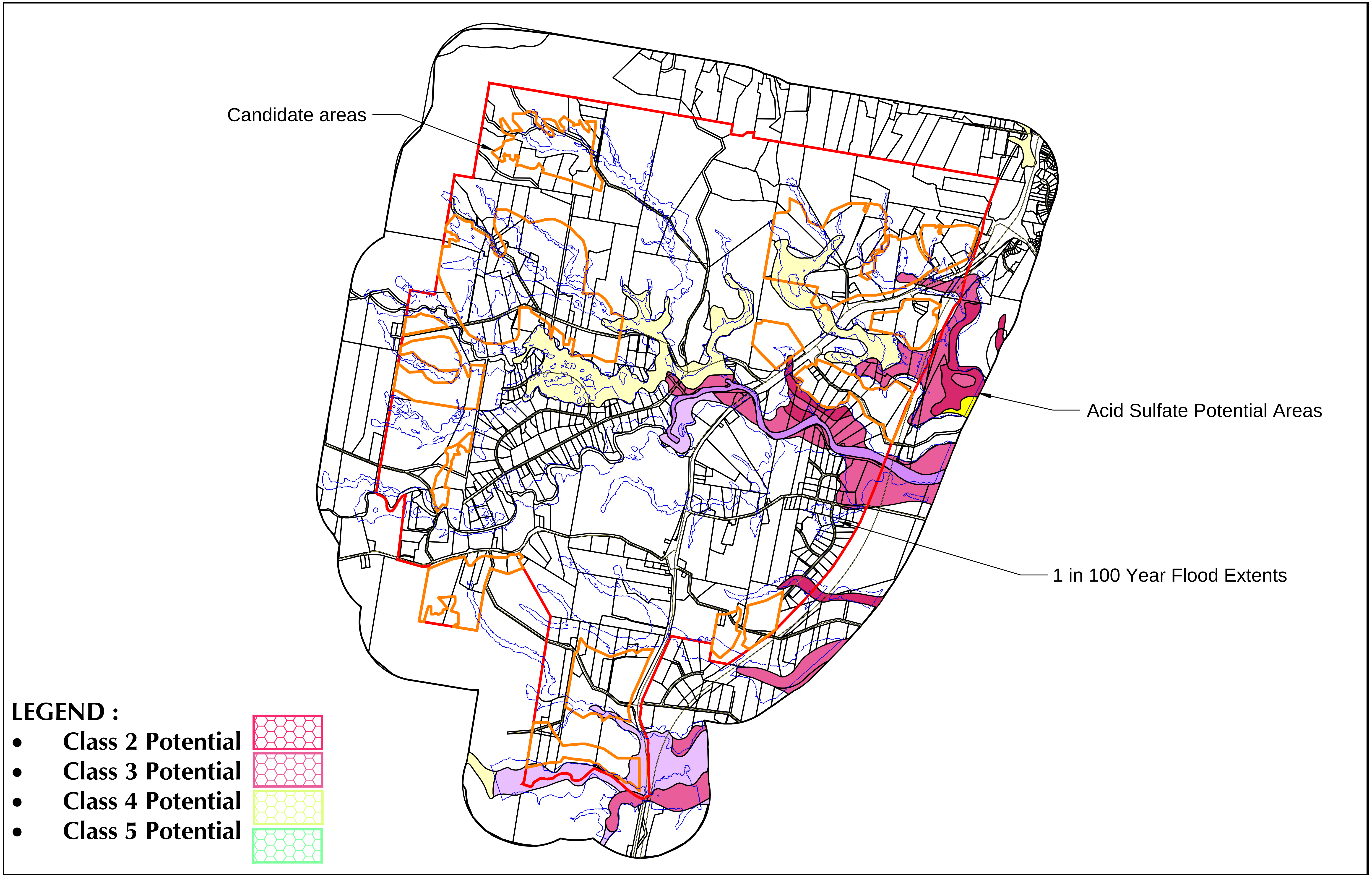

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Phone (02) 6652 1700
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0 750 1500
Meters

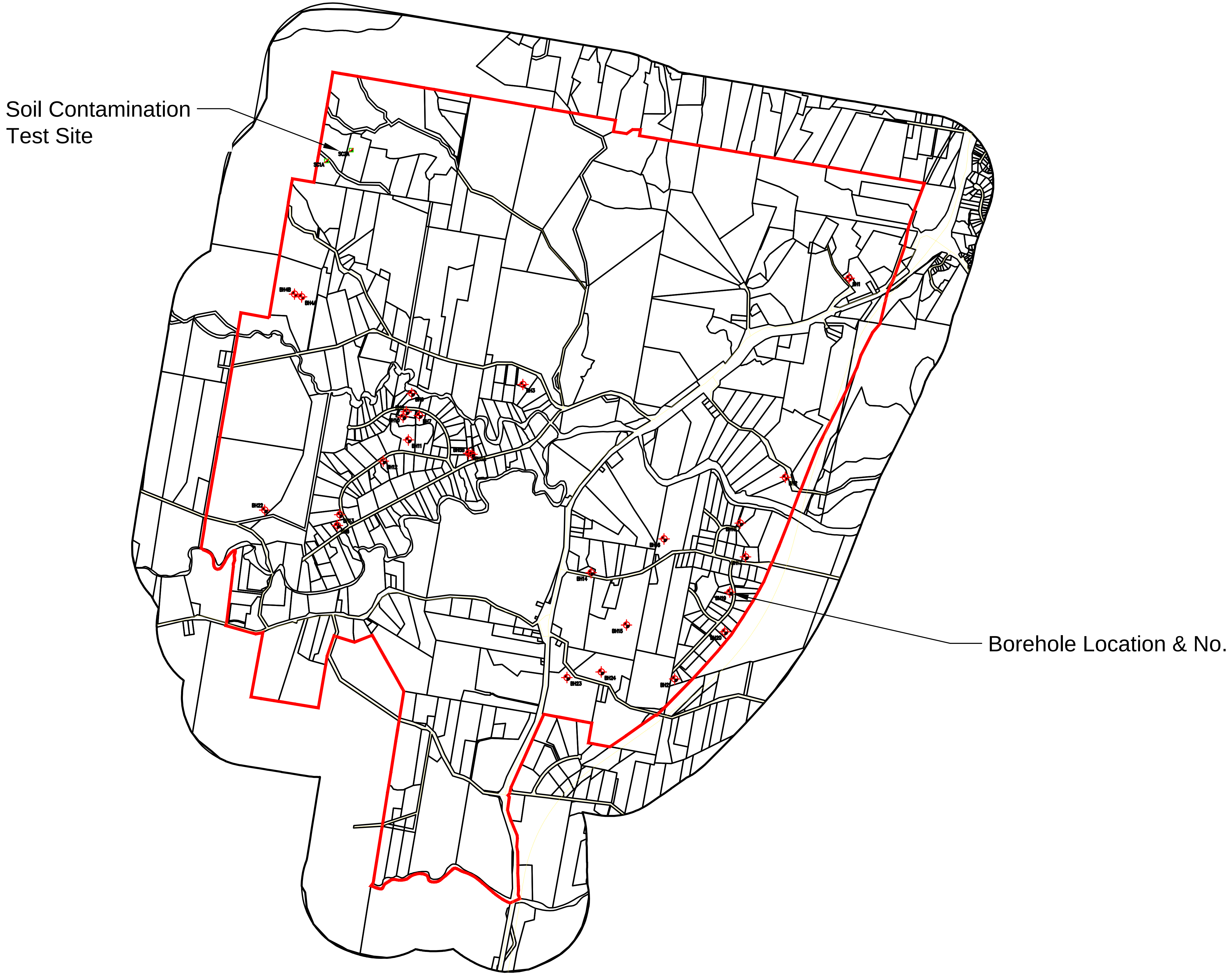
BONVILLE RURAL RESIDENTIAL PLANNING PROPOSAL

ACID SULFATE SOILS

MAR 2014 Plan. Prop.

Figure 3

Amendment No.
A



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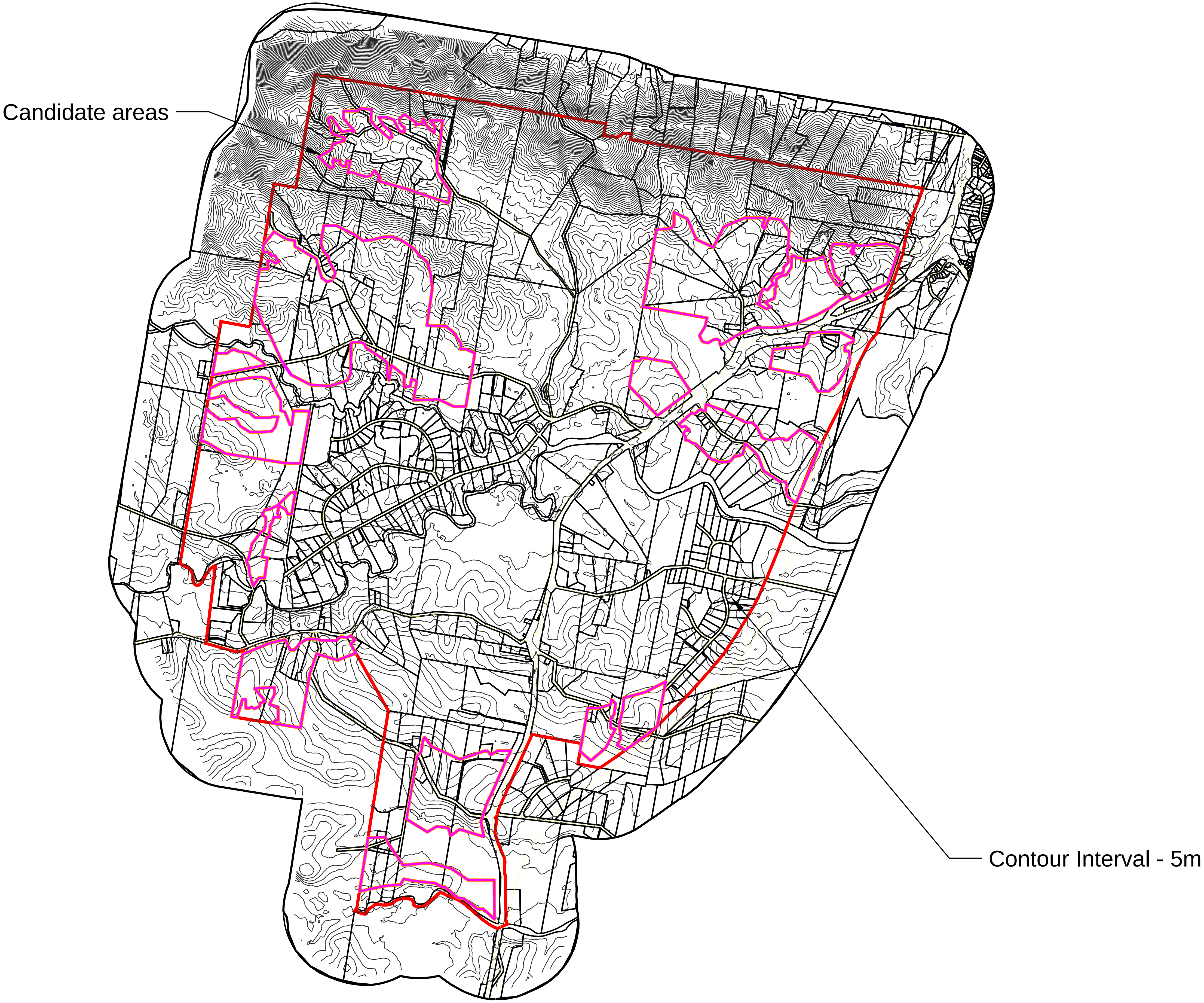
BONVILLE RURAL RESIDENTIAL PLANNING PROPOSAL

GEOTECHNICAL INVESTIGATIONS

MAR 2014 Plan. Prop.

Figure 4

Amendment No. A



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BONVILLE RURAL RESIDENTIAL PLANNING PROPOSAL

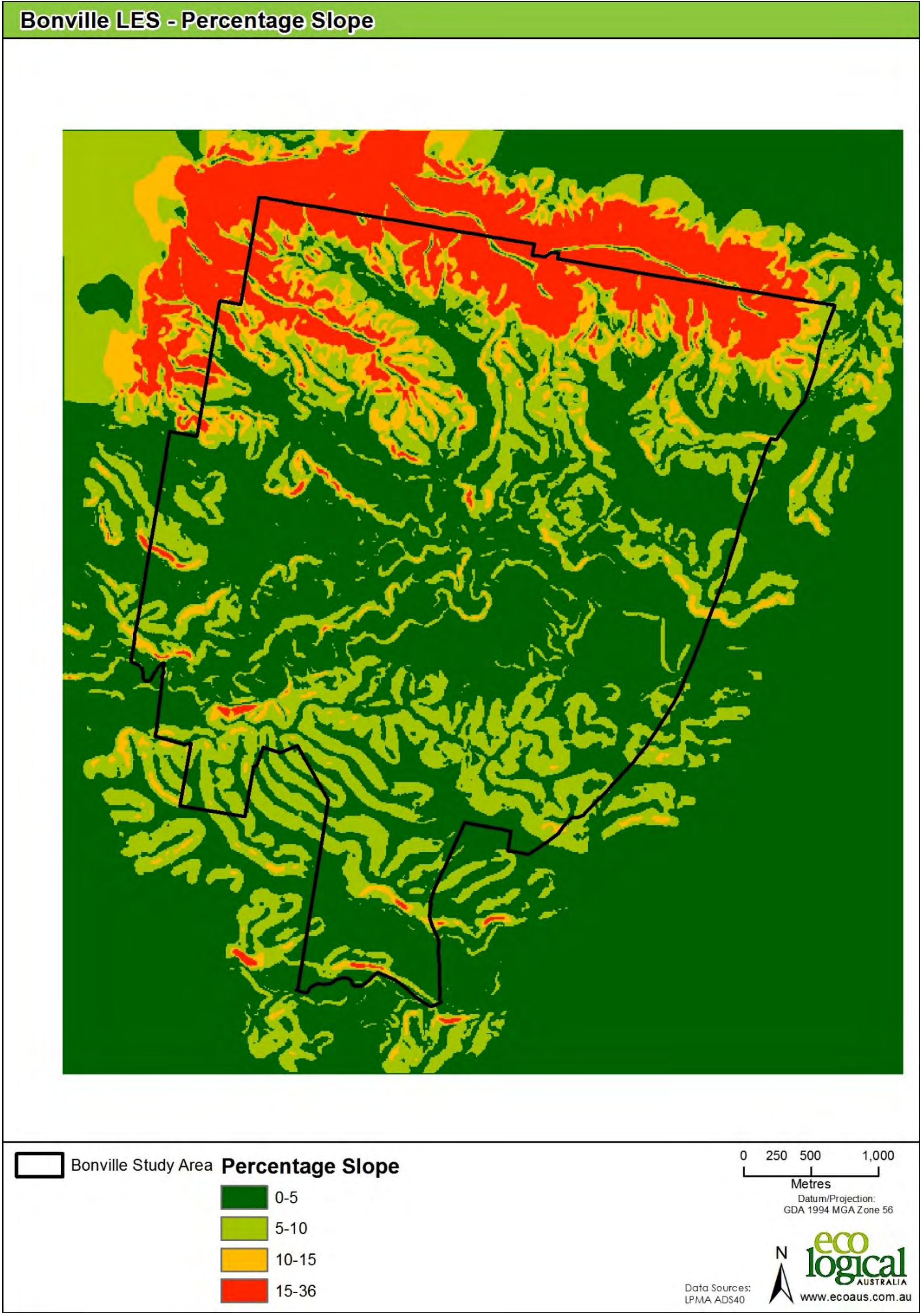
TOPOGRAPHY

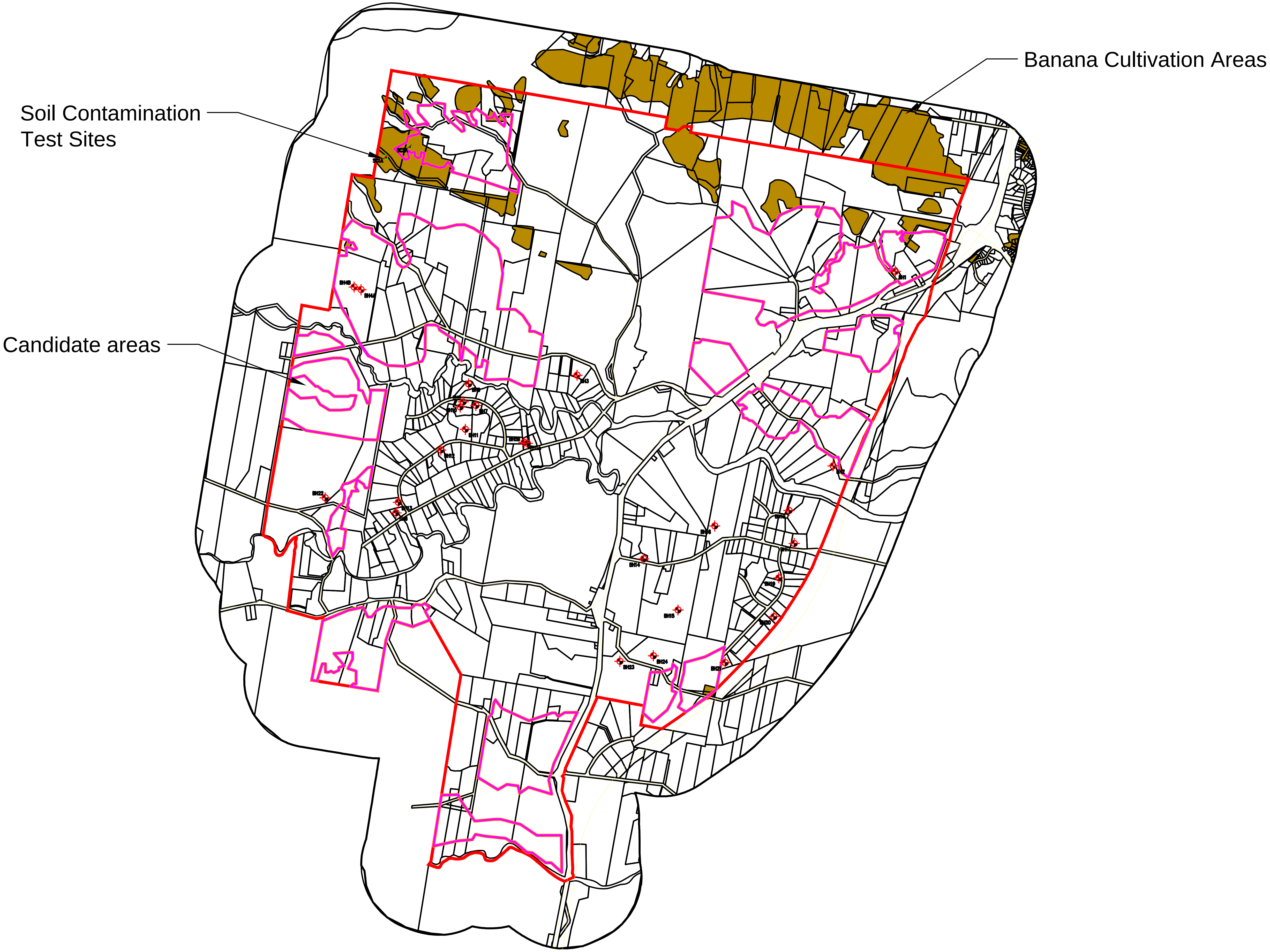
MAR 2014 Plan. Prop.

Figure 5

Amendment No.
A

Figure 6 - Slope Hazard Mapping





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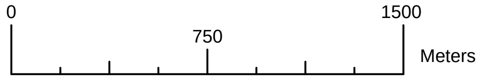


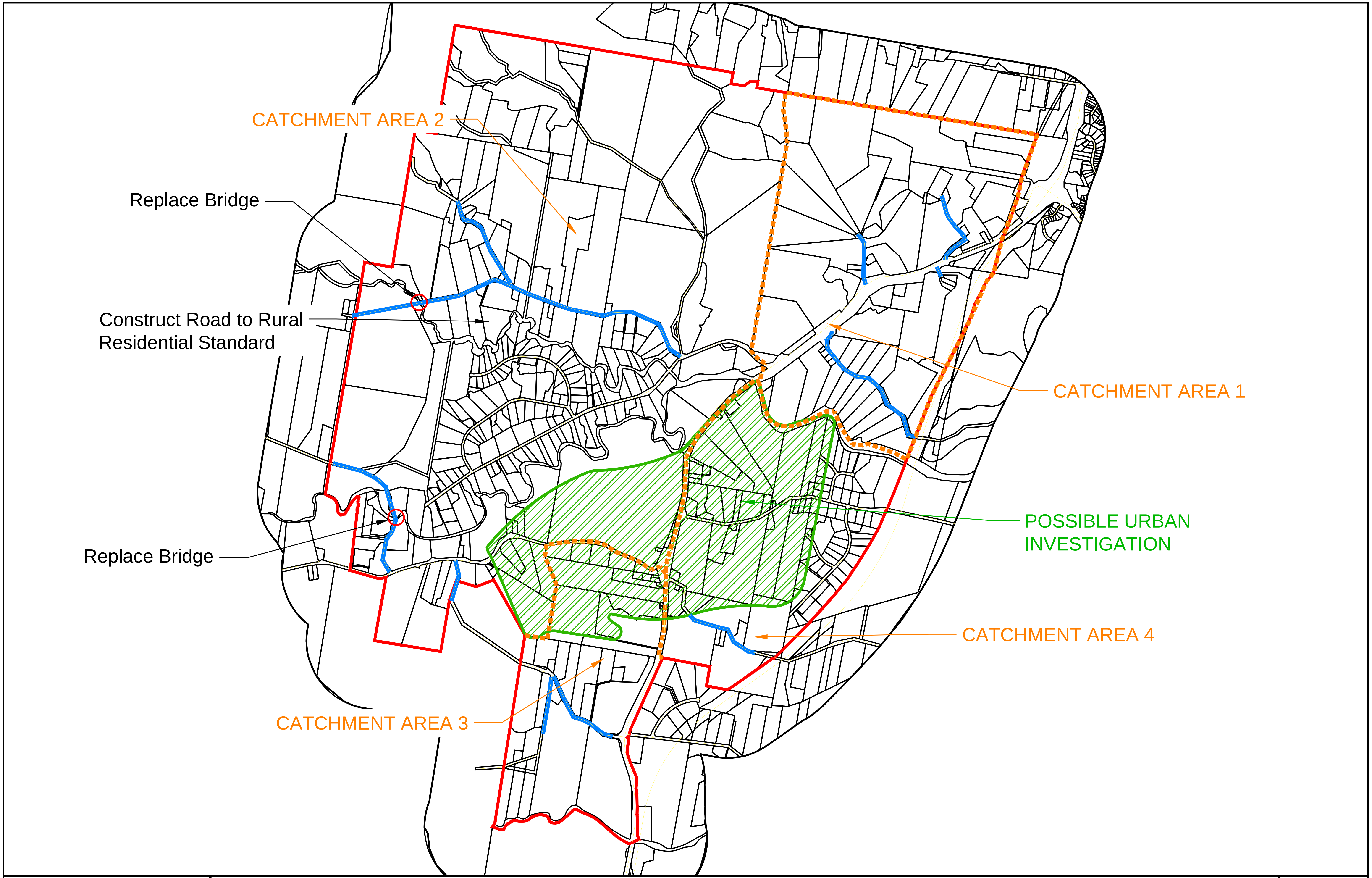
BONVILLE RURAL RESIDENTIAL PLANNING PROPOSAL

BANANA CULTIVATION AREAS

MAR 2014 Plan. Prop.

Figure 7

Amendment No.
A



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BONVILLE RURAL RESIDENTIAL PLANNING PROPOSAL

SECTION 94 CONTRIBUTIONS - DESIGNATED WORKS

MAR 2014 Plan. Prop.

Figure 8

Amendment No.
A

APPENDIX B – Bore Hole Logs

⊕ BH1

BOREHOLE & DCP FIELD LOG

Project

Location 22 TITAN CLOSE BONVILLE

Tested by KRC/MK

Job No. 05215

Date 19-9-05 Time 9-00

Borehole 1 of 1

BOREHOLE LOG

CL/CI – SILTY CLAY, MED/ LOW PLASTICITY, RED BROWN VERY MOIST, SOFT.

PROBABLE FILL FROM WATERTANK

500

CL/CI – CLAY, MED/LOW PLASTICITY, RED BROWN MOIST, FIRM

CREAM GRAVEL APPEARING FROM 1000 ↓

1300 E.O.H.

Site Description

GRADUAL FALL DOWN TO GARAGE.

EXISTING SLAB TO REMAIN IN PART OF EXTENSION – WATER TANK UNDER

Weather Conditions

FINE

Comments

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	1	6				
0.1 - 0.2	1	5				
0.2 - 0.3	1	7				
0.3 - 0.4	2.5	8				
0.4 - 0.5	2.5	8				
0.5 - 0.6	3	10				
0.6 - 0.7	4	9				
0.7 - 0.8	3	10				
0.8 - 0.9	3	10				
0.9 - 1.0	5	11				

⊕ BH2

BOREHOLE & DCP FIELD LOG

Project Proposed Extensions. 98 Williams Rd Bonville.

Location

Tested by KC

Job No. 05109

Date 17.5.05 **Time** 1pm.

Borehole 1 **of** 1

BOREHOLE LOG

0 0.3	~~Dk Red~~ Brown Topsoil
	Orange Brown clay Mod to low plasticity. moist
13	e.o.h.

Site Description

Exist B+T Residence on strip

Ftgs. 450w x 300d Ftg.

Site Slopes away from

existing dwelling

Rural.

Weather Conditions

Showers.

Comments

DCP TESTS

Test	1					
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	0	3				
0.1 - 0.2	1	3				
0.2 - 0.3	1	5				
0.3 - 0.4	2	5				
0.4 - 0.5	2	5				
0.5 - 0.6	2.5	5				
0.6 - 0.7	2.5	6				
0.7 - 0.8	3	6				
0.8 - 0.9	2.5	7				
0.9 - 1.0	2.5	7				

⊕BH3

BOREHOLE & DCP FIELD LOG

Project NO. 119
Location LOT 41 NTH BONVILLE RD BONVILLE
Tested by KRC

Job No. 01257
Date 24/9/01 Time 11.10
Borehole 1 of 1

BOREHOLE LOG

TOPSOIL & SILT

150

LIGHT BROWN SILTY CLAY
LOW PLASTICITY
LOW MOISTURE - DRY
FIRM

700 BECOMING RED BROWN SILTY CLAY

950
REFUSAL ON TREE ROOT

NOTE: NO TREES FOR 20m.

Site Description

SLIGHT FALL OVER HOUSE SITE - REFER CONTOURS
LARGE BASIN IN FRONT OF HOUSE SITE WITH CANAL ACCESS EACH SIDE OF BLOCK TO WATERCOURSE ON EAST BDRY.

Weather Conditions

FINE

Comments

SITE PEGGED OUT.

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	3					
0.1 - 0.2	3					
0.2 - 0.3	3					
0.3 - 0.4	4					
0.4 - 0.5	4					
0.5 - 0.6	4					
0.6 - 0.7	4					
0.7 - 0.8	4					
0.8 - 0.9	4					
0.9 - 1.0	4					

pg 1 of 2 -⊕ BH4A

BOREHOLE & DCP FIELD LOG

Project 284 NORTH BONVILLE RD,
Location BONVILLE.
Tested by JPA

Job No. 09145
Date 30-9-09 Time
Borehole of

BOREHOLE LOG

BH1	EXISTING SHED SHED FLOOR COMPACTED GRAVEL/ROADBASE. REFUSAL
BH2 0	UNIT 1 CL/[illegible] SILTY CLAY, LP-[illegible], YELLOWISH BROWN, DRY, STIFF. TRACE OF WHITE EWR FROM [illegible], INCREASING WITH DEPTH. END BH AT 1·3m (REFUSAL ON DRY EWR)
BH3 0	UNIT 2. ML SILTY TOPSOIL
300	CL/CI SILTY CLAY, LP-MP, BROWN, DRY, FIRM.
600	CL/[illegible] SILTY CLAY, LP-[illegible], YELLOWISH BROWN, GREY MOTTLE. DRY, STIFF. TRACE OF EWR FROM 800 INCREASING WITH DEPTH END BH AT 1-3m (REFUSAL ON DRY EWR)

Site Description
CLEAR GRASSED SITE.
NO SIGNS OF FILLING.

Weather Conditions

Comments

DCP TESTS

Test	DCP1	DCP2		DCP3.		
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	15	11	6	4	15	
0.1 - 0.2	REF.	6	6	5	REF.	
0.2 - 0.3		6	12	5		
0.3 - 0.4		7	REF.	3		
0.4 - 0.5		6		2		
0.5 - 0.6		7		2		
0.6 - 0.7		7		3		
0.7 - 0.8		7		6		
0.8 - 0.9		6		7		
0.9 - 1.0		6		10		

pg 2 of 2 ⊕ BH4B

BOREHOLE & DCP FIELD LOG

Project 284 NORTH BONVILLE RD.

Location BONVILLE

Tested by JPA

Job No. 09145

Date 30-9-09 Time

Borehole of

BOREHOLE LOG

BH5	UNIT 4
0	ML SILTY TOPSOIL
300	CL SILTY CLAY, LP, BROWN RED & WHITE GWR, DRY, STIFF.
	SOME GRAVEL AT 500.
	WHITE EWR INCREASING WITH DEPTH.
	END BH AT 1.2m (REFUSAL)

Site Description

Weather Conditions

Comments

DCP TESTS

Test	DCP4		DCP5			
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	3	12	5	3		
0.1 - 0.2	4	REF.	5	10		
0.2 - 0.3	5		5	REF.		
0.3 - 0.4	6		5			
0.4 - 0.5	3		~~8~~3			
0.5 - 0.6	2		~~4~~2			
0.6 - 0.7	3		2			
0.7 - 0.8	2		3			
0.8 - 0.9	8		3			
0.9 - 1.0	8		3			

page 1 of 2

⊕ BH5A

de Groot & Benson Pty Ltd
CONSULTING ENGINEERS & PLANNERS

236 High Street,
Coffs Harbour, N.S.W. 2450
Email rdegro@tpgi.com.au

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Phone (02) 6652 1700
Fax (02) 6652 7418

BORE HOLE LOG & SITE SKETCH FOR

SITE ADDRESS: Lot 103 (No 80) Bradford Drive
BONVILLE

Job No: deGroot & Benson: 03067
M3 : 7414

DATE: 27-02-2003

CONSULTING ENGINEERS

BOREHOLE No. 1 Refer to site sketch for location

DEPTH (m)	DESCRIPTION Soil type, colour, moisture, consistency	FILL	DCP	"C" kPa
			-	
0.0	CL SILTY CLAY FILL, Low plasticity, Red,	↓	1	
0.1	Moist to wet, Soft.		1	
0.2	ML CLAYEY SILT, Low plasticity, Dark reddish		3	
0.3	brown, Moist to wet, Firm.		3	
0.4	CL SILTY CLAY, Low plasticity, Red, Moist,		3	
0.5	Firm.		2	
0.6			3	
0.7	Becoming CI SILTY CLAY, Medium plasticity,		2	
0.8	Red, Moist, Firm.		2	
0.9			3	
1.0			4	
1.1			3	
1.2			3	
1.3			3	
1.4	**End of BH 1 @ 1.4m.**		5	
1.5			7	
1.6			7	
1.7			8	
1.8			9	
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				

BOREHOLE No. 2 Refer to site sketch for location

DEPTH (m)	DESCRIPTION Soil type, colour, moisture, consistency	FILL	DCP	"C" kPa	DCP 3
			-		0.5
0.0	CL/ML FILL, Mix of SILTY CLAY, Low plasticity	│	0.5		2
0.1	Red and SILT, low plasticity, Dark brown, Both	│	0.5		1
0.2	moist to wet and Soft (Firm below 0.6m).	│	1		1.5
0.3		│	1		1.5
0.4		│	1		2
0.5		│	3		2.5
0.6		↓	3		2.5
0.7			2		5
0.8	ML SILT, Low plasticity, Dark brown, Moist,		2		3
0.9	Firm.		3		5
1.0	CL SILTY CLAY, Low plasticity, Red, Moist,		3		4
1.1	Firm.		3		4
1.2	Becoming CI SILTY CLAY, Medium plasticity,		2		3
1.3	Red, Moist, Firm.		3		4
1.4			3		5
1.5			3		5
1.6			4		6
1.7	**End of BH 2 @ 1.7m.**		4		6
1.8			4		6
1.9			6		
2.0			5		
2.1			5		
2.2			5		
2.3			6		
2.4					
2.5					
2.6					
2.7					

NOMENCLATURE:
LP = Low Plasticity, MP = Medium Plasticity, HP = High Plasticity, Ref = DCP refusal (>20 blows or bounce)
"C" = cohesion (not allowable bearing capacity), EWR = Extremely Weathered Rock.
Some alluvial topsoils are indistinguishable from fill in boreholes. When these have similar capacities as fill, they may be logged as fill.

TEST METHODS:
Hand Auger ☑ Small Rig (100mm dia) ☐

SITING:
Existing ☐ Gen Setback ☐ Plans ☑
Pegged ☐ Met on site ☐ Prepared pad ☐

EXCAVATION PROBLEMS:
Shallow rock ☐ Gravels/Cobbles/Boulders ☐
Rubbish in fill ☐ Wet/Dry Collapse ☐
Water table ☐ Access to site ☐

VEGETATION (in and around house site)
Established garden ☐ Cleared ☑
Grasses: Nil Sparse [✓ Moderate] Dense
Bush-scrub: [✓ Nil] Sparse Moderate Dense
Trees: [✓ Nil] Sparse Moderate Dense
Recent tree removal: [✓ No evidence] Yes

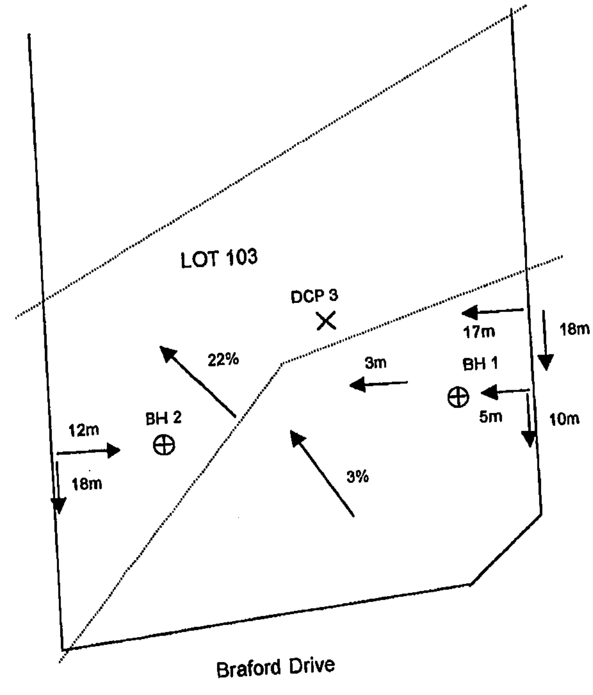
DRAINAGE:
From house site: Poor Fair [✓ Good]
Up slope catchment: [✓ Small] Medium Large
[✓ Within property] Neighbouring properties

COMMENTS:

Fill probably from Bradford Drive road construction and is probably deepest at top of bank (BH 2).

AS 2870 Class P site due to deep soft fill. The natural red soils are only slightly reactive, would be a class S site except for fill.

SITE SKETCH
N.T.S.



⊕ Test Site

Direction of fall →
Gradient (%)

page 2 of 2 BH5B

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Fax (02) 6652 7418

POST EARTHWORKS INVESTIGATION FOR

SITE ADDRESS: Lot 103 (80) Braford Drive
BONVILLE

Job No: dGB: 03067
M3 7414

DATE: 16-05-2003

CONSULTING ENGINEERS

NATURAL SOIL PROFILE / DCPS AND ESTIMATED FILL DEPTH

DEPTH (m)	DESCRIPTION Soil type, colour, moisture, consistency	DCP 1	DCP 2	DCP 3	DCP 4	DCP 5	DCP 6	DCP 7
0.0	ML CLAYEY SILT, Low plasticity, Dark reddish	Nat 3	Fill 0.5	Fill 1	Fill 2	Fill 1.5	Nat 2	Nat 2
0.1	brown, Moist to wet, Firm.	4	1	1.5	1	1.5	2	2
0.2	CL SILTY CLAY, Low plasticity, Red, Moist,	3	1	1.5	1	1	2	2
0.3	Firm.	3	1	Nat 2	1.5	1	2	2
0.4		3	3	2.5	1.5	0.5	4	3
0.5	Becoming CI SILTY CLAY, Medium plasticity,	5	3	2.5	1.5	0.5	3	3
0.6	Red, Moist, Firm.	7	Nat 2	5	1	3	4	4
0.7		7	2	3	1.5	2	4	4
0.8		8	3	5	Nat 3	1.5	4	5
0.9		9	3	4	3	1.5	5	5
1.0			3	4	3	1.5	4	
1.1			2	3	3	Nat 2.5	4	
1.2			3	4	3	3	4	
1.3			3	5	5	3	5	
1.4			3	5	3	3	6	
1.5			4	6	7	4	6	
1.6			4	6	4	4	7	
1.7			4	6	5	4	6	
1.8			6		4	4	6	
1.9			5		4	4	6	
2.0			5		5			
2.1			5		6			
2.2			6		7			
2.3					7			
2.4								
2.5								
2.6								
2.7								

NOMENCLATURE:
LP = Low Plasticity, MP = Medium Plasticity, HP = High Plasticity, Ref = DCP refusal (>20 blows or bounce)
"C" = cohesion (not allowable bearing capacity), EWR = Extremely Weathered Rock.
Some alluvial topsoils are indistinguishable from fill in boreholes. When these have similar capacities as fill, they may be logged as fill.

TEST METHODS:
Hand Auger ☑ Small Rig (100mm dia) ☐

SITING:
Existing ☐ Gen Setback ☐ Plans ☐
Pegged ☑ Met on site ☐ Prepared pad ☐

EXCAVATION PROBLEMS:
Shallow rock ☐ Gravels/Cobbles/Boulders ☐
Rubbish in fill ☐ Wet/Dry Collapse ☐
Water table ☐ Access to site ☐

VEGETATION (in and around house site)
Established garden ☐ Cleared ☑
Grasses: [✓ Nil] Sparse Moderate Dense
Bush-scrub: [✓ Nil] Sparse Moderate Dense
Trees: [✓ Nil] Sparse Moderate Dense
Recent tree removal: [✓ No evidence] Yes

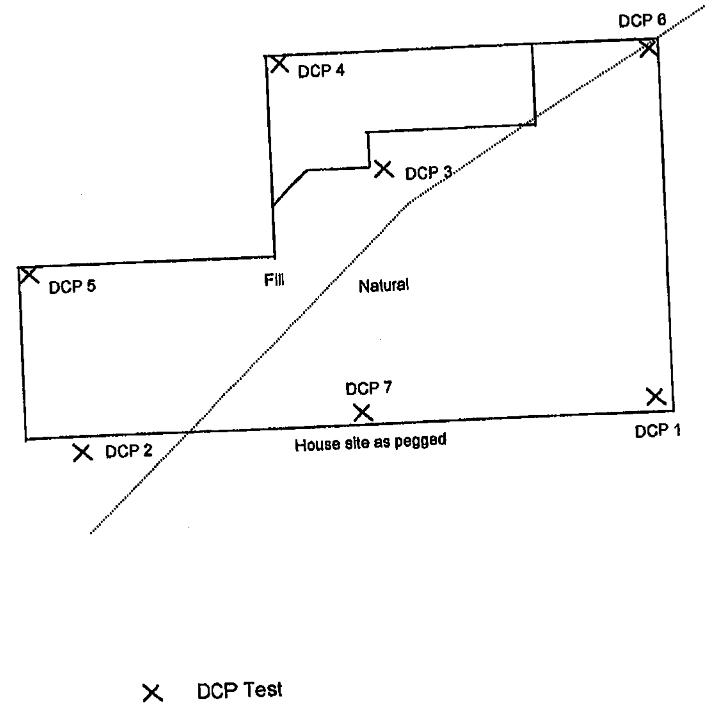
DRAINAGE:
From house site: Poor Fair [✓ Good]
Up slope catchment: [✓ Small] Medium Large
[✓ Within property] Neighbouring properties

COMMENTS:
House site has been cut and filled. The maximum cut is about 1 metre at BH & DCP 1. There is about 1 metre of new fill at DCP 4 & 5. Some old fill was present along the the bank prior to the recent cut and fill.

The natural soil profile as described above is uniform across the site and is AS2870 class "S".

DCP 1 to 3 above have been taken from the original investigation and adjusted for the recent cut to fill.

SITE SKETCH
N.T.S.



BOREHOLE SHEET

BH6

PROJECT : Proposed Residence - No. 186

JOB No. : 94092

LOCATION : lot 332 DP 812057 BRAFORD PARK DRIVE

DATE : 28-3-94

TESTED BY : R.M.

BOREHOLE 1 OF 1

0

RED CLAY

LOW /MED MOISTURE

Moisture decreasing with depth

Say optimum moisture @ 1m

GENERAL NOTES :

Large amounts of Rain in area over past 2 weeks.

Site striped of top soil only a small skin of topsoil left on Block

DEPTH

300mm @ 0 = 5 Blows

300mm @ 350 = 5 Blows

300mm @ 800 = 6 Blow

300mm @ 1100 = 9 Blows

300mm @ ____ = ____ Blows

BOREHOLE No. 1

⊕ BH7

BOREHOLE & DCP FIELD LOG

Project Mr & Mrs GREG SLATER
Location MMe 41 BAKKER DR BONVILLE
Tested by SN

Job No. 99418
Date 16/12/99 Time 2.30 pm
Borehole 1 of 1

BOREHOLE LOG

0.3 DARK BROWN Topsoil WITH SOME ORGANIC MATERIAL

BROWN SILT MIXED WITH CLAY

0.4 TRACES of ORANGE CLAY

0.65 ORANGE/BROWN CLAY MIXED WITH BROWN SILT, LOW/MED plasticity

0.7 ORANGE/BROWN CLAY MED plasticity MIXED WITH GREY SILT. & BLACK GRAVEL GRITS (ORGANIC ?)

0.9 LIGHT ORANGE CLAY MED/HIGH PLASTICITY MIXED WITH TRACES of ORGANIC MATERIAL (BROWN/ORANGE IN COLOUR)

1.2 LIGHT ORANGE/RED CLAY MIXED & GRAVEL & SILT, MED TO HIGH PLASTIC ABIT MOIST.

1.5

EN

Site Description

VIRTUALLY FLAT WITH TURF ON TOP

Weather Conditions

Very hot, NO FLIES

Comments

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	1	1	1½	1		
0.1 - 0.2	2½	2	1½	3		
0.2 - 0.3	2½	3	4	3		
0.3 - 0.4	3	3	4	5		
0.4 - 0.5	4	3	5	5½		
0.5 - 0.6	4	3	5	4		
0.6 - 0.7	3½	2½	4	3		
0.7 - 0.8	3	3	2	4		
0.8 - 0.9	3½	3	2	3½		
0.9 - 1.0	3½	3	2½	3½		

2½ 3

psc Liability is limited by the Professional Engineers Scheme

⊕ BH8

BOREHOLE & DCP FIELD LOG

Project NO SS
Location LOT 14 BAKKER DR BONVILLE
Tested by KRC

Job No. 02089
Date 18-3-02 Time 3-45
Borehole 1 of 1

BOREHOLE LOG

TOPSOIL

150
GREY BROWN SILTY CLAY/
CLAYEY SILT
LOW PLASTICITY
LOW MOISTURE
FIRM

500
GREY BROWN CLAY SOME
ORANGE MOTTLE
MEDIUM PLASTICITY
MEDIUM MOISTURE.
FIRM.
BECOMING GREYER WITH
DEPTH.

1100 ORANGE AND GREY
MOTTLED CLAY
MED PLASTIC
MED MOIST
FIRM

1300 E.O.H.

Site Description

BLOCK 1m ABOVE ROAD
LEVEL THEN RELATIVELY
FLAT

Weather Conditions

FINE - HOT

Comments

VERY LONG GRASS ON
BLOCK.
PEGS LOCATED.

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	1					
0.1 - 0.2	3					
0.2 - 0.3	3					
0.3 - 0.4	3					
0.4 - 0.5	4					
0.5 - 0.6	4					
0.6 - 0.7	4					
0.7 - 0.8	4					
0.8 - 0.9	3					
0.9 - 1.0	3					

⊕ BH9

BOREHOLE & DCP FIELD LOG

No. 58

Project Lot 34 BAKKER DR

Location BONVILLE

Tested by GPB

Job No. 99299

Date 3.9.99

Time

Borehole 1 of

BOREHOLE LOG

Grass

Topsoil

150

Yellow grey clayey silt
soft, moist

Some fine gravel at from
800mm

1.200
end of hole.

0135 26733

Site Description

near flat site
drainage channels/creeks surround

Weather Conditions

fine sunny.

Comments

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1						
0.1 - 0.2						
0.2 - 0.3						
0.3 - 0.4						
0.4 - 0.5						
0.5 - 0.6						
0.6 - 0.7						
0.7 - 0.8						
0.8 - 0.9						
0.9 - 1.0						

psc Liability is limited by the Professional Engineers Scheme

ɸ BH 10

BOREHOLE & DCP FIELD LOG

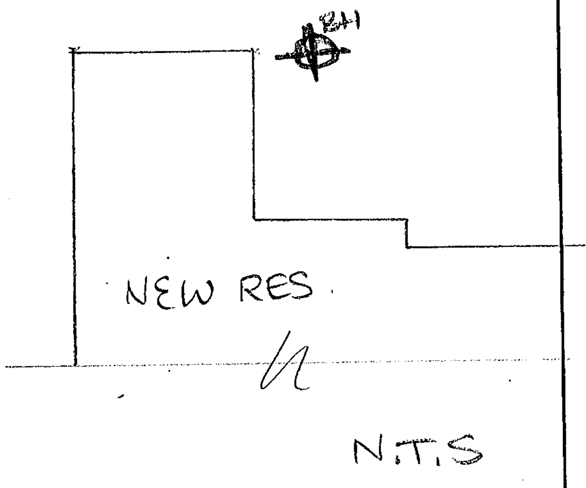
NO. 59

Project LOT 152 BAKKER ROAD
Location BONVILLE
Tested by BJW + JPA

Job No. 04150
Date 4/5/04 Time 12.00
Borehole 1 of 1

BOREHOLE LOG

0	ML SILTY TOPSOIL.
300	ML CLAYEY SILT, LOW PLASTICITY, BROWN, DRY TO MOIST, FIRM. INCREASING IN CLAY CONTENT WITH DEPTH.
500	CL SILTY CLAY, LOW PLASTICITY, BROWN, DRY TO MOIST, FIRM
900	CL/CI SILTY CLAY, LOW TO MED PLASTICITY, LIGHT BROWN, DRY TO MOIST, FIRM.
	END OF BH 1 @ 1.2 m



Site Description

- GRASSED SITE.
- APPROX 400 mm FALL ACROSS HOUSE SITE, SOUTH TO NORTH.
- MINOR (≈ 200-300 mm) ~~THE~~ PECAN NUT TREES AROUND HOUSE PAD

Weather Conditions

FINE.

Comments

DCP TESTS

Test	DCP1					
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	1	3				
0.1 - 0.2	1	3				
0.2 - 0.3	4	3				
0.3 - 0.4	4	5				
0.4 - 0.5	3	4				
0.5 - 0.6	3	5				
0.6 - 0.7	3	5				
0.7 - 0.8	3	4				
0.8 - 0.9	4	4				
0.9 - 1.0	4	4				

⊕ BH11

BOREHOLE & DCP FIELD LOG
No 34.

Project Lot'53 FAVIELL DRIVE

Location BONVILLE

Tested by JPA.

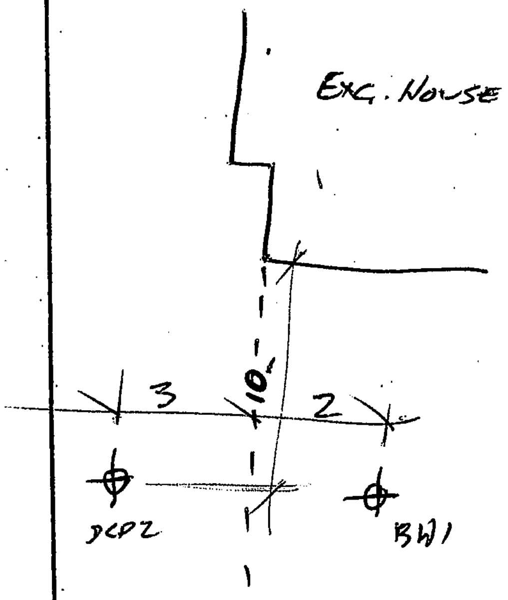
Job No. 06063

Date 29-5-06 Time 4:00

Borehole 1 of 1

BOREHOLE LOG

0	CL/CI SILTY CLAY, LP-MP BROWN, DRY, STIFF. ORANGE MOTTLE FROM 500 ORANGE MOTTLE INCREASING WITH DEPTH & BECOMING DRY TO MOIST. END BH @ 1.2m



Site Description

Weather Conditions

Comments

DCP TESTS

Test	DCP1			DCP2		
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	3	5		3	3	
0.1 - 0.2	8	5		7	4	
0.2 - 0.3	12	3		7	5	
0.3 - 0.4	9	4		6	5	
0.4 - 0.5	6	5		5	5	
0.5 - 0.6	7	5		5	5	
0.6 - 0.7	7	5		5	4	
0.7 - 0.8	7	4		4	4	
0.8 - 0.9	6	5		4	5	
0.9 - 1.0	6	5		4	4	

⊕ BH12

de Groot & Benson Pty Ltd
CONSULTING ENGINEERS & PLANNERS

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Phone (02) 6652 1700
Fax (02) 6652 7418

BORE HOLE LOG & SITE SKETCH FOR

SITE ADDRESS: Lot 1 Faviell Drive
No 57 BONVILLE
Job No: deGroot & Benson: 02083
M3 : 4275
DATE: 12-03-2002

BOREHOLE No. 1 Refer to site sketch for location

DEPTH (m)	DESCRIPTION Soil type, colour, moisture, consistency	FILL	DCP	"C" kPa
			1	
0.0	SILTY TOPSOIL		1	
0.1			1	
0.2	ML SILT, Low plasticity, Dark reddish brown,		1.5	
0.3	Moist, Soft.		1.5	
0.4			1.5	
0.5	CL SILTY CLAY, Low plasticity, Red, Moist,		1.5	
0.6	Firm.		2	
0.7			2.5	
0.8			2.5	
0.9			2	
1.0			3	
1.1			3	
1.2			4	
1.3	Light brown mottling below 1.3m.		4	
1.4			4	
1.5			5	
1.6	**End of BH 1 @ 1.6m.**		4	
1.7			5	
1.8			5	
1.9			6	
2.0			6	
2.1			9	
2.2			13	
2.3			10	
2.4				
2.5				

BOREHOLE No. 2 Refer to site sketch for location

DEPTH (m)	DESCRIPTION Soil type, colour, moisture, consistency	FILL	DCP	"C" kPa
			1	
0.0	SILTY TOPSOIL		1	
0.1			2	
0.2			3	
0.3	ML SILT, Low plasticity, Dark brown, Moist,		2	
0.4	Firm.		2	
0.5	CL SILTY CLAY, Low plasticity, Red, Moist,		2	
0.6	Firm.		2	
0.7			2	
0.8			2	
0.9			2	
1.0			2	
1.1			2	
1.2			3	
1.3	**End of BH 2 @ 1.3m.**		4	
1.4			5	
1.5			6	
1.6			6	
1.7			6	
1.8			6	
1.9			6	
2.0			8	
2.1			7	
2.2			6	
2.3			7	
2.4				
2.5				

NOMENCLATURE:
LP = Low Plasticity, MP = Medium Plasticity, HP = High Plasticity, Ref = DCP refusal (>20 blows or bounce)
"C" = cohesion (not allowable bearing capacity), EWR = Extremely Weathered Rock.
Some alluvial topsoils are indistinguishable from fill in boreholes. When these have similar capacities as fill, they may be logged as fill.

TEST METHODS:
Hand Auger ☑ Small Rig (100mm dia) ☐

SITING:
Existing ☐ Gen Setback ☐ Plans ☑
Pegged ☐ Met on site ☐ Prepared pad ☐

EXCAVATION PROBLEMS:
Shallow rock ☐ Gravels/Cobbles/Boulders ☐
Rubbish in fill ☐ Wet/Dry Collapse ☐
Water table ☐ Access to site ☐

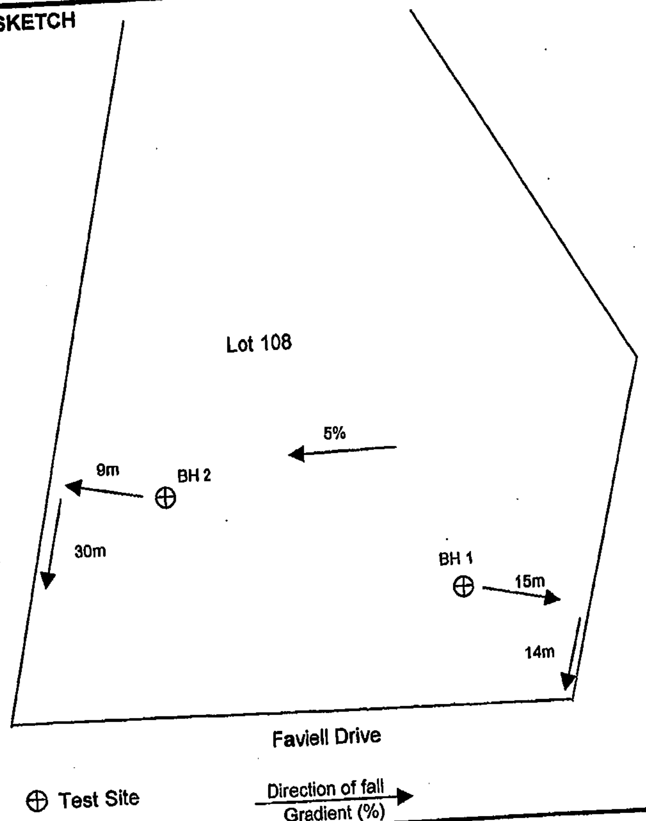
VEGETATION (in and around house site)
Established garden ☐ Cleared ☑
Grasses: Nil Sparse [✓ Moderate] Dense
Bush-scrub: [✓ Nil] Sparse Moderate Dense
Trees: [✓ Nil] Sparse Moderate Dense
Recent tree removal: [✓ No evidence] Yes

DRAINAGE:
From house site: Poor Fair [✓ Good]
Up slope catchment: Small [✓ Medium] Large
Within property [✓ Neighbouring properties]

COMMENTS:

Pegs on site do not agree with supplied plans, boreholes excavated after disscussion with Coral Homes.

SITE SKETCH
N.T.S.



⊕ BH13

BOREHOLE & DCP FIELD LOG

Project No 108

Location LOT 6 FAVIELL DR BONVILLE

Tested by KRC

Job No. 07203

Date 21-11-07 Time 11.00

Borehole 1 of 1

BOREHOLE LOG

TOPSOIL

300

CI/CL - SILTY CLAY, MED/LOW PLASTICITY, RED·BROWN MOIST, SOFT,

700 BECOMING FIRM FROM 700

1000 BECOMING STIFF TO VERY STIFF

REFUSAL AT 1800.

Site Description

EXG HOUSE TO BE BUILD AGAINST.

Weather Conditions

FINE

Comments

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	1.5	6				
0.1 - 0.2	1.5	7				
0.2 - 0.3	1.5	10				
0.3 - 0.4	1.5	12				
0.4 - 0.5	1.5	14				
0.5 - 0.6	1.5	16				
0.6 - 0.7	2	19				
0.7 - 0.8	3	22				
0.8 - 0.9	4					
0.9 - 1.0	5					

⊕ BH14

de Groot & Benson Pty Ltd
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Fax (02) 6652 7418

BOREHOLE LOG & SITE SKETCH FOR

SITE ADDRESS: Lot 123, Station road
Bonville
No. 21

DGB Job Number: 06100
Cavalier Job Number: 050072
Date: 22-5-06

Cavalier Homes
COFFS HARBOUR

BOREHOLE NUMBER 1 (refer to site sketch for location)					BOREHOLE NUMBER 2 (refer to site sketch for location)					
DEPTH (m)	DESCRIPTION soil type, colour, moisture, consistency	FILL	DCP	"C" kPa	DEPTH (m)	DESCRIPTION soil type, colour, moisture, consistency	FILL	DCP	"C" kPa	DCP 3
0.0	ML SILTY TOPSOIL		1		0.0			2		--
0.1			1		0.1			2		--
0.2	CL/CI SILTY CLAY, Low to medium plasticity,		1		0.2			1		--
0.3	Redish brown, Dry to moist, Soft.		2		0.3			2		--
0.4			1		0.4			2		--
0.5			2		0.5			1		--
0.6			2		0.6			2		--
0.7			2		0.7			2		--
0.8	Trace of gravel at 0.8m		2		0.8			3		--
0.9			1		0.9			3		--
1.0			2		1.0			3		--
1.1			3		1.1			3		--
1.2	End of Borehole 1 at 1.1m		3		1.2			2		--
1.3			4		1.3			3		--
1.4			3		1.4			4		--
1.5			4		1.5			4		--
1.6			4		1.6			4		--
1.7			5		1.7			4		--
1.8			5		1.8			4		--
1.9			7		1.9			4		--
2.0					2.0					--
2.1					2.1					--
2.2					2.2					--
2.3					2.3					--
2.4					2.4					--
2.5					2.5					--
2.6					2.6					--
2.7					2.7					--

NOMENCLATURE:

LP = Low Plasticity, MP = Medium Plasticity, HP = High Plasticity, Ref = DCP Refusal (>20 blows or bounce)
"C" = Cohesion (not allowable bearing capacity), EWR = Extremely Weathered Rock.
Some alluvial topsoils are indistinguishable from fill in boreholes. When these have similar capacities as fill, they may be logged as fill.

TEST METHODS:

Hand Auger ☑ Small Rig (100dia) ☐

SITING:

Existing ☐ Gen setback ☑ Plans ☐
Pegged ☐ Met on site ☐ Prepared pad ☐

EXCAVATION PROBLEMS:

Shallow rock ☐ Gravels/Cobbles/Boulders ☐
Rubbish in fill ☐ Wet/Dry collapse ☐
Water table ☐ Access to site ☐

VEGETATION (in and around house site)

Cleared ☑ Established garden ☐
Grasses: Nil Sparse [✓ Moderate] Dense
Bush-scrub: [✓ Nil] Sparse Moderate Dense
Trees: Nil [✓ Sparse] Moderate Dense
Recent tree removal: [✓ No evidence] Yes

DRAINAGE:

From house site: Poor [✓ Fair] Good
Up slope catchment: [✓ Small] Medium Large
[✓ Within property] Neighbouring properties

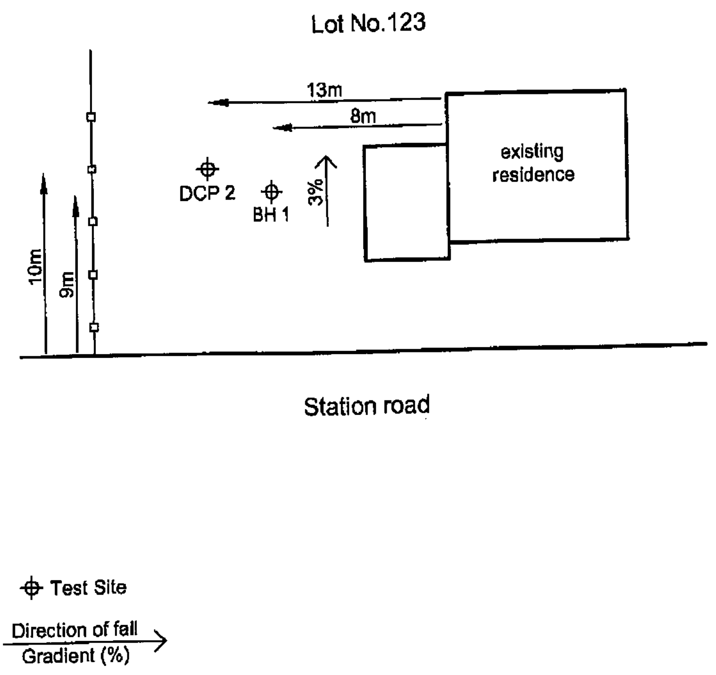
COMMENTS:

AS.2870 Class P site due to soft conditions at depth.

Recommend a class S slab with edge beams and any internal load bearing beams piered to min 1.2m below natural surface.

SITE SKETCH:

N.T.S.



⊕ BH15

BOREHOLE & DCP FIELD LOG

Project No. 50
Location Lot 4 Bonville Station Rd.
Tested by Klc

Job No. 1321
Date 9-11-01 Time 11.00
Borehole 1 of 1

BOREHOLE LOG

TOP SOIL

150

RED BROWN CLAYEY SILT
LOW PLASTICITY
DRY , FIRM

500

ORANGE RED CLAY
LOW PLASTICITY
LOW MOISTURE
FIRM.

900 SOME GREY
~~GREY~~ MOTTLE APPEARING
AND BECOMING DRY.

Site Description

RURAL SITE
SITE ON TOP OF HILL
SITE TO BE LEVELLED OVER
HOUSE

HOUSE SITE RELATIVELY
LEVEL

Weather Conditions

RAIN PREVIOUS DAY

Comments

EXG HOUSE REMOVED
OR DEMOLISHED – CLEAR SITE

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	3					
0.1 - 0.2	4					
0.2 - 0.3	5					
0.3 - 0.4	4					
0.4 - 0.5	3					
0.5 - 0.6	3					
0.6 - 0.7	5					
0.7 - 0.8	5					
0.8 - 0.9	6					
0.9 - 1.0	5					

⊕ BH16

BOREHOLE & DCP FIELD LOG

Project 81 Bonville Stn Rd.
Location
Tested by GTK

Job No. 01137
Date 4-6-01 Time 12:00
Borehole 1 - 3 of 3

BOREHOLE LOG

	BH1
0.0	CI SILTY CLAY, Medium plasticity, Red~~dish Brown~~ Moist, to wet, firm.
	Moist & Stiff below 0.8m
	End @ 1.2m
	BH2
0.0	CI AS above.
	Moist & Stiff below 0.6m.
	End @ 1.0m
	BH 3
0.0	ML CLAYEY SILT (TOPSOIL). Low plasticity, Dark Brown, Moist, ~~so~~ Firm.
0.5	CI SILTY CLAY, Medium plasticity, Red, Moist, to wet firm.
	Moist & Stiff below 1.0m
	End @ 1.1m

Site Description

~~Flatt~~ Flat.
Cleared
Old soil yard.
Hedge in middle - to remain.
See plan PTO.

Weather Conditions

Fine.

Comments

DCP TESTS

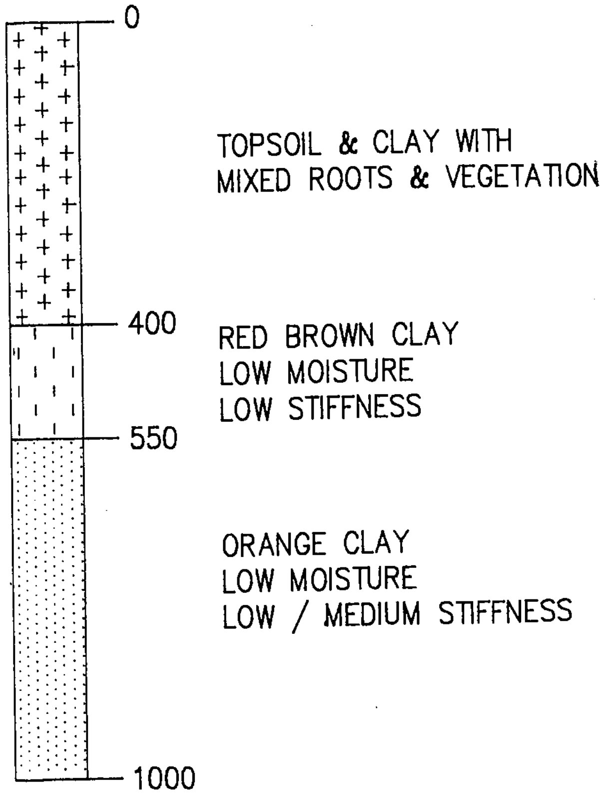
Test	1	2	3			
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	3	2	1			
0.1 - 0.2	2½	2	2			
0.2 - 0.3	1½	2	3			
0.3 - 0.4	2	2	3			
0.4 - 0.5	1½	2½	3			
0.5 - 0.6	2	[illegible]	2			
0.6 - 0.7	2½	4	2			
0.7 - 0.8	4	4	3			
0.8 - 0.9	3	5	2			
0.9 - 1.0	4	5	3			

93202

~~⊕~~ BH17

No 141 ·

Lot 19 Bonville Station Rd Bonville



·00 WIDE
ING

BORELOG

⊕ BH.18

BOREHOLE & DCP FIELD LOG

Project NO 29A .
Location LOT 11 FIG CLOSE BONVILLE
Tested by KRC

Job No. 06018
Date 7-2-06 Time 9.30
Borehole 1 of 1

BOREHOLE LOG

CL - CLAYEY SILT, LOW PLASTICITY, RED BROWN MOIST, FIRM.

200

CI - SILTY CLAY, MED PLASTICITY, DARK RED BROWN, MOIST, SOFT.

1000

CI/CL - SILTY CLAY, MEDIUM/LOW PLASTICITY RED, MOIST, FIRM

1300 E.O.H.

Site Description

RELATIVELY FLAT SITE
CLEAR.

Weather Conditions

SOME RAIN OVERNIGHT
OVERCAST.

Comments

DCP TESTS

Test						
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	4	3				
0.1 - 0.2	3	3				
0.2 - 0.3	3	3				
0.3 - 0.4	2.5	3				
0.4 - 0.5	2.5	4				
0.5 - 0.6	2	4				
0.6 - 0.7	1.5	6				
0.7 - 0.8	1.5	5				
0.8 - 0.9	2	5				
0.9 - 1.0	2	6				

⊕ BH19

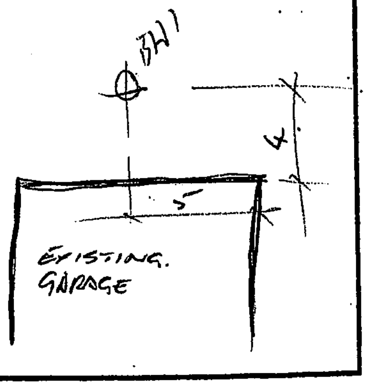
BOREHOLE & DCP FIELD LOG

Project 24 GRANDIS RD.
Location BONVILLE.
Tested by JPA

Job No. 06165
Date 3-7-06 Time 1100
Borehole 1 of 1

BOREHOLE LOG

0	CL/CI SILTY SANDY CLAY FILL CP-MP, LIGHT BROWN, ORANGE MOTTLE, DRY, FIRM.
400	CL/CI SILTY CLAY FILL, LP-MP BROWN, DRY, STIFF.
800	CI SILTY CLAY, MP. ORANGISH LIGHT BROWN DRY TO MOIST, SOFT. RED MOTTLE FROM 1.3m INCREASING WITH DEPTH.
1800	CL/CI SILTY CLAY, LP-MP GREYISH LIGHT BROWN, RED MOTTLE, DRY TO MOIST, STIFF. END BH AT 2.1m



Site Description

HOUSE ON A FILL PLATFORM.

Weather Conditions

Comments

DCP TESTS

Test	DCP					
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	7	1	4			
0.1 - 0.2	3	1	4			
0.2 - 0.3	3	1	4			
0.3 - 0.4	3	1	2			
0.4 - 0.5	8	1	2			
0.5 - 0.6	8	-	5			
0.6 - 0.7	5	1	2			
0.7 - 0.8	4	2	2			
0.8 - 0.9	2	4	7			
0.9 - 1.0	2	4	7			

⊕ BH20

BOREHOLE & DCP FIELD LOG

No 51

Project LOT 36 GRANDIS ROAD

Location BONVILLE

Tested by JPA

Job No. 05144

Date 2-6-05 Time 11:00

Borehole 1 of 1

BOREHOLE LOG

0	CL/CI SILTY CLAY, LOW-MED. PLASTICITY, REDISH BROWN DRY, STIFF BECOMING MOIST WITH DEPTH PLASTICITY INCREASING WITH DEPTH. END BH AT 1.0m

Site Description

REFER SITE PLAN.

Weather Conditions

FINE

Comments

DCP TESTS

Test	DCP					
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	7	8				
0.1 - 0.2	6	8				
0.2 - 0.3	2	8				
0.3 - 0.4	3	8				
0.4 - 0.5	3					
0.5 - 0.6	4					
0.6 - 0.7	3					
0.7 - 0.8	4					
0.8 - 0.9	8					
0.9 - 1.0	8					

⊕ BH21

BOREHOLE & DCP FIELD LOG

Project 101 GRANDIS AVE

Location BONVILLE.

Tested by JPA

Job No. 11014

Date 11-2-11 Time

Borehole 1 of 1

BOREHOLE LOG

0	ML SILTY TOPSOIL
200	CI SILTY CLAY, MEDIUM PLASTICITY, REDISH BROWN, DRY TO MOIST, SOFT TO FIRM TRACE OF FINE GRAVEL. BECOMING DRY & STIFF WITH DEPTH. RED INCREASING WITH DEPTH. END BH AT 1.1m

Site Description

CLEAR GRASSED SITE.

TREE TO BE REMOVED

SIGNS OF TREE ALREADY REMOVED.

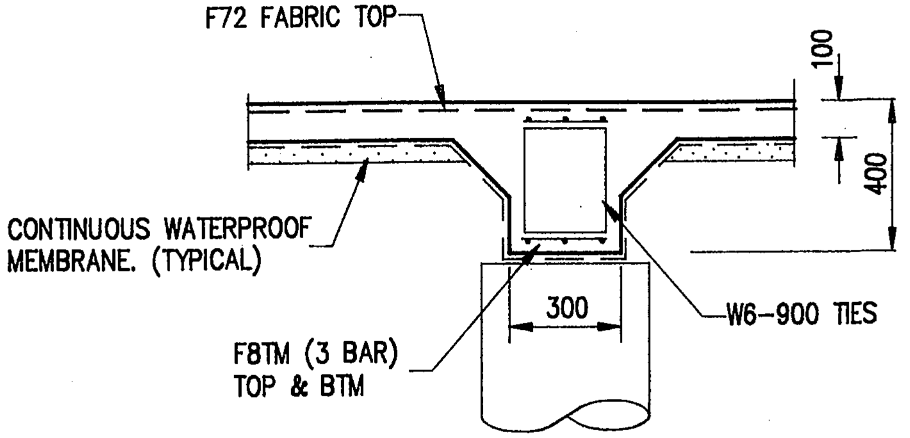
Weather Conditions

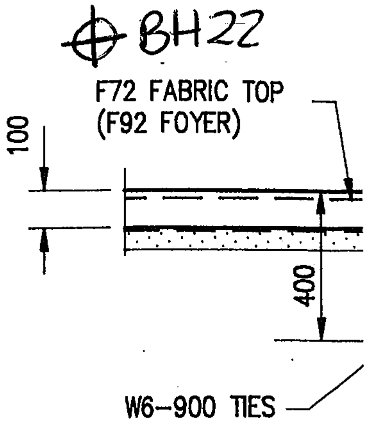
Comments

DCP TESTS

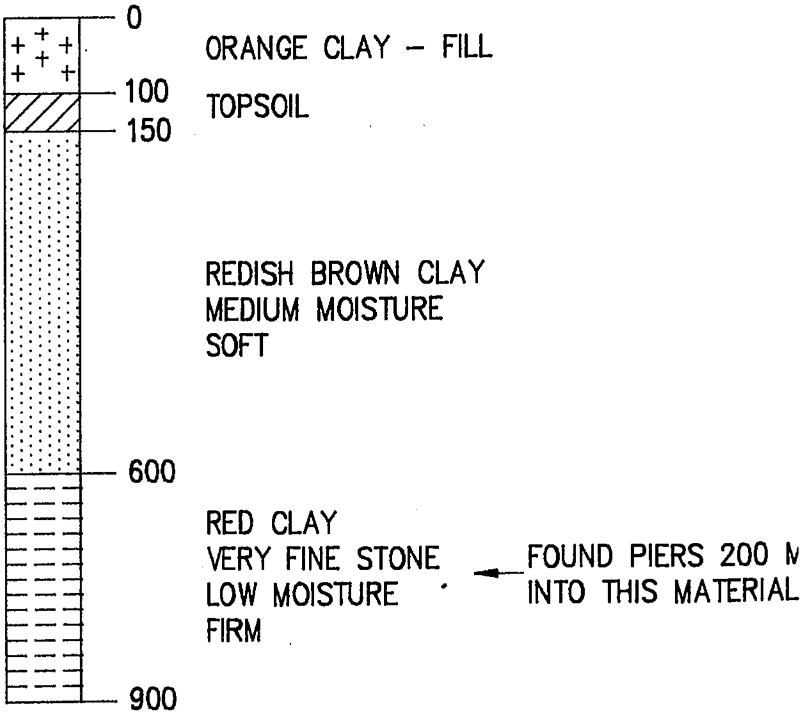
Test	DCP					
Depth (m)	Number of blows per 100 mm penetration					
0.0 - 0.1	2	4				
0.1 - 0.2	2	4				
0.2 - 0.3	2	5				
0.3 - 0.4	2	4				
0.4 - 0.5	2	5				
0.5 - 0.6	3	6				
0.6 - 0.7	3	5				
0.7 - 0.8	4	5				
0.8 - 0.9	4	6				
0.9 - 1.0	5	5				

psc Liability is limited by the Professional Engineers Scheme





SECTION 2



BORELOG

LING
MAGLEN ROAD

Lot 191 Crossmaglen Rd
No 80 Bonville.
SLAB PLAN AND DETAILS

92025

BH23

de Groot & Benson Pty Ltd
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BORE HOLE LOG & SITE SKETCH FOR

SITE ADDRESS: 54 East Bonville Road
BONVILLE

Job No: deGroot & Benson: 00269
M3 : 8817

DATE: 24-07-2003

CONSULTING ENGINEERS

BOREHOLE No. 1 Refer to site sketch for location					BOREHOLE No. 2 Refer to site sketch for location					
DEPTH (m)	DESCRIPTION Soil type, colour, moisture, consistency	FILL	DCP	"C" kPa	DEPTH (m)	DESCRIPTION Soil type, colour, moisture, consistency	FILL	DCP	"C" kPa	DCP 3
0.0	ML SILTY TOPSOIL		2		0.0	ML SILTY TOPSOIL		8		2
0.1			5		0.1	ML CLAYEY SILT, Low plasticity, Orangish		10		4
0.2			7		0.2	brown, Dry to moist, Stiff.		8		8
0.3			7		0.3			7		8
0.4	ML CLAYEY SILT, Low plasticity, Orangish		7		0.4			7		6
0.5	brown, Dry to moist, Stiff.		7		0.5			8		6
0.6			8		0.6			7		7
0.7			9		0.7			9		8
0.8			12		0.8	CL SILTY CLAY, Low plasticity, Light grey with		16		8
0.9	CL SILTY CLAY, Low plasticity, Light grey with		13		0.9	red mottling, Some gravel (EWR). Dry to moist,		16		9
1.0	red, pink & purple mottling, Some gravel (EWR)		13		1.0	Stiff.		9		13
1.1	increasing with depth, Dry to moist, Stiff.		13		1.1			10		12
1.2			12		1.2			12		10
1.3			10		1.3			12		12
1.4			11		1.4			9		12
1.5	**End of BH 1 @ 1.5m.**		12		1.5	**End of BH 2 @ 1.5m.**		10		15
1.6			13		1.6			17		23
1.7			13		1.7			20		22
1.8			15		1.8			20		18
1.9			22		1.9			18		18
2.0					2.0					
2.1					2.1					
2.2					2.2					
2.3					2.3					
2.4					2.4					
2.5					2.5					
2.6					2.6					
2.7					2.7					

NOMENCLATURE:
LP = Low Plasticity, MP = Medium Plasticity, HP = High Plasticity, Ref = DCP refusal (>20 blows or bounce)
"C" = cohesion (not allowable bearing capacity), EWR = Extremely Weathered Rock.
Some alluvial topsoils are indistinguishable from fill in boreholes. When these have similar capacities as fill, they may be logged as fill.

TEST METHODS:
Hand Auger ☑ Small Rig (100mm dia) ☐

SITING:
Existing ☐ Gen Setback ☐ Plans ☐
Pegged ☑ Met on site ☐ Prepared pad ☐

EXCAVATION PROBLEMS:
Shallow rock ☐ Gravels/Cobbles/Boulders ☐
Rubbish in fill ☐ Wet/Dry Collapse ☐
Water table ☐ Access to site ☐

VEGETATION (in and around house site)
Established garden ☐ Cleared ☑
Grasses: Nil [✓ Sparse] Moderate Dense
Bush-scrub: Nil Sparse [✓ Moderate] Dense
Trees: Nil Sparse [✓ Moderate] Dense
Recent tree removal: [✓ No evidence] Yes

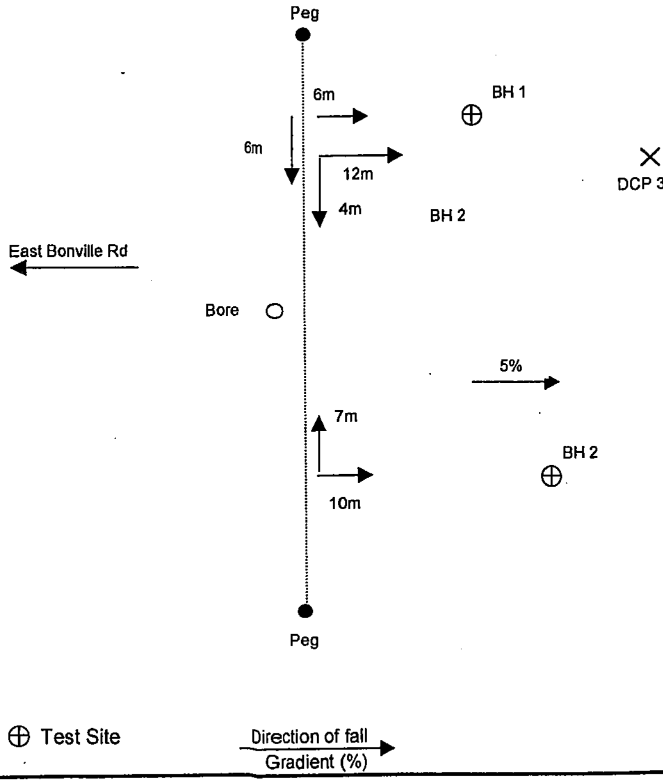
DRAINAGE:
From house site: Poor [✓ Fair] Good
Up slope catchment: Small [✓ Medium] Large
Within property [✓ Neighbouring properties]

COMMENTS:

Several trees to 300 dia in and around house site as pegged.

AS 2870 Class S site.

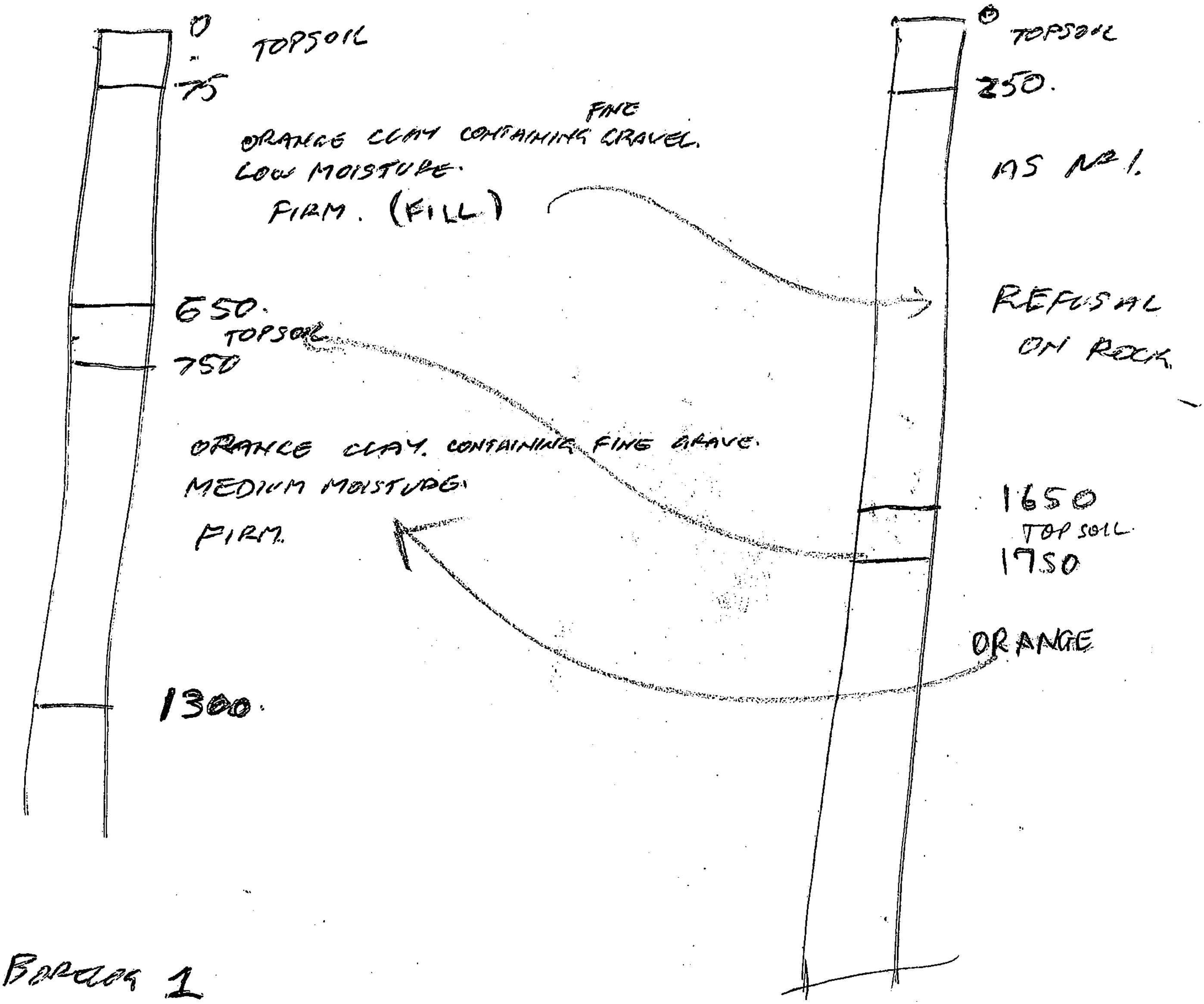
SITE SKETCH
N.T.S.



Lot 2 East Bonville Rd, Bonville 91292

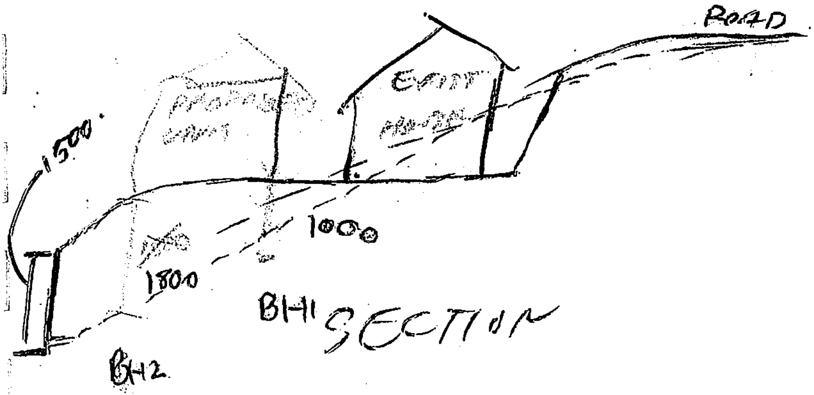
No. 79

⊕ BH24



BORELOG 1

BORELOG 2.



SECTION

APPENDIX C – Slope Hazard

Extracts from "Landside Risk Management Concepts and Guidelines", (Australian Geomechanics Society, Sub-Committee on Landslide Risk Management, March 2000)

LANDSLIDE RISK ASSESSMENT – EXAMPLE OF QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

Qualitative Measures of Likelihood

Level	Descriptor	Description	Indicative Annual Probability
A	ALMOST CERTAIN	The event is expected to occur	$>\approx 10^{-1}$
B	LIKELY	The event will probably occur under adverse conditions	$\approx 10^{-2}$
C	POSSIBLE	The event could occur under adverse conditions	$\approx 10^{-3}$
D	UNLIKELY	The event might occur under very adverse circumstances	$\approx 10^{-4}$
E	RARE	The event is conceivable but only under exceptional circumstances.	$\approx 10^{-5}$
F	NOT CREDIBLE	The event is inconceivable or fanciful	$<10^{-6}$

Note: "≈" means that the indicative value may vary by say ± ½ of an order of magnitude, or more.

Qualitative Measures of Consequences to Property

Level	Descriptor	Description
1	CATASTROPHIC	Structure completely destroyed or large scale damage requiring major engineering works for stabilisation.
2	MAJOR	Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.
3	MEDIUM	Moderate damage to some of structure, or significant part of site requiring large stabilisation works.
4	MINOR	Limited damage to part of structure, or part of site requiring some reinstatement/stabilisation works.
5	INSIGNIFICANT	Little damage.

Note: The "Description" may be edited to suit a particular case.

Qualitative Risk Analysis Matrix – Level of Risk to Property

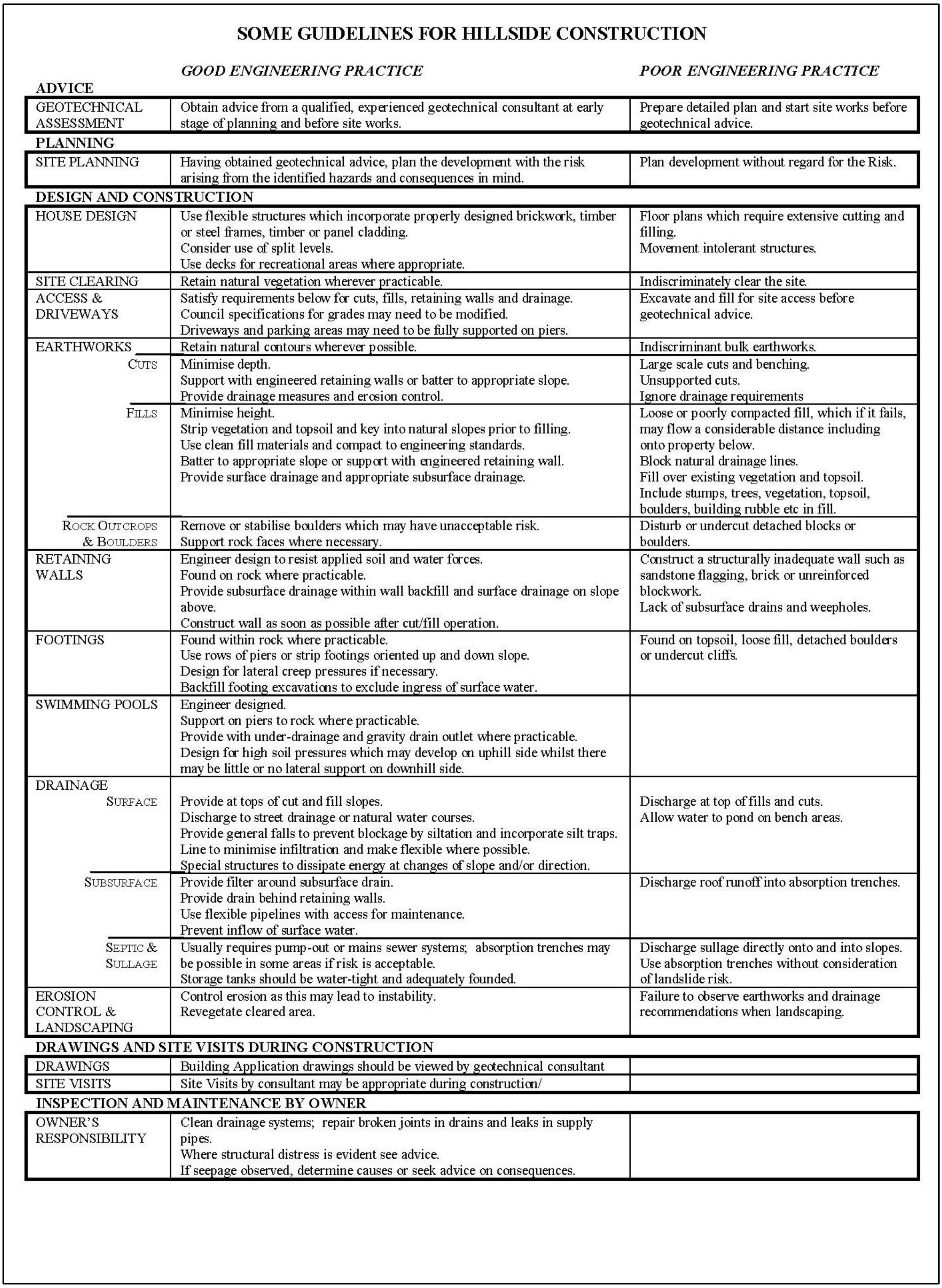
LIKELIHOOD	CONSEQUENCES to PROPERTY				
	1: CATASTROPHIC	2: MAJOR	3: MEDIUM	4: MINOR	5: INSIGNIFICANT
A – ALMOST CERTAIN	VH	VH	H	H	M
B – LIKELY	VH	H	H	M	L-M
C – POSSIBLE	H	H	M	L-M	VL-L
D – UNLIKELY	M-H	M	L-M	VL-L	VL
E – RARE	M-L	L-M	VL-L	VL	VL
F – NOT CREDIBLE	VL	VL	VL	VL	VL

Risk Level Implications

Risk Level		Example Implications(1)
VH	VERY HIGH RISK	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive and not practical
H	HIGH RISK	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels
M	MODERATE RISK	Tolerable provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options.
L	LOW RISK	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (1) The implications for a particular situation are to be determined by all parties to the risk assessment; these are only given as a general guide.

(2) Judicious use of dual descriptors for Likelihood, Consequence and Risk to reflect the uncertainty of the estimate may be appropriate in some cases.



SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

LANDSLIDE RISK MANAGEMENT

AGS SUB-COMMITTEE

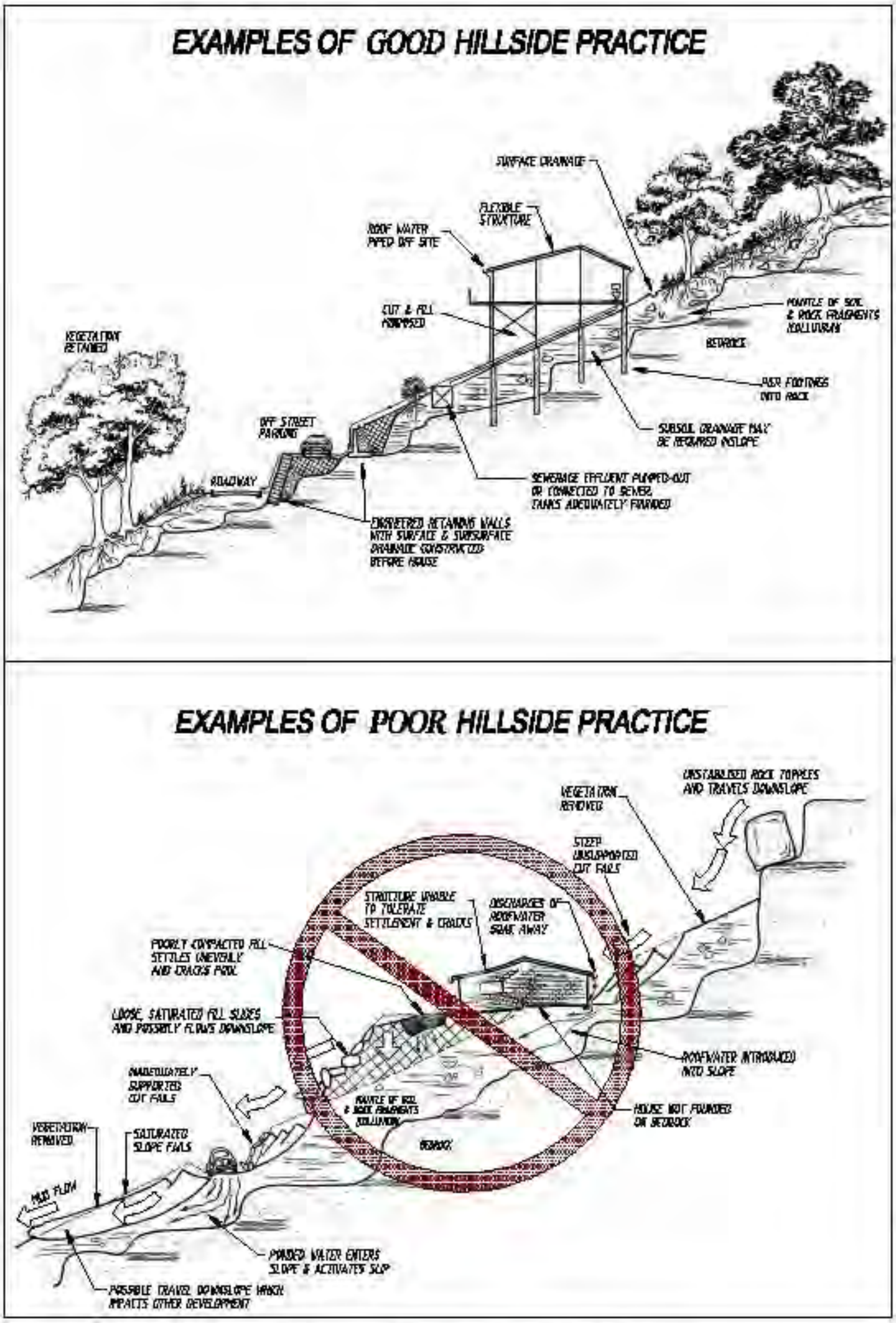


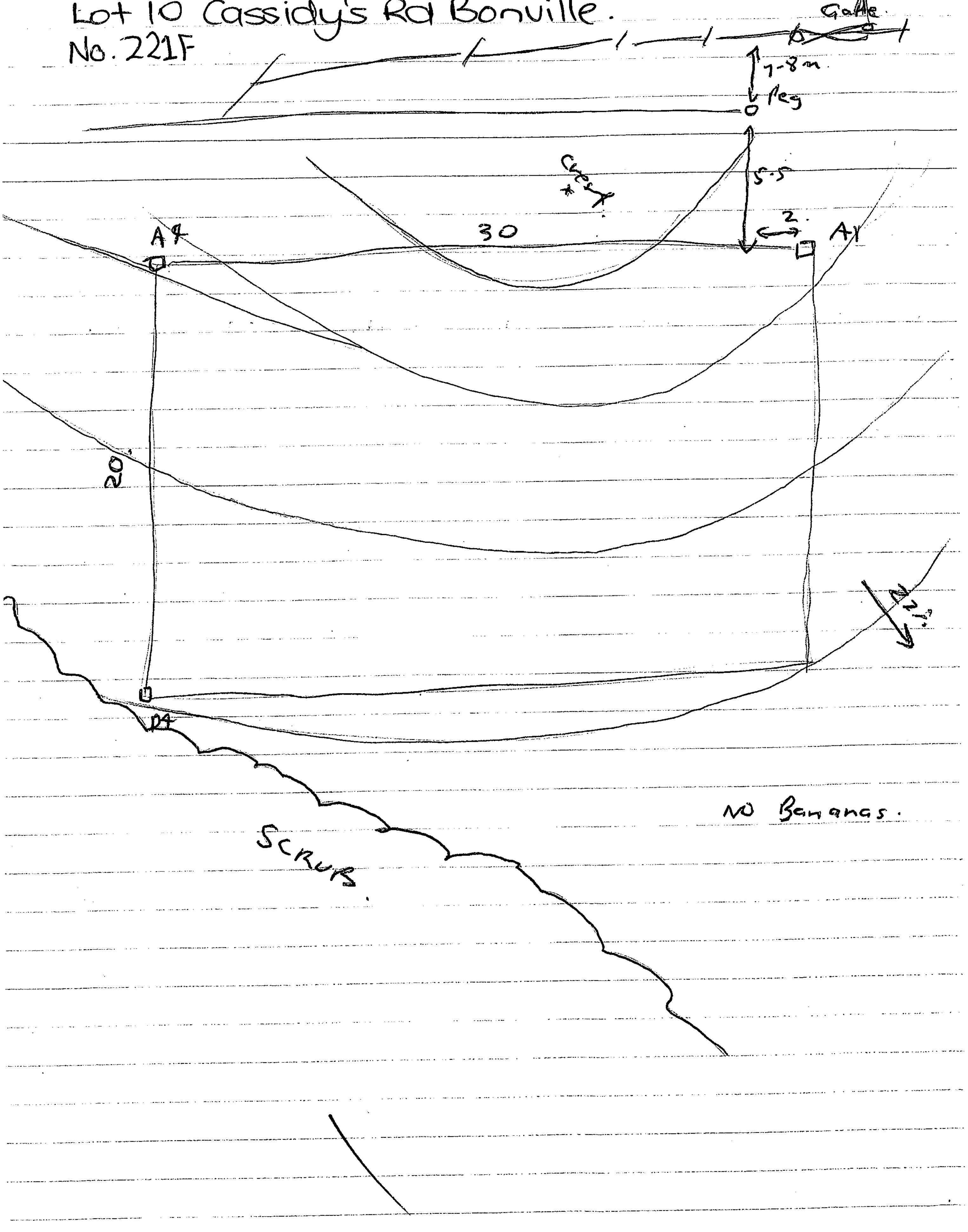
Figure J1 Illustrations of Good and Poor Hillside Practice

APPENDIX D – Contamination Testing

■ SC1A

Site sketch - 9-8-06 GJK.

Lot 10 Cassidy's Rd Bonville.
No. 221F



NO Bananas.

Lot 10 Cassidy's Rd Bonville

SC1B

Simmonds & Bristow Pty Ltd
Established 1965 ABN 33 010 252 418

P/O Box 3160 Yeronga 4104
40 Reginald St
Rocklea, Qld 4106

Ph : (07)3710 9100
Fax : (07)3710 9199

Attention : Mr Rob de Groot
Client : de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. :
Batch Reference No. : 66515

Analytical Results

Page : 1 of 1

Sample Reference			265169	265170	265171	265172
Sample Name			06103- A4 150- -300	06103- C1 150- -300	06103- C2 150- -300	06103- C4 150- -300
Date Collected			30/06/2006	30/06/2006	30/06/2006	30/06/2006
Date Recieved			3/07/2006	3/07/2006	3/07/2006	3/07/2006
Date Testing Completed			17/07/2006	17/07/2006	17/07/2006	17/07/2006
Analyte		**Units**				
SC010.4	Arsenic as As (Soils) by ICPMS	ug/kg	58000.	120000.	140000.	38000.
SC050.04	Lead as Pb (Soils) ICPMS	ug/kg	19000.	19000.	20000.	21000.

Notes : Samples are disposed of 14 days after completion of testing.

Results reported on an "as received" basis.
Results reported pertain only to the sample analysed.

Note : * All tests covered by NATA accreditation except where marked

NATA Accredited Laboratory
Number : 1500
NATA ENDORSED TEST REPORT
This document shall not be reproduced, except in full.

Authorised for release :

Date : 17/07/2006

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Fax : (07)3710 9199

Attention : **Mr Rob de Groot**
Client : **de Groot & Benson Pty Ltd**
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : **Ref: 06103**
Batch Reference No. : **66014**

Lot 10 Cassidy's Rd Bonville.

Analytical Results

Page : 1 Of 6

Sample Reference			263236	263237	263238	263239	263241	263245	263246
Sample Name			06103-A 0-75	06103-B 0-75	06103-C 0-75	06103-D 0-75	06103-A 0-150	06103-B 0-150	06103-C 0-150
Date Collected			3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006
Date Received			4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006
Date Testing Completed			18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006
Analyte		**Units**							
SC010.4	Arsenic as As (Soils) by ICPMS	ug/kg					120000.	66000.	110000.
SC050.04	Lead as Pb (Soils) ICPMS	ug/kg					18000.	19000.	19000.
GC021.02	alpha-BHC	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.03	beta-BHC	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.04	gamma-BHC (Lindane)	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.05	delta-BHC	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.06	Heptachlor	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.07	Aldrin	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.09	Heptachlor Epoxide	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.10	P,P-DDE	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.11	P,P-DDD	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.12	P,P-DDT	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.16	Dieldrin	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.17	Endrin	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.18	alpha-Endosulfan	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			

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Dated : 18/05/2006

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SC1D

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Rocklea, Qld 4106

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Fax : (07)3710 9199

Attention : **Mr Rob de Groot**
Client : **de Groot & Benson Pty Ltd**
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : **Ref: 06103**
Batch Reference No. : **66014**

Analytical Results

Page : 2 Of 6

Sample Reference			263236	263237	263238	263239	263241	263245	263246
Sample Name			06103-A 0-75	06103-B 0-75	06103-C 0-75	06103-D 0-75	06103-A 0-150	06103-B 0-150	06103-C 0-150
Date Collected			3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006
Date Received			4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006
Date Testing Completed			18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006
Analyte		**Units**							
GC021.19	beta-Endosulfan	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.20	Endosulfan Sulfate	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05			
GC021.21	Methoxychlor	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05			
GC021.22	CIS Chlordane	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.23	Trans-Chlordane	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.26	Dichlorfenthion	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.27	Chlorpyrifos-Methyl (Reldane)	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.28	Ethion	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.29	Carbophenothion (Trithion)	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.31	Fenitrothion	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.38	Trichlorfon	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4			
GC021.39	Thionazin (Zinophos)	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4			
GC021.41	Terbufos	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.42	Dioxathion	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4			
GC021.43	Fonofos (Dyfonate)	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			

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Attention : Mr Rob de Groot
Client : de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : Ref: 06103
Batch Reference No. : 66014

Analytical Results

Page : 3 Of 6

Sample Reference			263236	263237	263238	263239	263241	263245	263246
Sample Name			06103-A 0-75	06103-B 0-75	06103-C 0-75	06103-D 0-75	06103-A 0-150	06103-B 0-150	06103-C 0-150
Date Collected			3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006
Date Received			4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006
Date Testing Completed			18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006
Analyte		**Units**							
GC021.48	Famphur	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
G030.	Moisture Content @ 105øC	%	25.	30.	29.	26.			

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Client : **de Groot & Benson Pty Ltd**
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : **Ref: 06103**
Batch Reference No. : **66014**

Analytical Results

Page : 4 Of 6

Sample Reference		263247						
Sample Name		06103-D 0-150						
Date Collected		3/05/2006						
Date Received		4/05/2006						
Date Testing Completed		18/05/2006						
Analyte	**Units**							
SC010.4 Arsenic as As (Soils) by ICPMS	ug/kg	57000.						
SC050.04 Lead as Pb (Soils) ICPMS	ug/kg	19000.						
GC021.02 alpha-BHC	mg/kg							
GC021.03 beta-BHC	mg/kg							
GC021.04 gamma-BHC (Lindane)	mg/kg							
GC021.05 delta-BHC	mg/kg							
GC021.06 Heptachlor	mg/kg							
GC021.07 Aldrin	mg/kg							
GC021.09 Heptachlor Epoxide	mg/kg							
GC021.10 P,P-DDE	mg/kg							
GC021.11 P,P-DDD	mg/kg							
GC021.12 P,P-DDT	mg/kg							
GC021.16 Dieldrin	mg/kg							
GC021.17 Endrin	mg/kg							
GC021.18 alpha-Endosulfan	mg/kg							

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PO Box 1908
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N.S.W. **2450**

Client Order No. : **Ref: 06103**
Batch Reference No. : **66014**

Analytical Results

Page : 5 Of 6

Sample Reference			263247						
Sample Name			06103-D 0-150						
Date Collected			3/05/2006						
Date Received			4/05/2006						
Date Testing Completed			18/05/2006						
Analyte		**Units**							
GC021.19	beta-Endosulfan	mg/kg							
GC021.20	Endosulfan Sulfate	mg/kg							
GC021.21	Methoxychlor	mg/kg							
GC021.22	CIS Chlordane	mg/kg							
GC021.23	Trans-Chlordane	mg/kg							
GC021.26	Dichlorfenthion	mg/kg							
GC021.27	Chlorpyrifos-Methyl (Reldane)	mg/kg							
GC021.28	Ethion	mg/kg							
GC021.29	Carbophenothion (Trithion)	mg/kg							
GC021.31	Fenitrothion	mg/kg							
GC021.38	Trichlorfon	mg/kg							
GC021.39	Thionazin (Zinophos)	mg/kg							
GC021.41	Terbufos	mg/kg							
GC021.42	Dioxathion	mg/kg							
GC021.43	Fonofos (Dyfonate)	mg/kg							

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Rocklea, Qld 4106

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Attention : Mr Rob de Groot
Client : de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : Ref: 06103
Batch Reference No. : 66014

Analytical Results

Page : 6 Of 6

Sample Reference		263247						
Sample Name		06103-D 0-150						
Date Collected **Date Received** **Date Testing Completed**		3/05/2006 4/05/2006 18/05/2006						
Analyte	**Units**							
GC021.48 Famphur	mg/kg							
G030. Moisture Content @ 105øC	%							

Notes : Samples are disposed of 14 days after completion of testing.

Results reported on an "as received" basis. Results reported pertain only to the sample analysed.

Authorised for release :

Dated : 18/05/2006

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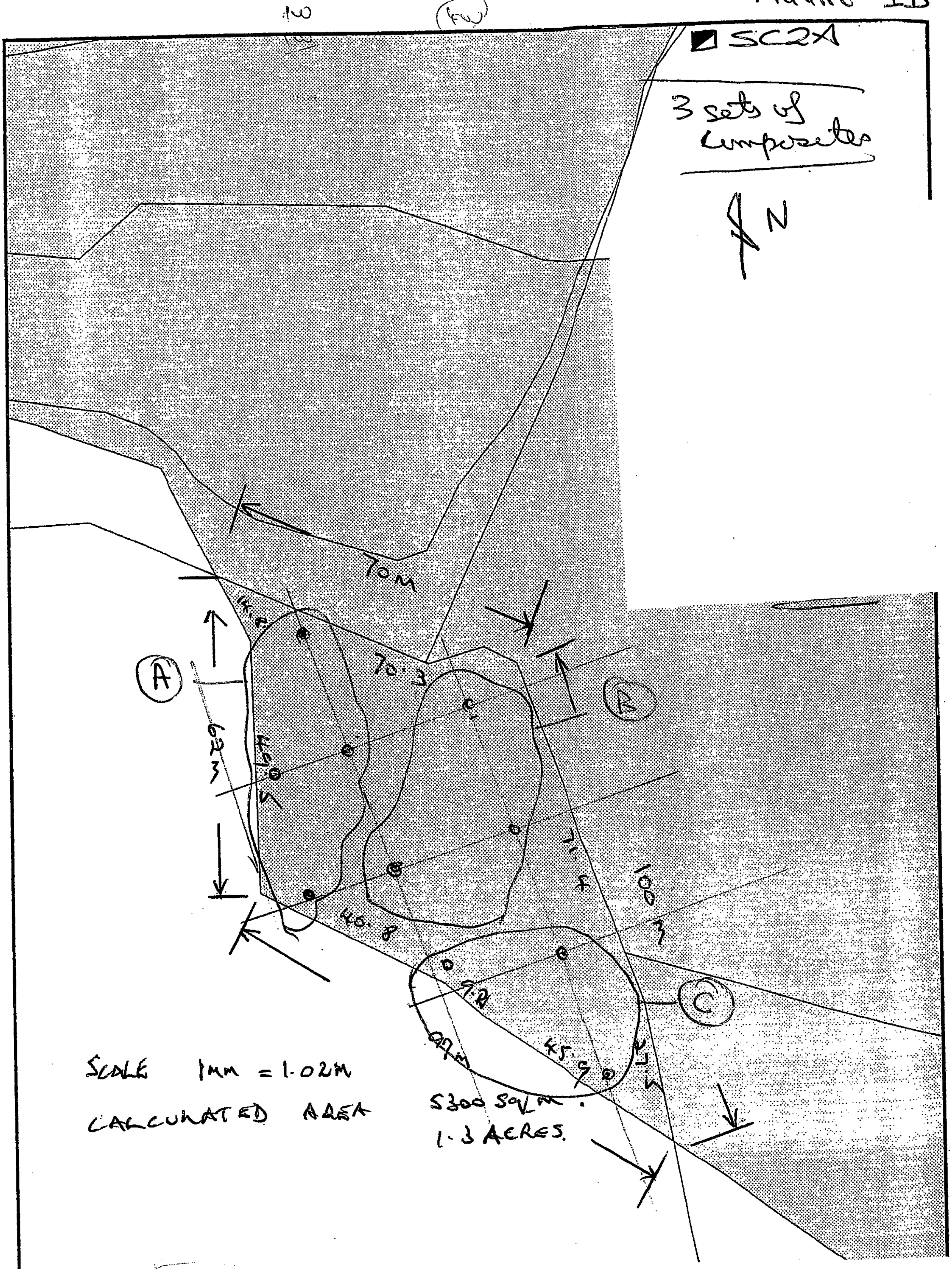
No 221C, Lot 21 Cassidy's Rd 99374
Bonville.

CITY OF COFFS HARBOUR
SCALE 1: 1000

DSY
Mon Oct 25 1999 14:52:42

FIGURE 1B



3 sets of composites

SCALE 1MM = 1.02M

CALCULATED AREA 5300 SQ M.
1.3 ACRES.

de Groot & Benson Pty Ltd
PO Box 1908
236 High Street
COFFS HARBOUR NSW 2450

SC2B

Simmonds & Bristow Pty Ltd
Established 1965 ACN 010 252 418

30 Shottery St
PO Box 3160
Yeronga Qld 4104
Australia
Ph: (07) 3848 7699
Fax: (07) 3892 3345

SOIL ANALYSIS

Ref. No: 45116
Page No: 1 of 2

Sampled By : Client

RECEIVED
26 NOV 1999

de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450
Attn : Mr Rob de Groot

Regd No	Sample Description	Collected	Received	Tested
171509	99374-A-150	9/11/1999	10/11/1999	10/11-19/11
171510	99374-A-300	9/11/1999	10/11/1999	10/11-19/11
171511	99374-B-150	9/11/1999	10/11/1999	10/11-19/11

S&B Method	Chemical Analysis		171509	171510	171511
	Major Elements				
SC010.14	Arsenic	as As mg/kg	7.8	7.1	16.
SC050.14	Lead	as Pb mg/kg	23.	32.	29.

* Confirmation of results faxed on 19/11/1999
* Sludge/soil samples tested and reported as mg/kg on an "as received" basis.
** Sludge and soil samples prepared as per EPA 3050 digest prior to metals' analysis.
*** Arsenic and/or selenium determined as per EPA method 206.3, EPA method 270.3 and EPA 600/4-79-020.

Client Manager

Julie Ivison BSc MBA

SIMMONDS & BRISTOW PTY LTD

PER

November 19, 1999

SC2D

Simmonds & Bristow
Established 1965 ACN 010 252 418 Pty Ltd

30 Shottery St
PO Box 3160
Yeronga Qld 4104
Australia
Ph: (07) 3848 7699
Fax: (07) 3892 3345

de Groot & Benson Pty Ltd

Ref. No: 45116
Page No: 1 of 2

PESTICIDES IN SOIL

Sampled By: Client

Regd No	Sample Description	Collected	Received	Tested
171509	99374-A-150	9/11/1999	10/11/1999	10/11-19/11
171510	99374-A-300	9/11/1999	10/11/1999	10/11-19/11
171511	99374-B-150	9/11/1999	10/11/1999	10/11-19/11

S&B Method	ORGANOCHLORINE PESTICIDES		171509	171510	171511
GC02.03	LOR (Soil)	mg/kg	0.1	0.1	0.1
GC021.01	HCB	mg/kg	<0.1	<0.1	<0.1
GC021.02	alpha-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.03	beta-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.04	gamma-BHC (Lindane)	mg/kg	<0.1	<0.1	<0.1
GC021.05	delta-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.06	Heptachlor	mg/kg	<0.1	<0.1	<0.1
GC021.07	Aldrin	mg/kg	<0.1	<0.1	<0.1
GC021.08	Oxychlordane	mg/kg	<0.1	<0.1	<0.1
GC021.09	Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1
GC021.10	P,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.11	P,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.12	P,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.13	O,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.14	O,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.15	O,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.16	Dieldrin	mg/kg	<0.1	<0.1	<0.1
GC021.17	Endrin	mg/kg	<0.1	<0.1	<0.1
GC021.18	alpha-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.19	beta-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.20	Endosulfan Sulfate	mg/kg	<0.1	<0.1	<0.1
GC021.21	Methyoxychlor	mg/kg	<0.1	<0.1	<0.1
GC021.22	CIS Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.23	Trans-Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.24	Dicofol	mg/kg	<0.1	<0.1	<0.1

S&B Method	ORGANOPHOSPHATE PESTICIDES		171509	171510	171511
GC02.04	LOR (Soil)	mg/kg	0.2	0.2	0.2
GC021.25	Diazinon	mg/kg	<0.2	<0.2	<0.2
GC021.26	Dichlorfenthion	mg/kg	<0.2	<0.2	<0.2
GC021.27	Chlorpyrifos-Methyl	mg/kg	<0.2	<0.2	<0.2
GC021.28	Ethion	mg/kg	<0.2	<0.2	<0.2
GC021.29	Carbophenothion (Trithion)	mg/kg	<0.2	<0.2	<0.2
GC021.30	(Dursban) Chloropyrifos	mg/kg	<0.2	<0.2	<0.2
GC021.31	Fenitrothion	mg/kg	<0.2	<0.2	<0.2
GC021.32	Parathion-Ethyl (Parathion)	mg/kg	<0.2	<0.2	<0.2
GC021.33	Bromophos-Ethyl	mg/kg	<0.2	<0.2	<0.2
GC021.34	Ronel (Fenchlorphos)	mg/kg	<0.2	<0.2	<0.2
GC021.35	Prothiophos	mg/kg	<0.2	<0.2	<0.2

* Confirmation of results faxed on 19/11/1999
* Sludge/soil samples tested and reported as mg/kg on an "as received" basis.

Client Manager

Julie Ivison BSc MBA

SIMMONDS & BRISTOW PTY LTD

PER

November 19, 1999

National Association of Testing Authorities, Australia
NATA Endorsed Test Report
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SC2E

Simmonds & Bristow
Established 1965 ACN 010 252 418 Pty Ltd

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de Groot & Benson Pty Ltd

Ref. No: 45116
Page No: 2 of 2

PESTICIDES IN SOIL

Sampled By: Client

Regd No	Sample Description	Collected	Received	Tested
171512	99374-B-300	9/11/1999	10/11/1999	10/11-19/11
171513	99374-C-150	9/11/1999	10/11/1999	10/11-19/11
171514	99374-C-300	9/11/1999	10/11/1999	10/11-19/11

S&B Method	ORGANOCHLORINE PESTICIDES		171512	171513	171514
GC02.03	LOR (Soil)	mg/kg	0.1	0.1	0.1
GC021.01	HCB	mg/kg	<0.1	<0.1	<0.1
GC021.02	alpha-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.03	beta-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.04	gamma-BHC (Lindane)	mg/kg	<0.1	<0.1	<0.1
GC021.05	delta-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.06	Heptachlor	mg/kg	<0.1	<0.1	<0.1
GC021.07	Aldrin	mg/kg	<0.1	<0.1	<0.1
GC021.08	Oxychlordane	mg/kg	<0.1	<0.1	<0.1
GC021.09	Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1
GC021.10	P,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.11	P,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.12	P,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.13	O,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.14	O,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.15	O,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.16	Dieldrin	mg/kg	<0.1	<0.1	<0.1
GC021.17	Endrin	mg/kg	<0.1	<0.1	<0.1
GC021.18	alpha-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.19	beta-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.20	Endosulfan Sulfate	mg/kg	<0.1	<0.1	<0.1
GC021.21	Methyoxychlor	mg/kg	<0.1	<0.1	<0.1
GC021.22	CIS Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.23	Trans-Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.24	Dicofol	mg/kg	<0.1	<0.1	<0.1

S&B Method	ORGANOPHOSPHATE PESTICIDES		171512	171513	171514
GC02.04	LOR (Soil)	mg/kg	0.2	0.2	0.2
GC021.25	Diazinon	mg/kg	<0.2	<0.2	<0.2
GC021.26	Dichlorfenthion	mg/kg	<0.2	<0.2	<0.2
GC021.27	Chlorpyrifos-Methyl	mg/kg	<0.2	<0.2	<0.2
GC021.28	Ethion	mg/kg	<0.2	<0.2	<0.2
GC021.29	Carbophenothion (Trithion)	mg/kg	<0.2	<0.2	<0.2
GC021.30	(Dursban) Chloropyrifos	mg/kg	<0.2	<0.2	<0.2
GC021.31	Fenitrothion	mg/kg	<0.2	<0.2	<0.2
GC021.32	Parathion-Ethyl (Parathion)	mg/kg	<0.2	<0.2	<0.2
GC021.33	Bromophos-Ethyl	mg/kg	<0.2	<0.2	<0.2
GC021.34	Ronel (Fenchlorphos)	mg/kg	<0.2	<0.2	<0.2
GC021.35	Prothiophos	mg/kg	<0.2	<0.2	<0.2

* Confirmation of results faxed on 19/11/1999
* Sludge/soil samples tested and reported as mg/kg on an "as received" basis.

Client Manager

Julie Ivison BSc MBA

SIMMONDS & BRISTOW PTY LTD

PER

November 19, 1999

National Association of Testing Authorities, Australia

NATA Endorsed Test Report
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Lot 10 Cassidy's Rd Bonville

SC1B

Simmonds & Bristow Pty Ltd
Established 1965
ABN 33 010 252 418

P/O Box 3160 Yeronga 4104
40 Reginald St
Rocklea, Qld 4106

Ph : (07)3710 9100
Fax : (07)3710 9199

Attention : Mr Rob de Groot
Client : de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. :
Batch Reference No. : 66515

Analytical Results

Page : 1 of 1

Sample Reference		265169	265170	265171	265172
Sample Name		06103- A4 150--300	06103- C1 150--300	06103- C2 150--300	06103- C4 150--300
Date Collected		30/06/2006	30/06/2006	30/06/2006	30/06/2006
Date Recieved		3/07/2006	3/07/2006	3/07/2006	3/07/2006
Date Testing Completed		17/07/2006	17/07/2006	17/07/2006	17/07/2006
Analyte	**Units**				
SC010.4 Arsenic as As (Soils) by ICPMS	ug/kg	58000.	120000.	140000.	38000.
SC050.04 Lead as Pb (Soils) ICPMS	ug/kg	19000.	19000.	20000.	21000.

Notes : Samples are disposed of 14 days after completion of testing.

Results reported on an "as received" basis.
Results reported pertain only to the sample analysed.

Note : * All tests covered by NATA accreditation except where marked

Authorised for release :

Date : 17/07/2006

NATA Accredited Laboratory
Number : 1500
NATA ENDORSED TEST REPORT
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Simmonds & Bristow
Established 1965 ABN 33 010 252 418 Pty Ltd

P/O Box 3160 Yeronga ~~4104~~
40 Reginald St
Rocklea, Qld 4106

Ph. : (07)3710 9100
Fax : (07)3710 9199

Attention : Mr Rob de Groot
Client : de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : Ref: 06103
Batch Reference No. : 66014

Lot 10 Cassidy's Rd Bonville.

Analytical Results

Page : 1 Of 6

Sample Reference			263236	263237	263238	263239	263241	263245	263246
Sample Name			06103-A 0-75	06103-B 0-75	06103-C 0-75	06103-D 0-75	06103-A 0-150	06103-B 0-150	06103-C 0-150
Date Collected			3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006
Date Received			4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006
Date Testing Completed			18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006
Analyte		**Units**							
SC010.4	Arsenic as As (Soils) by ICPMS	ug/kg					120000.	66000.	110000.
SC050.04	Lead as Pb (Soils) ICPMS	ug/kg					18000.	19000.	19000.
GC021.02	alpha-BHC	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.03	beta-BHC	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.04	gamma-BHC (Lindane)	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.05	delta-BHC	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.06	Heptachlor	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.07	Aldrin	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.09	Heptachlor Epoxide	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.10	P,P-DDE	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.11	P,P-DDD	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.12	P,P-DDT	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.16	Dieldrin	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.17	Endrin	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.18	alpha-Endosulfan	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			

Authorised for release :
Dated : 18/05/2006

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SC1C

SC1D

Attention : **Mr Rob de Groot**
Client : **de Groot & Benson Pty Ltd**
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : **Ref: 06103**
Batch Reference No. : **66014**

Analytical Results

Page : 2 Of 6

Sample Reference			263236	263237	263238	263239	263241	263245	263246
Sample Name			06103-A 0-75	06103-B 0-75	06103-C 0-75	06103-D 0-75	06103-A 0-150	06103-B 0-150	06103-C 0-150
Date Collected			3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006
Date Received			4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006
Date Testing Completed			18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006
Analyte		**Units**							
GC021.19	beta-Endosulfan	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.20	Endosulfan Sulfate	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05			
GC021.21	Methoxychlor	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05			
GC021.22	CIS Chlordane	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.23	Trans-Chlordane	mg/kg	< 0.02	< 0.02	< 0.02	< 0.02			
GC021.26	Dichlorfenthion	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.27	Chlorpyrifos-Methyl (Reldane)	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.28	Ethion	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.29	Carbophenothion (Trithion)	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.31	Fenitrothion	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.38	Trichlorfon	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4			
GC021.39	Thionazin (Zinophos)	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4			
GC021.41	Terbufos	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
GC021.42	Dioxathion	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4			
GC021.43	Fonofos (Dyfonate)	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			

Authorised for release :
Dated : 18/05/2006

Simmonds & Bristow
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Attention : Mr Rob de Groot
Client : de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : Ref: 06103
Batch Reference No. : 66014

Analytical Results

Page : 3 Of 6

Sample Reference		263236	263237	263238	263239	263241	263245	263246
Sample Name		06103-A 0-75	06103-B 0-75	06103-C 0-75	06103-D 0-75	06103-A 0-150	06103-B 0-150	06103-C 0-150
Date Collected		3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006	3/05/2006
Date Received		4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006	4/05/2006
Date Testing Completed		18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006	18/05/2006
Analyte	**Units**							
GC021.48 Famphur	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1			
G030. Moisture Content @ 105øC	%	25.	30.	29.	26.			

Authorised for release :

Dated : 18/05/2006

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Simmonds & Bristow Pty Ltd
Established 1965 ABN 33 010 252 418

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Client : **de Groot & Benson Pty Ltd**
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : Ref: 06103
Batch Reference No. : 66014

SC1F

Analytical Results

Page : 4 Of 6

Sample Reference			263247						
Sample Name			06103-D 0-150						
Date Collected			3/05/2006						
Date Received			4/05/2006						
Date Testing Completed			18/05/2006						
Analyte		**Units**							
SC010.4	Arsenic as As (Soils) by ICPMS	ug/kg	57000.						
SC050.04	Lead as Pb (Soils) ICPMS	ug/kg	19000.						
GC021.02	alpha-BHC	mg/kg							
GC021.03	beta-BHC	mg/kg							
GC021.04	gamma-BHC (Lindane)	mg/kg							
GC021.05	delta-BHC	mg/kg							
GC021.06	Heptachlor	mg/kg							
GC021.07	Aldrin	mg/kg							
GC021.09	Heptachlor Epoxide	mg/kg							
GC021.10	P,P-DDE	mg/kg							
GC021.11	P,P-DDD	mg/kg							
GC021.12	P,P-DDT	mg/kg							
GC021.16	Dieldrin	mg/kg							
GC021.17	Endrin	mg/kg							
GC021.18	alpha-Endosulfan	mg/kg							

Authorised for release :
Dated : 18/05/2006

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Simmonds & Bristow

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Client : de Groot & Benson Pty Ltd
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COFFS HARBOUR
N.S.W. 2450

Client Order No. : Ref: 06103
Batch Reference No. : 66014

SC1G

Analytical Results

Page : 5 Of 6

Sample Reference			263247						
Sample Name			06103-D 0-150						
Date Collected			3/05/2006						
Date Received			4/05/2006						
Date Testing Completed			18/05/2006						
Analyte		**Units**							
GC021.19	beta-Endosulfan	mg/kg							
GC021.20	Endosulfan Sulfate	mg/kg							
GC021.21	Methoxychlor	mg/kg							
GC021.22	CIS Chlordane	mg/kg							
GC021.23	Trans-Chlordane	mg/kg							
GC021.26	Dichlorfenthion	mg/kg							
GC021.27	Chlorpyrifos-Methyl (Reldane)	mg/kg							
GC021.28	Ethion	mg/kg							
GC021.29	Carbophenothion (Trithion)	mg/kg							
GC021.31	Fenitrothion	mg/kg							
GC021.38	Trichlorfon	mg/kg							
GC021.39	Thionazin (Zinophos)	mg/kg							
GC021.41	Terbufos	mg/kg							
GC021.42	Dioxathion	mg/kg							
GC021.43	Fonofos (Dyfonate)	mg/kg							

Authorised for release :
Dated : 18/05/2006

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Attention : **Mr Rob de Groot**
Client : **de Groot & Benson Pty Ltd**
PO Box 1908
COFFS HARBOUR
N.S.W. 2450

Client Order No. : **Ref: 06103**
Batch Reference No. : **66014**

		Analytical Results					Page : 6 Of 6	
Sample Reference		263247						
Sample Name **Date Collected** **Date Received** **Date Testing Completed**		06103-D 0-150 3/05/2006 4/05/2006 18/05/2006						
Analyte	**Units**							
GC021.48 Famphur	mg/kg							
G030. Moisture Content @ 105øC	%							

Notes : Samples are disposed of 14 days after completion of testing.

Results reported on an "as received" basis. Results reported pertain only to the sample analysed.

Authorised for release :
Dated : 18/05/2006

Protecting your people, profits and our environment

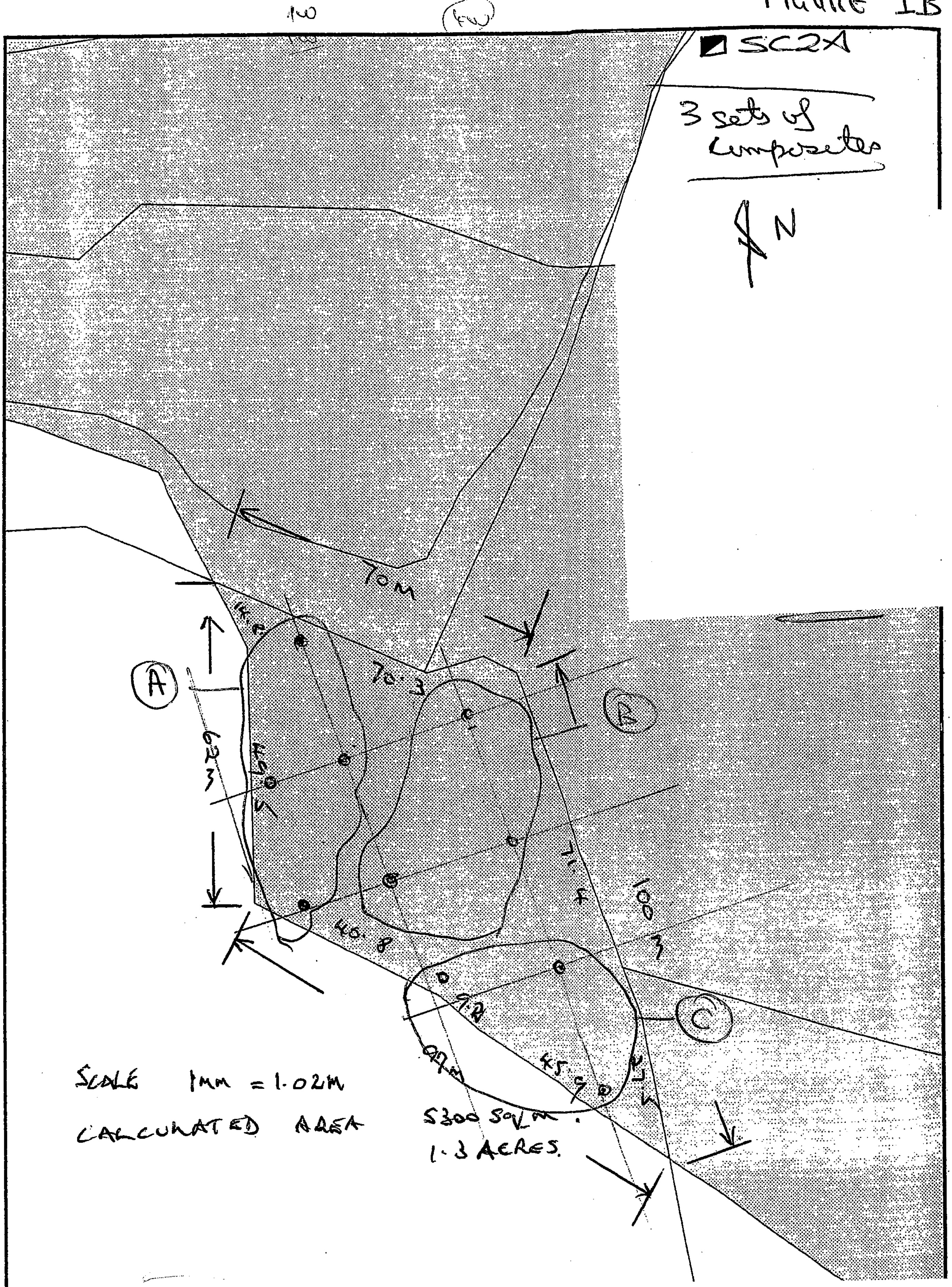
SC7 H

NO 221C, Lot 21 Cassidys Rd 99374
Bonville.

CITY OF COFFS HARBOUR
SCALE 1: 1000

DST
Mon Oct 25 1999 14:52:42

FIGURE 1B



3 sets of composites

SCALE 1MM = 1.02M

CALCULATED AREA 5300 SQ M.
1.3 ACRES.

de Groot & Benson Pty Ltd
PO Box 1908
236 High Street
COFFS HARBOUR NSW 2450

SC2B

Simmonds & Bristow
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PO Box 3160
Yeronga Qld 4104
Australia
Ph: (07) 3848 7699
Fax: (07) 3892 3345

SOIL ANALYSIS

Ref. No: 45116
Page No: 1 of 2

Sampled By : Client

RECEIVED
26 NOV 1999
RECEIVED

de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450
Attn : Mr Rob de Groot

Regd No	Sample Description	Collected	Received	Tested
171509	99374-A-150	9/11/1999	10/11/1999	10/11-19/11
171510	99374-A-300	9/11/1999	10/11/1999	10/11-19/11
171511	99374-B-150	9/11/1999	10/11/1999	10/11-19/11
S&B Method	**Chemical Analysis**	**171509**	**171510**	**171511**
	Major Elements			
SC010.14	Arsenic as As mg/kg	7.8	7.1	16.
SC050.14	Lead as Pb mg/kg	23.	32.	29.

* Confirmation of results faxed on 19/11/1999
* Sludge/soil samples tested and reported as mg/kg on an "as received" basis.
** Sludge and soil samples prepared as per EPA 3050 digest prior to metals' analysis.
*** Arsenic and/or selenium determined as per EPA method 206.3, EPA method 270.3 and EPA 600/4-79-020.

Client Manager

Julie Ivison BSc MBA

SIMMONDS & BRISTOW PTY LTD

PER

November 19, 1999

Simmonds & Bristow
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Yeronga Qld 4104
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SOIL ANALYSIS

Ref. No: 45116
Page No: 2 of 2

Sampled By : Client

de Groot & Benson Pty Ltd
PO Box 1908
COFFS HARBOUR
N.S.W. 2450
Attn : Mr Rob de Groot

Regd No	Sample Description			Collected	Received	Tested
171512 171513 171514	99374-B-300 99374-C-150 99374-C-300			9/11/1999 9/11/1999 9/11/1999	10/11/1999 10/11/1999 10/11/1999	10/11-19/11 10/11-19/11 10/11-19/11
S&B Method	Chemical Analysis			171512	171513	171514
	<u>Major Elements</u>					
SC010.14	Arsenic	as As	mg/kg	12.	20.	15.
SC050.14	Lead	as Pb	mg/kg	32.	29.	31.

* Confirmation of results faxed on 19/11/1999
* Sludge/soil samples tested and reported as mg/kg on an "as received" basis.
** Sludge and soil samples prepared as per EPA 3050 digest prior to metals' analysis.
*** Arsenic and/or selenium determined as per EPA method 206.3, EPA method 270.3 and EPA 600/4-79-020.

Client Manager

Julie Ivison BSc MBA

SIMMONDS & BRISTOW PTY LTD

PER

November 19, 1999

5C2D

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de Groot & Benson Pty Ltd

Ref. No: 45116
Page No: 1 of 2

PESTICIDES IN SOIL

Sampled By: Client

Regd No	Sample Description	Collected	Received	Tested
171509	99374-A-150	9/11/1999	10/11/1999	10/11-19/11
171510	99374-A-300	9/11/1999	10/11/1999	10/11-19/11
171511	99374-B-150	9/11/1999	10/11/1999	10/11-19/11

S&B Method	ORGANOCHLORINE PESTICIDES		171509	171510	171511
GC02.03	LOR (Soil)	mg/kg	0.1	0.1	0.1
GC021.01	HCB	mg/kg	<0.1	<0.1	<0.1
GC021.02	alpha-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.03	beta-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.04	gamma-BHC (Lindane)	mg/kg	<0.1	<0.1	<0.1
GC021.05	delta-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.06	Heptachlor	mg/kg	<0.1	<0.1	<0.1
GC021.07	Aldrin	mg/kg	<0.1	<0.1	<0.1
GC021.08	Oxychlordane	mg/kg	<0.1	<0.1	<0.1
GC021.09	Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1
GC021.10	P,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.11	P,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.12	P,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.13	O,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.14	O,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.15	O,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.16	Dieldrin	mg/kg	<0.1	<0.1	<0.1
GC021.17	Endrin	mg/kg	<0.1	<0.1	<0.1
GC021.18	alpha-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.19	beta-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.20	Endosulfan Sulfate	mg/kg	<0.1	<0.1	<0.1
GC021.21	Methyoxychlor	mg/kg	<0.1	<0.1	<0.1
GC021.22	CIS Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.23	Trans-Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.24	Dicofol	mg/kg	<0.1	<0.1	<0.1

S&B Method	ORGANOPHOSPHATE PESTICIDES		171509	171510	171511
GC02.04	LOR (Soil)	mg/kg	0.2	0.2	0.2
GC021.25	Diazinon	mg/kg	<0.2	<0.2	<0.2
GC021.26	Dichlorfenthion	mg/kg	<0.2	<0.2	<0.2
GC021.27	Chlorpyrifos-Methyl	mg/kg	<0.2	<0.2	<0.2
GC021.28	Ethion	mg/kg	<0.2	<0.2	<0.2
GC021.29	Carbophenothion (Trithion)	mg/kg	<0.2	<0.2	<0.2
GC021.30	(Dursban) Chloropyrifos	mg/kg	<0.2	<0.2	<0.2
GC021.31	Fenitrothion	mg/kg	<0.2	<0.2	<0.2
GC021.32	Parathion-Ethyl (Parathion)	mg/kg	<0.2	<0.2	<0.2
GC021.33	Bromophos-Ethyl	mg/kg	<0.2	<0.2	<0.2
GC021.34	Ronel (Fenchlorphos)	mg/kg	<0.2	<0.2	<0.2
GC021.35	Prothiophos	mg/kg	<0.2	<0.2	<0.2

* Confirmation of results faxed on 19/11/1999
* Sludge/soil samples tested and reported as mg/kg on an "as received" basis.

Client Manager

Julie Ivison BSc MBA

SIMMONDS & BRISTOW PTY LTD

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November 19, 1999

National Association of Testing Authorities, Australia

NATA Endorsed Test Report
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de Groot & Benson Pty Ltd

Ref. No: 45116
Page No: 2 of 2

PESTICIDES IN SOIL

Sampled By: Client

Regd No	Sample Description	Collected	Received	Tested
171512	99374-B-300	9/11/1999	10/11/1999	10/11-19/11
171513	99374-C-150	9/11/1999	10/11/1999	10/11-19/11
171514	99374-C-300	9/11/1999	10/11/1999	10/11-19/11

S&B Method	ORGANOCHLORINE PESTICIDES		171512	171513	171514
GC02.03	LOR (Soil)	mg/kg	0.1	0.1	0.1
GC021.01	HCB	mg/kg	<0.1	<0.1	<0.1
GC021.02	alpha-BHC	mg/kg	<0.1	<0.1	<0.1
GC021.03	beta-BHC	mg/kg	<0.1	<0.1	<0.1
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GC021.05	delta-BHC	mg/kg	<0.1	<0.1	<0.1
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GC021.07	Aldrin	mg/kg	<0.1	<0.1	<0.1
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GC021.09	Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1
GC021.10	P,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.11	P,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.12	P,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.13	O,P-DDE	mg/kg	<0.1	<0.1	<0.1
GC021.14	O,P-DDD	mg/kg	<0.1	<0.1	<0.1
GC021.15	O,P-DDT	mg/kg	<0.1	<0.1	<0.1
GC021.16	Dieldrin	mg/kg	<0.1	<0.1	<0.1
GC021.17	Endrin	mg/kg	<0.1	<0.1	<0.1
GC021.18	alpha-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.19	beta-Endosulfan	mg/kg	<0.1	<0.1	<0.1
GC021.20	Endosulfan Sulfate	mg/kg	<0.1	<0.1	<0.1
GC021.21	Methyoxychlor	mg/kg	<0.1	<0.1	<0.1
GC021.22	CIS Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.23	Trans-Chlordane	mg/kg	<0.1	<0.1	<0.1
GC021.24	Dicofol	mg/kg	<0.1	<0.1	<0.1

S&B Method	ORGANOPHOSPHATE PESTICIDES		171512	171513	171514
GC02.04	LOR (Soil)	mg/kg	0.2	0.2	0.2
GC021.25	Diazinon	mg/kg	<0.2	<0.2	<0.2
GC021.26	Dichlorfenthion	mg/kg	<0.2	<0.2	<0.2
GC021.27	Chlorpyrifos-Methyl	mg/kg	<0.2	<0.2	<0.2
GC021.28	Ethion	mg/kg	<0.2	<0.2	<0.2
GC021.29	Carbophenothion (Trithion)	mg/kg	<0.2	<0.2	<0.2
GC021.30	(Dursban) Chloropyrifos	mg/kg	<0.2	<0.2	<0.2
GC021.31	Fenitrothion	mg/kg	<0.2	<0.2	<0.2
GC021.32	Parathion-Ethyl (Parathion)	mg/kg	<0.2	<0.2	<0.2
GC021.33	Bromophos-Ethyl	mg/kg	<0.2	<0.2	<0.2
GC021.34	Ronel (Fenchlorphos)	mg/kg	<0.2	<0.2	<0.2
GC021.35	Prothiophos	mg/kg	<0.2	<0.2	<0.2

- * Confirmation of results faxed on 19/11/1999
- * Sludge/soil samples tested and reported as mg/kg on an "as received" basis.

Client Manager

Julie Ivison BSc MBA

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APPENDIX E – Road Audit

Table E-1 – Road Audits – Pavement Widths

Data For Road Seal Width and Formations For Portions of Roads Within CHCC Study Area

Street	Length of Road in Study Area (m)	Unsealed Length	Seal Width			Formation Width		
		Unsealed Length	< 4.5m	4.6m to 5.5m	6m	< 4.5m	4.6m to 7.5m	8m
CANDIDATE AREA 2								
Yarraman Road	750	0	0	750	0	0	0	750
North Bonville Road	2100	0	0	0	2100	0	200	2500
Jacarranda Dr	NA 200	0	NA 200	0	0	NA 200	0	0
Private road along easement								
Total	2850	0	0	750	2100	0	200	3250
North Bonville Road	500	0	0	0	500	0	500	0
CANDIDATE AREA 3 / 4	500	0	0	0	500	0	500	0
Crossmaglen Road	1123	0	0	0	1123	0	1123	0
Bradford Drive	NA 2150	0	0	0	NA 2150	0	0	na 2150
CANDIDATE AREA 5	1123	0	0	0	1123	0	1123	0
Butlers Road	300	0	0	0	300	0	300	0
Glennifer Road	NA 2500	0	0	0	NA 2500	0	NA2500	0
CANDIDATE AREA 6	300	0	0	0	300	0	300	0
Keoghs Road	450	450	0	0	450	0	0	0
CANDIDATE AREA 9	450	450	0	0	450	0	0	0
Butlers Road	650	0	0	0	650	0	650	0
CANDIDATE AREA 8	650	0	0	0	650	0	650	0
East Bonville Road	590	0	0	0	590	0	590	81
CANDIDATE AREA 10 / 11	590	0	0	0	590	0	590	81
Williams Road	1100	0	0	0	1100	0	0	1100
CANDIDATE AREA 13	1100	0	0	0	1100	0	0	1100
Herdegen Close	120	0	0	0	120	0	0	120
CANDIDATE AREA 14	120	0	0	0	120	0	0	120
Titans Close	600	100	500	0	0	500	0	0
Irvines Road	400	0	0	0	400	0	250	150
Strouds Road	NA 450	0	0	0	NA 450	0	NA 450	450
CANDIDATE AREA 15	1000	100	500	0	400	500	250	600
CANDIDATE AREA 16	0	0	0	0	0	0	0	0
CANDIDATE AREAS FOR UPGRADE	8683	550	500	750	7333	500	3613	5151

Table E-2– Road Audits – Summary

Street	Length of Road in Study Area (m)	Unsealed Length	Seal Width			Formation Width		
		m	< 4.5m	4.6m to 5.5m	6m	< 4.5m	4.6m to 7.5m	8m
CANDIDATE AREA 2	2850	0	0	750	2100	0	200	3250
CANDIDATE AREA 3 / 4	500	0	0	0	500	0	500	0
CANDIDATE AREA 5	1123	0	0	0	1123	0	1123	0
CANDIDATE AREA 6	300	0	0	0	300	0	300	0
CANDIDATE AREA 8	650	0	0	0	650	0	650	0
CANDIDATE AREA 9	450	450	0	0	450	0	0	0
CANDIDATE AREA 10 / 11	590	0	0	0	590	0	590	81
CANDIDATE AREA 13	1100	0	0	0	1100	0	0	1100
CANDIDATE AREA 14	120	0	0	0	120	0	0	120
CANDIDATE AREA 15	1000	100	500	0	400	500	250	600
CANDIDATE AREAS 1 and	0	0	0	0	0	0	0	0
TOTALS FOR ALL CANDIDATE AREAS	**8683**	**550**	**500**	**750**	**7333**	**500**	**3613**	**5151**

Table E-3 – Road Reconstruction Estimates

Cost Estimates:			
a) Unsealed roads:			
- Clearing and preperation	assume 5m wide for srtipping, tree removal etc @ $20,0000 /ha	$10.00	per lineal metre of road
- prepare base	assume 9m wide formation by 0.5m deep by $25 cut to fill	$112.50	per lineal metre of road
- gravel	assume 8m wide by 0.3m thick by $100 /m³	$240	per lineal metre of road
- seal costs	assume $25 /m² by 6m wide	$150	per lineal metre of
		$512.50	**per lineal metre of**
b) < 4.5m sealed roads (assume same as unsealed roads)			
- Clearing and preperation	assume 5m wide for srtipping, tree removal etc @ $20,0000 /ha	$10.00	per lineal metre of road
- prepare base	assume 9m wide formation by 0.5m deep by $25 cut to fill	$112.50	per lineal metre of road
- gravel	assume 8m wide by 0.3m thick by $100 /m³	$240	per lineal metre of road
- seal costs	assume $25 /m² by 6m wide	$150	per lineal metre of
		$512.50	**per lineal metre of**
c) 4.5m-6m sealed roads			
- Clearing and preperation	assume 2m wide for srtipping, tree removal etc @ $20,0000 /ha	$4.00	per lineal metre of road
- prepare base	assume 5m wide formation by 0.5m deep by $25 cut to fill	$62.50	per lineal metre of road
- gravel	assume 5m wide by 0.3m thick by $100 /m³	$150	per lineal metre of road
- seal costs	assume $25 /m² by 6m wide	$150	per lineal metre of
		$366.50	**per lineal metre of**
c) 6m sealed roads - create shoulder			
- Clearing and preperation	assume 2m wide for srtipping, tree removal etc @ $20,0000 /ha	$4.00	per lineal metre of road
- prepare base	assume 4m wide formation by 0.5m deep by $25 cut to fill	$40.00	per linenal metre or road
- gravel	assume 3m wide by 0.3m thick by $100 /m³	$90	per lineal metre of road
- gravel	assume 6m wide by 0.15m thick by $100 /m³	$90	per lineal metre of road
- seal costs	assume 1 coat - $12 /m² by 6m wide	$72	per lineal metre of
		$296.00	**per lineal metre of**

Table E-4 – Cost Estimates by Candidate Area

ROAD CONTRIBUTION CALCULATION

Candidate Area	Lots	Length of Road in Study Area (m)	Unsealed Length	Seal Width			Total
	No		m	< 4.5m	4.6m to 5.5m	6m	
CANDIDATE AREA 2	112	2850	$0	$0	$274,875	$621,600	$896,475
CANDIDATE AREA 3 / 4	28	500	$0	$0	$0	$148,000	$148,000
CANDIDATE AREA 5	17	1123	$0	$0	$0	$332,408	$332,408
CANDIDATE AREA 6	18	300	$0	$0	$0	$88,800	$88,800
CANDIDATE AREA 8	16	650	$0	$0	$0	$192,400	$192,400
CANDIDATE AREA 9	14	450	$230,625	$0	$0	$133,200	$363,825
CANDIDATE AREA 10 / 11	11	590	$0	$0	$0	$174,640	$174,640
CANDIDATE AREA 13	31	1100	$0	$0	$0	$325,600	$325,600
CANDIDATE AREA 14	12	120	$0	$0	$0	$35,520	$35,520
CANDIDATE AREA 15	71	1000	$51,250	$256,250	$0	$118,400	$425,900
CANDIDATE AREAS 16	10	0	$0	$0	$0	$0	$0
TOTALS FOR AREAS	340	8683	$281,875	$256,250	$274,875	$2,170,568	$2,983,568

Table E-4 – Cost Estimates by Catchment Area

CONTRIBUTTIONS BY CARCHMENT AREA

Catchment 1	Candidate areas		No of Lots	Contribution	Other Plans	TOTAL
	13,14,15,16					
Total Road Costs	$787,020					
Other Costs						
- Bridge						
- Bus Shelter	$20,000					
SubTotal	$807,020					
Survey Investigation and Design (15%)	$121,053					
Contingency (15%)	$139,211					
TOTAL	**$1,067,283.95**		**124**	**$8,607.13**	**$4,779.00**	**$13,386.13**

Catchment 2	Candidate areas		No of Lots	Contribution	Other Plans	TOTAL
	2,3,4,5 & 6					
Total Road Costs	$1,465,683					
Other Costs						
- Bridges (Nth Bonville Rd & Crossmaglen Rd)	$900,000					
- Bus Shelter	$40,000					
SubTotal	$2,405,683					
Survey Investigation and Design (15%)	$360,852					
Contingency (15%)	$414,980					
TOTAL	**$3,181,515.77**		**175**	**$18,180.09**	**$4,779.00**	**$22,959.09**

Catchment 3	Candidate areas		No of Lots	Contribution	Other Plans	TOTAL
	8 & 9					
Total Road Costs	$556,225					
Other Costs						
- Bus Shelter	$20,000					
SubTotal	$576,225					
Survey Investigation and Design (12.5%)	$72,028					
Contingency (15%)	$81,031.64					
TOTAL	**$729,284.77**		**30**	**$24,309.49**	**$4,779.00**	**$29,088.49**

Catchment 4	Candidate areas		No of Lots	Contribution	Other Plans	TOTAL
	10 & 11					
Total Road Costs	$174,640					
Other Costs						
- Bridge				`		
- Bus Shelter	$0					
SubTotal	$174,640					
Survey Investigation and Design (15%)	$26,196					
Contingency (15%)	$30,125.40					
TOTAL	**$230,961.40**		**11**	**$20,996.49**	**$4,779.00**	**$25,775.49**

APPENDIX C – Bushfire Risk Assessment

Bonville Rural Residential

Local Environmental Study – Bushfire Assessment

Prepared for
Coffs Harbour City Council

25 October 2013

DOCUMENT TRACKING

ITEM	DETAIL
Project Name	Bonville Rural Residential Local Environmental Study Bushfire Assessment
Project Number	12COFECO-0020
Project Manager	Peter Knock Ph: 02 8081 2762 35 Orlando Street, Coffs Harbour Jetty NSW 2450
Prepared by	David Peterson
Approved by	Peter Knock
Status	Final
Version Number	1
Last saved on	25 October 2013

ACKNOWLEDGEMENTS

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Contents

Figures

Tables

1 Introduction

1.1 BACKGROUND

This report was commissioned by Coffs Harbour City Council (CHCC) as part of a local consortium of consultants headed by Geoff Smyth Consulting and de Groot & Benson Pty Ltd in preparation for an amendment to the Draft Coffs Harbour Local Environment Plan 2013 (DLEP 2013) for a future rural residential release area for Bonville.

Bonville has been identified as a priority release area under the Rural Residential Study 2009. This technical report is prepared to inform a Planning Proposal to rezone the study area to further residential development.

1.2 LOCATION AND DESCRIPTION OF BONVILLE RELEASE AREA

The Bonville study area is located approximately 13 km south of the Coffs Harbour Central Business District on the western side of the Bonville extension to the Pacific Highway on the North Coast of NSW (**Figure 1**). The study area covers approximately 1860 ha (**Figure 2**).

The current land uses in the Bonville locality consist of existing rural residential subdivisions and agriculture including intensive horticulture cropping lands, private recreation in the form of Bonville Golf Resort and small rural allotments. The study area is bounded by Boambee and Pine Creek State Forests to the north, west and south and Bongil Bongil National Park to the east. The Pacific Highway forms the eastern boundary of the study area, with the old Pacific Highway (now Pine Creek Way) being the main access road running north-south through the study area. From north to south, the main roads that provide access to the upper and lower Bonville Valley from Pine Creek Way are, Titans Close, Irvines Road, Williams Rd, North Bonville Road (linking to Cassidy’s Rd and Bradford Dr), Bonville Station Rd, Glennifer Road (linking to Crossmaglen Rd) / East Bonville Rd and Butlers Rd.

1.3 AIMS AND OBJECTIVES OF BUSHFIRE ASSESSMENT

The aim of this study is to investigate the capability and general suitability of the site for future residential subdivision and other land uses with the appropriate bushfire protection measures as guided by the relevant legislation and policy into bushfire planning and design of new development in NSW. The findings and recommendations are to inform a Planning Proposal to appropriately rezone the site.

The objectives of this study are therefore to:

1. Provide statements as to the capability of the site to achieve the required minimum bushfire protection measures for future development, namely subdivision and the construction of dwellings;
2. Satisfy the legislative requirements for assessment of rezoning bushfire prone land for residential purposes under the *Environmental Planning and Assessment Act 1979*;
3. Investigate the application of Asset Protection Zone (APZ) building setbacks to vegetation/bushland and report on the location and dimensions of any required APZ;

4. Provide guidance on the access and egress requirements for residential development in bushfire prone land; and
5. Provide guidance on other bushfire protection measures such as the provision of utilities.

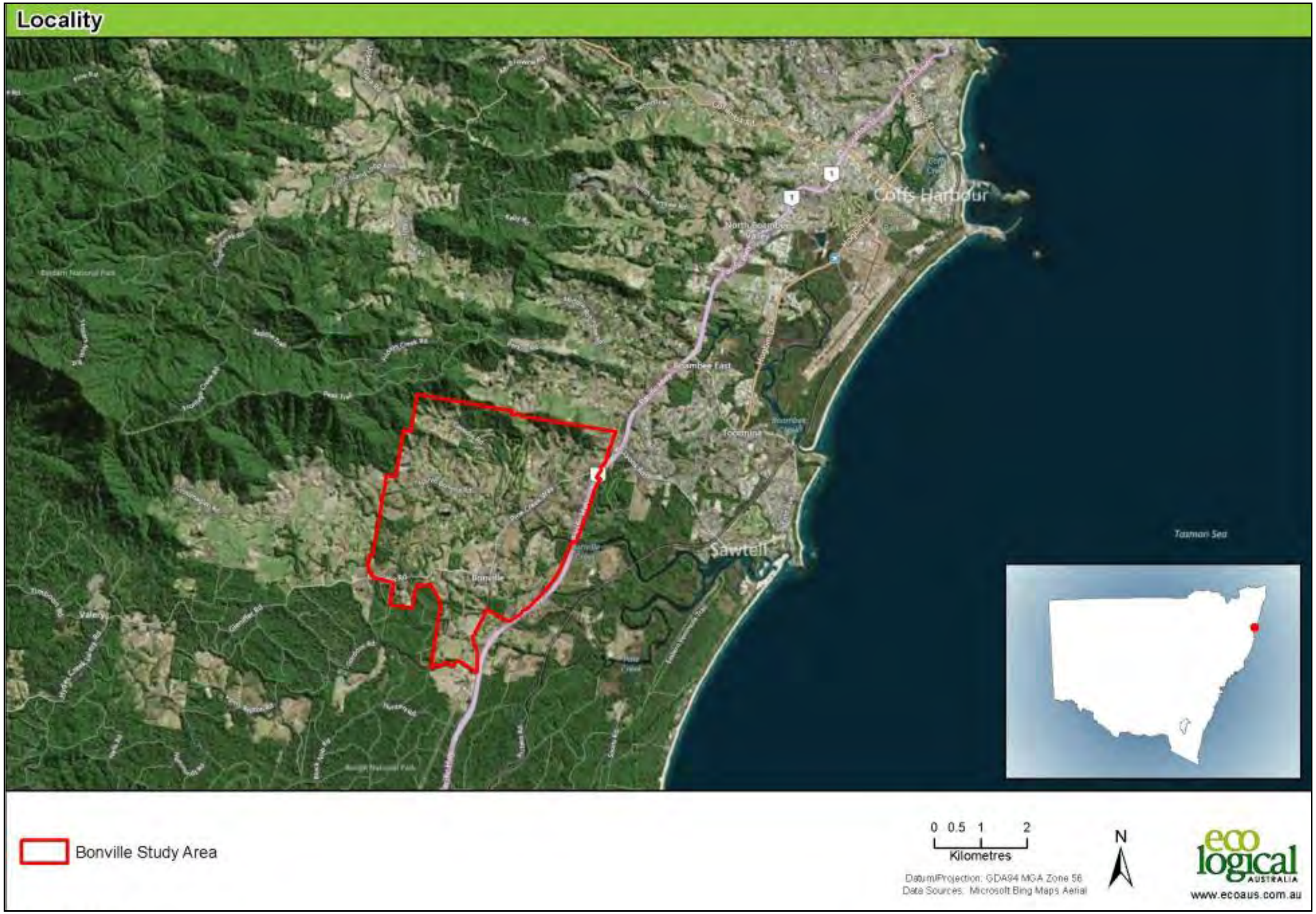

Figure 1: Location of Bonville Release Area

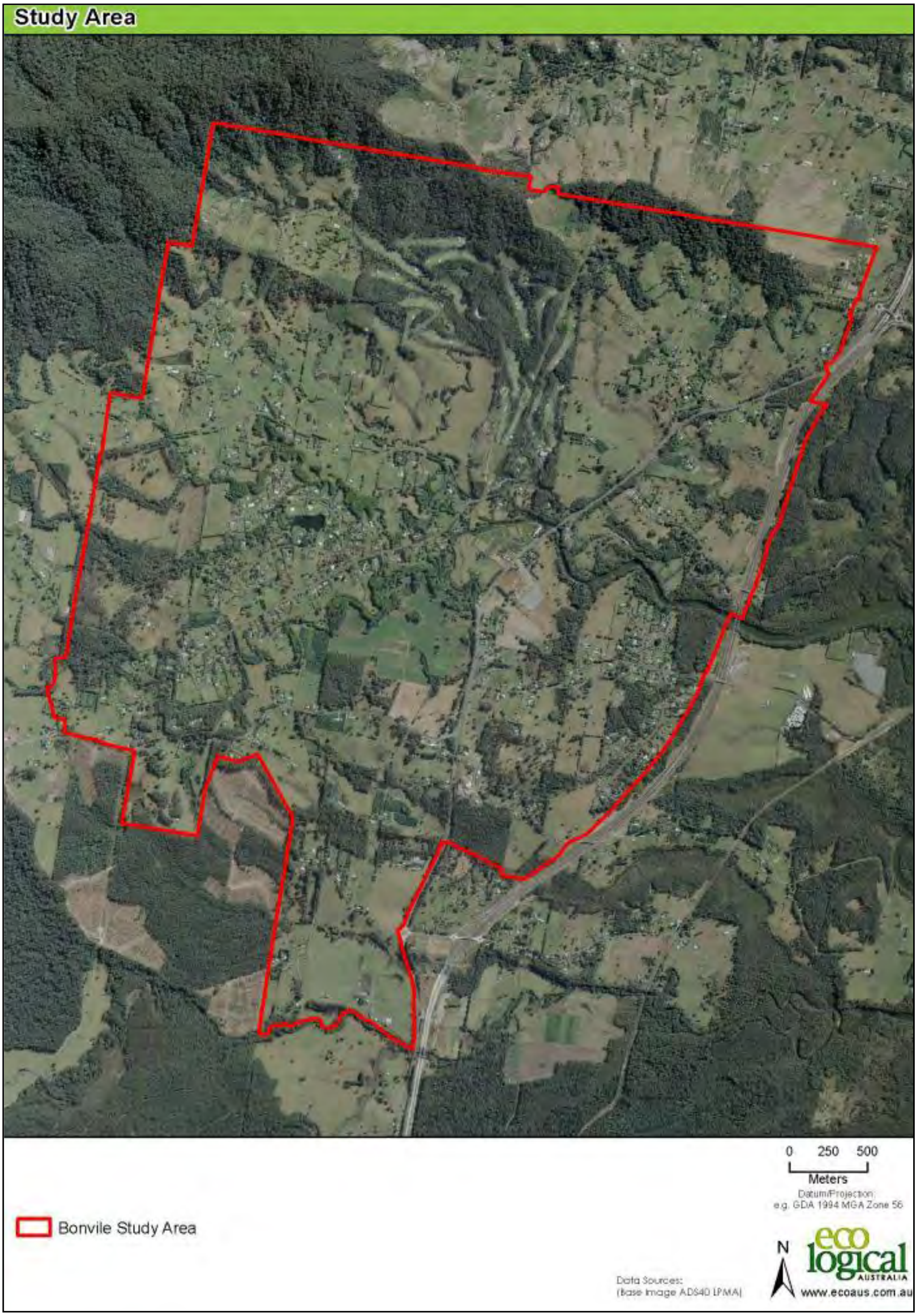

Figure 2: Bonville study area

2 Assessment Requirements

The study area has been identified as containing bushfire prone land as mapped by Coffs Harbour City Council and certified by the NSW Rural Fire Service (RFS) under a requirement of the *Rural Fires Act 1997*. In NSW, bushfire prone lands are those identified that could support a bushfire or are potentially likely to be subject to bushfire attack and are generally lands that contain or are within 100 m of significant stands of bushland.

When investigating the capability of bushfire prone land to be rezoned for residential purposes, local councils must have regard to s.117 (2) Direction 4.4 – 'Planning for Bush Fire Protection' of the *Environmental Planning and Assessment Act 1979*. The objectives of Direction 4.4 are:

- *To protect life, property and the environment from bushfire hazards, by discouraging the establishment of incompatible land uses in bushfire prone areas; and*
- *To encourage sound management of bushfire prone areas.*

Direction 4.4 instructs councils on the bushfire matters which need to be addressed when drafting LEPs. This includes:

- Consultation with the Commissioner of the RFS under s.62 of the EPA Act, and take into account any comments so made;
- Draft LEPs shall have regard to *Planning for Bushfire Protection 2006* (PBP)*;* and
- Compliance with numerous bushfire protection provisions where development is proposed.

After the rezoning stage, future subdivision of land and the construction of buildings also require an assessment against PBP. These assessments are based on a final development application for these uses.

3 Methods and Approach

This bushfire assessment followed the methods and approach outlined in **Table 1** below.

Table 1: Methods and Approach

Method and Approach	Task	Considerations
Review	A literature review of relevant reports and studies occurred.	Coffs Harbour Bush Fire Prone Land Map; Mid North Coast Bushfire Risk Management Plan.
Desk top analysis	Review and analysis of all available mapping layers in GIS relevant to bushfire hazard.	GIS layers include: satellite imagery; vegetation mapping; topographical data (e.g. contours).
Site inspection	An inspection of the study area occurred in June 2013.	The inspection ground-truthed the results of the desk-top analysis, particularly in regards to vegetation classification and slopes that influence the overall bushfire hazard and APZ calculations. The inspection took place with the consulting ecologist (ELA) so that discussions could take place on the likely retention and enhancement of remnant bushland for the protection and maintenance of biodiversity (e.g. Koala habitat and movement) including riparian treatments and buffers.
Ecological consultation	Consultation with ecologist to enable integrated design	Workshop sessions occurred with the consulting ecologist to refine the bushfire protection measures. The biodiversity constraints were first presented on which to base the required APZs (i.e. the vegetation to be retained due to conservation values forms the bushfire hazard to be assessed and the overall development footprint).
Assessment	Determine all relevant bushfire protection measures.	Assessment in accordance with PBP methodology, Direction 4.4 of EP&A Act and RFS requirements.
Reporting	Preparation of bushfire assessment.	Carry out all necessary reporting required for rezoning and Planning Proposals for development of bushfire prone land.

4 Bushfire Hazard

An assessment of the bushfire hazard is necessary to determine the application of bushfire protection measures such as Asset Protection Zone location and dimension. The following sub-sections provide a detailed account of the vegetation communities (bushfire fuels) and the topography (effective slope) that combine to create the bushfire hazard that may affect bushfire behaviour at the site.

This assessment is based on the possible future vegetation coverage as determined by ELA (2013) ecological assessment for the LES. The future vegetation is discussed in Section 4.1 below. Some of the current bushland areas will contribute to the future bushfire hazard, however this hazard will be significantly added to, particularly in the way of connectivity between remnants and along drainage lines to achieve biodiversity and riparian environmental objectives. The increase in hazard is not significant enough to preclude development or pose a future hazard that cannot be addressed by typical bushfire protection planning precautions as outlined within PBP.

Following on from above, the concept of bushfire risk as influenced by fire history and current and past bushfire issues has little bearing on the determination of bushfire protection strategies for rezoning and future development at this site. This is due to a different future vegetation layer and the fact that PBP assesses bushfire protection based purely on vegetation and slope (i.e. hazard and not risk), making the assumption that a fire may occur in any patch of bushland at a worst-case scenario (based on a set design fire).

Notwithstanding this, the *Mid North Coast Bushfire Risk Management Plan* was reviewed to gain a greater understanding of the bushfire environment, hazard and risk issues that affect the study area. The only impact the plan has specifically on the study area is the requirement to conduct hazard reduction within the forest plantations adjacent the southwest boundary of the study area. This complementary management offsite does not affect the bushfire protection measures required for future development within the study area.

4.1 VEGETATION COMMUNITIES INFLUENCING BUSHFIRE

The ‘predominant vegetation’ influencing fire behaviour approaching future developable areas has been assessed strictly in accordance with the methodology specified within PBP.

Comprehensive and site specific vegetation assessment and mapping has occurred as part of the ecological assessment (Eco Logical Australia 2013). A map displaying the current coverage of vegetation is provided in **Figure 3**. The bushland throughout and adjoining the site

Mapped vegetation formations within the study area include units mapped as Sclerophyll (Wet and Dry) Rainforest, Native Remnant, Native Pioneers, Exotic, and Plantation.

The primary hazard is predominantly Tall Open Forest of varying conditions with floristics, particularly within the understorey, changing from the wetter lowland areas such as along the drainage lines to the higher slopes.

Figure 3 shows the recommended future coverage of vegetation based on environmental objectives and constraints. It is this layer that the bushfire assessment is based on. The total constraints layer consists of the existing E2 zone, significant vegetation, remnant vegetation, riparian and minor drainage buffers and existing W1 and W2 zones.

The PBP predominant vegetation classification of all future vegetation for the study area is ‘forest’, with the exception of small remnants (less than 1 ha) and narrow corridors (less than 50 m in width) which are able to be classified as ‘low hazard’ due to the limited fire behaviour in small areas of vegetation.

The presence and potential for rainforest throughout the site has been carefully assessed. Although some gullies, sheltered slopes and riparian areas provide habitat for mesic components, these areas are relatively small and maintain (or likely to present) a Eucalypt dominant overstorey such that they cannot be classified as ‘rainforest’ in accordance with PBP methodology and RFS policy. Areas of true rainforest do exist, such as within the gullies on the southern aspects of the range that forms the northern boundary of the study area, however these areas are located away from the boundary and relatively small within the context of the total (predominant) hazard.

4.2 SLOPES INFLUENCING BUSHFIRE

The ‘effective slope’ influencing fire behaviour approaching the developable area has been assessed strictly in accordance with the methodology specified within PBP. This is conducted by measuring the worst-case scenario slope where the vegetation occurs over a 100 m transect measured outwards from the development boundary. The slope classes are listed in **Table 2** below.

All slope classes are represented within the study area, from the floodplains within the valley floor, to the gentle and undulating hills between the major drainage lines, to the steep slopes leading up the ridgelines and spurs in the north of the study area. The slopes across the study area can be appreciated from the digital terrain model presented in **Figure 5**.

Table 2: PBP slope classes

Upslope or Downslope	PBP Slope Class
Upslope / Flat Land	Flat land and all upslope land leading away from the development
Downslope	>0-5 degrees downslope leading away from the development
	>5-10 degrees downslope leading away from the development
	>10-15 degrees downslope leading away from the development
	>15-18 degrees downslope leading away from the development

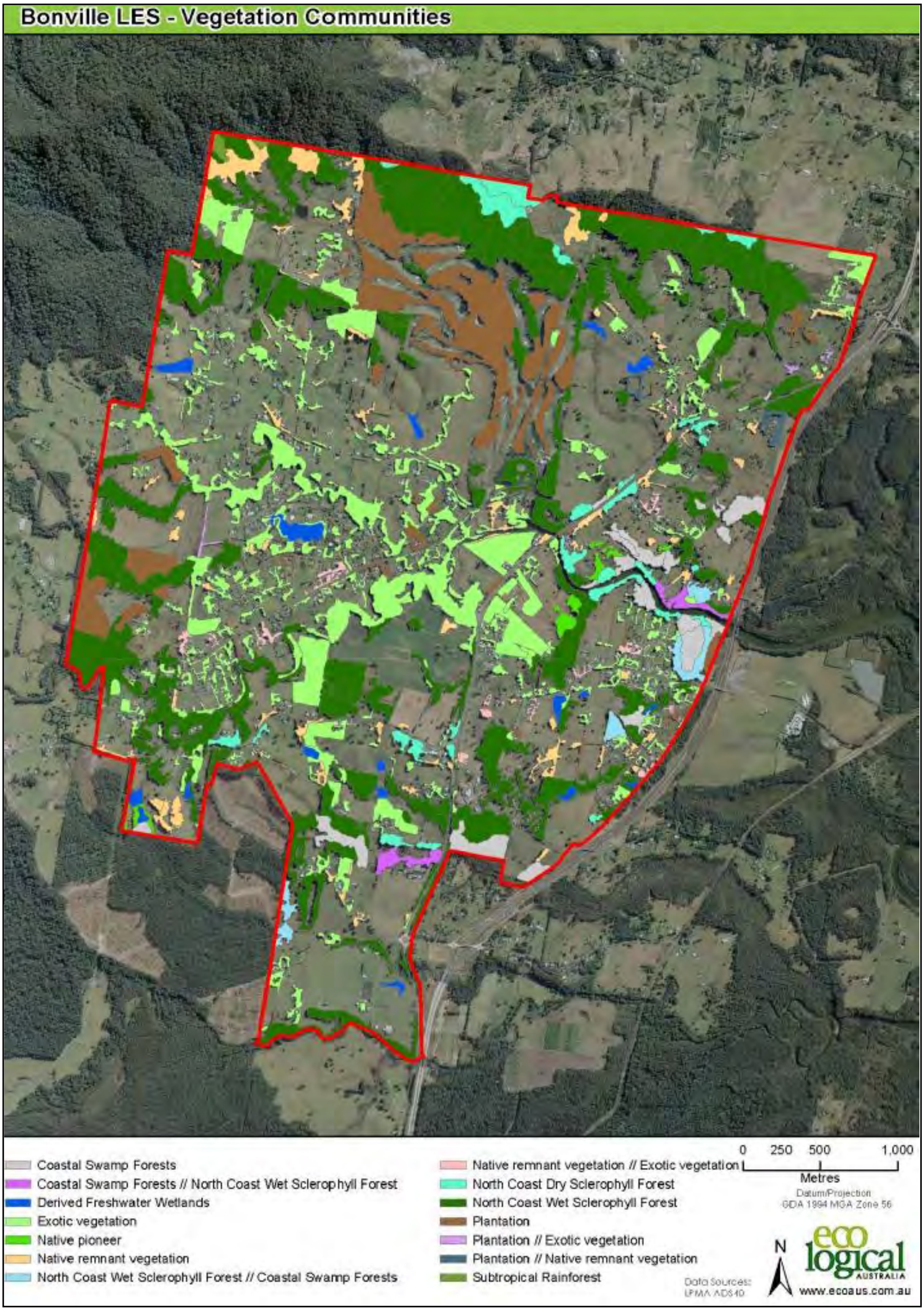

Figure 3: Current vegetation communities

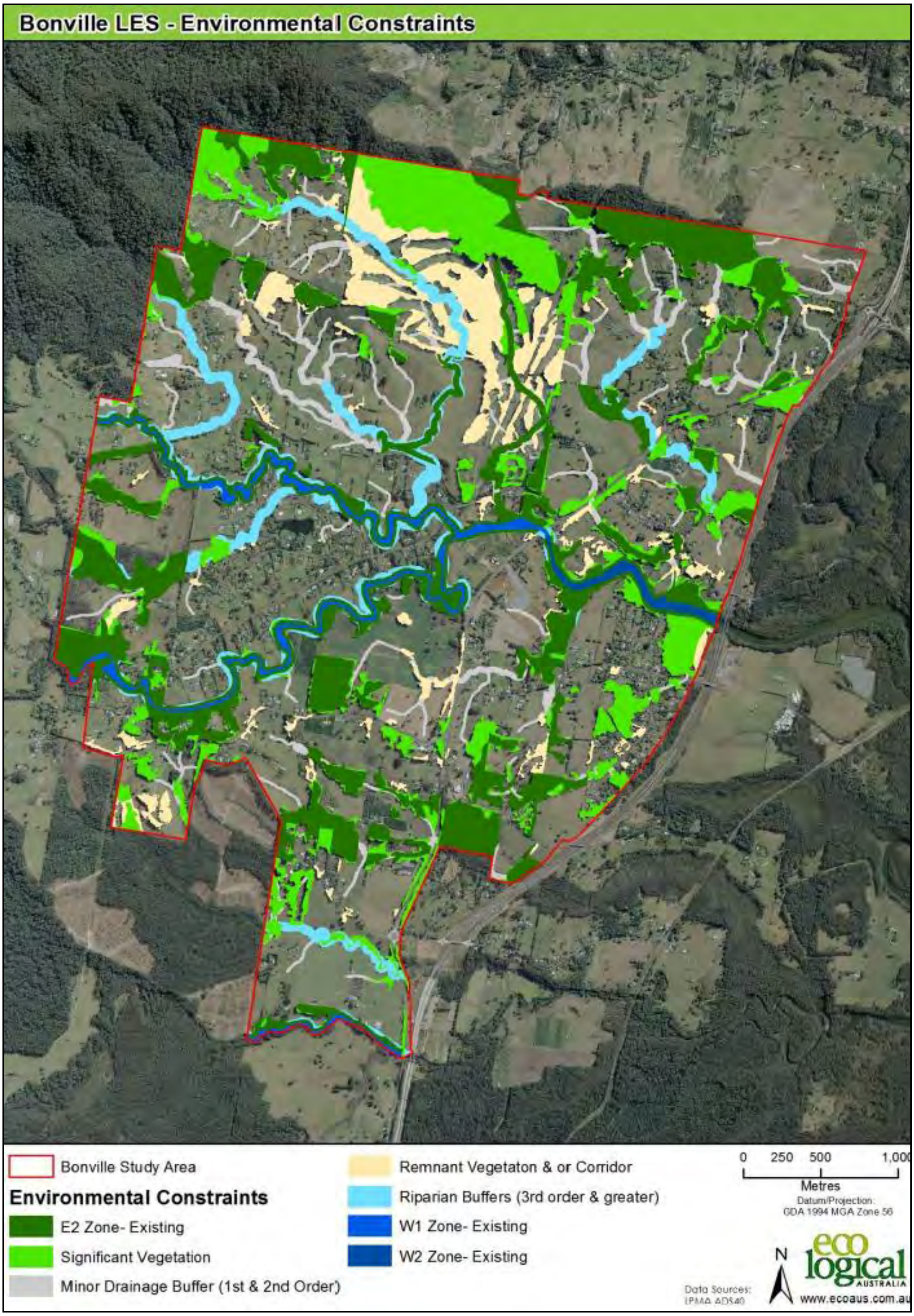

Figure 4: Future vegetation coverage

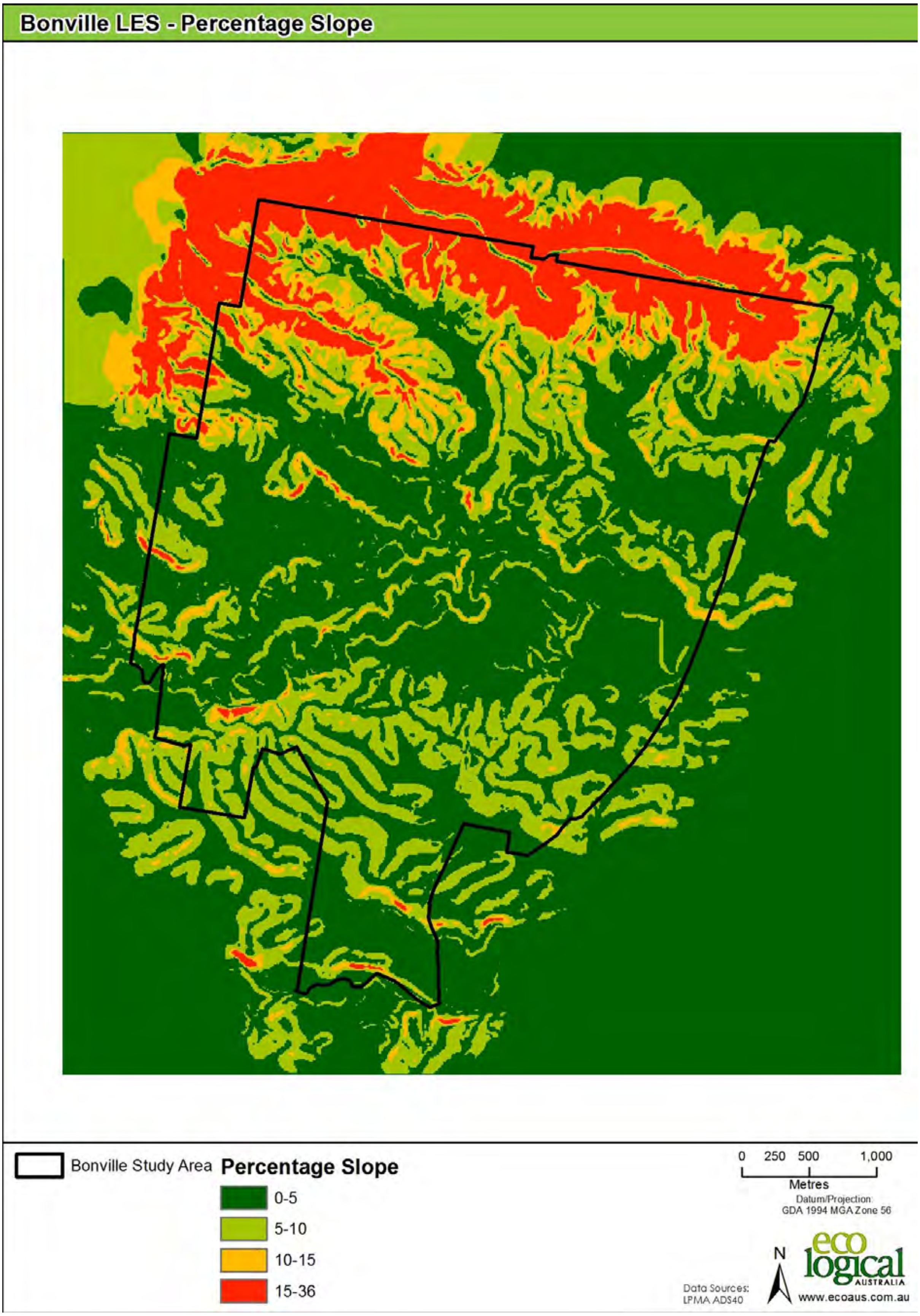

Figure 5: Planning for Bushfire Protection 2006 slope class distribution

5 Bushfire Protection Measures

PBP requires the assessment of a suite of bushfire protection measures that in total afford an adequate level of protection. The measures required to be assessed for rezoning are listed in **Table 3** below and are discussed in detail in the remainder of this section. This section demonstrates that the study area can accommodate the required bushfire protection measures and achieve the Direction 4.4 objectives and RFS requirements.

Table 3: PBP bushfire protection measures

Bushfire Protection Measure	Considerations
Asset Protection Zones (APZ)	Location and dimension of APZ setbacks from vegetation including prescriptions of vegetation management within the APZ.
Access	Assessment to include access and egress in and out of a developable area such as alternate access, operational response and evacuation options. APZ perimeter access to be considered as is design standards of public roads and any fire trails.
Water supply and other utilities	List requirements for reticulated water supply and hydrant provisions, and any static water supplies for fire fighting.
Building construction standards	Provide a guide on the application of construction standards for future buildings.

5.1 ASSET PROTECTION ZONES

5.1.1 APZ Location and Dimension

Using the vegetation and slope data discussed in Section 4, APZs suitable for residential subdivision around all environmentally constrained lands have been calculated. These have been mapped and identified on **Figure 6** and described in **Table 4**.

A second APZ dimension for Special Fire Protection Purposes (SFPP) is also listed in **Table 4**. These SFPP APZs are for schools, child care centres, accommodation, retirement villages and other uses listed under s100B (6) *Rural Fires Act 1997*.

It is recommended that development associated with employment lands, such as commercial and industrial development, be treated as residential development for the purpose of the rezoning analysis. Non-habitable development of this kind has the opportunity to have an APZ less than that required for residential subdivision. This flexibility relies on the known use of the building, its design and construction standard, and can be determined at the subdivision application stage.

It is currently considered best practice to provide an APZ dimension that achieves a building construction standard under *AS 3959-2009 Construction of buildings in bushfire-prone areas* (Standards Australia 2009) of Bushfire Attack Level (BAL)-29 at the maximum. The current accepted minimum APZ dimension allows for a BAL-40 standard. The increase in APZ provides a higher level of bushfire protection and ensures that future home owners are not impacted by the additional costs associated with construction of a dwelling at BAL-40. **Table 4** lists the current minimum APZ and best practice APZ related to BAL-29 (refer to Section 5.4 for more information on AS 3959-2009).

It is important to note that the APZ calculations quoted in this assessment are indicative only and have been determined at a landscape scale. This level of detail is suitable for a rezoning assessment whereby the aim is to demonstrate whether a parcel of land can accommodate the bushfire hazard, the expected APZ and future development. The final APZ dimensions for any future subdivision or development depends on the accuracy of a slope assessment undertaken at a site-specific level. The APZ dimensions quoted in this assessment should not be relied on to approve a future subdivision; they may be used as a guide only.

Table 4: Asset Protection Zone (APZ) calculation

Predominant Vegetation	Effective Slope	APZ width	APZ colour Figure 6	SFPP APZ width	BAL-29 APZ
Forest	Upslope/Flat	20 m (10 m OPA)	🟨	60 m (20 m OPA)	21 m
Forest	>0-5° downslope	20 m (5 m OPA)	🟨	70 m (20 m OPA)	27 m
Forest	>5-10° downslope	30 m (15 m OPA)	🟧	85 m (25 m OPA)	33 m
Forest	>10-15° downslope	40 m 20 m OPA)	🟥	100 m (30 m OPA)	42 m
Forest	>15-18° downslope	45 m (20 m OPA)	🟥	100 m (25 m OPA)	52 m
Low hazard	Upslope/Flat	10 m	🟪	30 m	9 m
Low hazard	>0-5° downslope	10 m	🟪	40 m	11 m
Low hazard	>5-10° downslope	15 m	🟦	50 m	15 m
Low hazard	>10-15° downslope	15 m	🟦	60 m	19 m

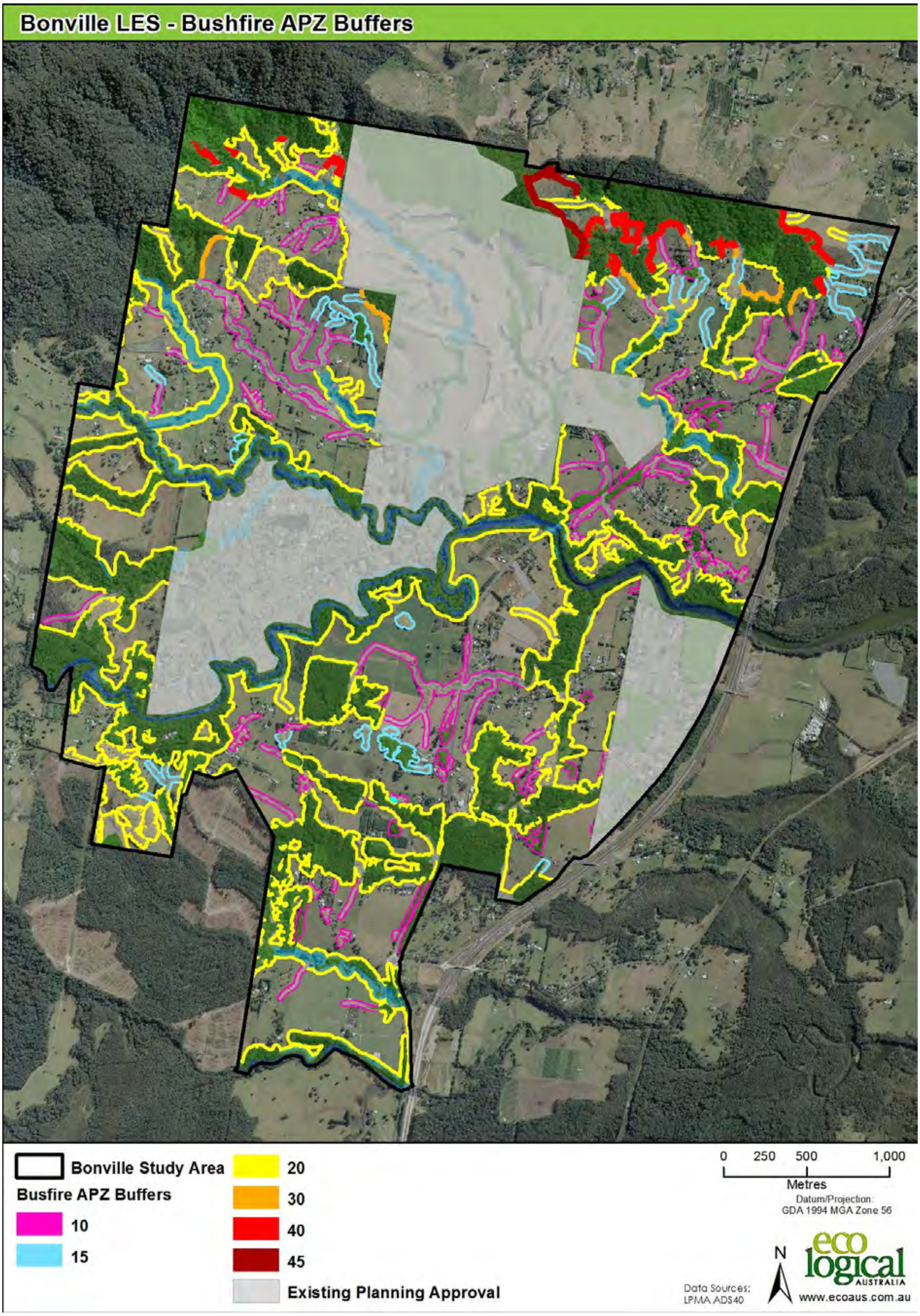

Figure 6: Asset Protection Zone (APZ)

5.1.2 Vegetation Management within APZ

The management of vegetation within the APZ is to achieve the specifications of an Inner Protection Area (IPA) and Outer Protection Area (OPA) as described by PBP. As such, the future APZ should be managed as follows:

- No tree or tree canopy is to occur within 2 - 5 m of future dwelling rooflines;
- The presence of a few shrubs or trees in the APZ is acceptable provided that they are well spread out, do not form a continuous canopy, and are located far enough away from future buildings so that they will not ignite the buildings by direct flame contact or radiant heat emission;
- Any landscaping or plantings should preferably be low flammability species such as local rainforest species;
- In the IPA, the ground fuel is to be maintained to less than 4 tonnes per hectare of fine fuel (4 t/ha is equivalent to a 1 cm thick layer of leaf litter and fine fuel means any dead or living vegetation of less than 6 mm in diameter, e.g. twigs less than a pencil in thickness); and
- In the OPA, the ground fuel may have up to 8 tonnes per hectare of fine fuel.

5.1.3 Perimeter Access within APZ

An APZ may require a perimeter road depending on the significance of the bushfire threat. The assessment of perimeter access is provided in the following Section 5.2.

5.2 ACCESS

PBP requires an access design that enables safe evacuation away from an area whilst facilitating adequate emergency and operational response to the area requiring protection. The following sections present the bushfire planning requirements for access in bushfire prone land.

5.2.1 Safe Access and Egress

All bushfire prone areas should have an alternate access or egress option. This is usually achieved by providing more than one public road into and out of a precinct. The need for an alternative road and its location depends on the bushfire risk, the density of the development, and the chances of the road being cut by fire. All precincts within the site should allow for an alternative public access road.

5.2.2 Perimeter Roads

Depending on the bushfire risk, all bushland interface areas containing an APZ for a significant bushfire hazard should feature a perimeter public road within the APZ. It is acceptable for some areas not to have a perimeter road or have a perimeter trail instead. These include areas of lower bushfire risk (such as adjoining low hazard areas), rural residential areas with large lot sizes whereby perimeter access can be provided within each lot, or areas where it may not be feasible to provide a continuous road due to the shape of the interface or the terrain. These areas should have some other access strategy such as trails or regular access points including access to a hydrant network.

The design details (PBP acceptable solutions) of public perimeter roads and fire trails are listed in Section 5.2.3 below.

5.2.3 Road Design and Construction Standards

Public roads and perimeter fire trails are to comply with the PBP acceptable solution design standards as listed in **Table 5** and **Table 6** respectively. Future residential subdivision within the site will be able to comply with these standards.

Table 5: Design and construction for public roads (RFS 2006; pg 21)

Performance Criteria	Acceptable Solutions
• *Firefighters are provided with safe all weather access to structures (thus allowing more efficient use of firefighting resources)*	• *Public roads are two-wheel drive, all weather roads*
• *Public road widths and design that allows safe access for firefighters while residents are evacuating an area*	• *Urban perimeter roads are two-way, that is, at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb), allowing traffic to pass in opposite directions. Non perimeter roads comply with PBP Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle)* • *The perimeter road is linked to the internal road system at an interval of no greater than 500 metres in urban areas* • *Traffic management devices are constructed to facilitate access by emergency services vehicles* • *Public roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end and direct traffic away from the hazard* • *Curves of roads (other than perimeter roads) are a minimum inner radius of six metres* • *Maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient* • *There is a minimum vertical clearance to a height of four metres above the road at all times*
• *The capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles*	• *The capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes or 9 tonnes per axle for all other areas). Bridges clearly indicated load rating*
• *Roads that are clearly sign posted (with easy distinguishable names) and buildings / properties that are clearly numbered*	• *Public roads greater than 6.5 metres wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water for fire suppression* • *Public roads between 6.5 metres and 8 metres wide are No Parking on one side with the services (hydrants) located on this side to ensure accessibility to reticulated water for fire suppression*
• *There is clear access to reticulated water supply*	• *Public roads up to 6.5 metres wide provide parking within parking bays and located services outside of the parking bays to ensure accessibility to reticulated water for fire suppression* • *One way only public access roads are no less than 3.5 metres wide and provide parking within parking bays and located services outside of the parking bays to ensure accessibility to reticulated water for fire suppression*
• *Parking does not obstruct the minimum paved width*	• *Parking bays are a minimum of 2.6 metres wide from kerb to kerb edge to road pavement. No services or hydrants are located within the parking bays* • *Public roads directly interfacing the bush fire hazard vegetation provide roll top kerbing to the hazard side of the road*

Table 6: Design and construction for fire trails (RFS 2006; pg 25)

Performance Criteria	Acceptable Solutions
• *The width and design of the fire trails enables safe and ready access for firefighting vehicles*	• *A minimum carriageway width of four metres with an additional one metre wide strip on each side of the trail (clear of bushes and long grass is provided* • *The trail is a maximum grade of 15 degrees if sealed and not more than 10 degrees if unsealed* • *A minimum vertical clearance of four metres to any overhanging obstructions, including tree branches is provided* • *The crossfall of the trail is not more than 10 degrees* • *The trail has the capacity for passing by:* *- Reversing bays using the access to properties to reverse fire tankers, which are six metres wide and eight metres deep to any gates, with an inner minimum turning radius of six metres and outer minimum radius of 12 metres; and / or* *- A passing bay every 200 meters, 20 metres long by tree metres wide, making a minimum trafficable width of seven metres at the passing bay* *Note: Some short construction in the access may be accepted where they are not less than the minimum (3.5m) and extend for no more than 30m and where obstruction cannot be reasonably avoided or removed*
• *Fire trails are trafficable under all weather conditions. Where the fire trail joins a public road, access shall be controlled to prevent use by non authorised persons*	• *The fire service is accessible to firefighters and maintained in a serviceable condition by the owner of the land* • *Appropriate drainage and erosion controls are provided* • *The fire trail system is connected to the property access road and / or to the through road system at frequent intervals of 200 metres or less* • *Fire trails do not traverse a wetlands or other land potentially subject to periodic inundation (other than a flood or storm surge)* • *Gates for fire trails are provided and locked with a key / lock system authorized by the local RFS*
• *Fire trails designed to prevent ween infestation, soil erosion and other land degradation*	• *Fire trail does not adversely impact on natural hydrological flows* • *Fire trail design acts as an effective barrier to the spread of weeds and nutrients* • *Fire trail construction does not expose acid-sulphate soils*

5.3 WATER SUPPLY AND OTHER UTILITIES

5.3.1 Water Supply and Hydrants

Future lots are to be serviced by reticulated water infrastructure suitable for fire fighting purposes. With the exception of rural residential subdivision, the furthest point from any future dwellings to a hydrant is to be less than 90 m (with a tanker parked in-line) in accordance with *AS 2419.1 – 2005 Fire Hydrant Installations - System Design, Installation and Commissioning* (Standards Australia 2005). The reticulated water supply is to comply with the following acceptable solutions within Section 4.1.3 of PBP:

- Reticulated water supply to use a ring main system for areas with perimeter roads;
- Fire hydrant spacing, sizing and pressures comply with AS 2419.1 – 2005;
- Hydrants are not located within any road carriageway;
- All above ground water and gas service pipes external to the building are metal, including and up to any taps; and

- The PBP provisions of parking on public roads are met.

Future dwellings on rural residential lots will require a static water supply at time of development application as the dwellings will be beyond the hydrant distance quoted above.

5.3.2 Electrical and Gas Supplies

In accordance with PBP, electricity should be underground wherever practicable. Where overhead electrical transmission lines are installed:

- Lines are to be installed with short pole spacing, unless crossing gullies, and
- No part of a tree should be closer to a powerline than the distance specified in *Vegetation Safety Clearances* issued by Energy Australia (NS179, April 2002).

Any gas services are to be installed and maintained in accordance with *AS/NZS 1596-2008 The storage and handling of LP gas* (Standards Australia 2008).

5.4 BUILDING CONSTRUCTION STANDARDS

The application of building construction standards for bushfire protection under *AS 3959-2009 Construction of buildings in bushfire-prone areas* (Standards Australia 2009) is to be considered at the development application stage for individual dwellings and buildings. An assessment under AS 3959-2009 is not required at the rezoning or subdivision stages. The following is a brief introduction on AS 3959-2009.

AS 3959-2009 contains six Bushfire Attack Levels (BAL) each with a prescribed suite of design and construction specifications aimed at preventing ignition during the passing of a bushfire front. The BALs are introduced below:

- BAL-Low: The threat does not warrant application of construction standards. Developments with BAL-Low are generally not within bushfire prone land (greater than 100 m from bushland);
- BAL-12.5: Addresses background radiant heat at lower levels and ember attack;
- BAL-19: Addresses mid-range radiant heat and ember attack;
- BAL-29: Addresses high range radiant heat and ember attack;
- BAL-40: Addresses extreme range of radiant heat and potential flame contact and ember attack; and
- BAL-FZ: Addresses construction within the flame zone. New subdivided lots are not permitted within the flame zone in NSW.

NSW has a minor variation to AS 3959-2009 which requires consideration in future development applications. The variation is contained within the document ‘PBP Appendix 3 Addendum’ (RFS 2010).

6 Conclusion

6.1 STATEMENT OF CAPABILITY

This bushfire assessment demonstrates that the study area is capable of accommodating future subdivision and land development with the appropriate bushfire protection measures.

6.2 RECOMMENDATIONS AND CONCLUSION

The recommendations of this bushfire assessment are located within Section 5 – Bushfire Protection Measures. They include the provision of Asset Protection Zones, adequate access, water supply for fire fighting, the safe installation of utilities, and building construction standards for future dwellings.

This bushfire assessment demonstrates that the subject land is capable of accommodating future residential subdivision and associated land use with the appropriate bushfire protection measures and bushfire planning requirements prescribed by s.117 (2) Direction 4.4 – 'Planning for Bush Fire Protection' (EP&A Act) and *Planning for Bushfire Protection* (RFS 2006).

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APPENDIX D – Wastewater Assessment

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Bonville Local Environment Study

Wastewater Assessment

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Joe Whitehead J. H. Whitehead	***Shann Mitchell*** SMitchell

Disclaimer

The information contained in this report is based on independent research undertaken by Shann Mitchell and Jasmin Kable of Whitehead & Associates Environmental Consultants Pty Ltd. To our knowledge, it does not contain any false, misleading or incomplete information. Recommendations are based on an honest appraisal of the site's opportunities and constraints, subject to the limited scope and resources available for this project, and follow relevant best practice standards and guidelines where applicable, including:

- AS/NZS 1547: *On-site Domestic Wastewater Management* (Standards Australia / Standards New Zealand, 2012);
- NSW Department of Local Government (1998) *Environment & Health Protection Guidelines: Onsite Sewage Management for Single Households*; and

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Appendices

1. Introduction

Bonville was identified as a priority release area for the Coffs Harbour Rural Residential Strategy (RRS) (2009) to allow rezoning of land for rural residential subdivision. This report forms part of a broad Local Environment Study for the preparation of a planning proposal to form an amendment to the Coffs Harbour City Local Environment Plan (LEP) 2000 and draft Coffs Harbour LEP 2012.

This Wastewater Assessment provides a hazard assessment of the study area in relation to site and soil limitations which can affect on-site wastewater management and the potential for subdivision. The report also provides a minimum lot size analysis and modelling to determine maximum lot density for subdivision.

1.1. The Study Area

Bonville is located on the Mid North Coast of New South Wales; approximately 13km south of Coffs Harbour to both the east and west of the Pacific Highway. Bonville was selected as a preferred area for rural residential subdivision because of its proximity to other town centres. It is proposed that approximately 420 hectares of land will be released in the area for rural residential/large lot residential subdivision. Preliminary assessments undertaken have determined the most suitable areas, with 17 Candidate Areas identified (CA1-17) for subdivision as shown in Figure 1.

W&A identified an average candidate area based on slopes, soil types and lot sizes upon which to undertake minimum lot size analysis upon. Candidate Area 2 (CA2) was adopted for these purposes. Ten lots were identified within this Candidate Area and minimum lot size analysis undertaken.

2. Site & Soil Assessment

2.1. Slope

Table K1 of *AS/NZS 1547:2012* (Standards Australia 2012) details a range of factors likely to limit the selection and applicability of land application systems; with slope/gradient identified as one critical factor. Steep slopes (>10-15%), particularly when combined with shallow or poorly drained soils, can lead to surface breakout of effluent downslope of the land application area. Conventional On-site Sewage Management (OSSM) systems will most likely be unsuitable and these lots will require a detailed site assessment and site specific design to enable a sustainable outcome. Steeply sloping sites are generally unsuitable for trenches and beds and can also be problematic for surface irrigation systems. Conversely, flat and gently sloping sites are less likely to experience such problems and are considered lower risk.

2.2. Soils

Soils and associated landform elements play a vital role in the design, operation and performance of OSSM systems. Key soil properties can be evaluated to assess a soil's capacity for absorption of wastewater, including soil texture, structure, permeability, drainage characteristics, total depth, and depth to limiting layers, such as bedrock, hardpans or water tables.

There are approximately sixteen (16) mapped soil landscapes within the Bonville Study Area; of which ten (10) soil landscapes fall within the Candidate Areas identified for potential subdivision. Most of the soil landscapes in the Candidate Areas are characterised by a similar limiting subsoil horizon of light clay. No detailed soil investigations have been undertaken for this project but interpretation based on the Coffs Harbour 1:100,000 soil landscape series (Milford, 1999). Indicates a limiting soil of light clay at approximately 300–400mm depth. Table 1 summarises the soil landscapes within the adopted Candidate Area 2 and provides an overview of the limiting soil horizons. Figure 2 shows the distribution of soil landscapes throughout the study area.

Table 1: Summary of Soil Landscapes (Milford 1999)

Soil Landscape Name	Landscape	Slopes	Vegetation	Soils
Coffs Creek	level to gently undulating floodplains	0-5%	Completely cleared tall open forest	Loamy sand to sandy loam
				Loam
				Clay loam to light clay
				Clay loam to light clay
				Light to medium clay
Megan	Rolling low hills	5-20%	Partially cleared tall open forest and tall closed forest	Loam
				Clay loam
				Light clay
				Clay loam to light clay
Promised Land	Undulating to rolling low hills	3-15%	Extensively cleared tall open forest	Loam
				Clay loam to silty clay loam
				Light clay
				Light clay
				Light to medium clay
Ulong	Undulating to low rolling hills	5-20%	Partially cleared tall open forest and tall closed forest	Loam to silty loam with fine sand
				Clay loam to silty clay loam
				Light to medium clay
				Light to medium clay

The predominant and most limiting soil landscapes in the Candidate Area 2 are the Promised Land and Megan Soil Landscapes. The Megan and Promised Land Soil Landscapes are similarly characterised by dark reddish brown pedal loam to clay loam, moderately structured topsoil (up to 300mm thick) underlain by reddish brown pedal light clay moderately pedal subsoil (to 3.5m depth depending on location). Bedrock is typically greater than 1.5m depth.

Light clay is considered the most limiting soil for effluent application with a Design Loading Rate (DLR) of 5mm/day for trenches and a Design Irrigation Rate (DIR) of 3mm/day for secondary treatment with subsurface irrigation recommended by *AS/NZS 1547:2012.*

2.3. Climate

The nearest Bureau of Metrology (BoM) weather station to Bonville is Coffs Harbour (BoM number 059040). Coffs Harbour experiences a mean annual rainfall of 1,647mm, with a monthly high of 232mm in March and monthly low of 68.2mm in September. Coffs Harbour experiences mean annual pan evaporation of 1,602mm, with a monthly high of 192mm in January and a monthly low of 69mm in June.

Mean rainfall data was conservatively utilised for the modelling of effluent application at this broad scale of study. Selection of the appropriate rainfall data for site specific modelling will be dependent on the size of the development and risk assessment, and may be reduced to "median" rainfall, or increased to 70-90th percentile.

2.4. Water & Nutrient Balance

2.4.1 Primary Treatment with Trenches/Beds

Water balance modelling was undertaken to determine sustainable effluent application rates, and from this estimate the necessary size of the Effluent Management Area (EMA) required for effluent to be applied from a primary treatment system to trench or beds. The procedures used in the water balance generally follow the *AS/NZS 1547:2012* standard and DLG (1998) guideline. The water balance used is a monthly nominated area model. These calculations determined minimum EMAs for given effluent loads for each month of the year. The water balance can be expressed by the following equation:

Precipitation + Effluent Applied = Evapotranspiration + Percolation + Storage

Mean monthly rainfall data was conservatively utilised in the modelling. Mean data has a higher rainfall than median data typically adopted for domestic wastewater investigations. The water balance conservatively assumes a retained rainfall coefficient of 0.8; that is, generally 80% of rainfall will percolate into the soil and 20% will run off. Given the moderate slopes and good groundcover in Candidate Area 2, this is considered a conservative value. The rainfall hydraulic load is incorporated into the water balance to ensure that runoff from the EMA will not occur under typical (design) climate conditions.

Water balance modelling has been based on a four bedroom home on tank water in accordance with *AS/NZS 1547:2012* with a rate of 120L/p/day. The input data and results for the trench water balance are presented in Table 2, and calculation sheets in Appendix A.

A conservative nutrient balance was also undertaken, which calculates the minimum buffer around a trench to enable nutrients to be assimilated by the soils and vegetation. The nutrient balance used here is based on the simplistic DLG (1998) methodology, but improves this by more accurately accounting for natural nutrient cycles and processes. It acknowledges that a proportion of nitrogen will be retained in the soil through processes such as ammonification (the conversion of organic nitrogen to ammonia) and a certain amount will be lost by denitrification, microbial digestion and volatilisation (Patterson, 2003). Patterson (2002) estimates that these processes may account for up to 40% of total nitrogen loss from soil. In this case, a more conservative estimate of

20% is adopted for the nitrogen losses due to soil processes. A summary of the nutrient balance is provided in Table 3..

Table 2: Inputs for and Results of Hydraulic Modelling

Data Parameter	Units	Value	Comments
Hydraulic load	L/day	720	6 persons
Precipitation	mm/month	Coffs Harbour	BoM, mean monthly
Pan Evaporation	mm/month	Coffs Harbour	BoM, mean monthly
Retained rainfall	unitless	0.8	Proportion of rainfall that remains onsite and infiltrates the soil, allowing for 10% runoff.
Crop Factor	unitless	0.7-0.8	Expected annual range for vegetation based on monthly values.
Design Loading Rate (DLR)	mm/day	5	Maximum rate for design purposes, based on light clay subsoils.
Minimum trench basal area for hydraulic load (m^2)			**272m^2**

Table 3: Inputs for and Results of Nutrient Balance Modelling

Data Parameter	Units	Value	Comments
Effluent total nitrogen concentration	mg/L	60	Target effluent quality for primary treatment systems.
Nitrogen lost to soil processes (denitrification and volatilisation)	annual percentage	20	Patterson (2002).
Effluent total phosphorus concentration	mg/L	30	Target effluent quality for primary treatment systems.
Soil phosphorus sorption capacity	mg/kg	702	Value based on reported data for soil landscape.
Nitrogen uptake rate by plants	kg/Ha/yr	130	Conservative estimated value.
Phosphorus uptake rate by plants	kg/Ha/yr	25	Conservative estimated value.
Design life of system (for nutrient management)	years	50	Reasonable minimum service life for system.
Minimum irrigation area for total phosphorus load, without off-site export			**970m^2**
Minimum irrigation area for total nitrogen load, without off-site export			**761m^2**

2.4.2 Secondary Treatment with Irrigation

Water and nutrient balance modelling was also undertaken to determine sustainable sizing of irrigation EMAs. The procedures for this generally follow the DLG (1998) guidelines.

The water balance used is a monthly model adapted from the "Nominated Area Method" described in DLG (1998). These calculations determined minimum EMA sizes for given effluent loads for each month of the year. The water balance can be expressed by the following equation:

Precipitation + Effluent Applied = Evapotranspiration + Percolation + Storage

Irrigation areas are calculated to achieve no net excess of water and hence zero storage for all months.

A conservative nutrient balance has also been undertaken. The water and nutrient balances were modelled using the estimated average daily effluent load of 720L/day based on a four bedroom dwelling on tank water. Table 4 and Table 5 below contain the input data and results of the water and nutrient balances.

Table 4: Inputs for and Results of Water Balance Modelling

Data Parameter	Units	Value	Comments
Average effluent load	L/day	720	Design dwelling 4 bedrooms, 120 L/person/day.
Precipitation	mm/month	Coffs Harbour	BoM, mean Monthly
Pan Evaporation	mm/month	Coffs Harbour	BoM, mean Monthly
Retained rainfall	unitless	0.8	Proportion of rainfall that remains onsite and infiltrates the soil, allowing for 20% runoff.
Crop Factor	unitless	0.7-0.8	Expected annual range for vegetation based on monthly values.
Design Irrigation Rate (DIR)	mm/day	3	Maximum rate for design purposes, based on light clay subsoils.
Minimum irrigation area for hydraulic load, without wet weather storage (m^2)		**1,043**	Assuming zero wet weather storage.

Table 5: Inputs for and Results of Nutrient Balance Modelling

Data Parameter	Units	Value	Comments
Effluent total nitrogen concentration	mg/L	30	Target effluent quality for secondary treatment systems.
Nitrogen lost to soil processes (denitrification and volatilisation)	annual percentage	20	Patterson (2002).
Effluent total phosphorus concentration	mg/L	15	Target effluent quality for secondary treatment systems.

Data Parameter	Units	Value	Comments
Soil phosphorus sorption capacity	mg/kg	702	Value based on reported data for soil landscape.
Nitrogen uptake rate by plants	kg/Ha/yr	130	Conservative estimated value.
Phosphorus uptake rate by plants	kg/Ha/yr	25	Conservative estimated value.
Design life of system (for nutrient management)	years	50	Reasonable minimum service life for system.
Minimum irrigation area for total phosphorus load, without off-site export			**381m^2**
Minimum irrigation area for total nitrogen load, without off-site export			**486m^2**

As a result of the two water and nutrient balances undertaken for absorption trenches and irrigation areas, the most limiting balance has been used in calculating lot density in Section 4 below (Table 6). Based on the modelling, a minimum EMA of 1,043m^2 required for secondary treatment with subsurface irrigation has been adopted.

Table 6: Minimum Land Application Area Required

LAA system	Area Required
Trench/Bed Absorption System	970m^2
Subsurface Irrigation	1,043m^2

2.5. Buffer Distances

Buffer distances from EMAs are typically enforced to minimise risk to public health, maintain public amenity and protect sensitive environments. Generally, adopted environmental buffers for subsurface irrigation based on DLG (1998), are:

- 250m from domestic groundwater bores;
- 100m from permanent watercourses;
- 40m from downslope intermittent watercourses and dams;
- 12m from property boundaries; and
- 6m if area up-gradient and 3m if area down-gradient of buildings.

These buffer distances have been applied to our Minimum Lot Size Analysis for all future OSSM systems in the assessed Candidate Area. Figure 3 highlights the buffers to watercourses within the Bonville LES study area.

3. Minimum Lot Size Analysis

3.1. Methodology

When considering the suitability for a lot to sustainably manage wastewater on-site, we typically refer to 'adequate available area'. This broadly refers to available areas (i.e. not built out or used for a conflicting purpose) where OSSM will not be unduly constrained by underlying site and soil characteristics. Available area on a developed (or potentially developable) lot is determined by the following factors:

- total building area (including dwellings, sheds, pools etc.);
- driveways and paths (impervious areas), and gardens/vegetated areas unsuitable for effluent reuse;
- dams, intermittent and permanent watercourses running through lots; and
- maintenance of appropriate setback distances from property boundaries, buildings, driveways and paths, dams and watercourses.

Available areas may also be unsuitable or constrained for OSSM, due to other factors, including (but not limited to):

- excessive slope;
- excessively shallow soils;
- heavy (clay) soils with low permeability;
- excessively poor drainage and/or stormwater run-on; and
- excessive shading by vegetation.

Ten (10) representative lots were selected that have already been subdivided to ~1ha or less lot sizes (zoned R5) from the Bonville LES study area associated with Grandis Road and Faviell Drive (Figure 4). Selected lots typically included a dwelling, garage/shed, pool, trees and shrubs and impervious surfaces (driveways, tanks etc). It is assumed that this existing development style will be similar to that proposed for the Candidate Areas and therefore minimum lot size and development potential should be consistent.

The residual areas (areas not otherwise occupied by improvements, buffers or conservation vegetation) were then calculated for the selected lots (eg. Figure 5), and the results recorded. A percentage of the total lot area that is available for effluent disposal was then determined and the lowest percentage of available area to lot size was then used to conservatively determine the minimum lot size.

3.2. Results

Table 7 shows the assessment of available area for each lot. As is evident the variability of lot sizes and on-lot improvements of developed lots in the study area makes selection of a "typical" lot difficult, however, we have adopted a conservative approach to define minimum sustainable lot size as many lots are affected by watercourses which were not always evident within the 10 lots assessed.

From the sample selection of lots investigated the minimum percentage of the lot available for effluent disposal is 27%. The corresponding minimum lot size (for sustainable irrigation of secondary effluent) is 3,863m^2. Thus, a conservative minimum lot size for subdivision in the study area would be ~4,000m^2. This lot size allows for development of the site with a four bedroom (or smaller) dwelling together with associated driveways, sheds, paths and pool, whilst still providing sufficient area for secondary wastewater treatment and sustainable land application.

The selection of 4,000m^2 as the minimum lot size presents a conservative approach that is similar in comparison to lot sizes that have been calculated for other catchments that have been assessed on the mid north coast. As can be seen by the variability in results, some lots may be capable of being developed to a smaller lot size. In addition, we assumed secondary treatment without full nutrient reduction capabilities, and use of mean rainfall rather than median rainfall which has resulted in larger required EMAs than could be achieved with site specific assessment and design.

Table 7: Minimum Lot Size Assessment Results

Lot	Lot Area (m^2)	Developed Area (m^2)	Available Area (m^2)	Percentage of Lot Available for Eff. Disp. (%)	Area required for Secondary Treatment (m^2)	Minimum Lot Size (m^2)
1	20,106	14,257	5,849	30	1,043	3,585
2	19,051	11,392	7,659	40	1,043	2,594
3	6,842	4,858	1,984	29	1,043	3,597
4	7,018	3,727	3,291	47	1,043	2,224
5	4,387	3,088	1,299	30	1,043	3,522
6	10,591	6,844	3,747	35	1,043	2,948
7	4,407	3,227	1,180	27	1,043	3,895
8	4,387	3,151	1,236	28	1,043	3,702
9	20,077	4,154	15,923	80	1,043	1,315
10	13,122	5,460	7,662	58	1043	1,786

4. Maximum Lot Density

The maximum number of 4,000m^2 lots was assessed for each of the lots within Candidate Area 2 (CA2) based on the lesser of the amount derived from total lot size or the amount derived following an aerial photograph review of available area. CA2 was selected due to its large variety of lot sizes, large total area and number of surface water features which may affect future development.

Table 8 provides the results of this assessment. In total, for the about 1,191.7ha CA2, 373 lots could be sustainably generated at a rate of 1.94lots/ha.

Table 8: Maximum Lot Density Assessment

Lot Number *	Total Lot Area m^2	Available Area m^2	Max No. Lots Using Lot size	Max No. Lots Using Min OSSM	Maximum Subdivision Potential for Lot
1	115,222	26,690	28.81	25.42	25
2	8,398	5,909	2.10	5.63	2
3	15,552	199	3.89	0.19	0
4	8,972	2,597	2.24	2.47	2
5	50,336	5,545	12.58	5.28	5
6	43,406	3,952	10.85	3.76	4
7	16,557	11,067	4.14	10.54	4
8	29,123	11,628	7.28	11.07	7
9	4,138	791	1.03	0.75	1
10	3,753	909	0.94	0.87	1
11	16,767	11,111	4.19	10.58	4
12	29,238	14,845	7.31	14.14	7
13	20,608	11,540	5.15	10.99	5
14	2,004	2,004	0.50	1.91	1
15	16,954	16,401	4.24	15.62	4
16	22,974	22,974	5.74	21.88	6
17	20,944	20,944	5.24	19.95	5
18	52,751	37,198	13.19	35.43	13
19	50,100	36,851	12.53	35.10	13
20	41,021	17,111	10.26	16.30	10
21	38,711	26,221	9.68	24.97	10
22	40,337	23,813	10.08	22.68	10
23	4,098	4,098	1.02	3.90	1
24	40,782	7,383	10.20	7.03	7
25	40,160	8,973	10.04	8.55	9
26	3,700	1,932	0.93	1.84	1
27	22,486	9,612	5.62	9.15	6
28	24,480	16,555	6.12	15.77	6
29	3,865	3,865	0.97	3.68	4
30	14,973	13,603	3.74	12.96	4
31	4,165	4,165	1.04	3.97	1
32	3,693	1,303	0.92	1.24	1
33	21,233	19,637	5.31	18.70	5
34	197,360	24,029	49.34	22.88	23
35	70,776	6,079	17.69	5.79	6
36	44,391	34,811	11.10	33.15	11
37	280,275	45,368	70.07	43.21	43
38	283,211	79,769	70.80	75.97	71
39	54,207	2,926	13.55	2.79	3
40	156,183	34,233	39.05	32.60	33

Note:
* Lot numbers are an identifier for assessment purposes only. They are not actual Lot/DP numbers.

5. Cumulative Impact Assessment

5.1. Rationale and Methodology

We assessed the sustainability of the lot density for application of wastewater on the local receiving environment from OSSM systems. Desktop data was used to model OSSM operation and pollutant discharge to groundwater and sensitive surface receptors for CA2 using the Decentralised Sewer Model (DSM) as described below.

5.2. Decentralised Sewerage Model

The DSM is a GIS based tool designed to compare a range of wastewater servicing options and has the ability to assess long term environmental and human health performance of wastewater systems.

The DSM was developed by W&A for the purpose of providing a rapid-assessment tool to predict the performance of on-site and decentralised wastewater management systems under varying environmental conditions. It does this by simulating the movement of pollutants (nitrogen, phosphorus and pathogens) within the effluent load as it travels from the point source (on-site or community-scale systems) down the catchment as surface or subsurface flows. The model simulates a 72 year period and is designed to provide conservative estimates of OSSM system performance CA2.

The DSM has five modules, an on-lot performance module, a particle tracking module, a node-link module, a central management components module and a costing module.

It is important to note that the OLPM makes the conservative assumption that the entire, non-attenuated pollutant load is transported down the catchment and that no dilution occurs within the receiving waters. The key model inputs are provided in Table 9 below. The raw data as used in the DSM has been included in Appendix B as well as the raw outputs.

Table 9: Input Data Summary for DSM

Input Parameter	Unit	On-site Scenario
Average Wastewater Flow per system	L/day (m^3/day)	720 (0.72)
Total Average Wastewater Flow per system	ML/year	0.02628
EMA Type	-	Future Development - SSI 325 systems Existing Development - Trenches 43 systems not upgraded
Application Type	-	No storage with fixed rate
Storage Type	-	No storage
Effluent Total Nitrogen Concentration	mg/L	SSI - 30 Trench - 60
Effluent Total Phosphorus Concentration	mg/L	15
Effluent Virus Concentration[1]	MPN/100mL	SSI – 100 Trench – 10,000,000
Average Annual Rainfall	mm	1,647
Average Annual Evaporation	mm	1,602

Input Parameter	Unit	On-site Scenario
Average Air Temperature (in lieu of ground temperature)	ºC	21.8
Crop Factor [2]	unitless	0.7-0.8 grass
Buffer From Dam/Intermittent Waterway	m	40
Buffer From Property Boundaries	m	12
Buffer From Driveways	m	6
Slope	%	5-20
Required Effluent Application Area	m^2	SSI - 1043 Trench - 272
Soil Phosphorus Adsorption (P-sorb) Capacity	mg/kg	702
Soil Depth for P-sorb	mm	800
Fixed Application Rate	Mm/day	SSI - 3 Trench - 5
Crop Nitrogen Uptake [3]	kg/ha/year	130
Crop Phosphorus Uptake [3]	kg/ha/year	25
Attenuation Rate for Total Phosphorus	%	94
Attenuation Rate for Total Nitrogen	%	93
Attenuation Rate for Viruses	%	97
Attenuation for Surface Flow	%	0.6

5.3. DSM Results

The predicted deep drainage of nutrients and viruses from the developed CA2 that reaches Bonville Creek was compared to expected background deep drainage from an agricultural catchment. Figure 6 provides an overview of the layout of the DSM model for CA2. A summary of the results of the DSM is provided in Table 10 below.

The results from the DSM modelling indicated that mean annual nutrient concentrations in deep drainage represented less than a 1% increase on existing background pollutant levels, and there were no net increase in nutrients in surface runoff. The DSM modelling also indicates that virus surface runoff would not occur at the applied loading rate and that virus deep drainage is very low.

Based on this, by improving the level of treatment and land application of OSSM an increase in lot density is predicted to have negligible effect on nutrient and virus export from the catchments and that the predicted maximum lot density is sustainable.

Table 10: Average Daily Modelled Deep Drainage

(For Candidate Area 2)	TP kg/day	TN kg/day	Virus $MPN/m^2/day$
Background Pollutants (Fletcher, 2004)	1.27	5.39	-
W&A DSM Model Deep Drainage	$3.7x10^{-5}$	$2.3x10^{-4}$	0.03
% increase from background levels	0.0029	0.0043	-
W&A DSM Model Surface Discharge	0	0	0
% increase from background levels	0	0	0

* All percentages are relative to the total background load generated annually (Fletcher et al., 2004)

5.4. *Discussion*

Whilst the DSM modelling undertaken has shown that one system per 4,000m^2 is sustainable, the limitations of this study should be noted. This study has been undertaken and based on a desktop analysis of site and soil data, there were no provisions for soil sampling and confirmation of site conditions throughout the study area and therefore individual site conditions may vary. As a consequence conservative modelling was undertaken using assumed soil and climate parameters to overestimate the minimum areas and maximum lot densities achievable.

Therefore is would still be necessary to undertake detailed land capability assessments for each lot prior to subdivision to ensure that there is sufficient available area OSSM land application plus improvements for each lot within a proposed subdivision which meets Council requirements.

6. Conclusions

This report provides a desktop hazard assessment of the study area in relation to site and soil limitations which can effect on-site wastewater management and the potential for subdivision.

The recommended minimum lot size for future subdivision is 4,000m^2 and DSM modelling indicates that lot density for subdivision allows one onsite wastewater management system per 4,000m^2. Due to the unique locality and minimum available area for effluent management identified within the CA2 we recommend that all future subdivision require a detailed land capability assessment for onsite wastewater management to ensure any proposed subdivision can be sustainable.

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FIGURES

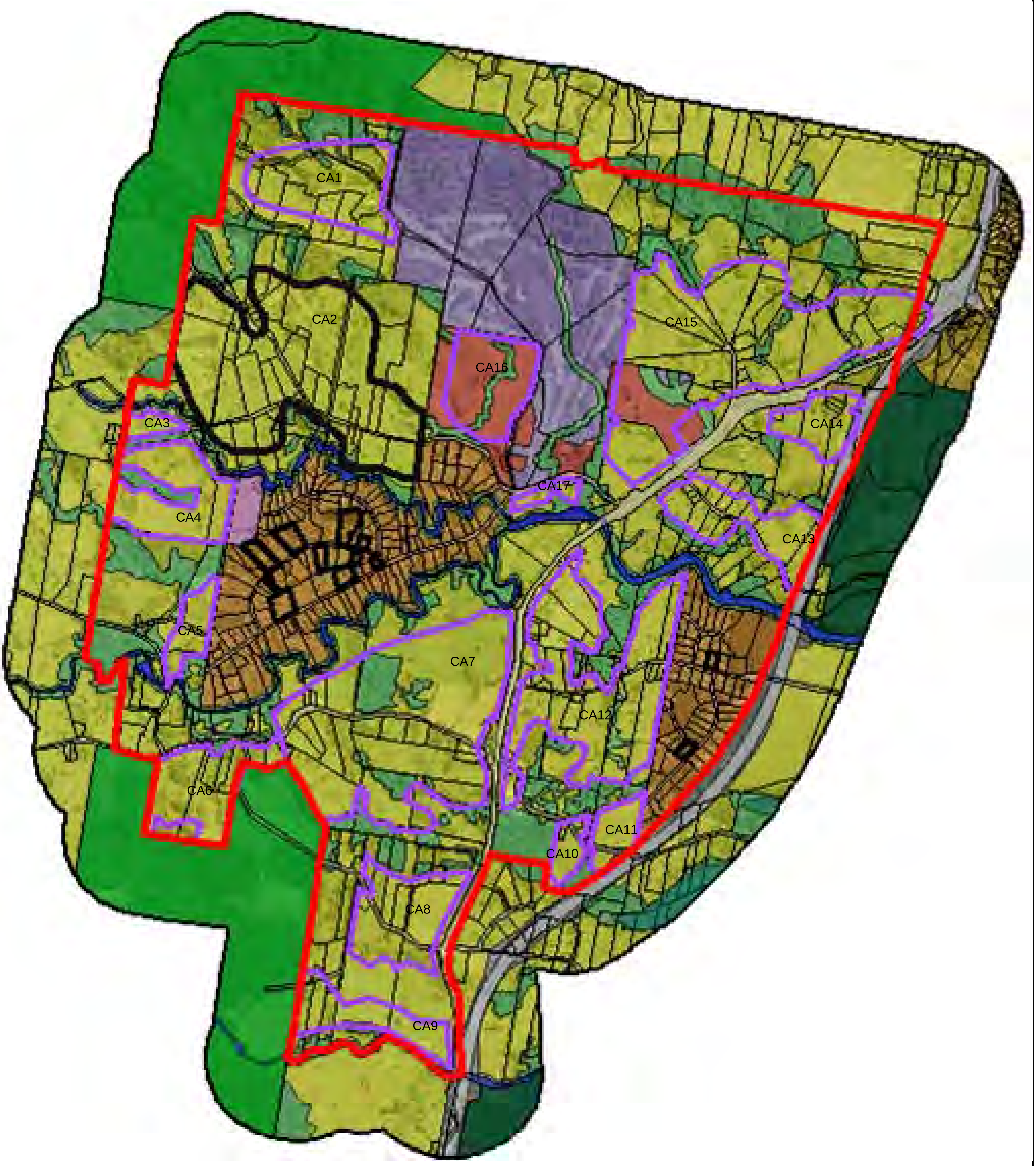

Figure 1: Existing Planning Scheme Zones Map Showing Selected Candidate Area and Lots for Assessment

CHCC Planning Zones (2009)

- R5
- R1
- Wetlands
- National Parks
- Roads
- Creeks
- RU2
- W2
- Forests
- W1
- SP2
- RU3
- R2
- E2
- E1
- RE1
- Bonville Study Area
- Candidate Areas 1-17
- Selected Candidate Areas and Lots for Assessment

Project: Bonville LES- Wastewater Assessment
Drawn: Jasmin Kable
Date: 17 July 2013
Scale: Not to Scale

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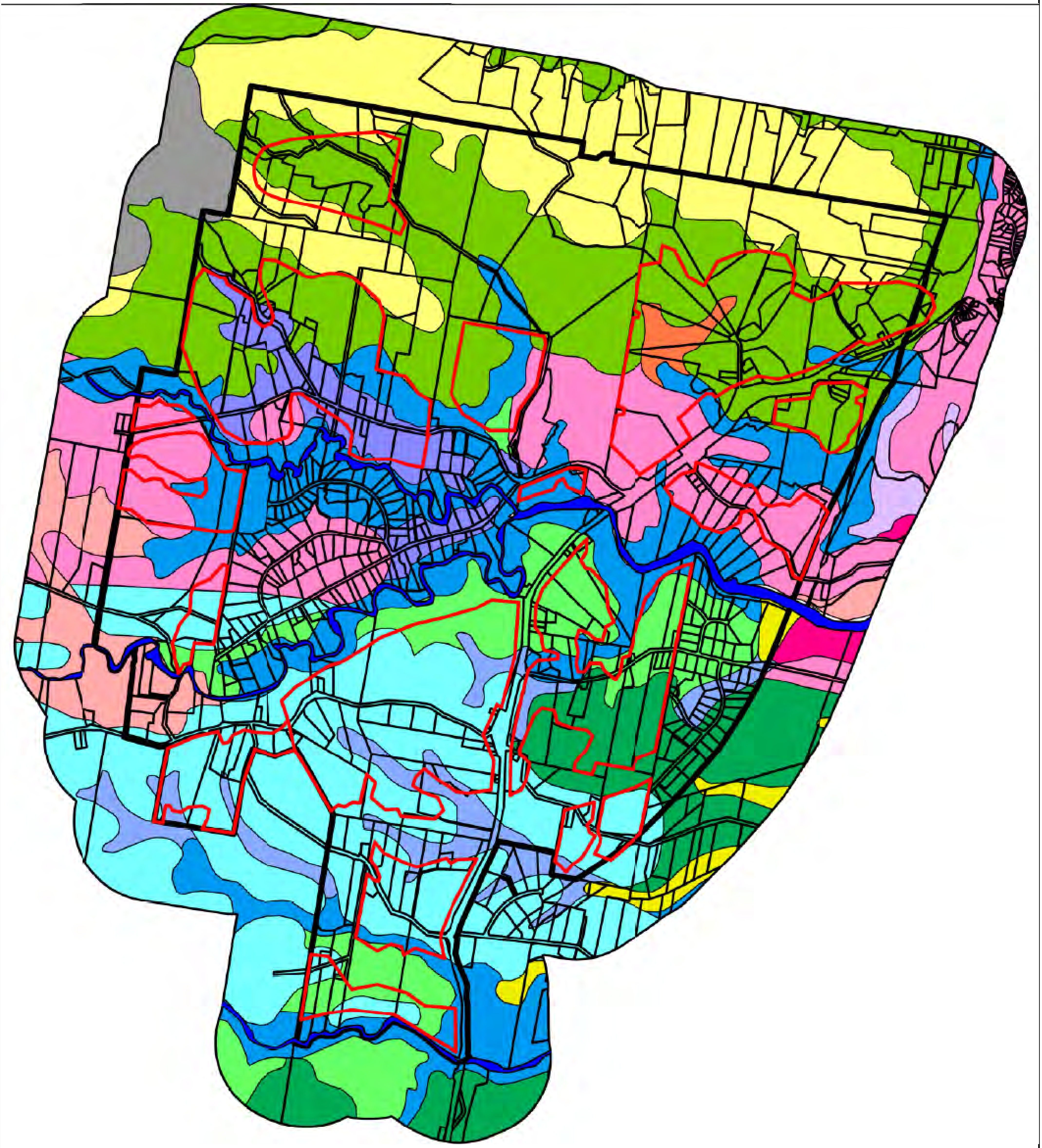

Figure 2:
Soil Landscape Map of Bonville

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Date: 17 July 2013
Scale: Not to Scale

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**Figure 3:
Buffer Analysis of
Bonville Showing
Available Areas for
OSSM**

- ▭ Bonville Study Area
- 🟩 Candidate Areas
- 🟥 Buffers
- ▭ Cadastre
- — Creeks
- 🟦 Surface Water Features

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Scale: Not to Scale

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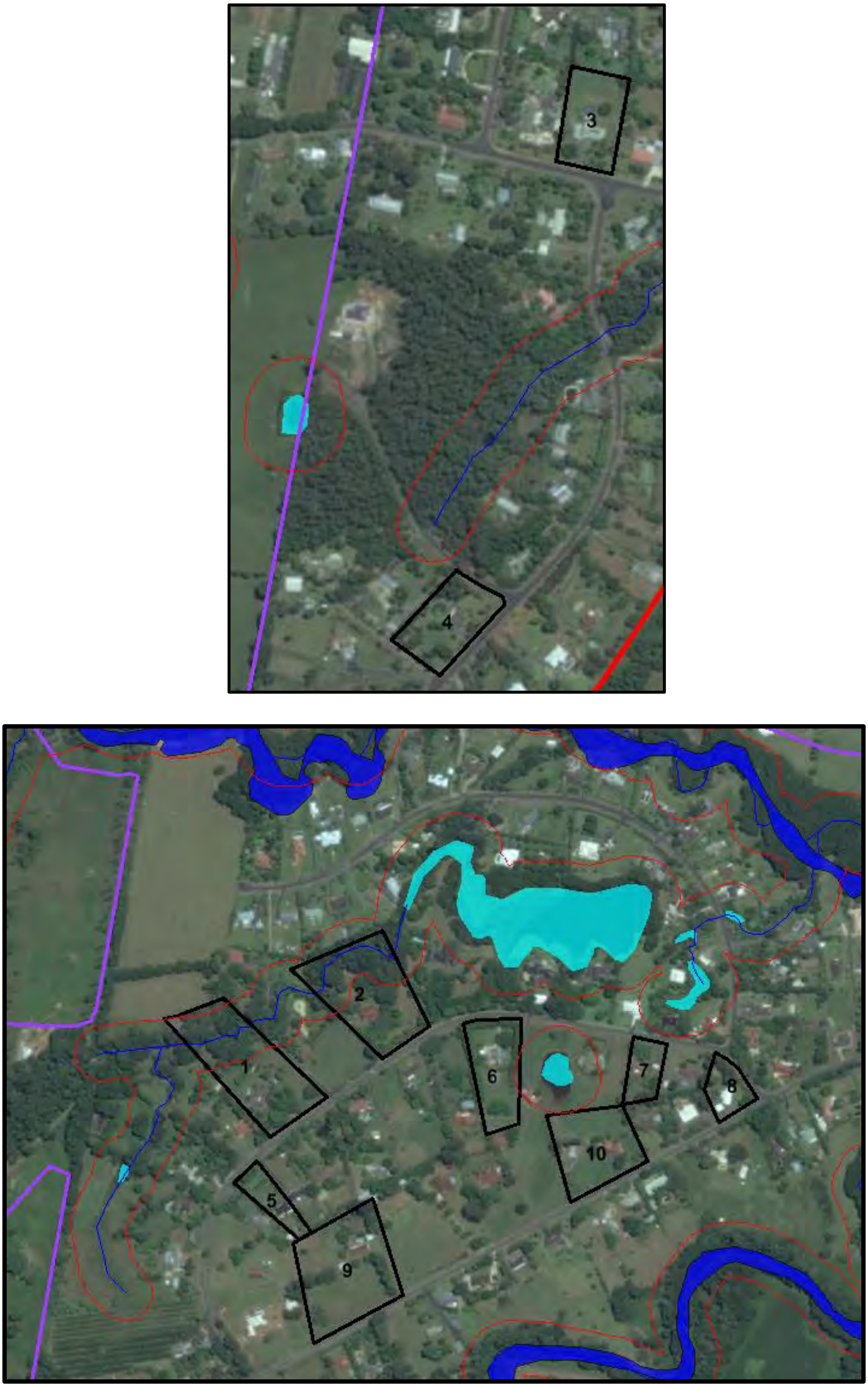

Figure 4:
Overview of Minimum Lot Size Analysis

☐ Candidate Area Boundary
☐ Lot Boundary
▭ Buffers
— Creeks
🟦 Surface Water Features

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Scale: Not to Scale

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Figure 5: Minimum Lot Size Analysis- Lot 1

▭	Lot Boundary
⬚	Buffers
🟩	Available Area for OSSM
—	Creeks
🟦	Surface Water Features

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Drawn: Jasmin Kable
Date: 17 July 2013
Scale: Not to Scale

N

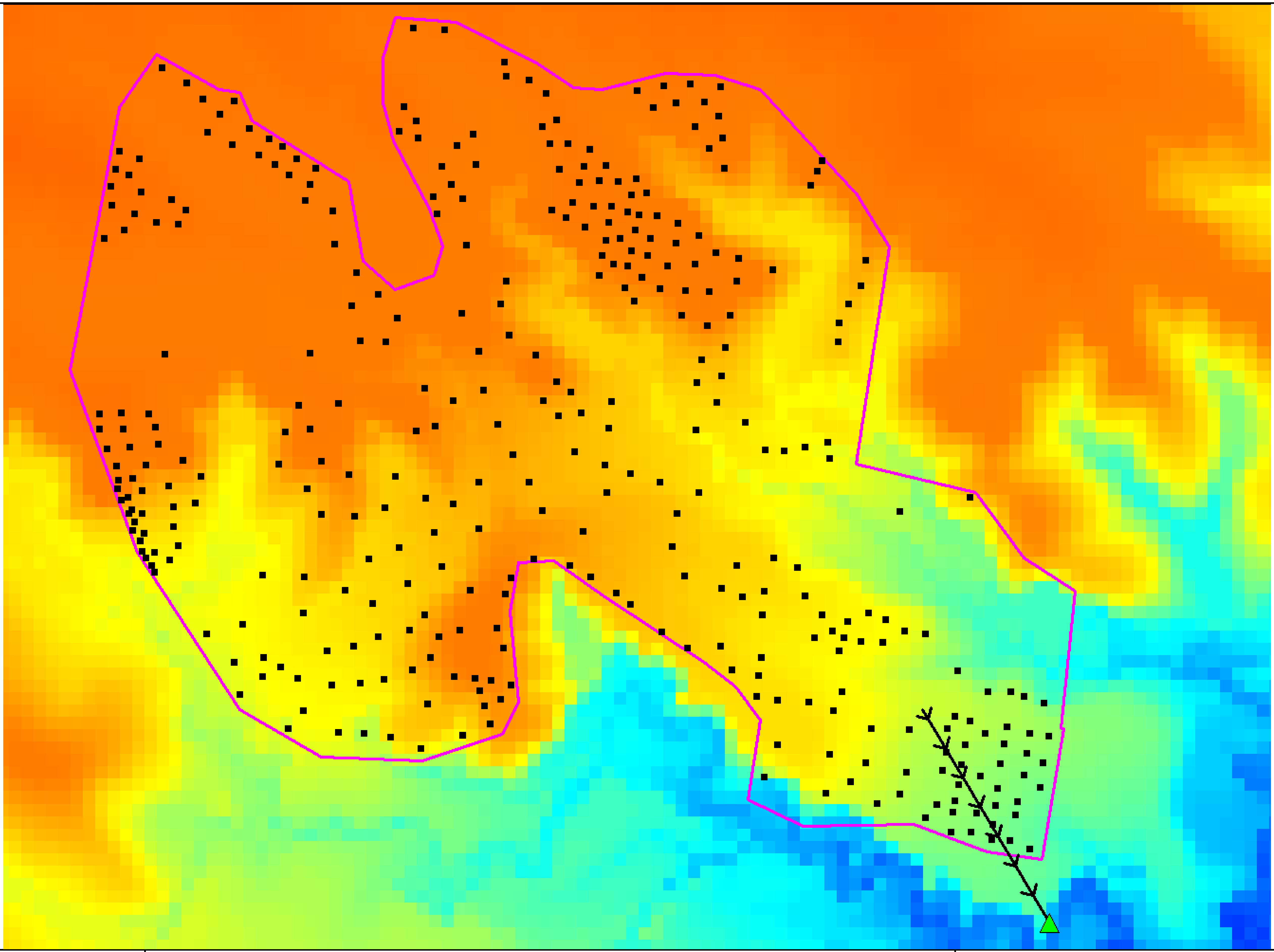

Figure 6:
Decentralised Sewage Model, Bonville

- ▭ Selected Candidate Area
- ⬚ Buffers
- ▭ Cadastre
- — Creeks
- 🟦 Surface Water Features
- *Soil Landscapes as labelled
- → Link
- ▲ Receiving Node
- ■ Site Point (Individual OSSM systems)

*Digital Elevation Model underlay (red is highest elevation and dark blue is the lowest elevation)

Whitehead & Associates Environmental Consultants Pty Ltd

Project: Bonville LES- Wastewater Assessment
Drawn: Jasmin Kable
Date: 17 July 2013
Scale: Not to Scale

N

APPENDIX A

Water & Nutrient Balances

Nominated Area Water Balance & Storage Calculations - Trench/Bed Design

Whitehead & Associates
Environmental Consultants Pty Ltd

Site Address: **Bonville Subdivision**

INPUT DATA

Design Wastewater Flow	Q	720	L/day	Estimated daily flow from residence with tank water
Daily DLR		5.0	mm/day	Litres per sq.m. per day - recommended max loading rate based on AS/NZS 1547:2012 for primary effluent
Nominated Land Application Area	L	272	m sq	Used for iterative purposes to determine storage requirements based on nominated trench/bed bottom area
Crop Factor	C	0.7	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type
Retained Rainfall	RR	0.8	untiless	Proportion of rainfall that remains onsite and infiltrates; function of slope/cover, allowing for any runoff
Void Space Ratio	V	0.3	unitless	Proportion of bed/trench that is available for storage
Rainfall Data	BOM Coffs Harbour			Mean Monthly data
Evaporation Data	BOM Coffs Harbour			Mean Monthly data

WW Flow Allowance	120	L/p/d
No. of Bedrooms	4	Bdrm
Occupancy	1.5	p/Bdrm

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Days in month	D	\	days	31	28	31	30	31	30	31	31	30	31	30	31	31	28	31	30	31	30	**365.0**
Rainfall	R	\	mm/month	169.3	207	232	189	138.4	129.9	93.9	81.3	68.2	95.7	104.4	136.8	169.3	207.0	232.0	189.0	138.4	129.9	**1,647**
Evaporation	E	\	mm/month	192.2	156.8	148.8	117	86.8	69	77.5	102	139.5	161.2	171	192.2	192.2	156.8	148.8	117.0	86.8	69.0	**1,602**
Crop Factor	C			0.80	0.80	0.80	0.70	0.70	0.70	0.70	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.70	0.70	
OUTPUTS (LOSSES)																						
Evapotranspiration	ET	ExC	mm/month	154	125	119	82	61	48	54	71	98	129	137	154	154	125	119	82	61	48	**1,232.0**
Percolation	B	(DLR)xD	mm/month	155.0	140.0	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0	155.0	140.0	155.0	150.0	155.0	150.0	**1,825.0**
Outputs		ET+B	mm/month	308.8	265.4	274.0	231.9	215.8	198.3	209.3	226.4	247.7	284.0	286.8	308.8	308.8	265.4	274.0	231.9	215.8	198.3	**3,057.0**
INPUTS (GAINS)																						
Retained Rainfall	Re	R*RR	mm/month	135.4	165.6	185.6	151.2	110.7	103.9	75.1	65.0	54.6	76.6	83.5	109.4	135.4	165.6	185.6	151.2	110.7	103.9	**1,316.7**
Applied Effluent	W	(QxD)/L	mm/month	82.1	74.1	82.1	79.4	82.1	79.4	82.1	82.1	79.4	82.1	79.4	82.1	82.1	74.1	82.1	79.4	82.1	79.4	**966.2**
Inputs		Re+W	mm/month	217.5	239.7	267.7	230.6	192.8	183.3	157.2	147.1	134.0	158.6	162.9	191.5	217.5	239.7	267.7	230.6	192.8	183.3	**2,282.9**
STORAGE CALCULATION (Δ)																						
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(Re+W)-(ET+B))/\	mm/month	-304.2	-85.7	-21.3	-4.3	-76.6	-49.9	-173.6	-264.3	-378.9	-417.8	-412.9	-390.9	-304.2	-85.7	-21.3	-4.3	-76.6	-49.9	**-2,580.4**
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage Depth for Nominated Area	N		mm	**0.0**																		
Maximum Storage Vol. for Nominated Area	V	NxL	L	**0**																		
BOTTOM AREA REQUIRED FOR ZERO STORAGE			m^2	129	202	252	268	212	229	166	138	112	108	106	112	129	202	252	268	212	229	

MINIMUM BOTTOM AREA REQUIRED FOR ZERO STORAGE: **267.7** m^2

Value is based on the worst month of the year, so the balance overestimates the storage requirement for all other months. Assumes zero effluent depth (storage) in trench/bed. Model is run for 18-months to ensure trench/bed empties at least once per cycle.

Nutrient Balance

Site Address: **Bonville**

Whitehead & Associates
Environmental Consultants Pty Ltd

Please read the attached notes before using this spreadsheet.

SUMMARY - LAND APPLICATION AREA REQUIRED BASED ON THE MOST LIMITING BALANCE = **970 m^2**

INPUT DATA [1]

Wastewater Loading			Nutrient Crop Uptake					
Hydraulic Load	720	L/Day	Crop N Uptake	130	kg/ha/yr	which equals	**36**	$mg/m^2/day$
Effluent N Concentration	60	mg/L	Crop P Uptake	25	kg/ha/yr	which equals	**7**	$mg/m^2/day$
% Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal	**Phosphorus Sorption**					
Total N Loss to Soil	8,640	mg/day	P-sorption result	702	mg/kg	which equals	**7,862**	kg/ha
Remaining N Load after soil loss	34,560	mg/day	Bulk Density	1.4	g/cm3			
Effluent P Concentration	30	mg/L	Depth of Soil	0.8	m			
Design Life of System	50	yrs	% of Predicted P-sorp.[2]	0.5	Decimal			

METHOD 1: NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer

Nitrogen	**970.34**	m^2
Phosphorus	**760.83**	m^2

Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)

Nominated LAA Size	1,044.00	m^2
Predicted N Export from LAA	**-0.96**	kg/year
Predicted P Export from LAA	**-2.93**	kg/year
Phosphorus Longevity for LAA	**78**	Years
Minimum Buffer Required for excess nutrient	**0**	m^2

PHOSPHORUS BALANCE

STEP 1: Using the nominated LAA Size

Nominated LAA Size	**1,044**	m^2				
Daily P Load	0.0216	kg/day	→	Phosphorus generated over life of system	394.2	kg
Daily Uptake	0.007151	kg/day	→	Phosphorus vegetative uptake for life of system	0.125	kg/m^2
Measured p-sorption capacity	0.78624	kg/m^2				
Assumed p-sorption capacity	0.393	kg/m^2	→	Phosphorus adsorbed in 50 years	0.393	kg/m^2
Site P-sorption capacity	410.42	kg	→	Desired Annual P Application Rate	10.818	kg/year
				which equals	0.02964	kg/day
P-load to be sorbed	5.27	kg/year				

NOTES

Nominated Area Water Balance & Storage Calculations

Whitehead & Associates
Environmental Consultants Pty Ltd

Site Address: Bonville

INPUT DATA

Design Wastewater Flow	Q	720	L/day	
Design Percolation Rate	DIPR	21	mm/week	
Daily DPR		3.0	mm/day	Litres per sq.m. per day - based on Table M1 AS/NZS 1547:2012 for secondary effluent
Nominated Land Application Area	L	1044	m sq	
Crop Factor	C	0.7-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type
Runoff Coefficient		0.8	untiless	Proportion of rainfall that remains onsite and infiltrates; function of slope/cover, allowing for any runoff
Rainfall Data		Coffs Harbour		Mean Monthly Data
Evaporation Data		Coffs Harbour		Mean Monthly Data

Flow Allowance	120	L/p/d
No. of bedrooms	4	
Occup Rate	1.5	

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D	\	days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R	\	mm/month	169.3	207	232	189	138.4	129.9	93.9	81.3	68.2	95.7	104.4	136.8	**1,647**
Evaporation	E	\	mm/month	192.2	156.8	148.8	117	86.8	69	77.5	102	139.5	161.2	171	192.2	**1,602**
Daily Evaporation				6.2	5.6	4.8	3.9	2.8	2.3	2.5	3.3	4.7	5.2	5.7	6.2	
Crop Factor	C			0.80	0.80	0.80	0.70	0.70	0.70	0.70	0.70	0.70	0.80	0.80	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	154	125	119	82	61	48	54	71	98	129	137	154	**1232.0**
Percolation	B	(DPR/7)xD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	**1095.0**
Outputs		ET+B	mm/month	246.8	209.44	212.0	171.9	153.8	138.3	147.3	164.4	187.7	222.0	226.8	246.8	**2327.0**
INPUTS																
Retained Rainfall	RR	R*runoff coef	mm/month	135.44	165.6	185.6	151.2	110.72	103.92	75.12	65.04	54.56	76.56	83.52	109.44	**1316.7**
Effluent Irrigation	W	(QxD)/L	mm/month	21.4	19.3	21.4	20.7	21.4	20.7	21.4	21.4	20.7	21.4	20.7	21.4	**251.7**
Inputs		RR+W	mm/month	156.8	184.9	207.0	171.9	132.1	124.6	96.5	86.4	75.2	97.9	104.2	130.8	**1568.4**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B	mm/month	-89.9	-24.5	-5.1	0.0	-21.7	-13.7	-50.8	-78.0	-112.4	-124.0	-122.6	-115.9	**-193.7**
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Maximum Storage for Nominated Area	N		mm	**0.00**												
	V	NxL	L	**0**												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	201	460	844	1043	519	628	309	225	162	154	151	163	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: **1,043** m^2

Nutrient Balance

Site Address: **Bonville**

Whitehead & Associates
Environmental Consultants Pty Ltd

Please read the attached notes before using this spreadsheet.

SUMMARY - LAND APPLICATION AREA REQUIRED BASED ON THE MOST LIMITING BALANCE = **485 m^2**

INPUT DATA [1]

Wastewater Loading			Nutrient Crop Uptake					
Hydraulic Load	720	L/Day	Crop N Uptake	130	kg/ha/yr	which equals	36	$mg/m^2/day$
Effluent N Concentration	30	mg/L	Crop P Uptake	25	kg/ha/yr	which equals	7	$mg/m^2/day$
% Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal	Phosphorus Sorption					
Total N Loss to Soil	4,320	mg/day	P-sorption result	702	mg/kg	which equals	7,862	kg/ha
Remaining N Load after soil loss	17,280	mg/day	Bulk Density	1.4	g/cm3			
Effluent P Concentration	15	mg/L	Depth of Soil	0.8	m			
Design Life of System	50	yrs	% of Predicted P-sorp.[2]	0.5	Decimal			

METHOD 1: NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer

Nitrogen	485.17	m^2
Phosphorus	380.41	m^2

Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)

Nominated LAA Size	1,044.00	m^2
Predicted N Export from LAA	-7.26	kg/year
Predicted P Export from LAA	-6.88	kg/year
Phosphorus Longevity for LAA	308	Years
Minimum Buffer Required for excess nutrient	0	m^2

PHOSPHORUS BALANCE

STEP 1: Using the nominated LAA Size

Nominated LAA Size	**1,044**	m^2			
Daily P Load	0.0108	kg/day	→ Phosphorus generated over life of system	197.1	kg
Daily Uptake	0.007151	kg/day	→ Phosphorus vegetative uptake for life of system	0.125	kg/m^2
Measured p-sorption capacity	0.78624	kg/m^2			
Assumed p-sorption capacity	0.393	kg/m^2	→ Phosphorus adsorbed in 50 years	0.393	kg/m^2
Site P-sorption capacity	410.42	kg	→ Desired Annual P Application Rate	10.818	kg/year
			which equals	0.02964	kg/day
P-load to be sorbed	1.33	kg/year			

NOTES

APPENDIX B

DSM Model Inputs and Outputs

Project Dir = C:\Users\JasminKable\Desktop\
Output Dir = C:\Users\JasminKable\Desktop\Outputs\
Table Dir = C:\Users\JasminKable\Desktop\Tables\
MU Filenames =
MU1.csv
RN Filenames =
receiving node creek.csv
nUnits = 1
nNodes = 1
nSites = 368
nLinks = 1
nSoils = 8
nCrops = 1
nData = 26664
StartDate = 1/01/1940
EndDate = ########

SiteID	X_coord	Y_coord	LAA	WWF	WWF_File	TN	TP	Virus	StorageTy	LAAType	AppMethoc	SC	SD	SKsat	FAD	SWT	AAD	CropN	CropP	CropFactor
1	501577.9	6641069	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
2	501543.6	6641043	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
3	501771.9	6640978	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
4	501753.6	6641131	1043	0.72		30	15	100	1	2	1	0	0	0	5	0	0	130	25	Grass
5	501676	6641109	1043	0.72		30	15	100	1	2	1	0	0	0	5	0	0	130	25	Grass
6	501762	6641065	1043	0.72		30	15	100	1	2	1	0	0	0	5	0	0	130	25	Grass
7	501683.1	6641056	1043	0.72		30	15	100	1	2	1	0	0	0	5	0	0	130	25	Grass
8	501693	6640985	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	DEFAULT
9	501828.7	6641028	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
10	501877.1	6641140	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
11	501823.5	6641163	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
12	501832.5	6641098	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
13	501881.3	6640981	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
14	501907.2	6641048	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
15	501893.1	6641200	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
16	501942.9	6641112	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
17	501946.2	6641196	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
18	502136.4	6641179	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
19	502183.4	6641137	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
20	502290.5	6641080	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
21	502334.2	6641098	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
22	502360	6641033	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
23	502359.1	6640966	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
24	502339.8	6640917	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
25	502407.5	6641030	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
26	502501.9	6640991	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
27	502559.7	6640990	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
28	502444.6	6641018	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
29	502555	6640924	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
30	502493.4	6640939	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
31	502438	6640952	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
32	502432.4	6640893	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
33	502510.3	6640877	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
34	502622.6	6640833	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
35	502600.5	6640875	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
36	502609.5	6640928	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
37	502617	6640990	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
38	502674.8	6640984	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
39	502666.8	6640918	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
40	502661.1	6640862	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
41	502712.8	6641047	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
42	502737.7	6640954	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
43	502724.1	6640880	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
44	502632.5	6641078	272	0.72		60	15	10000000	1	1	1	0	0	0	0	0	0	130	25	Grass
45	501631	6641067	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
46	501639.4	6641018	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
47	501579.7	6641099	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
48	501534.2	6641092	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
49	501616.4	6640991	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
50	501605.1	6641084	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
51	501716.5	6641116	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
52	501725.4	6641060	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass

53	501732	6640983	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
54	501817.9	6640960	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
55	501869.1	6641070	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
56	501846.1	6641131	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
57	501801	6641140	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
58	501804.8	6641079	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
59	501900.6	6641067	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
60	501925	6641064	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
61	501954.6	6641056	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
62	501939.1	6641036	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
63	501923.6	6640998	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
64	501914.7	6641025	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
65	502114.8	6641196	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
66	502075.8	6641221	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
67	501932.5	6641143	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
68	501954.6	6641219	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
69	501988.9	6641248	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
70	502043.9	6641239	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
71	502221.9	6641113	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
72	502273.1	6641116	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
73	502330	6641071	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
74	502327.1	6641040	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
75	502545.6	6640892	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
76	502469.9	6640910	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
77	502456.8	6641046	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
78	502650.8	6641342	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
79	502552.6	6641139	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
80	502583.6	6641134	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
81	502678.5	6641046	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
82	502734	6641040	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
83	502764.5	6641029	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
84	502771.5	6640979	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
85	502762.1	6640938	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
86	502757.9	6640901	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
87	502742.4	6640983	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
88	502734	6640919	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
89	502720.3	6640859	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
90	502712.3	6640820	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
91	502741.9	6640808	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
92	502707.2	6640993	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
93	502703.9	6640968	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
94	502697.8	6640937	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
95	502692.6	6640901	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
96	502689.8	6640873	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
97	502686.5	6640845	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
98	502684.6	6640822	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
99	502651.7	6641002	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
100	502643.8	6640967	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
101	502639.1	6640935	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
102	502634.8	6640905	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
103	502627.8	6640881	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
104	502625.9	6640863	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
105	502653.6	6640833	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
106	502615.6	6640955	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
107	502628.7	6641009	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
108	502583.2	6640856	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
109	502545.1	6641320	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
110	502497.2	6641166	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
111	502524	6641157	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
112	502486.4	6641124	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
113	502519.7	6641121	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
114	502426.7	6641164	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
115	502390.1	6641236	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
116	502465.2	6641153	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
117	502460.5	6641129	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
118	502415.5	6641129	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
119	502442.2	6641139	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
120	502453.5	6641108	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
121	502435.7	6641426	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass

122	502438	6641401	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
123	502401.4	6641418	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
124	502368.9	6641413	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
125	502340.3	6641413	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
126	502310.7	6641455	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
127	502452.1	6641577	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
128	502452.6	6641607	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
129	502467.6	6641636	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
130	502485.5	6641662	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
131	502492.5	6641701	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
132	502352	6641688	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
133	502409.3	6641816	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
134	502419.7	6641837	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
135	502427.7	6641852	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
136	502297.5	6641238	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
137	502353	6641249	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
138	502339.8	6641199	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
139	502335.6	6641163	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
140	502305.5	6641190	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
141	502275	6641203	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
142	502400.9	6641192	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
143	502198.9	6641267	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
144	502218.1	6641222	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
145	502240.2	6641349	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
146	502181.5	6641365	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
147	502207.1	6641317	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
148	502099.7	6641349	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
149	502136.8	6641378	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
150	502096.7	6641390	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
151	502102.5	6641446	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
152	501992.2	6641558	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
153	502023.5	6641518	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
154	502003.2	6641488	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
155	502046.1	6641501	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
156	502026.4	6641465	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
157	502061.8	6641471	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
158	502050.8	6641411	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
159	502088.6	6641678	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
160	501886.8	6641724	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
161	501948	6641670	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
162	501939.3	6641635	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
163	501952.6	6641588	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
164	502064.7	6641289	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
165	502001.7	6641322	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
166	501913.7	6641504	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
167	501935.2	6641452	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
168	501957.8	6641407	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
169	501982.2	6641364	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
170	501840.4	6641450	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
171	501867.2	6641488	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
172	501905.6	6641365	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
173	501867.2	6641332	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
174	501906.1	6641294	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
175	501692.4	6641484	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
176	501745.2	6641180	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
177	501798.1	6641211	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
178	501850.4	6641236	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
179	501738.2	6641248	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
180	501784.7	6641266	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
181	501838.2	6641288	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
182	501716.8	6641313	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
183	501763.8	6641325	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
184	501825.4	6641340	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
185	501709.2	6641376	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
186	501778.9	6641373	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
187	501810.9	6641443	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
188	501667.3	6641316	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
189	501632.5	6641481	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
190	501611.6	6641441	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass

191	501649.9	6641445	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
192	501601.7	6641392	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
193	501666.8	6641397	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
194	501644.7	6641355	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
195	501703.4	6641200	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
196	501577.9	6641223	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
197	501547.7	6641149	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
198	501639.5	6641167	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
199	501640.6	6641220	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
200	501357.7	6641354	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
201	501359.5	6641368	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
202	501374	6641342	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
203	501363	6641337	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
204	501379.2	6641323	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
205	501374.6	6641317	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
206	501382.7	6641305	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
207	501380.4	6641292	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
208	501392	6641276	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
209	501394.9	6641260	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
210	501400.1	6641249	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
211	501408.9	6641238	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
212	501413.5	6641228	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
213	501429.8	6641559	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
214	501492.5	6641134	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
215	501329.8	6641469	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
216	501363.5	6641469	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
217	501405.4	6641468	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
218	501329.8	6641446	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
219	501365.9	6641446	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
220	501414.7	6641448	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
221	501341.5	6641415	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
222	501375.7	6641418	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
223	501419.3	6641422	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
224	501356	6641389	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
225	501400.7	6641390	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
226	501457.1	6641397	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
227	501395.5	6641351	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
228	501435.6	6641360	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
229	501484.4	6641374	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
230	501394.9	6641317	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
231	501442.5	6641327	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
232	501475.7	6641333	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
233	501398.4	6641287	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
234	501443.1	6641297	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
235	501412.9	6641258	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
236	501448.9	6641268	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
237	501437.3	6641247	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
238	501381	6641371	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
239	501348.4	6641785	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
240	501382.7	6641772	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
241	501416.4	6641759	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
242	501336.8	6641734	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
243	501367.6	6641748	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
244	501450.1	6641756	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
245	501374.9	6641831	272	0.72		60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
246	501641.8	6641793	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
247	501649.4	6641816	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
248	501658.1	6641842	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
249	501629	6641856	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
250	501618	6641831	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
251	501608.1	6641875	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
252	501595.9	6641848	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
253	501587.8	6641886	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
254	501571.5	6641861	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
255	501557	6641902	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
256	501532	6641878	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
257	501534.9	6641943	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
258	501512.8	6641924	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
259	501494.3	6641896	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass

260	501487.3	6641946	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
261	501462.9	6641971	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
262	501425.7	6641994	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
263	501360.6	6641867	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
264	501390.8	6641856	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
265	501354.8	6641840	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
266	501346.7	6641814	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
267	501439.6	6641794	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
268	501461.1	6641777	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
269	501393.8	6641805	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
270	501684.3	6641776	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
271	501687.7	6641726	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
272	501649.6	6641561	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
273	501719.6	6641683	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
274	501753.4	6641649	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
275	501726	6641580	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
276	501712.7	6641632	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
277	501781.5	6641613	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
278	501765.6	6641577	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
279	501879.4	6641622	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
280	501905.6	6641564	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
281	501823.6	6641508	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
282	501842.8	6641771	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
283	501836.3	6641798	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
284	501849.3	6641844	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
285	501872.7	6641875	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
286	501902.1	6641847	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
287	501863.4	6641817	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
288	501897.7	6641892	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
289	501881.7	6641795	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
290	501982.2	6641975	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
291	501944.2	6642003	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
292	501948	6641981	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
293	501814.1	6641887	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
294	501792.6	6641935	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
295	501853.6	6642052	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
296	501806.2	6642054	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
297	501811.4	6641913	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
298	501784.4	6641898	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
299	502236	6641444	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
300	502108	6641487	272	0.72	60	15	10000000	1	1	1	0	0	0	5	0	0	130	25	Grass
301	502267.2	6641486	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
302	502274.2	6641526	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
303	502280	6641569	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
304	502286.9	6641618	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
305	502296.8	6641669	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
306	502300.3	6641704	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
307	502266	6641713	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
308	502255	6641654	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
309	502253.2	6641603	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
310	502244.5	6641551	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
311	502236.4	6641517	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
312	502240.5	6641738	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
313	502234.1	6641695	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
314	502219.5	6641655	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
315	502214.3	6641619	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
316	502208.5	6641758	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
317	502205	6641727	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
318	502191.7	6641693	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
319	502181.2	6641658	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
320	502141.7	6641640	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
321	502153.3	6641676	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
322	502162.6	6641709	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
323	502166.7	6641734	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
324	502176	6641770	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
325	502160.9	6641804	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
326	502148.7	6641770	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
327	502143.4	6641748	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
328	502137.1	6641716	1043	0.72	30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass

329	502131.8	6641693	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
330	502127.2	6641660	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
331	502110.9	6641696	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
332	502120.2	6641734	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
333	502131.8	6641774	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
334	502137.6	6641801	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
335	502144.6	6641825	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
336	502092.9	6641709	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
337	502098.1	6641732	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
338	502102.8	6641759	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
339	502107.4	6641784	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
340	502117.3	6641820	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
341	502098.1	6641846	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
342	502088.3	6641822	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
343	502080.1	6641784	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
344	502067.3	6641752	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
345	502038.3	6641766	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
346	502048.8	6641789	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
347	502058.6	6641819	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
348	502065.6	6641845	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
349	502074.3	6641870	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
350	502017.4	6641777	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
351	502028.4	6641840	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
352	502041.8	6641879	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
353	502013.3	6641878	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
354	502023.8	6641915	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
355	502002.3	6641905	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
356	502008.1	6641955	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
357	502145.8	6641959	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
358	502186.4	6641966	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
359	502226.5	6641970	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
360	502272.4	6641964	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
361	502170.2	6641934	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
362	502205.6	6641940	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
363	502248	6641942	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
364	502270.7	6641920	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
365	502234.1	6641905	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
366	502275.3	6641888	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
367	502255.6	6641872	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
368	502279.4	6641841	1043	0.72		30	15	100	1	2	1	0	0	0	3	0	0	130	25	Grass
LinkID	k_Flow_ov	k_TN_over	k_TP_over	k_Virus_ov	k_Flow_su	k_TN_surf	k_TP_surf	k_Virus_su	k_Flo	k_TN_dd	k_TP_dd	k_Virus_dd								
1	0.6	0.93	0.94	0.97	0.6	0.93	0.94	0.97	0.6	0.93	0.94	0.97								
Date	R	ET	E	T																
26664	26664	26664	26664	26664				325												
1/01/1940	0	5.3	6.2	23				43												
2/01/1940	1.6	4.8	6.4	20.8																
3/01/1940	0	4.8	6.4	23.5																
4/01/1940	0	6	6.4	25.2																
5/01/1940	0.8	4.6	6.4	22.8																
6/01/1940	0	4.5	6.4	23.2																
7/01/1940	0	4.3	6.4	21.5																
8/01/1940	8.9	5.3	6.4	21.5																
9/01/1940	1.1	4.8	6.4	22																
10/01/1940	0	4.4	6.4	23.5																
11/01/1940	0	4.3	6.2	24																
12/01/1940	0	5	6.2	25																
13/01/1940	0	4.8	6.2	23.2																
14/01/1940	0.9	4.1	6	22.5																
15/01/1940	0.5	6.4	6.2	25.5																
16/01/1940	46.5	4.8	6.2	27																
17/01/1940	1.4	5.7	6.2	27.8																
18/01/1940	0.6	5.3	6	25.5																
19/01/1940	7.2	5.8	6.2	25.2																
20/01/1940	8.6	5.4	6.4	24.5																
21/01/1940	0	4.3	6.4	25.5																
22/01/1940	0.7	7.2	6.4	28																
23/01/1940	0	7.1	6.4	24.5																
24/01/1940	0	7.7	6.4	27.2																
25/01/1940	0	6.8	6.2	29																

DSM Soil Data Inputs

Data Input	Code	Value	Unit	Typical Source of Information
Bio-physical Data				
Soil water at effective saturation	SAT	mm	352-437	saturated capacity. need to represent a trench media if trench, but soil if irrig area. porosity *0.9 or 0.95
Field capacity	FC		130-240	field capacity. point at which soil stops draining. See Interp Soil Test Results (Hazelton 2007) table 2.5
Permanent Wilting Point	PWP		16-25	permanent wilting point. Point at which plants cannot obtain enough water. See Interp Soil Test Results (Hazelton 2007) table 2.5
Saturated hydraulic conductivity	SHC	mm/day	60-380	rate of percolation through the saturated soil profile. Use limiting layer
Soil depth for phosphorus sorption	SDP	mm	350-1500	soil depth for p sorp. Use limiting layer
Bulk density	BD	kg/m^3	1400-1600	bulk density. Average value based on soil depth
Initial depression storage	DS	mm	6	depression storage. Initial loss before infiltration
Dry soil infiltration rate	INF	mm/day	60-120	infiltration rate of water
Infiltration exponent	EXP1	dimensionless	5698	exponent 1. how slowly ifiltration decreases once soil gets wet.
Freundlich adsorption coefficient	A1	g/L	259	A1 is exp10 of intercept of isotherm with y axis
Freundlich adsorption exponent	B1	dimensionless	0.99	B1 is slope of log normal line
Freundlich desorption exponent	B2		0.495	B2 is half of B1

DSM Output Summary

DSM Outputs	**Receiving Node**
Mean Annual Surface Runoff (m3) =	0.00
Mean Annual Surface N (g) =	0.00
Mean Annual Surface P (g) =	0.00
Mean Annual Surface V (MPN) =	0.00
Mean Annual Deep Drainage (m3) =	315.45
Mean Annual Deep Drainage N (g) =	84.52
Mean Annual Deep Drainage P (g) =	13.61
Mean Annual Deep Drainage V (MPN) =	170921296.00

N: Total Nitrogen
P: Total Phosphorus
V: viruses (Most Probable Number).

APPENDIX E – Visual Assessment

Bonville Rural Residential

Visual Analysis

September 2013

Issue A

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Revision	Date	Description	Checked
A	25.10.13	Draft for Client Issue	JA

Foreword

In 2009, Coffs Harbour City Council endorsed the Coffs Harbour City Rural Residential Strategy and ratified Bonville as the Priority Release Area. The Department of Planning endorsed the strategy in 2010 facilitating the rezoning of land in the release area for rural residential purposes.

This Visual Analysis Report has been prepared for Coffs Harbour City Council as a specialist study to inform the future rezoning of the Bonville Release Area for rural residential purpose to meet future market demand. This study is part of a series of studies commissioned by Council for that purpose.

This Visual Analysis establishes the visual quality of the area and its surrounds. It identifies the key features, within and beyond the site, that contribute to the scenic value of Bonville. The Visual Analysis identifies locations that may be particularly sensitive to visual impact from future development. In particular, consideration will be given to ridgelines, steep slopes, significant view corridors and views from public roads including the Pacific Highway and Pine Creek Way.

The report considers the character of existing development in terms of its settings, density, built form and aesthetics. An assessment is made as to the scenic value of various locations within Bonville and the potential for those locations to be visually impacted by future development. The potential for an area to be visually impacted by future development will be affected by its existing character, the locations from which it can be viewed and its context. The report considers whether existing view corridors available from the Pacific highway and Pine Creek Way are likely to be affected by future rural residential development in the study area.

The final part of the report is dedicated to providing Visual Enhancement Strategies to lessen the visual impact of future development in the study area. These strategies are aimed at creating a future Bonville that retains the positive aspects of its visual character and has a distinct sense of place. These strategies relate to the planning of new communities as well as to the design of individual properties. It is intended these strategies will provide input into a Development Control Plan for rural residential development at Bonville.

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1.0 Introduction

This Visual Analysis has been prepared for Coffs Harbour City Council as one of a series of environmental studies which will inform the future rezoning of the Bonville rural residential area. This report reflects issues and considerations identified in the Rural Residential Strategy (RRS) 2009.

The Rural Residential Strategy was adopted by Council in 2009 after a lengthy period of debate and community input. The strategy identified Bonville as the Priority Release Area. To enable Bonville to be rezoned for rural residential/large lot residential purposes a range of environmental studies need to be prepared. These studies, including this visual analysis, will inform the preparation of a Development Control Plan (DCP) and Contributions Plan (CP) for Bonville. These studies will also inform the Coffs Harbour City Local Environment Plan (LEP) 2000 and draft Coffs Harbour LEP 2013 in the form of a Planning Proposal.

The purpose of the Visual Analysis is to:

- establish key features that contribute toward the scenic value of the study area. Of particular importance will be an assessment of all existing vegetation to determine visual (and ecological) significance and importance having regard to the overall natural heritage of the city;

- identify visual impact in the context of adjoining and surrounding development in relation to its setting, density, built form, aesthetics and building mass as viewed from the public domain;

- identify locations that may be particularly sensitive to visual impact, such as ridgelines and steep slopes; and

- identify view corridors and key sources of views, particularly along the Pacific Highway bypass route, including addressing landscape treatment and screening to the Pacific Highway Bypass.

2.0 Background

Coffs Harbour City Council endorsed the Rural Residential Strategy (RRS) in 2009 and ratified Bonville as the Priority Release Area. The Department of Planning (DoP), now the Department of Planning and Infrastructure, endorsed the RRS in May 2010 to allow additional lands to be rezoned for rural residential purpose to meet the market.

Prior to 1999 the development of rural residential allotments was generally carried out in an ad hoc manner. Typically, 'concessional allotment' provisions resulted in the establishment of three allotments created for family members within a primary allotment. Concerns arose that this type of development resulted in environmental damage, adversely affected agriculture and quarrying activities, affected urban development and was inefficient in terms of services distribution.

In 1999, Council instigated a more strategic approach to rural residential development and evolved the Rural Residential Strategy. The strategy outlined short, medium and long term release programs with a yield of 890 lots. Areas within Korora, Nana Glen, Coramba and Boambee were subsequently rezoned for rural residential purposes. Under the Coffs Harbour City Council LEP 2000 this land was zoned Rural 1B Living.

The Local Government Area (LGA) of Coffs Harbour City was expanded after 1999 to include Red Rock, Corindi and Upper Corindi. Coffs Harbour City Council prepared a city-wide settlement strategy called 'Our Living City (OLC) Settlement Strategy". Additional candidate areas for rural residential purposes were identified at Corindi Beach, Nana Glen, Coramba, Karangi and Moonee. These areas were typically 2 kilometres from the village centre.

The Rural Residential Strategy was eventually endorsed, but it was after considerable debate and community response. Council finally endorsed the strategy in November 2009 and as part of this endorsement required the strategy also being endorsed by the DoP which it was in May 2010.

Bonville was recommended as the preferred area due to its proximity to Boambee, Sawtell/Toormina and the Coffs Harbour city centre. Approximately 420 hectares of land were to be released at Bonville equating to about 424 allotments.

A range of environmental studies need to be prepared to facilitate the rezoning of the Bonville area for rural residential/large lot residential purposes. These studies will inform the preparation of a Development Control Plan (DCP) and Contributions Plan (CP) for the Bonville area. These studies will also inform the Coffs Harbour City Local Environmental Plan (LEP) 2000 and draft Coffs Harbour LEP 2012 in the form of a Planning Proposal.

This Visual Analysis represents one of the environmental studies prepared to inform the rezoning of the Bonville area for rural residential/large lot residential purposes.

3.0 Coffs Harbour City Rural Residential Strategy 2009

The Rural Residential Strategy 2009 identified Bonville as the Priority Release Area for rezoning for rural residential purposes. It is relevant to briefly include aspects of that strategy as they relate to Bonville and it being identified for rural residential development. In particular, aspects relative to visual character have been extracted from the strategy.

3.1 Background

The Rural Residential Strategy identified by 2031 the Coffs Harbour City Local Government Area will have increased in population by 30, 200 people and that these people will require another 12, 000 dwellings. Of these dwellings 5-10% will be expected to be rural residential dwellings. The challenge in developing rural residential is to maximise the benefits of the lifestyle while minimising the economic, social and environmental costs to the broader community. (RRS 2009, p 1)

The RRS considered a range of statutory controls relevant to rural residential development at the Local, Regional and State levels. In preparing LEPs for rural residential development, Councils are required to avoid rural land fragmentation and rural land use conflicts, to minimise impacts from natural hazards, to protect farmland, natural resources and biodiversity; and to consider the impacts on social and economic welfare, services and infrastructure on the community. State level polices require the protection of state significant vegetation and the remediation of contaminated land. (RRS 2009, p 28)

3.2 'Hard' Constraints

The Rural Residential Strategy (RRS) undertook a study to select candidate areas for future rezoning for rural residential purposes. An assessment of the physical catchment considered the environmental capacity of the candidate areas to support rural residential development. This assessment considered 'hard' or prohibitive constraints and 'soft' or limiting constraints. 'Hard' constraints included:

- land identified in the Our Living City Settlement Strategy for urban purposes;
- regionally significant farmland;
- flood prone land within the 1 in 100 year flood extent;
- land mapped a Class 1 and 2 acid sulphate soils;
- land with regionally significant scenic qualities;
- land on prominent ridgelines;
- land of ecological significance; and
- land with a slope of greater than 20%.

Flooding

Flood mapping indicated Bonville to be generally free of the 1 in 100 year flood level. (RRS 2009, p 38) A property partly in a flood prone area can be considered for development if there is sufficient non flood prone area for a dwelling, ancillary uses and effluent disposal. That property must also have reasonable access in the event of a flood and development on that property will not have an adverse impact on flood behaviour.

Water Quality

The protection of water quality, both surface and ground is necessary to sustain biodiversity and human life. Rural residential development can have adverse impacts on both through ineffective effluent disposal. Council requires all rural residential developments to be serviced by aerated sewage systems. Council has a policy to not provide rural residential developments with reticulated water and, as such, rural residential developments must supply their own drinking and fire fighting water. (RRS 2009, p 39)

Ecologically Significant Areas

The LGA contains a variety of vegetation types, numerous waterways, extensive coastline and various aquatic habitats. Human activity has played a major role in the decline of biodiversity. Day to day activities such as daily travel to long term actions such as development potentially impact on biodiversity. Human impacts can result in the introduction of pest species, the spread of disease, clearing, pollution and climate change. Land clearing can fragment habitats and corridors.

The RRS reflects the classification of vegetation used in the Coffs Harbour City Council Vegetation Strategy 2003. Vegetation in that strategy was mapped as Very High, High, Moderate and Low Value. The RRS excludes all four categories of vegetation from proposed rural residential development. (RRS 2009, p 42)

Bushfire Prone Areas

Bushfire prone land is land that can support a bushfire or is likely to be subject to bushfire attack. Forests, grasslands and certain plantations can pose a bushfire threat to rural residential development. (RRS 2009, p43) The RRS included bushfire prone land as a ‘hard’ constraint and recommended it be avoided for rural residential development. The strategy recommended concentric development patterns over linear patterns that have a greater bushfire risk.

Scenic Quality

The appealing visual character of the Coffs Harbour region is the result of the Great Dividing Range being close to the coast at this location. The region’s geology has resulted in dramatic mountains with small steep catchments that discharge to the ocean is short, relatively narrow waterways. The RRS identified Korora as the only candidate area with regional scenic qualities. Bonville, however, does have scenic amenity characterised by forested ridges and hillsides and rural pastures within the valley. (RRS 2009, p 45)

The RRS reflects that rural residential development is less visually obtrusive than urban development and that larger lots allow for the protection of sensitive areas, the retention of natural areas and the provision of buffers between dwellings. The strategy recognises, however, that scattered rural residential dwellings can have greater visual impact than open pasture land or bushland. (RRS 2009 p 45) Infrastructure associated with rural residential development can have a visual impact upon a rural landscape. Visual intrusions can include clearing, buildings and other structures, accesses, fencing and power lines. The RRS proposes that rural residential development be designed to enhance the setting through appropriate building design, revegetation and landscaping works. (RRS 2009 p 46) Development should be located away from prominent ridgelines, waterways should be protected and visual buffers should be incorporated.

Urban Capability

Rural residential development should utilise land that is physically capable of supporting that type of development. 'Hard' constrained land should be avoided. Development should be kept away from steep land to avoid potential environment damage such as erosion, slippage and the pollution of waterways through surface run off. Developing steep land can also be associated with visual impacts associated with earthworks and establishing access roads. (RRS 2009, p 46)

3.3 'Soft' Constraints

The RRS considered 'soft' or limiting constraints and determined that land with numerous 'soft' constraints should be given a lower preference than land with less overlapping 'soft' constraints. (RRS 2009, p iv) Given preference to rural residential development with less environmental constraints would result in lower development costs, less environmental impacts, greater likelihood of the development proceeding and reduced Council resources in terms of determining applications.

3.4 Bonville as the priority release area

The RRS identified Bonville as the priority release area due to its proximity to Coffs Harbour, Sawtell/Toormina and Bonville. Rural residential development typically relies on car travel. The RRS indicated proposals for the development of Bonville should consider the existing road network. The Pacific Highway deviation at Bonville means the existing highway has now been degraded to a 'collector road' which would allow for the safe entry and exit from this road for rural residential development. (RRS 2009, p 65)

The RRS recommended a one hectare lot size be adopted to provide a semi-rural ambience and to avoid the suburban character established by smaller lot sizes. A minimum one hectare lot size would facilitate management of a wide variety of environmental constraints. The LEP 2000 identified rural residential land as 1B Rural Living. Under the draft LEP 2013 rural residential land would be zoned as R5 Large Lot Residential.

According to the RRS, Bonville is to retain its village atmosphere while the Crossmaglen Valley will remain a productive agricultural area. Bonville will develop as a large centre with limited retail and community facilities. There is an existing private school and public primary school at Bonville. Public recreation areas are to provide for a range of activities including sporting needs, markets and entertainment. (RRS 2009, p 83) In the short term, Bonville will rely on its access to Boambee, Sawtell, Toormina and Coffs Harbour for its business centre. (RRS 2009, p 84)

3.5 Community Input in the Rural Residential Strategy

The evolution of the RRS 2009 included consultation with interested community members and relevant government agencies. The draft strategy was exhibited and 82 submissions were received. Community concerns raised, relative to the visual character of future development, included:

- the desire to minimise rural land fragmentation and land use conflicts;
- concern for the impacts on adjoining rural land and businesses;
- potential environmental impacts;
- potential visual impacts on the scenic quality and amenity of an area;
- the need for adequate buffers to new lots;
- that density and lot size to be cognisant of the aesthetics and amenity of a locality; and
- that the green backdrop was important to Coffs Harbour.

3.6 Local Environmental Study

The RRS recommended a Local Environmental Study (LES) be prepared for the areas identified for short term release. Areas found to be suitable should be zoned accordingly. Environmentally constrained areas should be zoned for environmental protection.

The RRS recommended a place based Development Control Plan be prepared for each candidate area. Each DCP should determine building exclusion zones and protect these by appropriate controls. DCPs should include the following buffers to agricultural land from rural residential housing; grazing of stock – 50m, bananas – 150m, turf farms – 200 to 300m, state and regionally significant farmland – 300m. DCPs should provide for a minimum setback of 10m to first order streams, 20m to second order streams, 30m to third order streams and 40m to fourth order streams. DCPs should require a minimum vegetated landscape buffer of 10m to be provided along drainage lines. DCPs should require a separation between dwellings of at least 20m. DCPs should include a minimum landscape buffer of 10m to be provided to screen adjoining dwelling houses. (RRS 2009, p 88)

4.0 The Study Area

Bonville is in the Coffs Harbour Local Government Area approximately 12km southwest of the city centre. The eastern extent of the study site is traversed by the Pacific Highway. This length of the highway opened in September 2008 and provided a bypass to Bonville. The former Pacific Highway, now Pine Creek Way, provides access through the study site. Bonville includes a number of roads with connections to the Pine Creek Way.

The Bonville study site includes a public primary school on Gleniffer Road not far from the Pine Creek Way intersection. The Pine Creek Way includes a service station and Australia Post outlet. Two former fruit stores are not far from the service station, but these closed with the completion of the highway bypass. The Waterside Caravan Park is on Pine Creek Way near the North Bonville Road intersection. Further south, the Brookhaven over 55's village is on Pine Creek Way and this development is growing with the construction of a number of mobile homes underway. The Bonville International Golf Resort is on North Bonville Road.

North Bonville is on the catchment of Bonville Creek. There is a ridge at the very north of Bonville that extends from west to south. The south face of this ridge is mostly vegetated. The northern side of this ridge is Boambee and these slopes were previously banana plantations. A second major ridge runs across the southern part of the site at the location of Gleniffer Road. This ridge divides the study site into two major catchments. The north part of the site is a catchment for Bonville Creek whilst the area south of Gleniffer Road falls south to Reedys and Pine Creeks The main land uses in the study site are rural agricultural and rural living. There is a scattering of environmental protection areas across the site and along riparian areas.

Bonville is mostly zoned 1A Rural Agriculture, 1B Rural Living and 7A Environmental Protection – Habitat and Catchment under the *Coffs Harbour Local Environmental Plan 2000*. There are small pockets of 6A Open Space Public Recreation. The Bonville International Golf Resort includes areas zoned 6C Open Space Private Recreation and 2E Residential Tourist. The areas of 1B Rural Living are on Braford, Faviell and Bakker Drives west of Pine Creek Way and about Grandis Road and Fig Close west of the new highway bypass.

The site is a mixture of rural living and agriculture with small areas of cropping and grazing land. Cropping activities tend to be limited to small holdings with crops including bananas, orchards and vegetables. Grazing land is mostly for cattle and horses with the southern part of the site appearing to have large expanses of pasture.

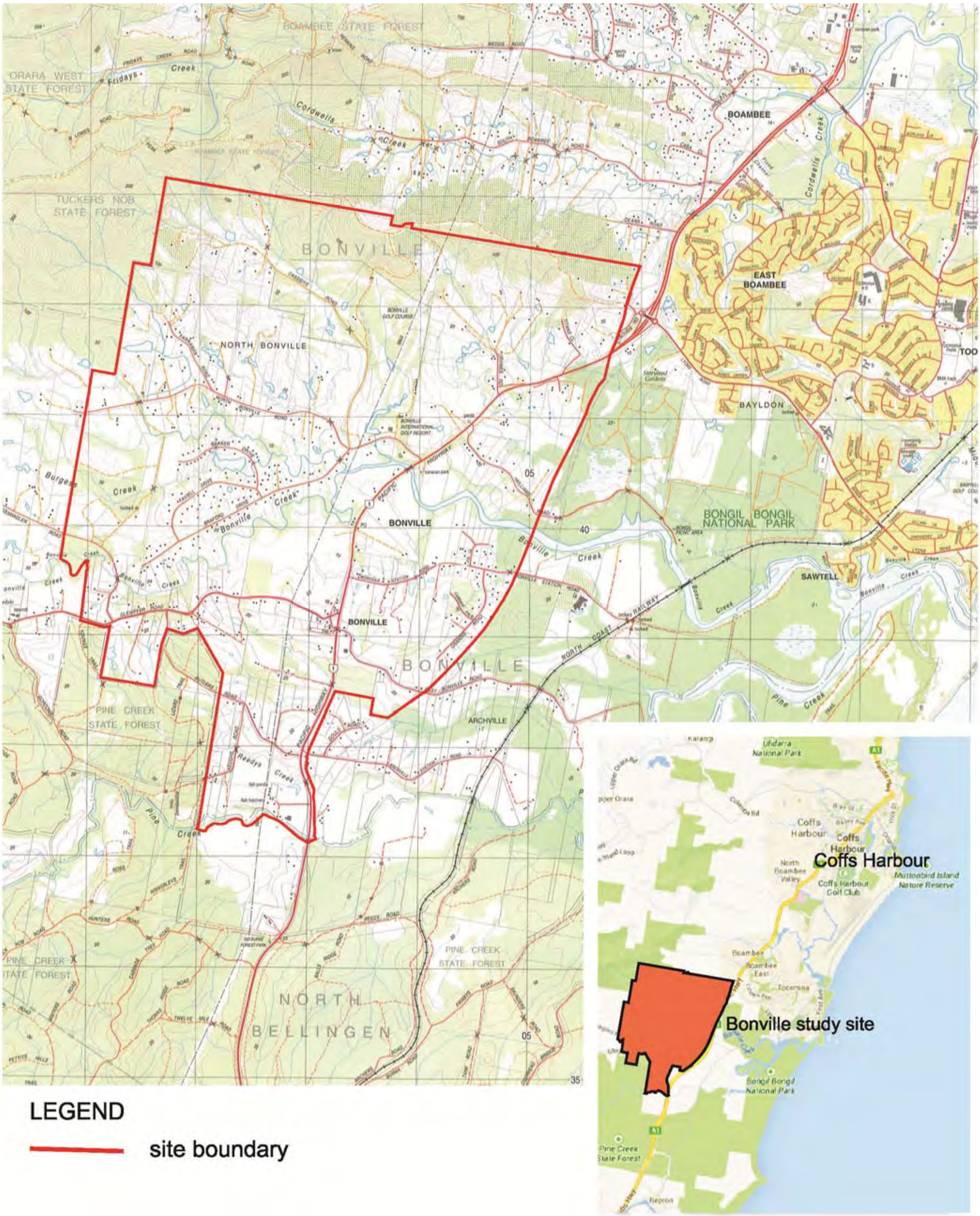
Vegetation is scattered across the site. The largest extent of remnant native vegetation is in north Bonville on the south face of the ridge extending from Tuckers Nob State Forest. The lower part of this vegetation is the setting for the Bonville International Golf Course. Riparian vegetation is a combination of native vegetation and exotic weeds, predominantly Camphor Laurel. There are areas of native wetland along Bonville Creek between Pine Creek Way and the Pacific Highway. Native vegetation across the site is fragmented and has been affected by past and current land uses. Bongil Bongil National Park is east of the study site at the end of Williams Road. This area represents a relatively intact area of native vegetation on the banks of Bonville Creek.

The study area contains primary and secondary koala habitat with most of the koala habitat concentrated in the north of the site and within vegetation at the western end of Braford Drive. The balance of the koala habitat is within fragments of native vegetation throughout the site.

The topography of Bonville is established by the mountains to the west that descend to create the valleys about the Bonville and Pine Creeks. Bonville is undulating with the higher locations in the west of the site. The undulating nature of the site means there is a variety of views available across the site with the ridges and peaks to the west often visible in the distance.

Bonville represents a picturesque location on the mid North Coast. The combination of the vegetated mountains as a backdrop, the green undulating landscape, vegetated creek lines and the rural character of many properties establishes a distinct visual character to the study site. Bonville appears as a rural landscape within a natural setting.

Figures 1 to 9 describe the key characteristics of the study site. Figure 10 identifies the areas identified as candidate areas for potential rural residential development in the Coffs Harbour City Council Rural Residential Strategy 2009. Those candidate areas were to be subject to further studies. As part of those further studies, this Visual Analysis will consider the extent of the study site.



site context map

Bonville Rural Residential
Visual Analysis - The Existing Site

September 2013 Issue A

base map sourced from Coffs Harbour City Council GIS system under data license agreement

FIGURE 1 - Site Location

scale 1:50, 000 @ A4 size

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FIGURE 2 - Study Area

scale 1:30, 000 @ A4 size

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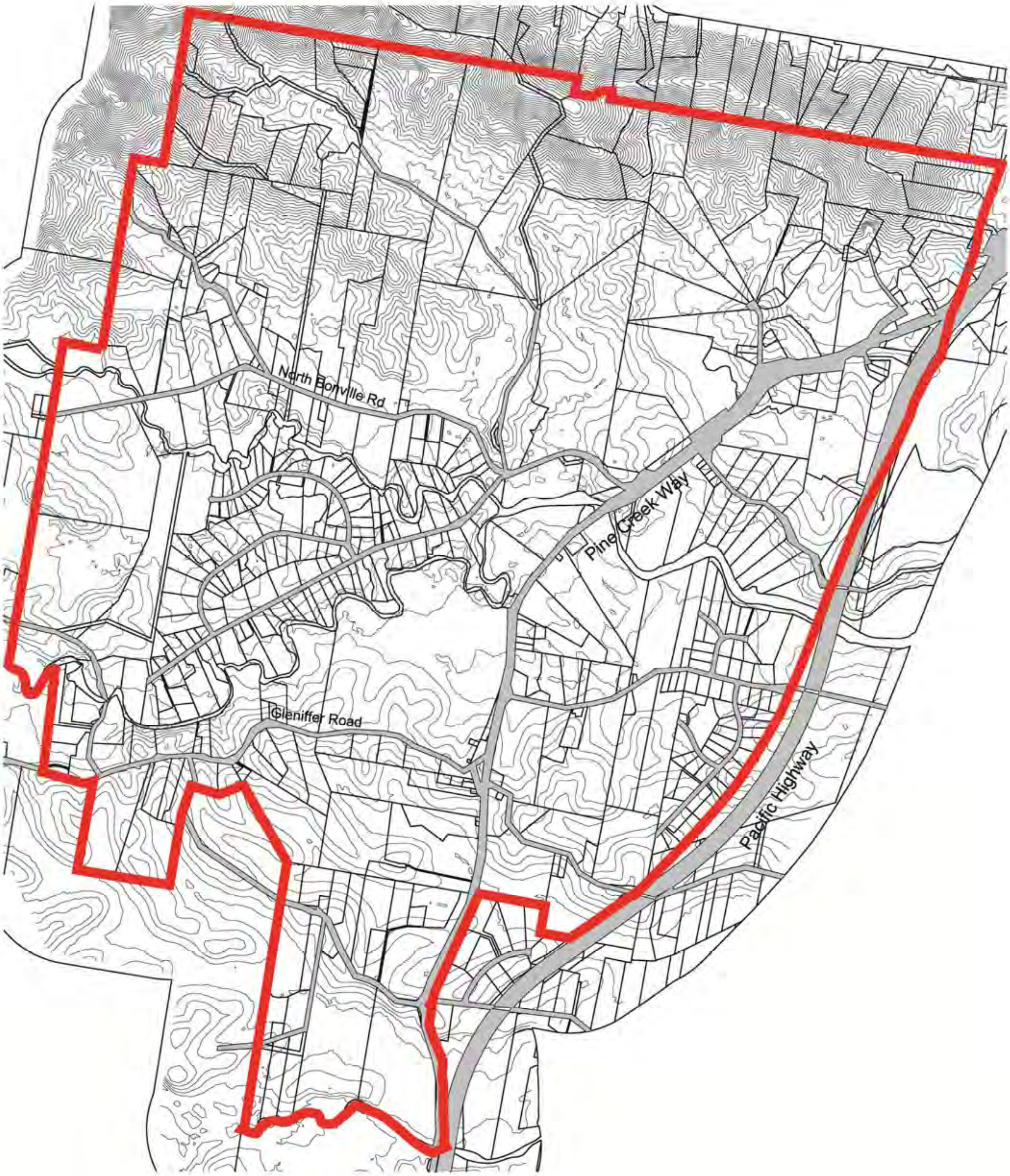

LEGEND

🟥 site boundary

Bonville Rural Residential
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FIGURE 3 - Site Contours
5m intervals

scale 1:30, 000 @ A4 size

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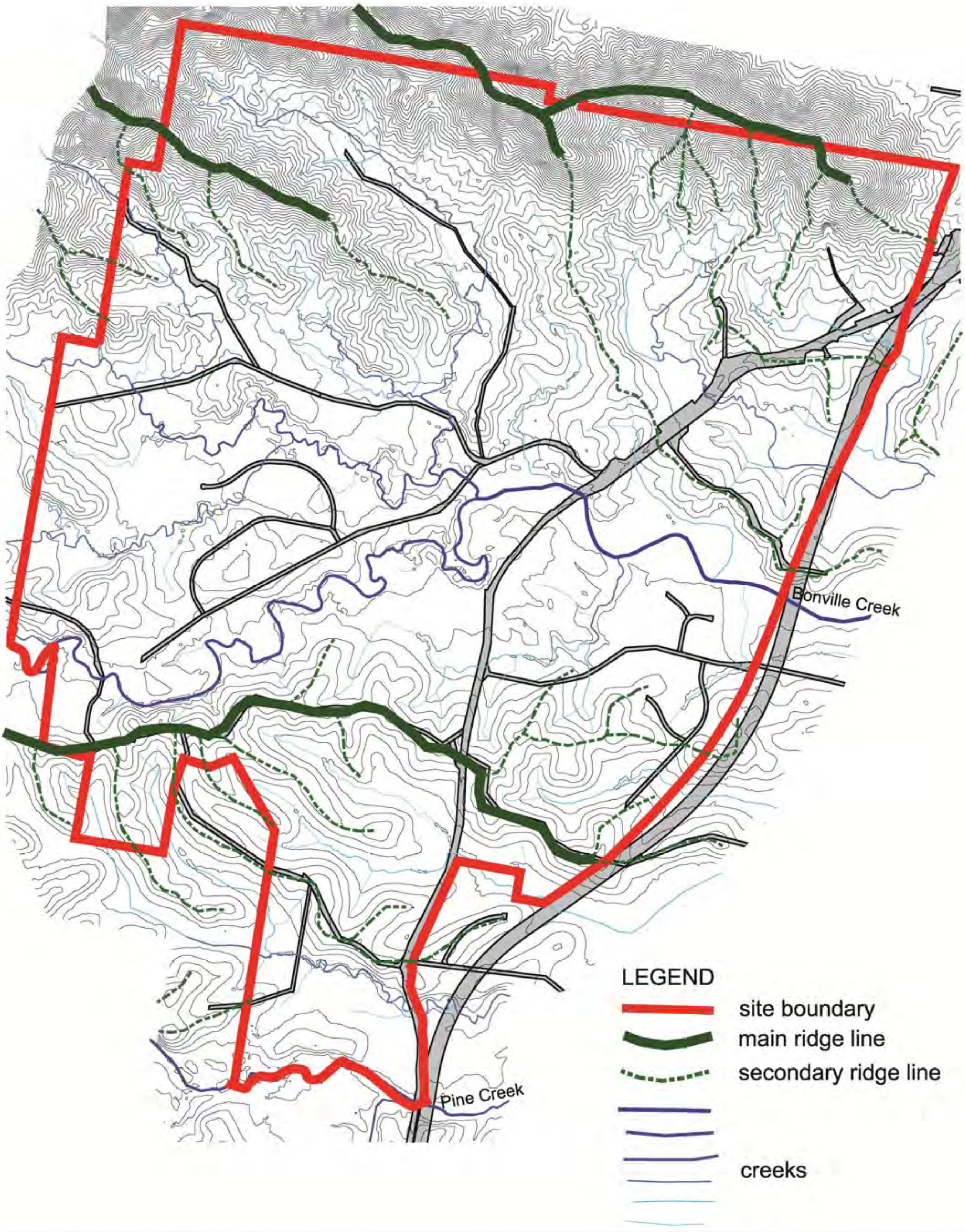

Bonville Rural Residential
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FIGURE 4 - Site Topography

scale 1:30, 000 @ A4 size

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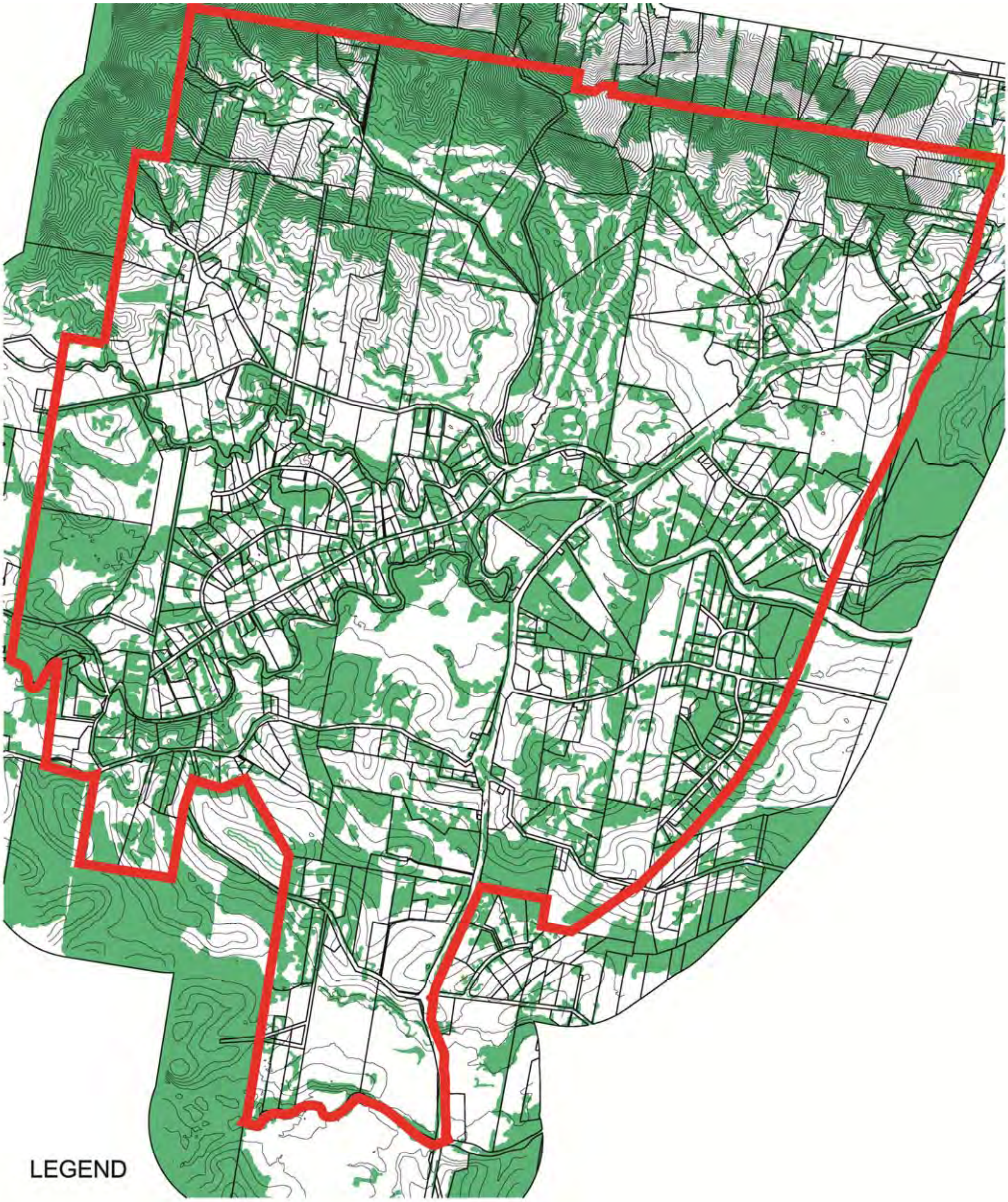

LEGEND

━ site boundary

🟩 Class 5 Vegetation Mapping (includes, but is not limited to, exotic vegetation , planted exotic species, forest & shrubland associated with the northern ridge, parperbark forest associated with riparian areas) Refer to Eco Logical Australia Flora & Fauna Study for detail of mappping)

Bonville Rural Residential
Visual Analysis - The Existing Site

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base map sourced from Coffs Harbour City Council GIS system under data license agreement

FIGURE 5 - Site Vegetation

scale 1:30, 000 @ A4 size

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