with rare lignite and gravel; Bright yellow = Late Cainozoic terrace deposits of gravel and sand alluvial materials; Light yellow = Quaternary talus; Yellow+blue dashes = Quaternary estuarine deposits

Site investigations confirm that most of the proposed subdivision (below) is underlain by partly consolidated sand (weakly cemented sandstone) and claystone of inferred Tertiary age. The balance along













(1 page) **1947 aerial photograph of the area, showing 2010 – 2011 diamond drill hole locations DDH A, DDH B AND DDH C** Mineral Resources Tasmania library: Launceston Run3 Print 20







(1 page) Geotechnical sketch map of the proposal showing topography, 2009 test pit locations, and 2010 – 2011 diamond drill hole locations DDH A, DDH B AND DDH C







(18 pages including this page) Drill hole logs and site and core photographs











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PCDRINB	roj ooi atu L iclii ear	jec rdir im nat ring	t E0 nates 51 54 GI 35 ion Ve	COAST 3962mE 10874 DA94 5.07m AS ertical	HOM E; mN SL	ES			Location Eastm Drill type Hydra Equipment 140mr 0- 10. wirelin Drill fluid(s) None and Li	an's G power m Hollov 0m, follo e (triple to 10.0n P2000 lu	w Auger owed by tubing) n, then v	age 3 su (HA) I HQ3 I vater I	Ibdivisi Hole sta Hole fini Drilled b Logged Checked	on, Penq inted 2 ished 3 by D K by W d by W	uite Road, L. December 20' arren Richards MR Drilling Pty J. C. Cromer J. C. Cromer	auncesto 10 10 50n 7. Ltd.
_	_	_	Drillin	a inform	ation				Rock subs	tance			Ro	ock mass	defects	
Bit type/size	Case type/size/lift	Fluid loss/water	Notes Samples, tests, unit weight (UW, g/cc) Visible reaction to 10% HCL A B C	20% Core 40% recovery 80% recovery	20% 40% 60%	RL (mAHD)	Inclined depth sa	Graphic log	Substance descript rock type, grain characterist colour, structure, minor compo	ion ics, inents	и Meathering	a c Est. strength	Nature of defects	Defect spacing (mm)	Defect description thickness, type, inclination, planarity, roughness, coating Signif, General	Completion details
	mu		pp = pocke penetrome (kPa)	erNo core orientation		-			Sandy SILT (SP/SM); grey; friable	dry;					A	
	65 65 33 65r		readings of core on sit pp300 pp300 pp400	toof used (vintical hole)		- 34	1-	10/01/	CLAY (CH): patchy grey and red, locally yellow orange an red; high plasticity, McPL; V: locally sandy; with occasion; purple-coated orange ironst clasts to 50mm; trace silt throughout; clayey sand porizon 2-2 2m	d Id St; al one		SPT 1 3, 3, 6 N = 9			No defects	
	35 65 33		pp100-200 pp300 pp300 pp350 po350			- 32	3-	1111	Clay becoming darker orang below 3m	e		SPT 2 5, 5, 9 N =14				ce: 0.1m stickup
	65 33 6		pp430 pp400			- 31	4-	1-	Clay light olive grey 4 to 4.2r Clay reddish orange	m		SPT 3 4, 6, 6 N = 12			Subhorizontal preferred partings about1cm apart	11.1mbg; cap at surfa
	65 33 65		pp550 pp350 pp400 pp450			- 30	5-	1711	Clay paling to light olive gre and light yellowish grey belo 5m	w		SPT 4 4,7,11 N = 18				threaded PVC casing 0 to
-	65 33 65		pp300			- 28	7-	1111				SPT 5 5, 8, 13 N = 21			No defects	Somm
	33 65		-	7.8 – 8.0m: core accident discarded	шy	- 27	8-	/ / }				SPT 6 5, 9, 11			8.6 to Bm: 2 x joints inclined at 700 to	
ŀ	65					- 26	9-	12	clayey sand lens at 9.3m			N = 20			stained; rough, planar	
rill = = = A = A = A	ling Tripi Blad Roll = S0	le tut tes ler/Tr blid a	be coring ricone uger	r core pieces d by the total	drilling breaks	Water 1 Init weight = >2.55) = 2 :10-2	E Le nt (UV B = 2 .25 E	vel V, g/cc) .40-2.55 = <2.10	H Inflow H Outflow	Sample R = SP D = Dis N = Sta pp = Ha	es and Note T penetratio turbed samp ndard Pene and penetron site Sheer	ts in refusal ple tration Test meter test Vane test	Soil Fine VS = S = S F = F St =	consistency grained soils Very Soft Soft Soft Stiff	Defects Joint Constant zone	Vein Crusi Zone
V = V = NAM	Bar	sildw sh bi buble Rota ft sing ed mel	auger oring tube coring ry hammer Fluid loss 50% lc 100%	QD (Rock Quality Designation In the sum of the lengths of 'sound' 100mm in a drilling run is divided	ore run lengtin. Expressed as %. leasured along centreline. Core (of included	A = r A = r B = p C = c D = c E = r Note: X Visually es op = Pock	eboun it (PQ lent (C rater noldat on lo timati et Pei eactio	test (RQ) (CQ) (CQ) (CQ) ble, friab g is ter ed. US = netrome n to 10	Approx. point load Approx. UCS MPa sts(50, MPa UCS MPa	SV = In CS = Ci Ux = 1 (xmm c Nd = SF Weather A = Mic B = Visi C = Sta D = Par E = Co (CDS)	undisturbed Undisturbed tiameter) PT and Disturbed tiameter) PT and Disturbed to fresh stal ually fresh s ined state(S thy decomp mpletely de	te (MFS) tate (VFS) tate (VFS) tate (PFS) tate (PFS) tate (PFS)	Solid Solid Solid Coan Fb = VY = DS) L = L MD = D = C	density index ard density index se grained soi Friable Very Loose oose • Medium Den Jense	A = Solid randou B = Solid refer C = Solid latent D = Non interse Is E = Intersecting Core loss Core loss Se Withow In Grap	EW seam n breaks (SR breaks (SLR) cting planes (open planes (open planes (interval kr loss (interval kr loss (interval kr h). Loss is sh





Willia	m C. Cron	ner Pty. I	Ltd. Er		ntal, e	Cored bor	water g	eologist	S		1	DDH B		
	rating the U	nified Roo		ification Sy	stem	(URCS) and Unified Soil Cla	ssificatio	ハC on System	n (USCS)		s	Sheet 2 of	2	
Proje Coore Datur RL Inclin Beari	ect E dinates 51 54 m Gl 35 ation Ve	COAST 3962mE 10874 DA94 5.07m AS ertical	HOME E; mN SL	ES		Location Eastm Drill type Hydraj Equipment 140mr 0-10. wirelin Drill fluid(s) None 1 and L/	an's Gr power m Hollow 0m, follo e (triple to 10.0m P2000 lu	v Auger wed by tubing) n, then w ubricant	(HA) HQ3 ater	Ibdivision Hole sta Hole fini Drilled b Logged Checked	n, Penq rted 2 shed 3 y D K by W I by W	uite Road, La December 201 December 201 arren Richards MR Drilling Pty I. C. Cromer I. C. Cromer	aunces 10 10 con 7. Ltd.	tor
	Drillin	q inform	ation			Rock subs	tance			Ro	ck mass	defects		_
Case type/size/lift	Notes Samples, tests, unit weight (UW, g/cc) Visible reaction to 10% HCL A B C	20% Core 40% recovery 80%	20% 60% 80% 80%	RL (mAHD) a anta Inclined depth s	Graphic log	Substance descript rock type, grain characterist colour, structure, minor compo	ion ics, nents	ара Meathering	а ро Est. strength в	A Nature of defects	Defect spacing (mm)	Defect description thickness, type, inclination, planarity, roughness, coating Signif. General	Completion details	
65 65 33 65mm	pp = pocke penetrome (kPa) readings of córe on sit pp300 pp300 pp400	er No core orientation tool used (vertical hole)		-25 ¹⁰ -	111124044	CLAY (CH): as above SANDSTONE: gray and yell orange flecked with cream; interbedded and finely laminated (1-2mm to 20-30m with wispy grey clay	ow Im)		SPT 7 5, 17, 30 N = 47	<u>NUUUU</u>		At 10.7- 10.8m, 2 x orange ironstone horizons	1. Sacielli 9.10.10.6440	
65 65 33	pp100-200 pp300 pp300 pp350 pp350 pp430 pp400	Standing w level 12.624 23 April 20	ater hbg 1	-23 ¹² - -22 ¹³ -	THE PARTY AND A PARTY	Below c12m, mainly orange; weakly cemented SAND: orange; trace-some s and clay; wet?; very soft SANDSTONE: orange streaked with yellow and dar prover: located	silt k					Near 13m, subhorizontal preferred and PVC casising 0 0 10 11 11 11 11 11 11 11 11 11 11 11	ut siots (1,1,1,1,1,1,1,1,1,1,1,1,1,1,1)	
65 65 33 65 6f	pp330 pp450 pp550 pp350 pp400 pp450			-21 ¹⁴ -	NH HAXXX	Ienses; weakly cemented; subhorizontal SANDSTONE: orange-yelloo interbedded with grey clay (0 steeply dipping 45-60°, with numerous offsets in opposite sense about 45° to horizontal becoming clayier below 16.8 clayey wisps subhorizontal b	w; CH); i; m; elow			-		to bedding At 14.4m, sealed clayey sand failure surface 5- 8mm thick dipping 1-2° Bedding in interval 14.5 17m dips c 45°	reen 11.1 to 13.1mbg. 0.4mm machine- 200m sand pack 13.351m 18.5mbg	
5 33 65 65 33 6	pp300	7.8 – 8.0m: core accidents discarded	Νy	-1916 - -1917 - -1817 -	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	CLAYSTONE: light yellow grading to grey flecked with black						x closed joint dipping 45°	50mm threaded PVC sor	
rilling	and 5 Dec	mbg.4 2010 22 76 £	E S W	ater Y I er	vel	End of hole at 18.5m as requ	ired Samples	s and Notes		Soil	onsistency	Defects		L
= Triple = Blade = Roller A = Solic A = Holle / = Wash T = Doul AM = Rc Case lift Lasse lift Barre	tube coring s d'auger to boring ble tube coring otary hammer Fluid loss ng No loss 100% lo	8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	iun migui. Expresseu as %. Cure reng ured along centreline. Core driling breat pluded B 5,0/2 H = H	it weight (UW = 22.55 B = 2. = 22.55 E = 2. = 22.10-2.25 E rength ammer impact A = rebound B = pit (PQ) C = dent (D D = crater () E = moldab te: X on log sually estimate = Pocket Pen	(, g/cc) 40-2.55 = <2.10 test d (RQ)) Q) CQ) le, friabl j is tes d, US = etromat	Approx. point load Approx. strength index UCS MPa 3 4 >103 2:4 55-103 1-2 1:2 21-55 0:2-1 0:2-5 7-21 rt t result. Otherwise, strength is 'Unconfined Compress Strength	R = SPT $D = Disto$ $N = Stam$ $pp = Har$ $SV = In-t$ $CS = Co$ $Ux = U$ $(x mm di$ $Nd = SP$ Weather A = Micn $B = Visu$ $C = Stain$ $D = PartI$ $F = Correctors$	penetration urbed sampl idard Peneth ind penetrom site Shear V re Sample Indisturbed Indisturbed Indisturbed inameter) T and Distur T and Distur ing o fresh state ally fresh state (ST y decomposi-	refusal e ation Test eter test ane test tube sample ted Sample e (MFS) ate (VFS) rS) sed state (PI	Fine (VS = S = S VSt = VSt = H = H Soil d Coars Fb = I VY = Coars Fb = I VY =	Irained soils Very Soft oft im Stiff ard Very stiff ard Very stiff ard Very stiff very Loose very Loose Needium Dense	A = Solid random B = Non intersecting a Core loss Core loss	Vei Cru Zon EW Bew Bew Seaks (SLE ting planes open planes sopen planes sopen planes sopen planes sopen planes	in ush ne V am RB s (5 3) s (2 s (1 kni nte





DDH B Core photos

ECoast Homes Pty Ltd: Eastman's Green subdivision, Penquite Road, Newstead 22 GEOTECHNICAL ASSESSMENT ADDENDUM REPORT 22 May 2011

Bax | er Core loss 00 1m 2m 3m 4m 5m 6m 7m Core loss 8m 9m 10m 11m 12.00 12m Core loss 13m 14m 15m 16m 17m 18m Ra 19m

















Willian	n C. Cror	ner Pty. I	Ltd. Er	ivironmer	ntal, e	engineering and ground	water g		ts	1	[DDH C		
Incorpora	ating the U	nified Roo	ck Class	ification Sy	stem	(URCS) and Unified Soil Cla	ssificati	on Syster	m (USCS)	-	S	Sheet 1 of	3	
Projec Coord Datum RL	ct E inates 5 ⁴ 54 G 41	COAST 3945mE 10938 DA94 1.07m AS	HOME ; mN L	ES		Location Eastm Drill type Hydra Equipment 140mr 0- 10. wirelin	an's G power n Hollo 0m, foll e (triple	w Auger owed by tubing)	age 3 sul H (HA) H HQ3 D	odivisi ole sta ole fin rilled b	on, Penq inted 6 ished 7 by D K	uite Road, La April 2011 April 2011 es and Camero MR Drilling Pty	on Ltd.	ston
Inclina Bearin	ation Ve	ertical			-	Drill fluid(s) None t and LF	to 10.0r 2 <i>000</i> li	n, then v ubricant	vater L C	ogged hecked	by W d by W	I. C. Cromer I. C. Cromer		_
	Drillin	g intorm	ation	r		ROCK SUDS	tance			R	CK mass	defects	-	-
Bit type/size Case type/size/lift Fluid loss/water	Notes Samples, tests, unit weight (UW, g/cc) Visible reaction to 10% HCL A B C	20% Core 40% recovery 80%	20% 80% 80%	RL (mAHD) metres	Graphic log	Substance descripti rock type, grain characteristi colour, structure, minor compo	on cs, nents	и Meathering	е Во Во Во Во Во Во Во Во Во Во Во Во Во	Dature of defects	Defect spacing (mm)	Defect description thickness, type, inclination, planarity, roughness, coating Signif, General	Completion details	Geol interp
HA 0 - 10.0m 33 65mm	pp = pocke penetrome (kPa) readings of core on sit pp>600	er No core celentation tool used (vertical hole)		401-		Sandy SILT (SP/SM); grey brown; nonplastic; dry; friable Silty CLAY, silty CLAYSTONE (CH): orange grading to olive grey; high plasticity; M< <pl; locall<br="" vst;="">with gravelly clay lenses and</pl;>	ə y		SPT 1 4, 8, 12 N = 20				cased. See Note page 3	Soi
65 33 65 65	pp600 pp600			- 39 ² -	11444	ironstone wisps; some black charcoal? or MnO2? In place with sandy clay and clayey sand horizons (high to moderate plasticity) Below about 2m, consists of finely interbedded olive grey high plasticity clay and fine- medium grained orange clay sand (SC)	es ey		SPT 2 4, 8, 10 N =18			No defects	Not	S
65 33 65	pp>600		÷	- 37 4 -	1 11 417 11				SPT 3 6, 10, 17 N = 27		1	stained partings; defects are clayey sandstone partings subhorizontal up to 30° to horizontal; also some drilling- induced partings parallel to bedding dipping <5°		solidated sediment
65 33 65	No pp; too many partings			- 36 ⁵ -	ノフラスノ	Some orange plant leaf impressions near 4.75m			SPT 4 6, 10, 15 N = 25			Subhorizontal dark orange, fractured ironstone coatings and horizons 2-		v-ade weakly cons
65 33 65	pp400 pp350 pp300 pp350			- 34 7 -	21114	Occasional quartzite fragmer to 3-5mm diameter	nts		SPT 5 6, 8, 12 N = 20					Tertiar
65 33 65	pp450			- 33 8 - - 32 9 -	++ + + ==	Orange clayey sand (SC); lor plasticity	w		SPT 6 6, 11, 17 N = 27					
Drilling T = Triple tu B = Blades R = Roller/T SA = Solid a HA = Hollow W = Wash I DT = Doubl HAM = Rota Case lift	ube coring Fricone auger boring le tube coring ary hammer Fluid loss	Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma	it weight (UW >2.55 B = 2. = 2.10-2.25 E rength immer impact A = rebounce	vel 40-2.55 = <2.10 test 1 (RQ)	Approx. point load Approx. strength index UCS MPa (50), MPa >4 >103	Sample R = SPT D = Dist N = Stal pp = Ha SV = In- CS = CC UX = U (x mm d Nd = SP	s and Note r penetration unched samp ndard Penel nd penetron site Shear \ ore Sample Jndisturbed liameter) PT and Distu	s n refusal ile ration Test neter test /ane test tube sample irbed Sample	Soll (Fine) VS = S = S F = F St = S VSt = H = F	consistency grained soils Very Soft oft im Stiff Very stiff ard	Defects Joint Cone Infill Seam A = Solid random B = Solid prefere	Ve Cr Zo Cr Zo Ev se se n breaks (S ntial break	in ush ne W am SRB) is (SPE	
Caaing used Barrel withdraw	se lift Fluid loss Gasing used Barrel Withdrawn Barrel Sofk loss Sofk loss S				Q) CQ) le, friab is tes d. US = etrome n to 10°	2-4 55-103 1-2 21-55 0.25-1 7-21 (MQ) <0.25 <7 st result. Otherwise, strength is Unconfined Compress Strength ter % HCL terate and rank marting men	Weathe A = Mici B = Visu C = Stai D = Part E = Coo (CDS)	ring ro fresh stati ially fresh st ned state(S tly decompo mpletely de	e (MFS) ate (VFS) TS) sed state (PDS composed state	Soil c Coars Fb = 1 VY = L = Le MD = D = D VD =	lensity index e grained soil Friable Very Loose oose Medium Dens lense Very Dense	B = Solid preferential breaks (SLB) C = Solid latent breaks (SLB) D = Non intersecting planes (2 E = Intersecting planes (3 Core loss Core loss (interval kno Core loss (interval kno in Graphic log column		B) s (2-D) es (3-D known interva showr umn a





willia Er	m C. Cror	ner Pty. L Berir	.td. En	ivironmer	ntal, e	Cored bor	water g		ts			DDH C	3	
Proje Coor Datu	ect E dinates 5' m G	Inified Roc COAST 13945mE 410938n DA94	HOME	ification Sy S	stem	(URCS) and Unified Soil Cla Location Eastm Drill type Hydraj Equipment 140mr 0-10. wirelin	ssification an's G bower n Hollov Om, follo e (triple	on System reen St w Auger owed by tubing)	m (USCS) age 3 su (HA) H HQ3 [Ibdivisi Hole sta Hole fini Drilled b	on, Penq inted 6 ished 7 by De	uite Road, La April 2011 April 2011 es and Camero	aunces	ton
Inclin Beari	nation Ve	ertical			-	Drill fluid(s) None 1 and LF	o 10.0n 2000 lu	n, then v ubricant	vater L (ogged Checked	by W d by W	C. Cromer		
1	Drillin	g informa	ation	1	-	Rock subs	tance	-		Ro	ock mass	defects	-	-
Bit type/size Case type/size/lift	Samples, tests, unit (UW, g/cc) Visible reaction to 10% HCL A B C	20% Core 60% recovery 80%	RQD 80% 80%	RL (mAHD) metres Inclined depth	Graphic log	Substance descripti rock type, grain characteristi colour, structure, minor compo	ON cs, nents	и Meathering	a DEst. strength	Dature of defects	Defect spacing (mm)	Defect description thickness, type, inclination, planarity, roughness, coating signif. General	Completion details	Gaol intern
65mm	pp450	No core crientation tool used (vertical bole)			主子	As above, becoming sandier depth	with					Å	e Note page 3	
35 33				- 31 ¹⁰⁻	11	SANDSTONE: patchy grey a	ind		SPT 7 10, 10, 19 N = 29	Subhori	zontal failure s	urface at 10.47m;	lot cased. Ser	
65 [6]				- 30 ^{11 -}	17	orange with some thin black wisps; trace silt and clay; apj dip 5 ⁰	orox		Very soft and low	clay; san by steep partings, 10.6r	dstone from 10 ly dipping, irreg some slickens n, sandstone is	1.47 to 10.6m is cut jular, wispy clayey ided; below about s subhorizontal	2	
				- 2912 -	7	SAND; soft when wet orange brown; med-coarse grained; locally feldspathic o volcanogenic; soft when wet;	r		strength when wet (from drilling)			Numerous drilling-induced partings parallel to bedding varying from 5°		dimente
65	pp300			- 28 ^{13 -}	11/1	SAND: dark brown, coarse, interbedded with finely lamin fine-med grained sandstone; locally EW and vuggy Sandy CLAYSTONE and cl SANDSTONE: mainly grey b orading to orange below 15n	ated ayey rown					to 10°		and and and and
65	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			- 27 ¹⁴ - - 27 ¹⁵ -	1/1/1	some silt; finely interbedded; impressions; dip <5°	plant							and shippens and s
65				- 2516 -	1	CLAYSTONE: light yellowish grading to orange brown near some silt and sand SANDSTONE: light yellowish	n grey r base;					1 x clean, smooth joint dipping 45° to axis		Table
65				- 24 ¹⁷ -		brown grading to orange bro feldspathic; volcanogenic?; t clay; variably fine to coarse g occasional clay, clay pellet a orange clastic "conglomerate horizons	wn; race grained; nd "							
H				- 23 ¹⁸ -										
Drilling T = Triple B = Blade R = Rolle SA = Soli HA = Holl W = Wash DT = Double AM = C	e tube coring es rr/Tricone id auger low auger h boring uble tube coring	ation Index) 'sound' core pleces i divided by the total 1 as %. Core lendth	Core driling breaks	ater ¥ Le it weight (UW >2.55 B = 2 = 2.10-2.25 E rength immer impact	vel (, g/cc) 40-2.5 = <2.1 test	Inflow Outflow C = 2.25-2.40 Approx. point load Approx. strength index UCS MPa Is(50). MPa	Sample R = SPT D = Dist N = Star pp = Ha SV = In- CS = Cc Ux = U	s and Note penetratio urbed samp indard Penetror ind penetror site Shear ' pre Sample Indisturbed ismeter	s n refusal ple tration Test meter test Vane test tube sampl	Soil (Fine VS = S = S F = F St = 3 VSt = VSt = H = F	consistency grained soils Very Soft Soft Tim Stiff Very stiff fard	Defects Joint Shear zone Infill searn		in ush ne V am
HAM = Ri Case lift Case used Barry with:	Vashi boring Double tube coring = Rotary hammer : lift Fluid loss caang used Barrel Barrel 100% loss 20 sellaption 100% loss 20 sellaption 20 sella				Jact test strength index UCS MPa ound (RQ) 2-4 >103 (PQ) 2-4 55-103 tf (DQ) 1-2 21-55 ter (CQ) 0-25-1 7-21 idable, friable (MQ) <0.25-2			UX = Unasturbed tube sample (x mm diameter) Nd = SPT and Disturbed Sample Weathering A = Micro fresh state (MFS) B = Visually fresh state (VFS) C = Stained state(VFS) D = Partly decomposed state (PDS) E = Completely decomposed state			tensity index se grained soils Friable Very Loose oose Medium Dens Jense	A = Solid random B = Solid prefere C = Solid latent I D = Non intersecting Core loss Core loss Core los Core los Core los	Seam Seam Seam Solid random breaks (SRB) Solid preferential breaks (SLB) Non intersecting planes (2-1 Intersecting open planes (3- e loss Core loss (interval knov Core los	





Will Incorp Pro Cool Dat RL Inc Bes	liam pora ojec ordi tum	ting the U ting the U tot E nates 51 54 G 41 tion Ve g	ner Pty. nified Ro COAST 3945mt 10938 DA94 .07m AS ertical	Ltd. En NG ck Classi HOME E; mN SL	vironmer IOG - fication Sy S	stem	Cored bore (URCS) and Unified Soil Cla Location Eastmi Drill type Hydraj Equipment 140mr 0-10. wirelin Drill fluid(s) None t and LF	water g Ssificati an's G power n Hollor Om, foll e (triple to 10.0r P2000 I	eologist on System reen Sta w Auger owed by e tubing) n, then w ubricant	s age 3 su (HA) H HQ3 g ater L	Ibdivisio Hole sta Hole fini Drilled b Logged Checked	on, Penq rted 6 shed 7 by D K by W	Cheet 3 of uite Road, La April 2011 April 2011 es and Camero MR Drilling Pty J. C. Cromer J. C. Cromer	3 aunces on v. Ltd.	ston
		Drillin	q inform	nation			Rock subs	tance			Ro	ck mass	defects		
Bit type/size Case type/size/lift	Fluid loss/water	Notes Samples, tests, unit weight (UW, g/cc) Visible reaction to 10% HCL A B C	20% Core 40% recovery 80% recovery	20% 80% 80%	RL (mAHD) add inclined depth s	Graphic log	Substance descripti rock type, grain characteristi colour, structure, minor compo	on cs, nents	Weathering	а расти а	A B C D B C	Defect spacing (mm)	Defect description thickness, type, inclination, planarity, roughness, coating Signif. General	Completion details	Geol interp
T (HQ3) 10.4 to 20.0m 65 65 65	3	No core prientation tool used (vertical hole)			- 22 ¹⁹⁻		As above, becoming sandier depth CLAYSTONE: grey; finely laminated with cream sandy wisps; some plant impression apparent dip 10 ⁰	with clay ns;					Numerous drilling-induced partings parallel to bedding varying from 5° to 10°		Tertiary-age weakly consolidated
Dritting	9		ces total	E Sa We		vel	(RL21.07m)	Sample B = 50°	rs and Notes	s	Soil	d cosing 50n Sand Bent E E T	niled 2m away was mpleted as follows: mm Class 18 UPVC Casing 0 – 12.8m creen 12.8 - 13.8m pack 12.7 - 13.8m conite 11.7 - 12.7m Bantonite 0.5 - 1.0,		-
T = Tri B = Bi R = Ri SA = S HA = N W = W DT = I HAM = Case	iple tu ades oller/T Solid a Hollow Vash b Double = Rota lift Casing used Barrel withdraw	tabe coring ricone auger v auger ooring e tube coring ary hammer Fluid loss No loss 50% lo 100%	R COLOR ROUND AND A COLOR OF COLOR O	ore run length. Expressed as %. Core drailing breat reasured along centreline. Core drailing breat of inducted is ଅର୍ଦ୍ଧ ତିହୁର ହ	t weight (UW >2.55 B = 2. 2.10-2.25 E ength mmer impact A = rebound B = pit (PQ) C = dent (PQ) C = dent (PQ) D = crate(PQ) E = moldab te: X on log ually estimate = Pocket Per sible reaction	(, g/cc) 40-2.5: = <2.1 (RQ) (Q) (Q) (CQ) le, friat i is te d. US : etrome n to 10	5 C = 2.25-2.40 Approx. point load Approx. strength index UCS MPa Is(50), MPa 24 >103 2-4 >55-103 1-2 21-55 0.25-1 7-21 st result. Otherwise, strength is = Unconfined Compress Strength ter	$ \begin{array}{l} R = SP \\ D = Dist \\ D = Dist \\ N = Sta \\ sV = In \\ SV = In \\ CS = Ct \\ Ux = t \\ (x mm d \\ Nd = SF \\ \hline Weather \\ A = Mic \\ B = Visi \\ C = Sta \\ D = Par \\ E = Co \\ (CDS) \end{array} $	T penetration turbed samp indard Peneti and penetrom -site Shear V ore Sample Undisturbed Jiameter) PT and Distu Pring ro fresh state ually fresh sta ined state(S' tty decompoor impletely decompoor	e refusal le ration Test heter test ane test tube sample rbed Sample e (MFS) ate (VFS) TS) sed state (Pf composed st	Fine VS = S = S <td>grained soils Very Soft ioft imm suff Very stiff lard density index is grained soil Friable Very Loose pose Medium Densiense Verse Consol</td> <td>A = Solid random A = Solid random B = Non intersecting Core Ioss Core Ioss Core Ioss Core Ioss Core Ioss Core Ioss</td> <td>Ve Cn Se n breaks (SLI ting planes open planes open planes open planes (SLI ting planes open planes (SLI ting planes open planes ting planes open planes ting planes open planes ting planes open planes ting planes open planes</td> <td>in ush ne W am SRB) ts (SPE B) ts (2-D) ts (2-D)</td>	grained soils Very Soft ioft imm suff Very stiff lard density index is grained soil Friable Very Loose pose Medium Densiense Verse Consol	A = Solid random A = Solid random B = Non intersecting Core Ioss Core Ioss Core Ioss Core Ioss Core Ioss Core Ioss	Ve Cn Se n breaks (SLI ting planes open planes open planes open planes (SLI ting planes open planes (SLI ting planes open planes ting planes open planes ting planes open planes ting planes open planes ting planes open planes	in ush ne W am SRB) ts (SPE B) ts (2-D) ts (2-D)





HOLE C B GAPAR 2411 BOX 1 OF 1 Core loss 1m 2m . 3m 4m 5m 6m 7m 8m 9m 10m 11m 12m Core 13m loss 14m Core loss 15m 16m HOLF 17m 18m 19m Core loss

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20m















(3 pages) Interpreted geological map and cross sections





$\label{eq:general-cross-sections-from-2009-report-with-2010-and-2011-diamond-drill-holes-added. \end{tabular} Ignore-red-line-(proposed-topography) \end{tabular}$













Cross section through section line G – H

	RL	Easting	Northing	Total depth (m)
Bore A	40.69	513916	5411014	20.0
Bore B	35.07	513962	5410874	18.5
Bore C	41.07	513945	5410939	20.0

