LAND DEVELOPMENT CERTIFICATES

ABN 74 572 465 870

67 MELBOURNE ROAD, ST JOHNS PARK NSW 2176
Phone : 02 9610 2008 Fax : 02 9753 3118 Web: www.Ldcerts.com.au Email : mail@Ldcerts.com.au

STEPHEN JOHNSON *BE MIEAust CPEng*
Accreditation No. BPB 0530

ANDREW SYMONDS *BE (Civil) Hons MIEAust*
Accreditation No. BPB 1837

11 July, 2014

Our Ref: 98/059/1
Your Ref: N 0085/11

The General Manager
Pittwater Council
PO Box 882
MONA VALE NSW 2103

RECEIVED MONA VALE
14 JUL 2014
CUSTOMER SERVICE

Dear Sir,

RE: SUBDIVISION – 23B MACPHERSON ST, WARRIEWOOD

NOTIFICATION OF CERTIFICATE ISSUE

Environmental Planning & Assessment Act, 1979

Section 109Q(a) and Regulation 142(2)

Pursuant to Clause 142(2) of the Environmental Planning and Assessment Regulation 2000, Notice is hereby given of the issue of a Certificate under Part 4A of the Environmental Planning and Assessment Act, 1979.

Attached is a copy of the Certificate issued, together with related documents, plans and specifications as listed on the face of the certificate. Our cheque in the sum of $36 being the required Certificate Registration Fees are also enclosed, Council's receipt by return mail would be appreciated.

Should you require further information regarding the basis for this certification or the extent of compliance with respect to the relevant Development Consent, please contact the undersigned.

Yours faithfully
LAND DEVELOPMENT CERTIFICATES

S G JOHNSON
Accredited Certifier - Subdivision
Registration No.BPB 0530

PRVC $36
Rec 362776

Encl.

98/059/1 CC to Pittwater Ccl.ltr

LAND DEVELOPMENT CERTIFICATES

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Accreditation No. BPB 1837

CONSTRUCTION CERTIFICATE

Environmental Planning and Assessment Act, 1979, Sections 109C (1) (b) and 81A(4)

Applicant:

Warriewood Properties Pty Ltd,
C/- AusPacific Property Group,
L.1, 4 Ponderosa Pde,
WARRIEWOOD NSW 2102

Development Consent No.

N0085/2011	Dated: 07/07/2011

S.96 Modifications:

Date: 19/03/2012	N0085/11/S96/1
Date:	

Subject Land:

Lot 11 Section C in DP 5464,
H/No. 23B Cnr MacPherson & Garden Streets, WARRIEWOOD NSW 2102

Construction Category:

Subdivision Works – Road and Drainage Works Construction.

Notes / Attachments:

Nil

Plans & Specifications Approved:

Engineering Design Drawings by Craig & Rhodes Pty Ltd as detailed in Annexure A attached in three (3) sheets.

I certify that the above construction works, as more fully detailed in plans/specifications attached to this certificate, if completed strictly in accordance with these approved documents, will comply with the requirements of the Environmental Planning & Assessment Regulation 2000 as referred to in Section 81A(5) of the Environmental Planning & Assessment Act, 1979.

Certificate No: **13115**

Date of Issue: 11/07/2014

Note: The applicant is reminded of his obligation under S.81A(4)(c) of the EP&A Act 1979, that two days minimum notice must be given to the relevant Council of an intention to commence subdivision works.

.....
Stephen Grant Johnson
Accredited Certifier
(Subdivision Certification)
Category B1
Registration No. BPB 0530
Building Professionals Board

Annexure A

APPROVED DOCUMENTS LISTING:

CRAIG & RHODES PTY LTD
– PROJECT NO. 1736C CC 01

Drawing	Rev'n	Date	Description
001	E	24/06/14	COVER SHEET – SHEET INDEX, LOCALITY SKETCH, LEGEND & GENERAL NOTES
002	E	24/06/14	LAYOUT PLAN (SHEET 1 OF 2)
003	E	24/06/14	LAYOUT PLAN (SHEET 2 OF 2)
004	E	24/06/14	CUT – FILL PLAN
005	E	24/06/14	ROAD NO. 1 LONG SECTION & CROSS SECTIONS Ch.2.64 TO Ch.35.03
006	E	24/06/14	ROAD NO.1 CROSS SECTIONS Ch.35.53 TO Ch.99.31
007	E	24/06/14	ROAD NO.2 LONG SECTION & CROSS SECTIONS Ch.8.75 TO Ch.45
008	E	24/06/14	ROAD NO.2 CROSS SECTIONS Ch.55.21 TO Ch.59.50
009	E	24/06/14	ROAD NO.3 LONG SECTION & CROSS SECTIONS Ch.4.66 TO Ch.75
010	E	24/06/14	ROAD NO.3 CROSS SECTIONS Ch.83.43 TO Ch.99.58
011	E	24/06/14	ROAD NO. 4 LONG & CROSS SECTIONS
012	E	24/06/14	KERB RETURNS NO.1 TO NO.6
013	E	24/06/14	KERB DEVELOPMENT ROAD NO.3 TURNING HEAD
014	E	24/06/14	PATHWAY LONG SECTION, TYPICAL CROSS SECTIONS & CROSS SECTIONS Ch.8.82 TO Ch.60

.....

Stephen Grant Johnson
Accredited Certifier (Subdivision Certification) Category B1
Registration No. BPB 0530
Building Professionals Board.

Annexure A (Cont'd)

APPROVED DOCUMENTS LISTING:

CRAIG & RHODES PTY LTD
– PROJECT NO. 1736C CC 01

Drawing	Rev'n	Date	Description
015	E	24/06/14	PATHWAY CROSS SECTIONS Ch.61.43 TO Ch. 120
016	E	24/06/14	ROAD NO.7 (GARDEN STREET) LONG SECTION & CROSS SECTIONS Ch.113.84 TO Ch.165.69
017	E	24/06/14	ROAD NO.7 (GARDEN STREET) CROSS SECTIONS Ch.170.41 TO Ch.246.529
018	E	24/06/14	ROAD NO.7 (GARDEN STREET) CROSS SECTION Ch.250 KERB DEVELOPM'T INT. GARDEN ST & MACPHERSON ST
019	E	24/06/14	ROAD NO.8 (MACPHERSON STREET) LONG SECTION & CROSS SECTIONS Ch.15.06 TO CH.46.68
20	E	24/06/14	ROAD NO.8 (MACPHERSON STREET) CROSS SECTIONS Ch.60 TO CH.104.08
021	E	24/06/14	DESIGN VEHICLES TURN PATHS
022	E	24/06/14	TYPICAL KERB DETAILS, TRAFFIC CALMING DEVICE DETAILS, RETAINING WALL DETAILS
023	E	24/06/14	CATCHMENT PLAN
024	E	24/06/14	DRAINAGE LINES 1 TO 6
025	E	24/06/14	DRAINAGE LINE 7 DRAINAGE NOTES & CALCULATION SHEETS
026	E	24/06/14	DRAINAGE LINES 8 & 9 DRAINAGE CALCULATION SHEETS
027	E	24/06/14	OSD TANK DETAILS
028	E	24/06/14	OSD TANK DETAILS

.....
Stephen Grant Johnson
Accredited Certifier (Subdivision Certification) Category B1
Registration No. BPB 0530
Building Professionals Board.

Annexure A (Cont'd)

APPROVED DOCUMENTS LISTING:

CRAIG & RHODES PTY LTD
– PROJECT NO. 1736C CC 01

Drawing	Rev'n	Date	Description
029	E	24/06/14	BIO RETENTION BASIN PLAN & SECTIONS
030	E	24/06/14	BIO BASIN & RAIN GARDEN DETAILS
031	E	24/06/14	SEDIMENT & EROSION CONTROL PLAN
032	E	24/06/14	SEDIMENT & EROSION CONTROL NOTES
033	E	24/06/14	TRAFFIC CONTROL PLAN

.....
Stephen Grant Johnson
Accredited Certifier (Subdivision Certification) Category B1
Registration No. BPB 0530
Building Professionals Board.

A1

the grove

WARRIEWOOD PROPERTIES Pty Ltd

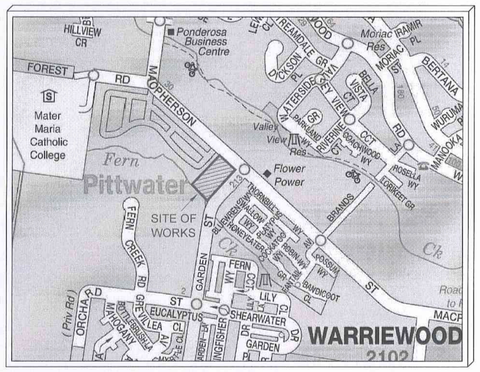
PROPOSED SUBDIVISION OF

LOT 11 SECTION C D.P.5464

corner GARDEN & MACPHERSON STREETS, WARRIEWOOD

WARRIEWOOD VALLEY SECTOR 8

ROAD & DRAINAGE DESIGN



LOCALITY DIAGRAM
NOT TO SCALE

This plan/specification forms part of Construction Certificate No ...1.5...1...1.5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

INDEX TO SHEETS

SUBDIVISION ROAD & DRAINAGE

GENERAL NOTES

1. ALL WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH PITTWATER COUNCIL'S STANDARDS AND SPECIFICATIONS.

2. THE CONTRACTOR SHALL LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND SHALL MAKE ALL NECESSARY ARRANGEMENTS WITH THE RELEVANT AUTHORITY TO RELOCATE OR ADJUST AS FOUND NECESSARY AT THE DEVELOPERS COST.
SERVICES SHOWN ON THESE PLANS HAVE BEEN LOCATED FROM INFORMATION SUPPLIED BY THE RELEVANT AUTHORITIES AND FIELD INVESTIGATIONS AND ARE TO BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
THE CONTRACTOR IS TO TAKE ALL REASONABLE CARE TO PROTECT EXISTING SERVICES. DAMAGED SERCIVES ARE TO REPAIRED AT THE CONTRACTORS EXPENSE.

3. THE CONTRACTOR SHALL NOT ENTER UPON OR DO ANY WORK WITHIN ADJACENT LANDS WITHOUT PRIOR WRITTEN PERMISSION OF THE LAND OWNER.

4. THE CONTRACTOR SHALL MAINTAIN SERVICES AND ALL WEATHER ACCESS AT ALL TIMES TO THE PUBLIC FOOTWAYS, ROAD WAYS AND PROPERTIES ADJACENT TO THE SITE IN A SAFE CONDITION TO THE SATISFACTION OF COUNCIL'S ENGINEER.

5. SURVEY MARKS SHOWN THUS ▲ ⊡ △ SHALL BE MAINTAINED AT ALL TIMES. WHERE RETENTION IS NOT POSSIBLE THE ENGINEER SHALL BE NOTIFIED AND CONSENT RECEIVED PRIOR TO THEIR REMOVAL.

6. THE CONTRACTOR SHALL OBTAIN ALL LEVELS FROM ESTABLISHED BENCHMARKS.

7. A SUBDIVIDER OR CONTRACTOR CARRYING OUT CONSTRUCTIONAL WORKS ON THE SUBDIVISION SHALL RESTRICT SUCH ACTIVITY TO WITHIN THE HOURS OF 7.00a.m. TO 6.00p.m. MONDAY TO FRIDAY INCLUSIVE AND SATURDAY 8.00a.m. TO 1.00p.m. NO WORK SHALL BE UNDERTAKEN OUTSIDE THE HOURS SPECIFIED ABOVE OR ON SUNDAYS WITHOUT THE WRITTEN APPROVAL OF COUNCIL.

8. ALL NEW WORKS SHALL MAKE SMOOTH JUNCTION WITH EXISTING CONDITIONS.

9. SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED PRIOR TO SOIL DISTURBANCE IN KEEPING WITH LANDCOM'S MANAGING URBAN STORMWATER – SOILS & CONSTRUCTION MANUAL 4th EDITION.

10. THE CONTRACTOR SHALL CLEAR AND DISPOSE OF ONLY THOSE TREES THAT ARE CONDEMNED BY THE ENGINEER. COUNCIL'S TREE PRESERVATION ORDER SHALL BE OBSERVED AND NO TREE SHALL BE FELLED, LOPPED OR REMOVED WITHOUT PRIOR APPROVAL FROM COUNCIL'S ENGINEER. ONLY THOSE TREES LOCATED WITHIN ROAD AREAS ARE TO BE REMOVED. TREES TO BE RETAINED ON SITE SHALL PROTECTED BY THE ERECTION OF PROTECTIVE FENCING PRIOR TO COMMENCEMENT OF SITE WORKS.

11. ALL TREES TO BE RETAINED SHALL BE PROTECTED BY PARAWEB FENCING FIRMLY STAKED 4m FROM THE TRUNK OF THE TREE & MAINTAINED IN POSITION FOR THE DURATION OF THE CONSTRUCTION WORKS. NO STOCKPILING OF ANY MATERIALS OR THE PARKING OF VEHICLES OR MACHINERY WITHIN THE DRIPLINE AREA OF THESE TREES.

12. NO BUILDING MATERIALS, MACHINERY OR THE LIKE ARE TO BE STORED ON THE ROAD OR FOOTPATH. THE PATHWAY IS TO BE KEPT IN A CLEAN, TIDY & SAFE CONDITION DURING THE CONSTRUCTION PERIOD.

13. THE CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH, BUILDINGS (AS NOMINATED), FENCES, OUT-HOUSES, CAR BODIES, DEBRIS, ETC. THE CONTRACTOR SHALL NOT DISPOSE OF ANY DEBRIS BY BURNING OFF IN AN OPEN FIRE.

14. TOPSOIL IS TO BE STRIPPED AND STOCKPILED ON THE SITE WITH EROSION CONTROL MEASURES PROVIDED AS DETAILED. UPON COMPLETION OF WORKS, MINIMUM 150mm THICK TOPSOIL SHALL BE SPREAD ON ALL FOOTPATHS, BERMS, BATTERS AND SITE REGRADED AREAS. EXCESS TOPSOIL SHALL BE DISPOSED OF AS DIRECTED BY COUNCIL'S ENGINEER/CERTIFYING AUTHORITY.

15. PROVIDE 150mm TOPSOIL WITH TURF OR GRASS SEEDING ON ALL FOOTPATHS AND FILLED AREAS.

16. EARTHWORKS TO BE CARRIED OUT TO THE SATISFACTION OF COUNCIL'S ENGINEER/CERTIFYING AUTHORITY. UNSOUND MATERIALS ARE TO BE REMOVED FROM ROADS AND LOTS PRIOR TO FILLING.

17. SURPLUS EXCAVATED MATERIAL SHALL BE DISPOSED OF IN CONSULTATION WITH COUNCIL'S ENGINEER. DOCUMENTATION OF THE DISPOSAL SITE IS TO BE CERTIFYING AUTHORITY PRIOR TO COMMENCEMENT OF WORKS.

18. WHERE THE SLOPE OF THE NATURAL SURFACE EXCEEDS ONE IN FOUR (1:4) FILL EMBANKMENTS, BENCHES ARE TO BE CUT TO PREVENT SLIPPING OF THE FILL MATERIAL AS REQUIRED BY COUNCIL'S ENGINEER/CERTIFYING AUTHORITY.

19. ALL LAND DISTURBED BY EARTHWORKS SHALL BE SPRAY-GRASSED, OR SIMILARLY TREATED TO ESTABLISH GRASS COVER. SEED MIXTURES ARE TO BE APPROVED BY COUNCIL PRIOR TO SPRAYING. ALL GRASSED AREAS SHALL BE REGULARLY WATERED AND MAINTAINED UNTIL EXPIRATION OF THE MAINTENANCE PERIOD.

20. THE CONTRACTOR SHALL MAINTAIN DUST CONTROL THROUGHOUT THE DURATION OF THE PROJECT.

21. THE CONTRACTOR SHALL MAINTAIN IN GOOD WORKING ORDER ALL SOIL AND WATER MANAGEMENT STRUCTURES FOR THE DURATION OF THE WORKS AND FOR A MINIMUM PERIOD OF 6 MONTHS AFTER THE DATE OF PRACTICAL COMPLETION.

22. ALL DRAINAGE LINES THROUGH LOTS SHALL BE CONTAINED WITHIN THEIR EASEMENTS AND CONFORM WITH COUNCIL'S STANDARDS.

23. ALL STORMWATER PIPES USED FOR THE DRAINAGE SYSTEM IN MACPHERSON STREET AND GARDEN STREET ARE TO BE CLASS 3 REINFORCED CONCRETE WITH SPIGOT AND SOCKET RUBBER RING JOINTS. E

24. ALL DRAINAGE LINES ON HIGH SIDE AND UNDER ROADS SHALL BE BACKFILLED WITH 20mm METAL (NOT RECYCLED) AND HAVE 3.0m OF AGRICULTURAL LINE WRAPPED IN AN APPROVED FILTER FABRIC, DISCHARGING INTO THE DOWNSTREAM PIT.

25. ALL PITS TO BE BENCHED AND STREAMLINED AND PITS DEEPER THAN 900mm SHALL HAVE STEP IRONS PROVIDED IN ACCORDANCE WITH COUNCIL'S STANDARDS.

26. ALL STORMWATER GRATES ARE TO BE BICYCLE SAFE E

27. PRECAST KERB INLET LINTELS SHALL BE USED ON GULLY PITS. GRATES SHALL BE "WELDLOCK" TYPE GG 78/50 OR EQUIVALENT. GULLY PITS ARE GENERALLY TO BE IN ACCORDANCE WITH COUNCIL'S STANDARDS UNLESS NOTED OTHERWISE & IN PUBLIC ROAD USE "DURHAM" D.G.G.P.

28. INTERALLOTMENT DRAINAGE LINES SHALL HAVE A MINIMUM 300mm COVER AND DESIRABLE MINIMUM GRADE OF 1%.

29. 100x50mm HOT DIPPED GALVANISED RHS OR SIMILAR WITH 90mm ADAPTER FOR ROOF WATER CONNECTION SHALL BE PROVIDED TO ALL LOTS DRAINING TO THE KERB AT THEIR DOWNSTREAM BOUNDARY.

30. LENGTH OF LINTEL SHOWN INDICATES CLEAR LENGTH OF OPENING.

31. CONDUIT TRENCHES AND STORMWATER DRAINAGE LINES TO BE BACKFILLED WITH 20mm METAL, FLOODED AND VIBRATED. CONDUIT TRENCHES TO BE GRADED AT A MINIMUM ONE PERCENT (1 %). GRADE TO EITHER SUB-SOIL OR STORMWATER DRAINAGE LINES.

32. CONDUITS SHALL BE LAID AFTER POSITIONS HAVE BEEN DETERMINED BY THE RELEVANT AUTHORITIES AND BEFORE FINAL A.C. IS LAID.

33. ADEQUATE PROVISION TO BE MADE FOR SCOURING AND SEDIMENTATION TO ALL DRAINAGE WORKS AS DIRECTED.

34. WHERE KERB AND GUTTER IS LAID BY THE USE OF A KERB AND GUTTER MACHINE THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE TAKING AND TESTING OF CORE SAMPLES, FORWARDING THEIR RESULTS TO COUNCIL AND REMOVAL OF KERB AND GUTTER, ALL AT HIS OWN EXPENSE, WHERE THE MINIMUM STRENGTH IS NOT ACHIEVED IN ACCORDANCE WITH COUNCIL'S STANDARD SPECIFICATIONS.

35. ACCESS RAMPS ARE TO BE PROVIDED IN KERB AND GUTTER IN ACCORDANCE WITH COUNCIL'S STANDARDS.

36. CONDUITS ARE TO BE PROVIDED FOR THE FOLLOWING SERVICES:
1) WATER – AS DIRECTED BY THE SUPERINTENDENT
2) ELECTRICAL – AS DIRECTED BY THE SUPERINTENDENT AND IN ACCORDANCE WITH ENERGY AUSTRALIA
3) TELSTRA – ADJACENT TO EACH ENERGY AUST. CROSSING

37. POSITION OF ALL CONDUITS SHALL BE MARKED ON THE KERB.

38. PROVIDE SUBSOIL DRAINAGE LINES WITH FLUSHING POINTS AND STANDARD COVERS AT MAXIMUM 60m INTERVALS ON HIGH SIDE OF ROAD AND ELSEWHERE AS DIRECTED BY THE SITE SUPERINTENDENT. MARK FACE OF KERB ADJACENT TO COVER "S.S.".

39. CATCH DRAINS TO BE CONSTRUCTED AS REQUIRED BY THE SITE SUPERINTENDENT AND/OR COUNCIL'S ENGINEER.

40. FELLED TREES SHALL BE SALVAGED FOR REUSE AS WOODCHIP MULCH OR LOG FORM FOR SITE REHABILITATION, NON-SALVAGEABLE MATERIAL SUCH AS STUMPS AND ROOTS SHALL BE DISPOSED OFF SITE AS NOMINATED BY THE ENGINEER.

41. PROVISIONS TO BE MADE FOR SUITABLE PROTECTION OF ROAD PAVEMENT, KERB & GUTTER AND FOOTPATH FORMATION.

42. SUB-GRADE IN ROCK IS TO BE RIPPED, SCARIFIED, SPREAD AND COMPACTED TO A MINIMUM DEPTH OF 300mm BELOW THE FINISHED SUB-GRADE LEVEL.

43. THE CONTRACTOR SHALL PROVIDE A MINIMUM 24 HOURS NOTICE TO SUPERINTENDENT OR COUNCIL'S ENGINEER FOR ALL INSPECTIONS. (ph. 0438777556)

44. THE CONTRACTOR SHALL UNDERTAKE TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH COUNCIL'S TRAFFIC MANAGEMENT POLICY AND TRAFFIC CONTROL PLAN AND SHALL DISPLAY ALL APPROPRIATE WARNING SIGNS THROUGHOUT THE DURATION OF CONSTRUCTION.

45. ERECT STREET NAME SIGNS, CONDUIT WARNING SIGNS AND NO THROUGH ROAD SIGNS AS REQUIRED, COMPLYING WITH COUNCIL'S STANDARDS.

46. ALL TRAFFIC SIGNS ARE TO BE INSTALLED IN V-LOCK (OR SIMILAR) SOCKETS TO ALLOW THEIR REMOVAL WHEN FUTURE REPLACEMENT IS NECESSARY E

47. DETAILS OF ALL SOIL TESTS AND THE PAVEMENT DESIGN ARE TO BE SUBMITTED TO COUNCIL/CERTIFYING AUTHORITY PRIOR TO INSPECTION OF SUBGRADE.

LEGEND

	EXISTING EDGE OF BITUMEN
	EXISTING KERB & GUTTER
	PROPOSED KERB & GUTTER
	FUTURE KERB & GUTTER (BY OTHERS)
K&G	150mm BARRIER KERB & GUTTER
RK	ROLL KERB
KO	KERB ONLY
ES	100mm WIDE CONCRETE EDGE STRIP
SS	SUBSOIL DRAINAGE LINE (2 x ø90mm IN SOCK)
	EXISTING DRAINAGE LINE
IAD	PROPOSED INTERALLOTMENT DRAINAGE
	PROPOSED DRAINAGE LINE
S	EXISTING SEWER
PS	PROPOSED SEWER
12.5	EXISTING CONTOURS (0.5m INTERVAL)
12.25	PROPOSED CONTOURS (0.25m INTERVAL)
W	EXISTING WATERMAIN
PW	PROPOSED WATERMAIN
T	EXISTING UNDERGROUND TELSTRA
E	EXISTING UNDERGROUND ELECTRICITY
G	EXISTING GAS MAIN
UG TANK	1kL UNDERGROUND RAINWATER TANK WITH OVERFLOW PIPE
TANK	3kL ABOVEGROUND SLIMLINE RAINWATER TANK WITH OVERFLOW PIPE
	FRONT YARD RAINGARDEN ($3m^2$/LOT)
	REAR YARD RAINGARDEN ($6m^2$/LOT)
	RETAINING WALL
	TREE TO BE RETAINED
	TREE TO BE REOVED

CC

AMEND. No. E	DATE 24.6.14	DETAILS ADDITIONAL NOTES ADDED - SHEETS 2, 3 & 26 AMENDED			

DIAL 1100 BEFORE YOU DIG

Project: COVER SHEET - SHEET INDEX, LOCALITY SKETCH, LEGEND & GENERAL NOTES

Principal:	WARRIEWOOD PROPERTIES PTY LTD				
Scale	N.T.S.	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.
Client Ref:					

CRAIG & RHODES

ABN 77 050 209 991
Level 4, Suite 400
16-18 Cambridge St
EPPING NSW 2121
PO Box 233
EPPING NSW 1710

ACN 050 209 991
DX 4408 EPPING
Tel. 9869-1855
Fax. 9869-2341
reception@crhodes.com.au
www.craigandrhodes.com.au

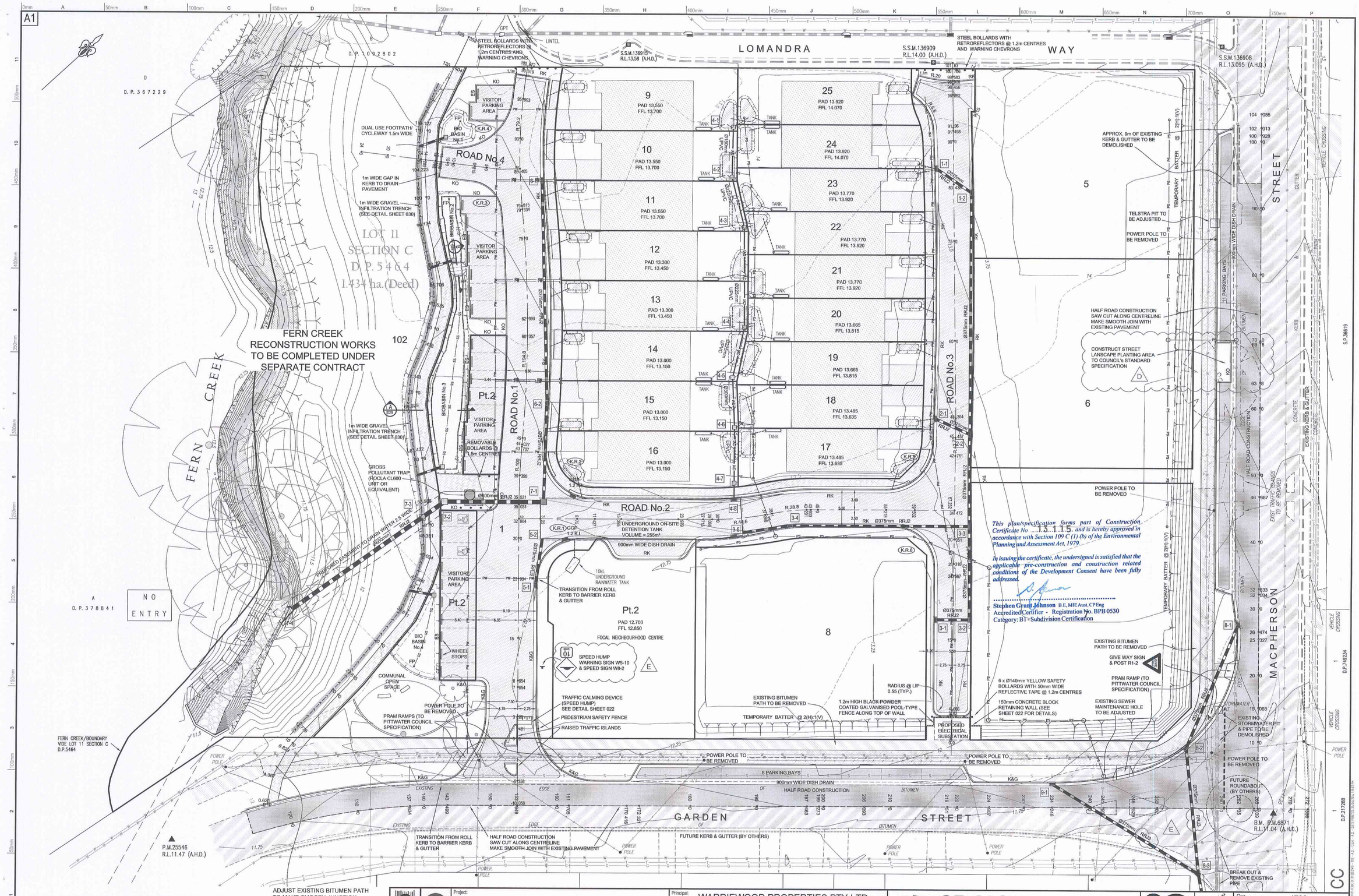
90th ANNIVERSARY 1923 - 2013

ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 001



This plan/specification forms part of Construction Certificate No ...15.1.115.. and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

A1

NO ENTRY

D. P. 378841

VISITORS PARKING AREA

Pt.2

BIO BASIN No.4

WHEEL STOPS

COMMUNAL OPEN SPACE

FERN CREEK/BOUNDARY VIDE LOT 11 SECTION C D.P.5464

POWER POLE TO BE REMOVED

PRAM RAMPS (TO PITTWATER COUNCIL SPECIFICATION)

10kL UNDERGROUND RAINWATER TANK

TRANSITION FROM ROLL KERB TO BARRIER KERB & GUTTER

Pt.2

PAD 12.700
FFL 12.850

FOCAL NEIGHBOURHOOD CENTRE

SPEED HUMP WARNING SIGN W5-10 & SPEED SIGN W8-2

TRAFFIC CALMING DEVICE (SPEED HUMP) SEE DETAIL SHEET 022

PEDESTRIAN SAFETY FENCE

RAISED TRAFFIC ISLANDS

8

7

EXISTING BITUMEN PATH TO BE REMOVED

TEMPORARY BATTER @ 2(H):1(V)

1.2m HIGH BLACK POWDER COATED GALVANISED POOL-TYPE FENCE ALONG TOP OF WALL

RADIUS @ LIP 0.55 (TYP.)

PROPOSED ELECTRICAL SUBSTATION

6 x Ø140mm YELLOW SAFETY BOLLARDS WITH 50mm WIDE REFLECTIVE TAPE @ 1.2m CENTRES

150mm CONCRETE BLOCK RETAINING WALL (SEE SHEET 022 FOR DETAILS)

EXISTING BITUMEN PATH TO BE REMOVED

GIVE WAY SIGN & POST R1-2

PRAM RAMP (TO PITTWATER COUNCIL SPECIFICATION)

EXISTING SEWER MAINTENANCE HOLE TO BE ADJUSTED

TEMPORARY BATT

MACPHERSON

EXISTING STORMWATER PIT & PIPE TO BE DEMOLISHED

POWER POLE TO BE REMOVED

FUTURE ROUNDABOUT (BY OTHERS)

B.M. P.M.6871 R.L.11.04 (A.H.D.)

BREAK OUT & REMOVE EXISTING PIPE

FUTURE KERB & GUTTER (BY OTHERS)

POWER POLE TO BE REMOVED

POWER POLE TO BE REMOVED

8 PARKING BAYS

900mm WIDE DISH DRAIN

HALF ROAD CONSTRUCTION

GARDEN STREET

FUTURE KERB & GUTTER (BY OTHERS)

TRANSITION FROM ROLL KERB TO BARRIER KERB & GUTTER

HALF ROAD CONSTRUCTION
SAW CUT ALONG CENTRELINE
MAKE SMOOTH JOIN WITH EXISTING PAVEMENT

P.M.25546 R.L.11.47 (A.H.D.)

ADJUST EXISTING BITUMEN PATH TO MAKE SMOOTH JUNCTION WITH CONCRETE PATH PAVING

D. P. 16387

CONSTRUCT TEMPORARY JUNCTION PITS (TO BE CONVERTED TO GRATED GULLY PIT IN THE FUTURE BY OTHERS)

CONSTRUCT JUNCTION PIT OVER EXISTING PIPE

EXISTING Ø375mm PIPE

EXISTING BUS SHELTER

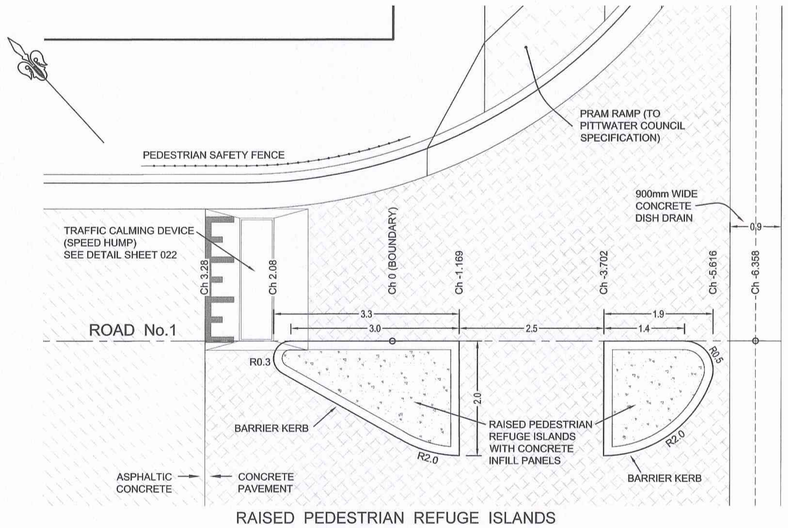
EXISTING JUNCTION PIT

VEHICLE CROSSING

POWER POLE

D.P.749234

D.P.217288



RAISED PEDESTRIAN REFUGE ISLANDS

SCALE 1:50

This plan/specification forms part of Construction Certificate No ...13...15... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

ORIGIN OF LEVELS: P.M.6871 R.L.11.04 (A.H.D.) VIDE SCIMS DATED 21/11/07

10 8 6 4 2 0 5 10

1:250 @ A1

AMEND. No.	DATE	DETAILS
E	24.6.14	PIPE CLASS AMENDED - DRAINAGE LINES 8 & 9, SPEED SIGN ADDED TO SPEED BUMP WARNING SIGN

Civil Cert

DIAL 1100 BEFORE YOU DIG

Project: LAYOUT PLAN (SHEET 2 OF 2)

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:250	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref.

CRAIG & RHODES

ABN 77 050 209 991
Level 4, Suite 400
16-18 Cambridge St
EPPING NSW 2121
PO Box 233
EPPING NSW 1710

ACN 050 209 991
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90th ANNIVERSARY 1923 - 2013

ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 003

LEGEND

▨ AREA OF FILL

▨ AREA OF CUT

0.25 FILL DEPTH CONTOUR (0.25m INTERVAL)

-0.25 CUT DEPTH CONTOUR (0.25m INTERVAL)

ALL EARTHWORKS TO BE IN ACCORDANCE WITH AS 3798

LOT FILL NOTES

AS PER GEOTECHNICAL ENGINEERS REPORT PREPARED BY:
JK Geotechnics
REF: 27045Vrpt-Warriewood 12.12.13

- MATERIALS USED AS ENGINEERED FILL SHOULD BE WELL-GRADED MATERIALS, SUCH AS RIPPED OR CRUSHED SANDSTONE, FREE OF DELETERIOUS SUBSTANCES OR CONTAMINANTS;
- THE FILL MATERIAL MUST HAVE A MAXIMUM PARTICLE SIZE NOT EXCEEDING 75mm;
- THE FILL MATERIAL MUST HAVE A PLASTICITY INDEX (PI) LESS THAN 10%;
- THE FILL MATERIAL SHOULD HAVE A 4 DAY SOAKED CBR OF AT LEAST 5% WHEN COMPACTED TO 98% OF STANDARD MAXIMUM DRY DENSITY;
- SOILS COMPRISING CLAYS OF MEDIUM TO HIGH PLASTICITY MUST NOT BE USED AS FILL.

CONTROL
- LEVEL 1 CONTROL OF FILL COMPACTION, AS DEFINED IN THE AS3798-2007, BE ADHERED TO;
- THE FILL SHOULD BE COMPACTED IN LAYERS NOT GREATER THAN 200mm LOOSE THICKNESS, TO A MINIMUM DENSITY OF 98% SMDD (NOTE: PRIOR TO PLACEMENT OF FIRST LAYER OF FILL THE SUBGRADE MUST BE PREPARED AS PER SECTION 4.3 ITEMS 1 TO 5 OF THE GEOTECHNICAL REPORT);
- DENSITY TESTS SHOULD BE REGULARLY CARRIED OUT TO CONFIRM THE ABOVE SPECIFICATIONS ARE ACHIEVED. THE FREQUENCY OF DENSITY TESTING SHOULD BE AT LEAST ONE TEST PER LAYER PER 500 SQUARE METRES, OR THREE TESTS PER VISIT, WHICHEVER REQUIRES THE MOST TESTS.

This plan/specification forms part of Construction Certificate No. ...13.1.15... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

ORIGIN OF LEVELS: P.M.6871 R.L.11.04 (A.H.D.) VIDE SCIMS DATED 21/11/07

10 8 6 4 2 0 5 10
1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: CUT-FILL PLAN	Principal: WARRIEWOOD PROPERTIES PTY LTD		
Scale 1:250	Date 24.6.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref:

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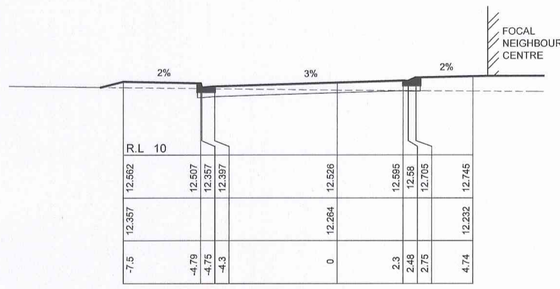
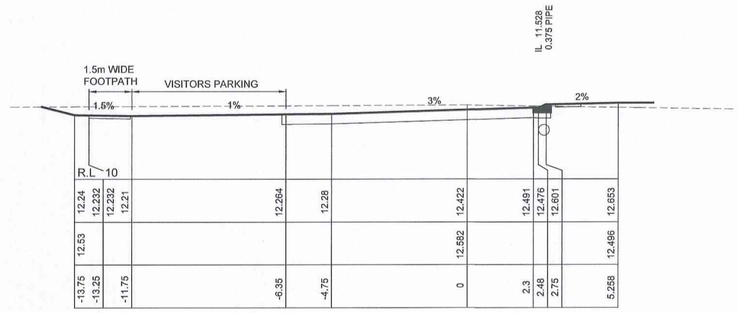
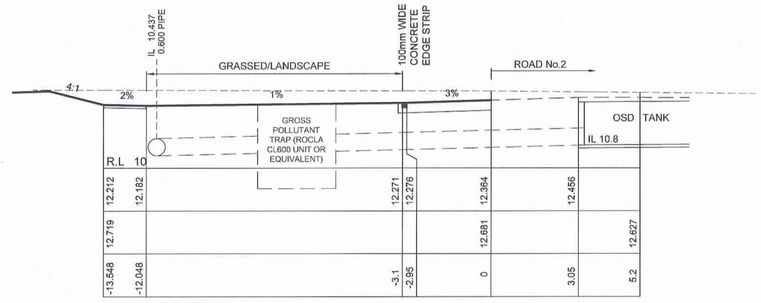
90th ANNIVERSARY 1923 - 2013

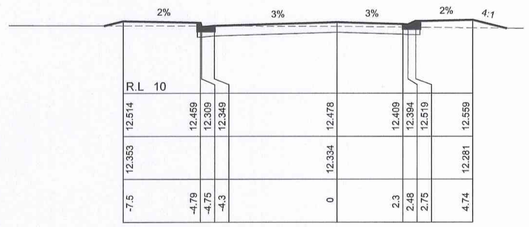
QMS ISO 9001 Approved Company

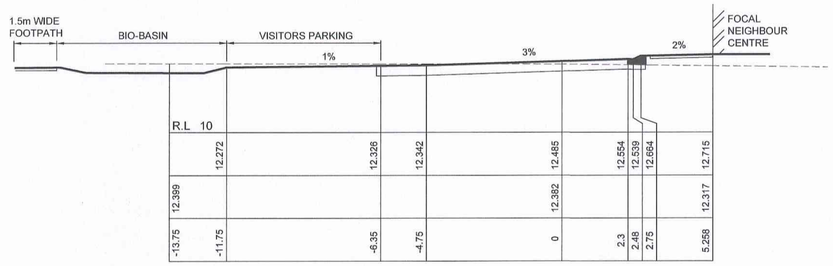
Our Ref. 1736
Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [E] - 004

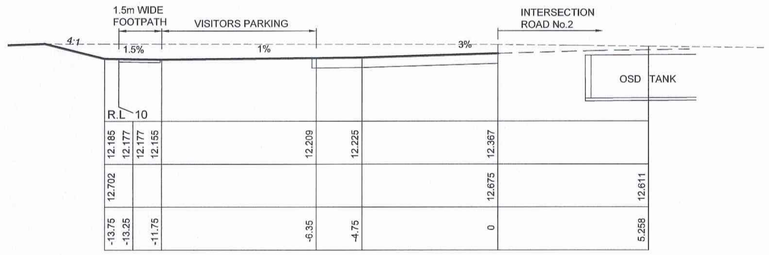


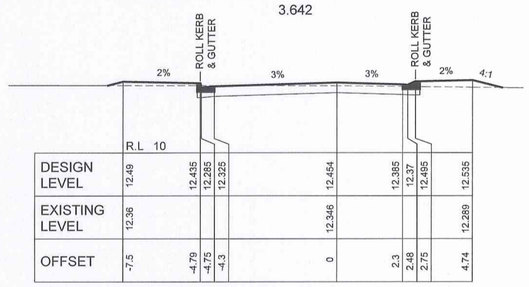


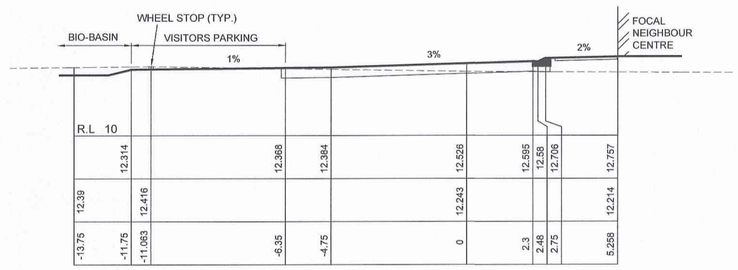


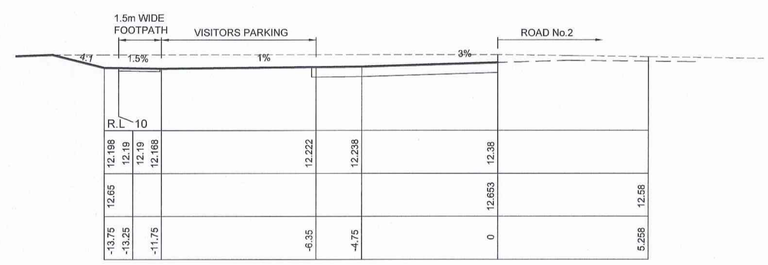


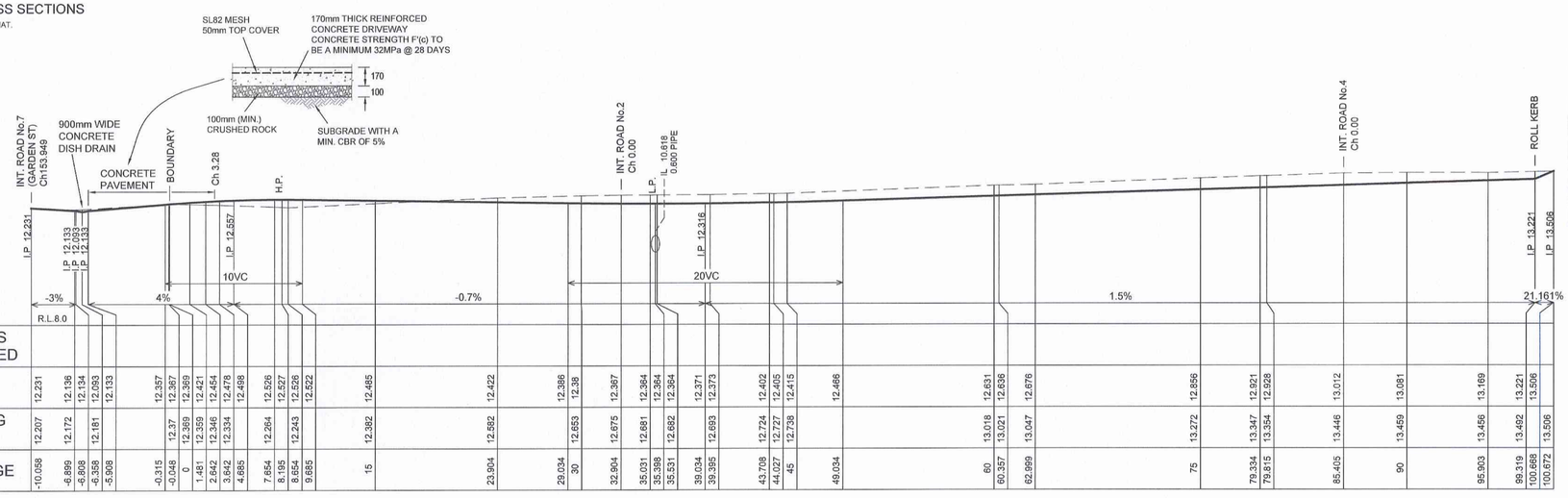












A1

ROAD No.1 - CROSS SECTIONS

SCALE 1:100 NAT.

PAVEMENT DESIGN
ROAD No.1

DESIGN ESA's: $6x10^4$
CBR : 4

WEARING COURSE:	30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE:	150mm D.G.B.20
SUB-BASE COURSE:	200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD

* FINAL PAVEMENT DEPTH SUBJECT TO TO GEOTECHNICAL ENGINEERS DESIGN

ROAD No.1

H=1:200 V=1:100

This plan/specification forms part of Construction Certificate No. ...13..1..15... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that all applicable pre-construction and construction and conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

1:100 @ A1

1:200 @ A1

CC

DIAL 1100 BEFORE YOU DIG

Project:
ROAD No.1
LONG SECTION &
CROSS SECTIONS Ch2.64 TO Ch35.03

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
LONG SECT. H.1:200 V.1:100 CROSS SECT. 1:100 NAT.	24.6.14	
	Datum A.H.D.	L.G.A. PITTWATER

Calc's	Drawn.	Proj.Man.	Client Ref.
A.D.	C.G.H.	A.D.	

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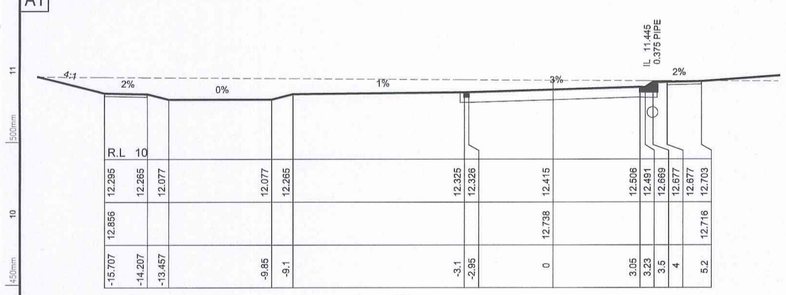
90th ANNIVERSARY 1923 - 2013

QMS ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [E] - 005

A1



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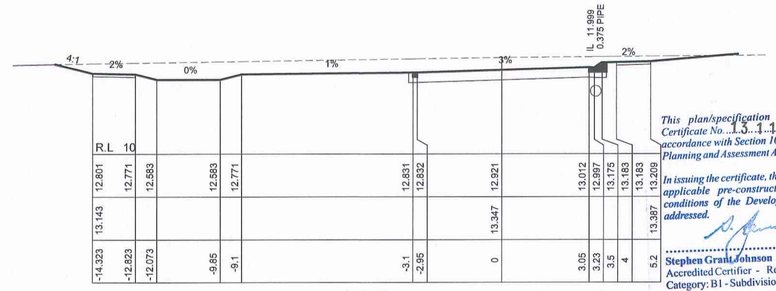
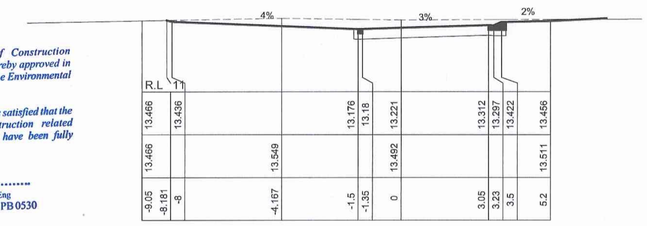


79.334

This plan/specification forms part of Construction Certificate No. 13.1.15 ... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E.,MIEAust,CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



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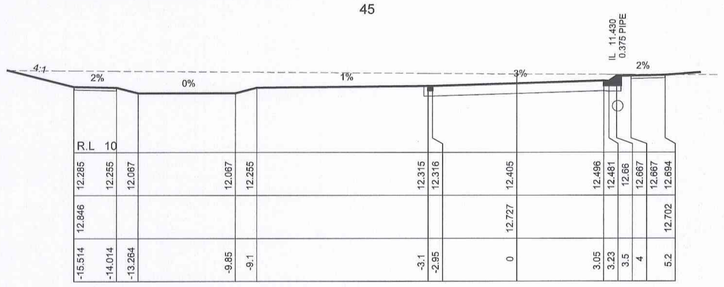

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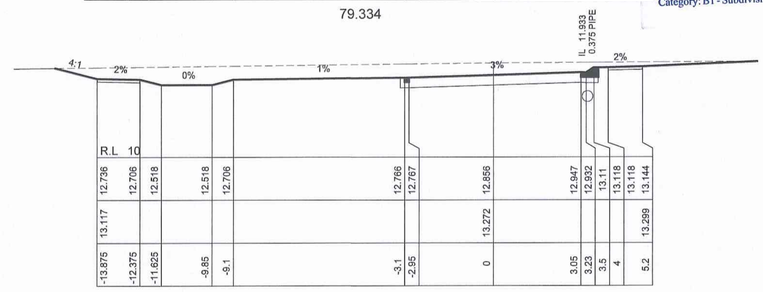

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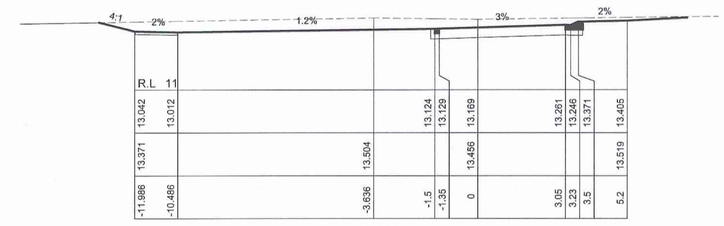

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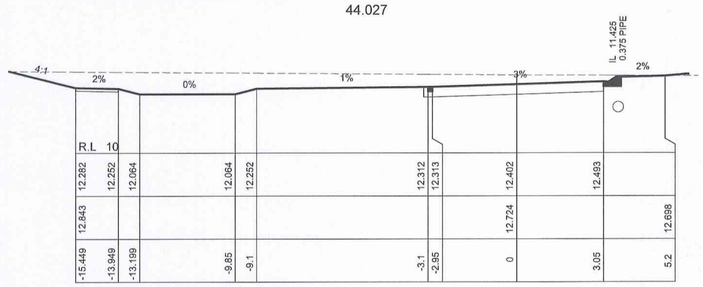

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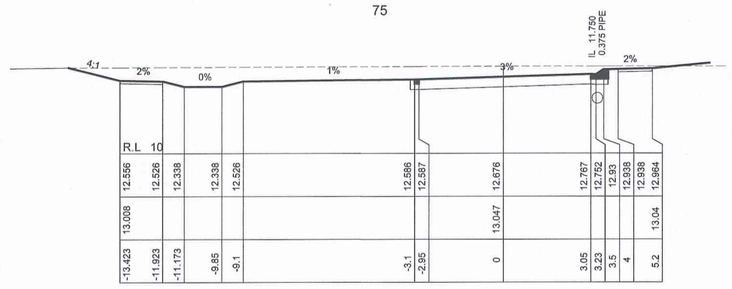

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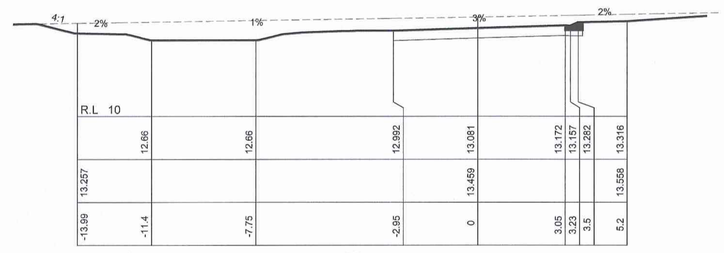

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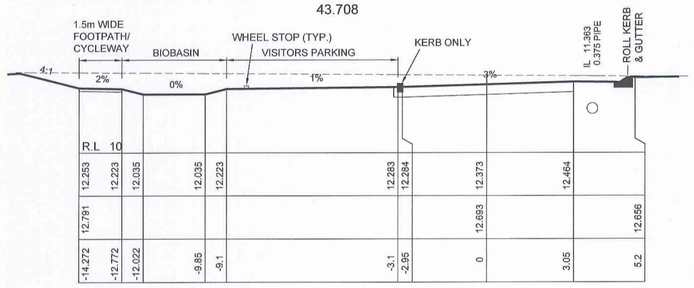

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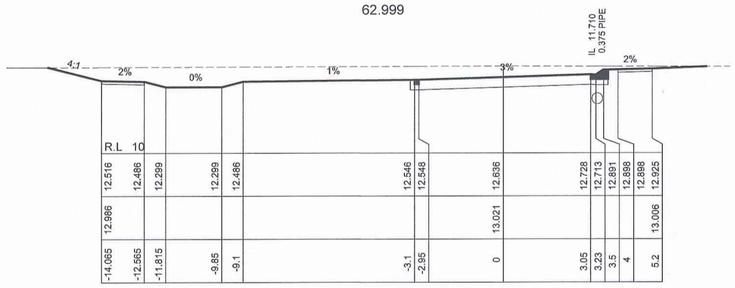

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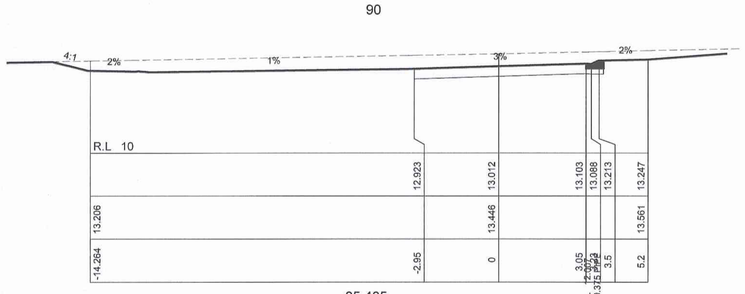

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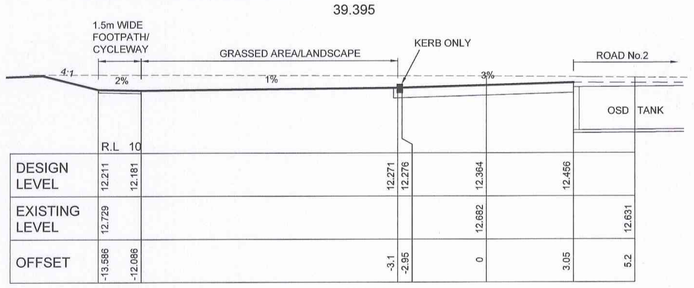

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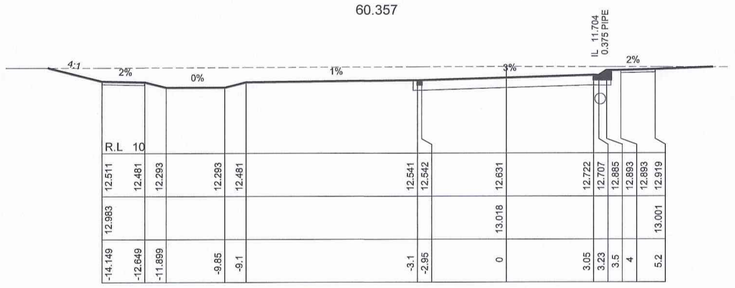

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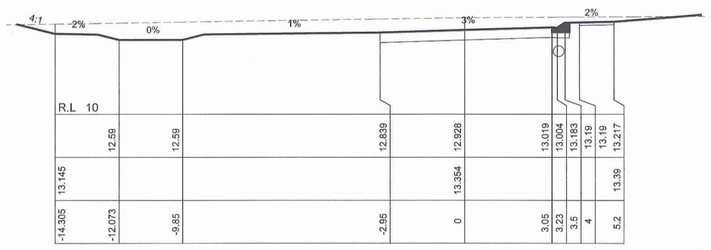

79.815

ROAD No.1 - CROSS SECTIONS

SCALE 1:100 NAT.

5 4 3 2 1 0 5

1:100 @ A1

CC

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.1
CROSS SECTIONS Ch35.53 TO Ch99.31

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
1:100 NAT.	24.6.14	
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D. / Client Ref.

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90th ANNIVERSARY 1923 - 2013

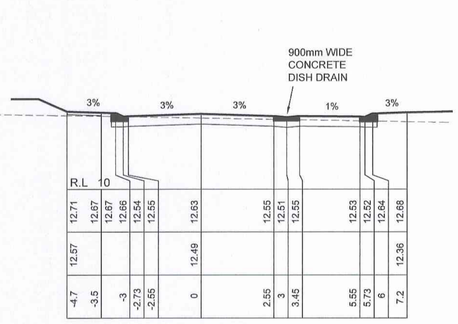
IQMS ISO 9001 Approved Company

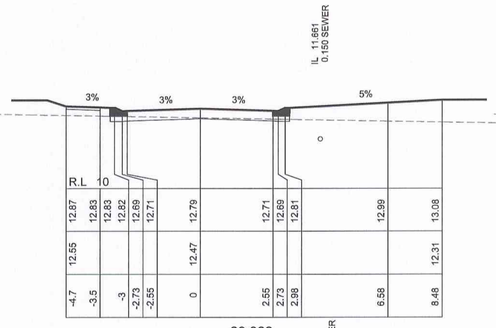
Our Ref. 1736

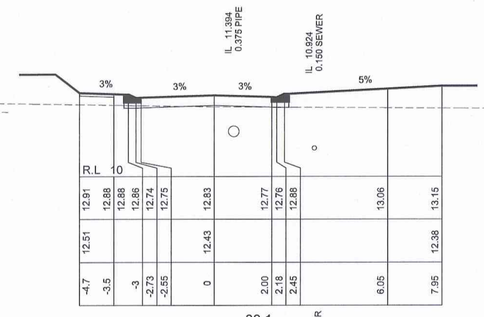
Dwg File Ref. [Rev] - Sheet Ref.

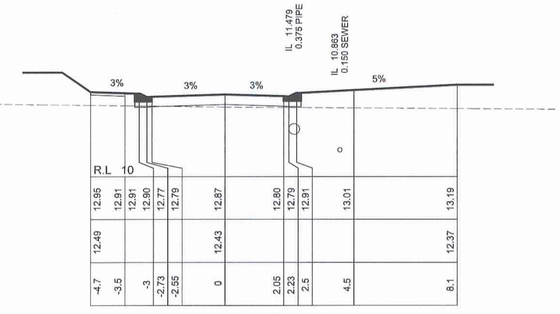
1736C CC 01 [E] - 006

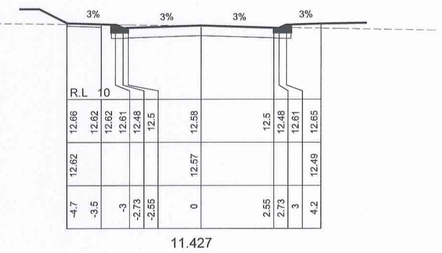
A1

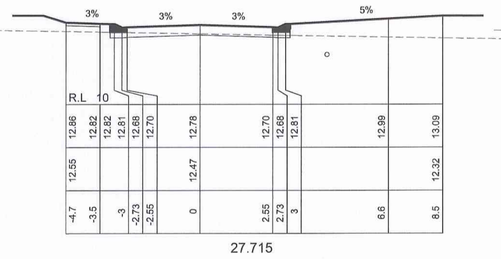


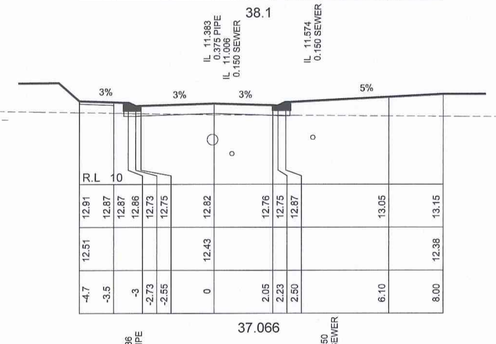


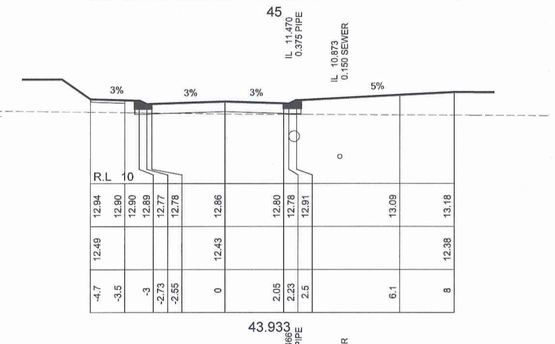


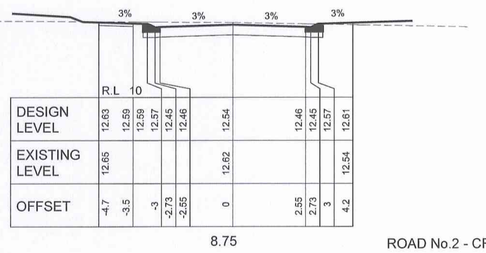


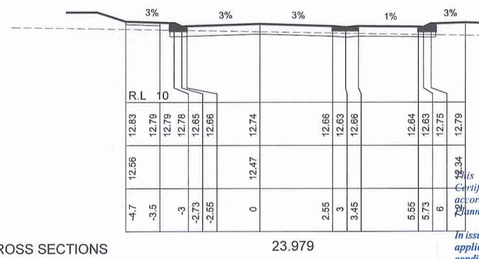


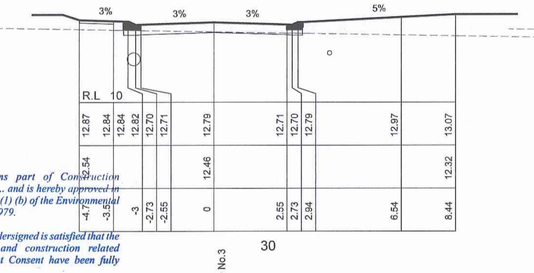


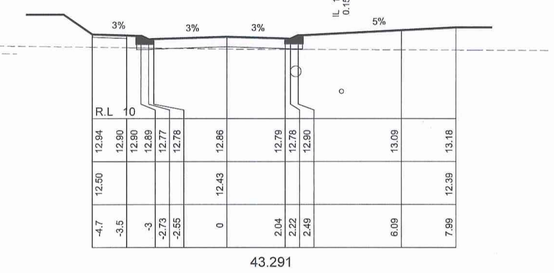












ROAD No.2 - CROSS SECTIONS

SCALE 1:100 NAT.

This plan/specification forms part of Construction Certificate No. ...13.1.1.5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

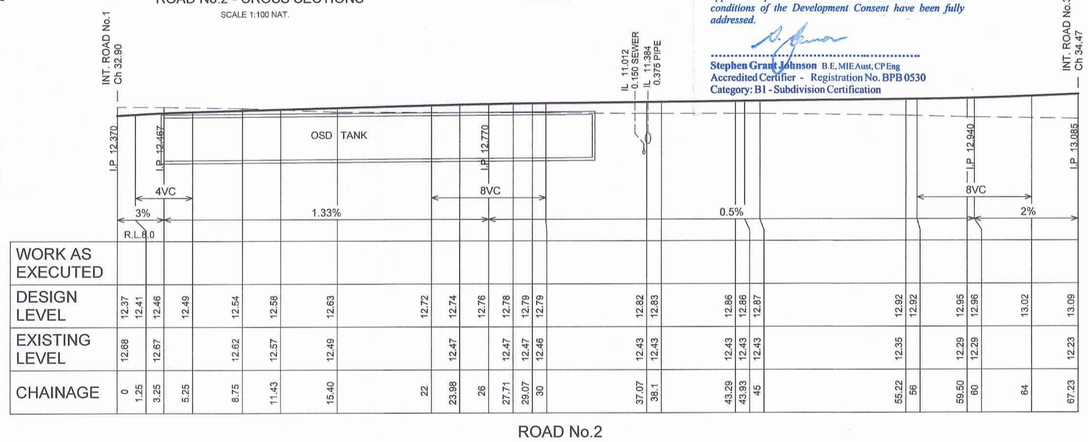
Stephen Grant Johnson B.E., MIEAust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

PAVEMENT DESIGN
ROAD No.2

DESIGN ESA's: 6×10^4
CBR : 4

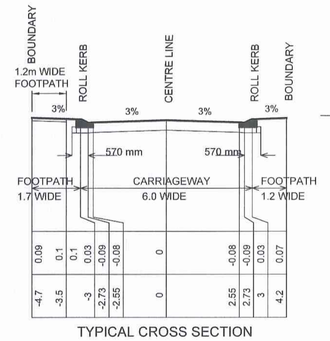
WEARING COURSE: 30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 150mm D.G.B.20
SUB-BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD

* FINAL PAVEMENT DEPTH SUBJECT TO TO GEOTECHNICAL ENGINEERS DESIGN



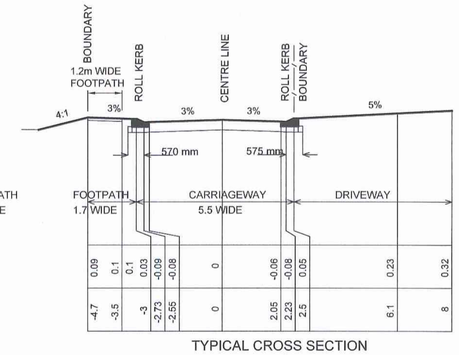
ROAD No.2

H=1:200 V=1:100



TYPICAL CROSS SECTION
Ch 8.75 TO Ch 11.427

SCALE 1:100 NAT.



TYPICAL CROSS SECTION
Ch 27.715 TO Ch 55.219

SCALE 1:100 NAT.

5 4 3 2 1 0 5
1:100 @ A1

5 4 3 2 1 0 5 10
1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.2
LONG SECTION &
CROSS SECTIONS Ch8.75 TO Ch45

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: LONG SECT. H.1:200 V.1:100 CROSS SECT 1:100 NAT.	Date: 24.6.14	Council Ref.	
	Datum: A.H.D.	L.G.A. PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref.

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reception@crrhodes.com.au
www.craigandrhodes.com.au

90th ANNIVERSARY 1923 - 2013

IQNS ISO 9001 Approved Company

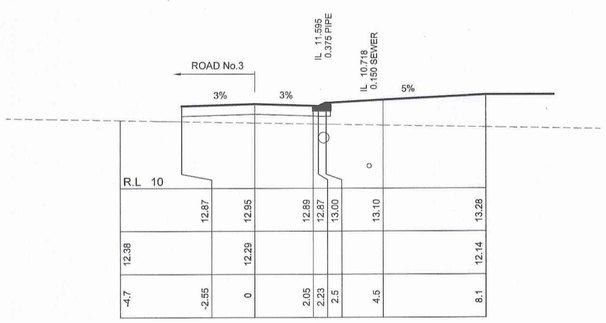
Our Ref. 1736

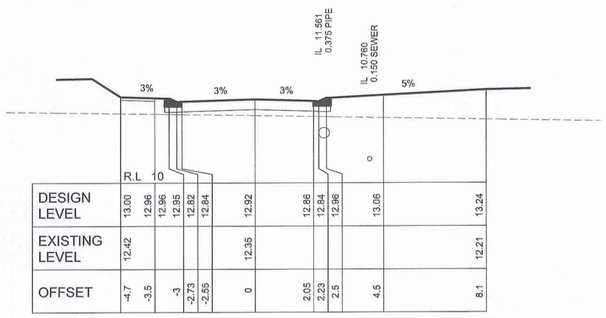
Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 007

CC

A1





ROAD No.2 - CROSS SECTIONS

SCALE 1:100 NAT.

This plan/specification forms part of Construction Certificate No. ...L.S...L.5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

5 4 3 2 1 0 5
1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.2
CROSS SECTIONS Ch55.21 TO Ch59.50

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
1:100 NAT.	24.6.14	
	Datum A.H.D.	L.G.A. PITTWATER

Calc's A.D. Drawn. C.G.H. Proj.Man. A.D. Client Ref:

CRAIG & RHODES
ABN 77 050 209 991
Level 4, Suite 400
16-18 Cambridge St
EPPING NSW 2121
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EPPING NSW 1710
ACN 050 209 991
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90th ANNIVERSARY 1923 - 2013

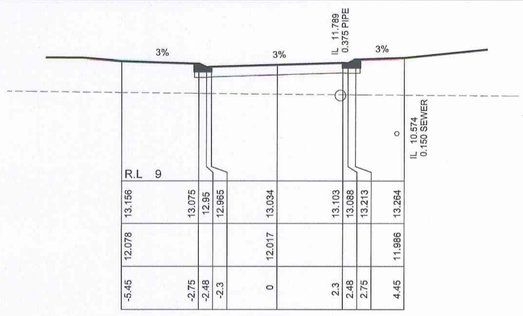
ISO 9001 Approved Company

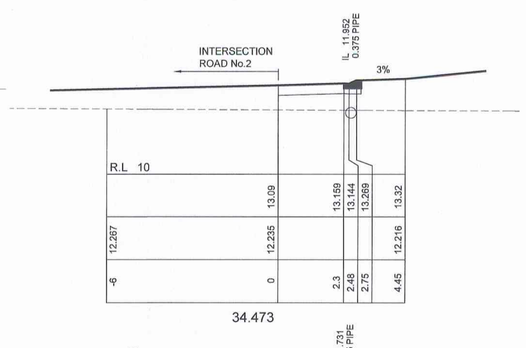
Our Ref. 1736

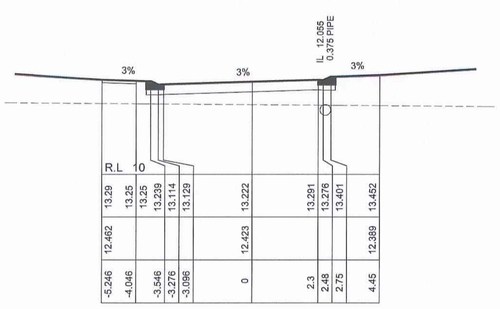
Dwg File Ref. [Rev] - Sheet Ref.

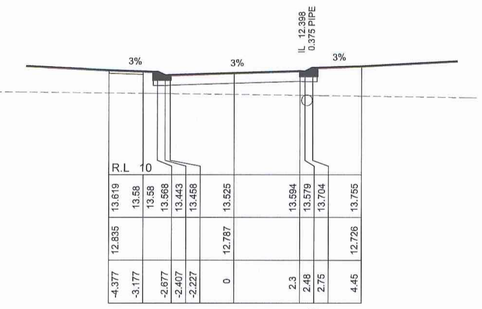
1736C CC 01 [E] - 008

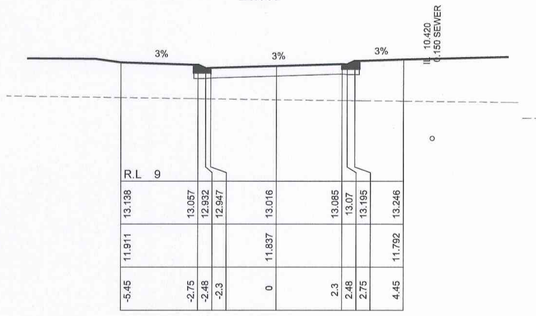
A1

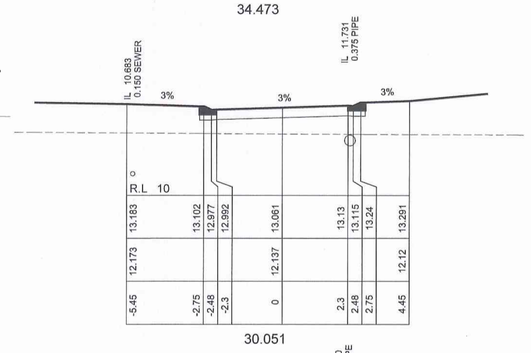


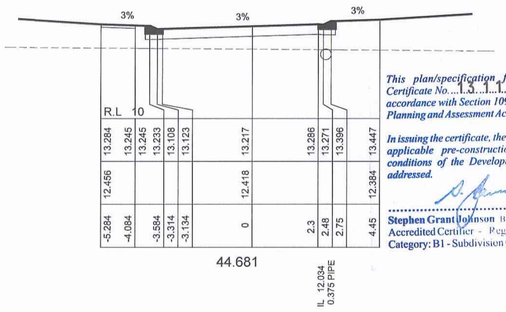


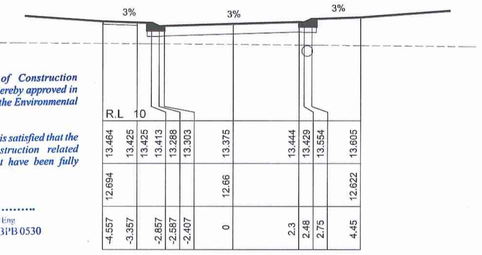








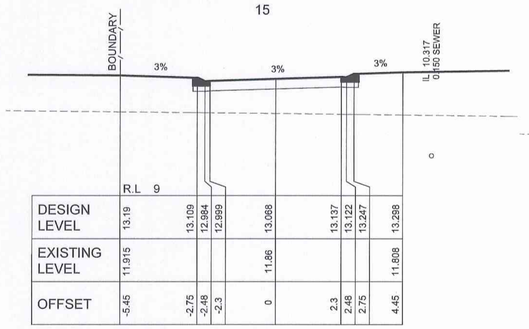


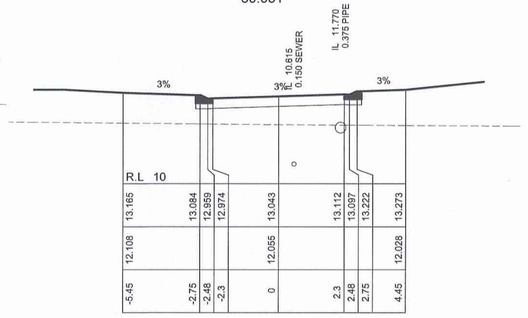


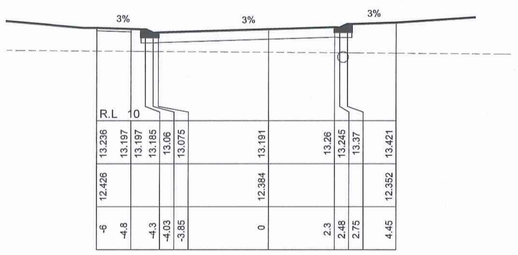
This plan/specification forms part of Construction Certificate No. 13.1.15 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

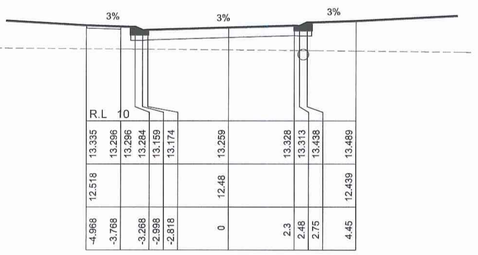
In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E.,MIE,Aust.,CPEng
Accredited Certifier – Registration No. BPB 0530
Category: B1 - Subdivision Certification



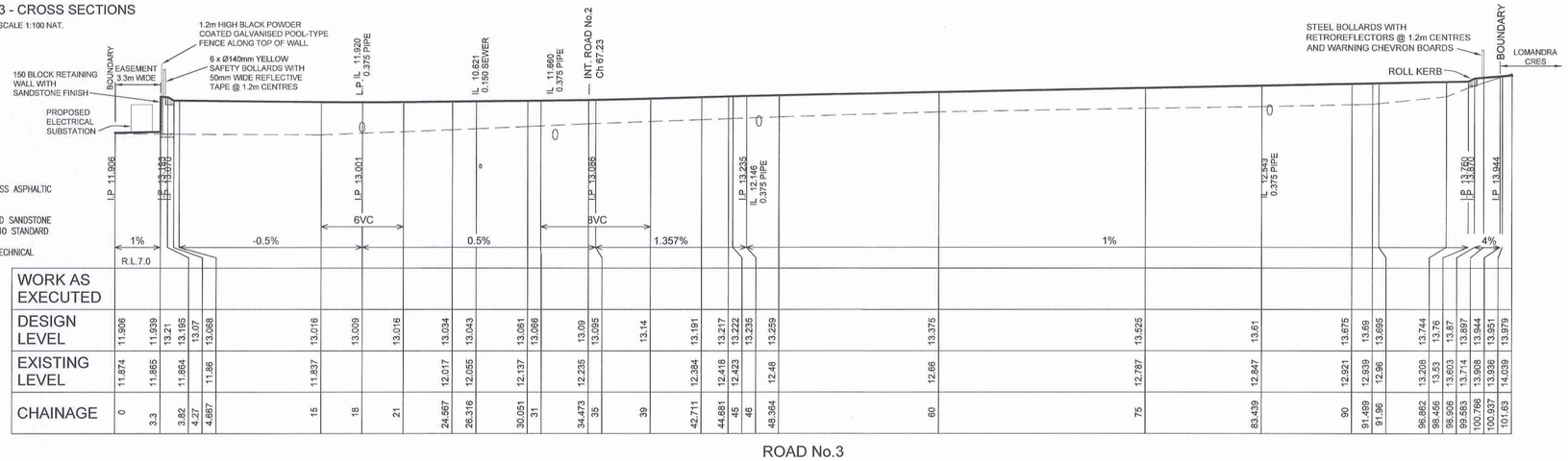






ROAD No.3 - CROSS SECTIONS

SCALE 1:100 NAT.



PAVEMENT DESIGN ROAD No.3

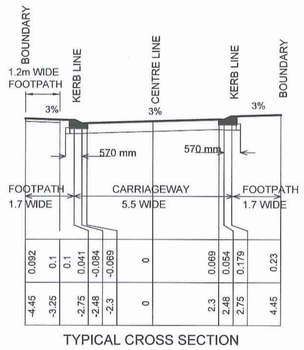
DESIGN ESA's: 6×10^4
CBR : 4

WEARING COURSE: 30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – AC.10
BASE COURSE: 150mm D.G.B.20
SUB-BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD

* FINAL PAVEMENT DEPTH SUBJECT TO TO GEOTECHNICAL ENGINEERS DESIGN

ROAD No.3

H=1:200 V=1:100



TYPICAL CROSS SECTION

CC

1:100 @ A1 1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.3 LONG SECTION & CROSS SECTIONS Ch4.66 TO Ch75

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: LONG SECT H.1:200 V.1:100 CROSS SECT 1:100 NAT.	Date: 24.6.14	Council Ref.	
	Datum: A.H.D.	L.G.A. PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref:

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Our Ref. 1736

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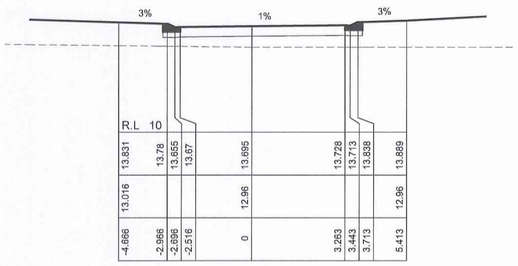
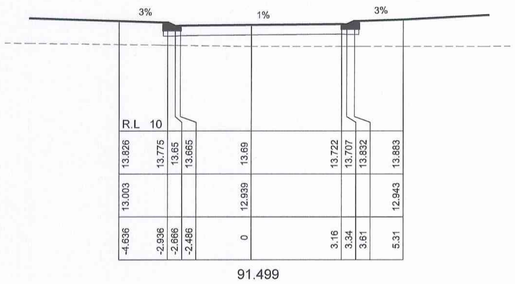
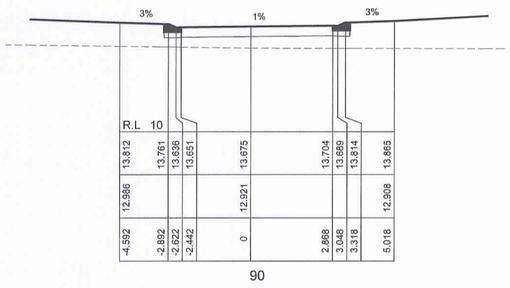
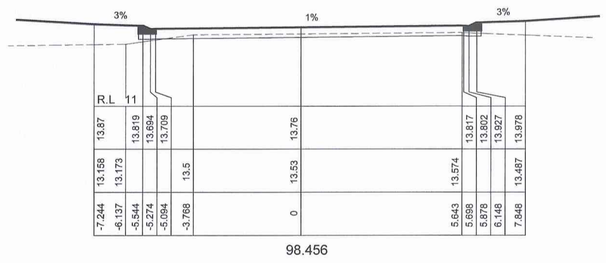
1736C CC 01 [E] - 009

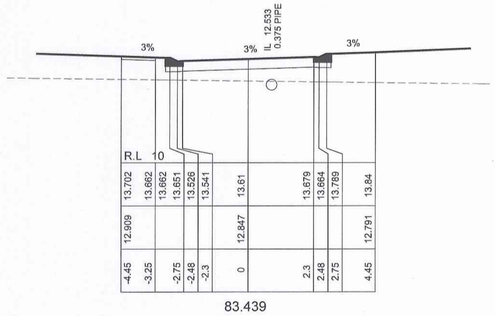
A1





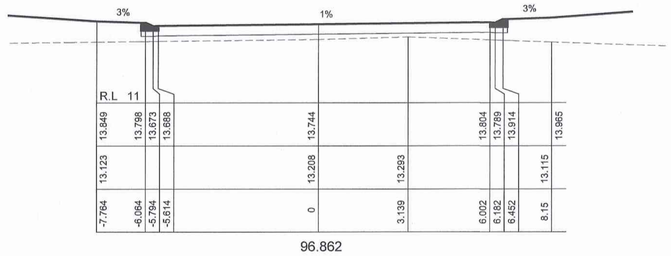






ROAD No.3 - CROSS SECTIONS

SCALE 1:100 NAT.



This plan/specification forms part of Construction Certificate No. 15.115 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

5 4 3 2 1 0 5
1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.3
CROSS SECTIONS Ch83.43 TO Ch99.58

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:100 NAT.	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref:

CRAIG & RHODES

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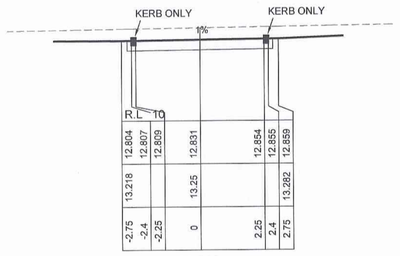
Dwg File Ref. [Rev] - Sheet Ref.

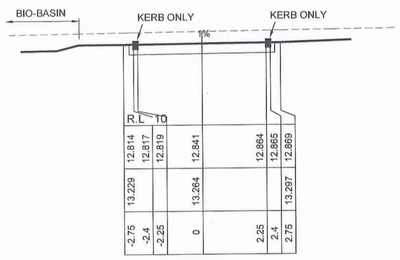
1736C CC 01 [E] - 010

CC

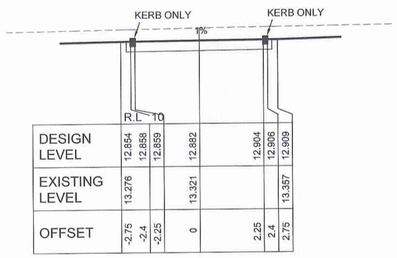
A1



11.896



10.9



6.815

ROAD No.4 - CROSS SECTIONS

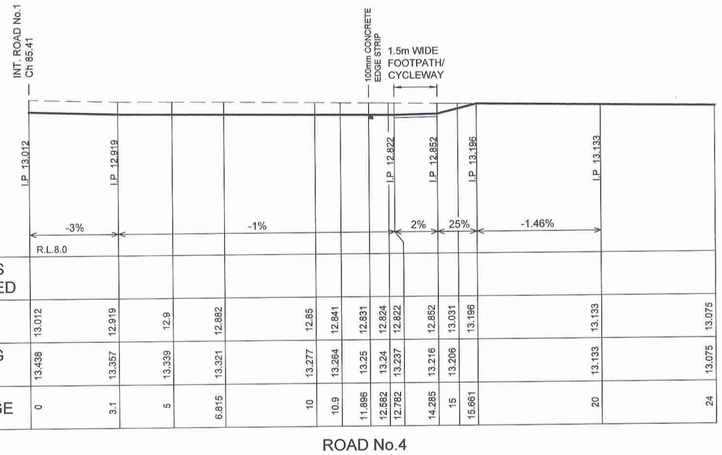
SCALE 1:100 NAT.

PAVEMENT DESIGN
ROAD No.4

DESIGN ESA's: $6x10^4$
CBR : 4

WEARING COURSE: 30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 150mm D.G.B.20
SUB-BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD

* FINAL PAVEMENT DEPTH SUBJECT TO TO GEOTECHNICAL ENGINEERS DESIGN



WORK AS EXECUTED													
DESIGN LEVEL	13.012	12.919	12.9	12.882	12.85	12.841	12.831	12.824	12.822	12.852	13.031	13.196	13.133	13.075
EXISTING LEVEL	13.438	13.357	13.339	13.321	13.277	13.264	13.25	13.24	13.237	13.216	13.206		13.133	13.075
CHAINAGE	0	3.1	5	6.815	10	10.9	11.896	12.582	12.792	14.285	15	15.661	20	24

ROAD No.4

H=1:100 V=1:100

This plan/specification forms part of Construction Certificate No. 13115 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

1:100 @ A1 (5 4 3 2 1 0 5)

1:200 @ A1 (5 4 3 2 1 0 5 10)

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.4 LONG & CROSS SECTIONS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: LONG SECT H.1:200 V.1:100 CROSS SECT 1:100 NAT.	Date: 24.6.14	Council Ref.	
	Datum: A.H.D.	L.G.A.: PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref.

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90th ANNIVERSARY 1923 - 2013

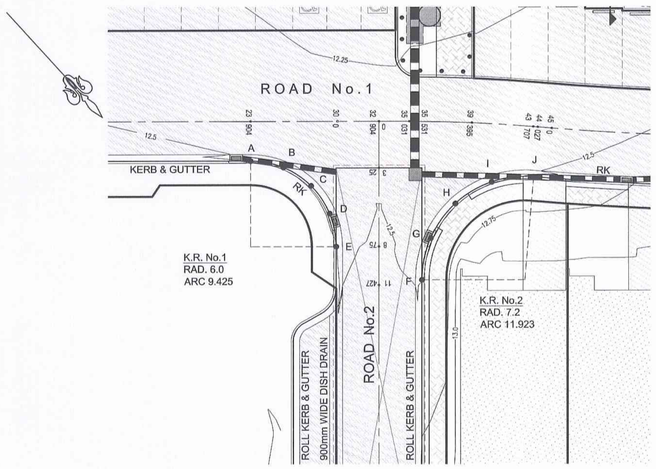
ISO 9001 Approved Company

Our Ref. 1736

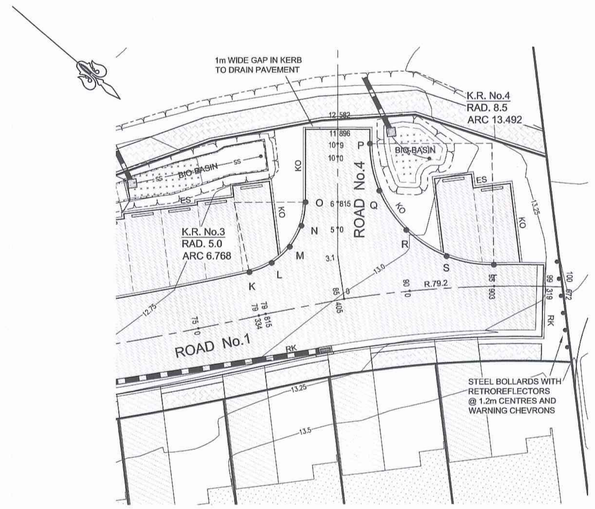
Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 011

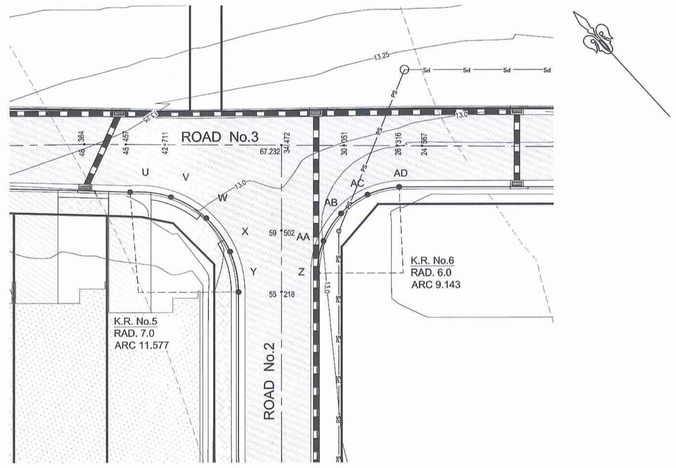
A1



PLAN
1:200



PLAN
1:200



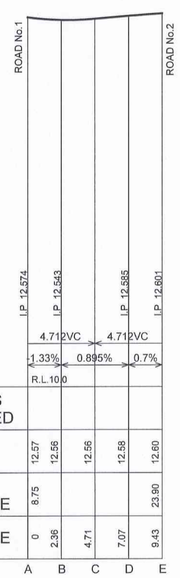
PLAN
1:200

This plan/specification forms part of Construction Certificate No. 1315 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

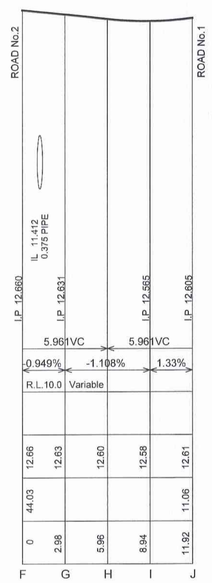
.....

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



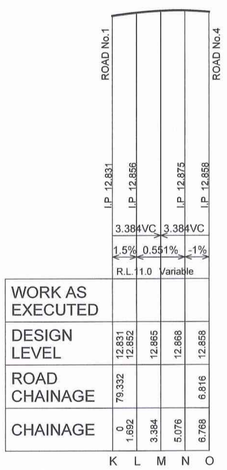
	A	B	C	D	E
WORK AS EXECUTED					
DESIGN LEVEL	12.57	12.56	12.56	12.58	12.60
ROAD CHAINAGE	8.75				23.90
CHAINAGE	0	2.36	4.71	7.07	9.43

K.R.No1
H=1:200 V=1:20



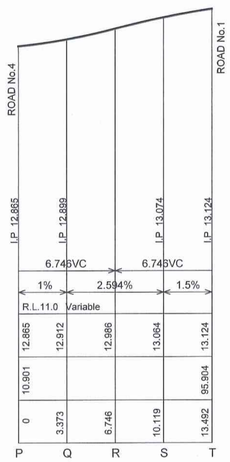
	F	G	H	I	J
WORK AS EXECUTED					
DESIGN LEVEL	12.66	12.63	12.60	12.58	12.61
ROAD CHAINAGE	44.03				11.06
CHAINAGE	0	2.98	5.96	8.94	11.92

K.R.No2
H=1:200 V=1:20



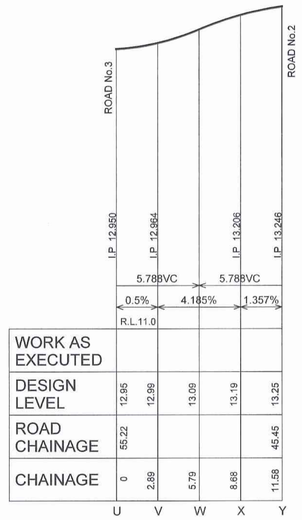
	K	L	M	N	O
WORK AS EXECUTED					
DESIGN LEVEL	12.831	12.852	12.865	12.868	12.858
ROAD CHAINAGE	79.332			6.816	
CHAINAGE	0	1.692	3.384	5.076	6.768

K.R.No3
H=1:200 V=1:20



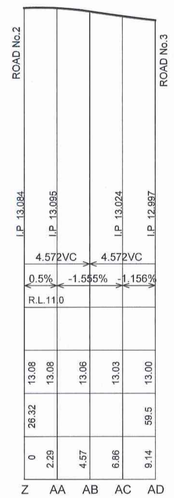
	P	Q	R	S	T
WORK AS EXECUTED					
DESIGN LEVEL	12.865	12.912	12.986	13.064	13.124
ROAD CHAINAGE	10.901			95.804	
CHAINAGE	0	3.373	6.746	10.119	13.492

K.R.No4
H=1:200 V=1:20



	U	V	W	X	Y
WORK AS EXECUTED					
DESIGN LEVEL	12.95	12.99	13.09	13.19	13.25
ROAD CHAINAGE	55.22			45.45	
CHAINAGE	0	2.89	5.79	8.68	11.58

K.R.No5
H=1:200 V=1:20



	Z	AA	AB	AC	AD
WORK AS EXECUTED					
DESIGN LEVEL	13.08	13.08	13.06	13.03	13.00
ROAD CHAINAGE	28.32				59.5
CHAINAGE	0	2.29	4.57	6.86	9.14

K.R.No6
H=1:200 V=1:20

CC

5 4 3 2 1 0 5 10
1:200 @ A1

0.5 0.4 0.3 0.2 0.1 0 0.5
1:20 @ A1

DIAL 1100 BEFORE YOU DIG

Project: KERB RETURNS No.1 TO No.6

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	H.1:200 V.1:20	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.
Client Ref:					

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ISO 9001 Approved Company

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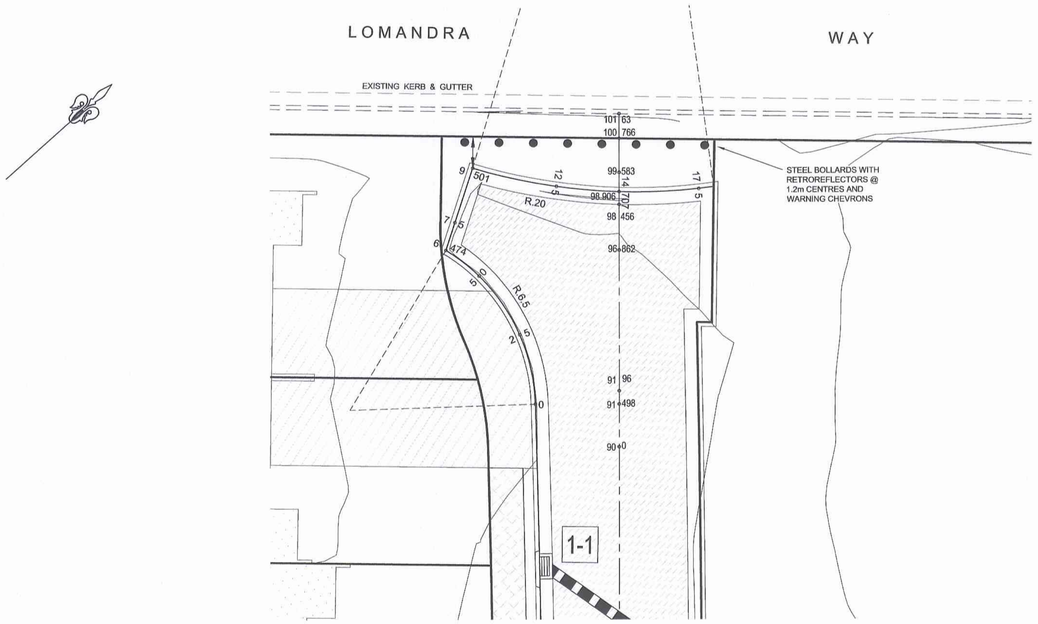
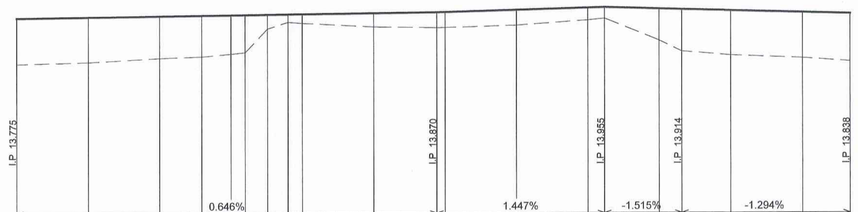
Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 012

A1



PLAN
1:100



WORK AS EXECUTED																						
DESIGN LEVEL	13.775	13.791	13.807	13.817	13.823	13.827	13.832	13.838	13.84	13.856	13.87	13.874	13.91	13.947	13.955	13.926	13.914	13.892	13.86	13.838
EXISTING LEVEL	12.978	13.01	13.077	13.102	13.15	13.174	13.585	13.7	13.681	13.617	13.603	13.604	13.643	13.732	13.76	13.375	13.165	13.117	13.067	13.009
CHAINAGE	0	2.5	5	6.474	7.5	7.997	8.778	9.501	10	12.5	14.707	15	17.5	20	20.583	22.5	23.289	25	27.5	29.162

KERB DEVELOPMENT - TURNING HEAD ROAD No.3

H=1:100 V=1:50

This plan/specification forms part of Construction Certificate No .....13..1.1.5. and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E,MIEAust,CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

5 4 3 2 1 0 5
1:100 @ A1

5 4 3 2 1 0 5
1:150 @ A1

DIAL 1100 BEFORE YOU DIG

Project: KERB DEVELOPMENT ROAD No.3 TURNING HEAD

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.	
PLAN 1:100 SECTION H.1:100 V.1:50	24.6.14		
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref:

CRAIG & RHODES
ABN 77 050 209 991
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15-18 Cambridge St
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EPPING NSW 1710
ACN 050 209 991
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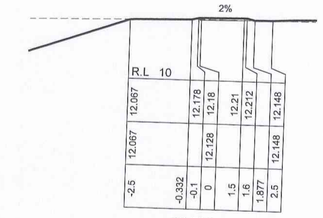
Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 013

A1



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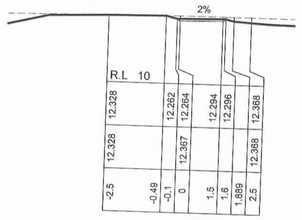

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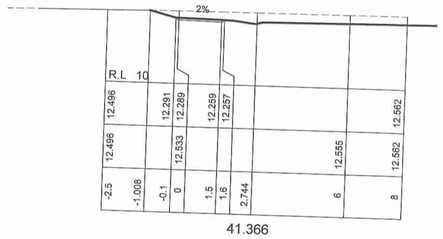

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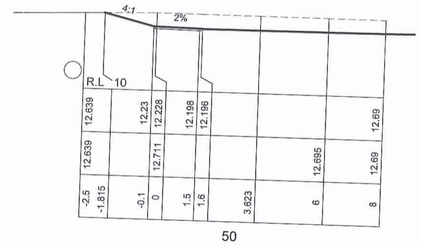
IL 10.328
0.600 PIPE



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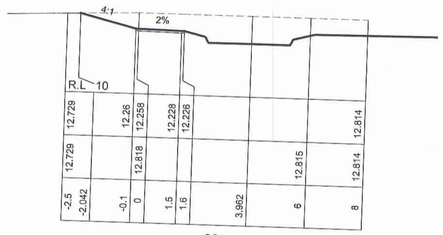

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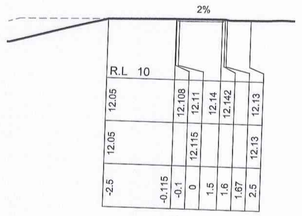

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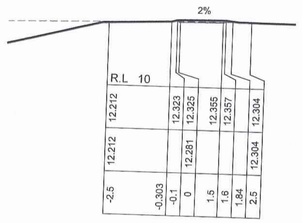

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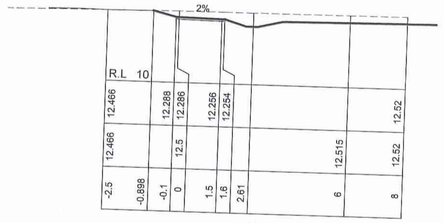

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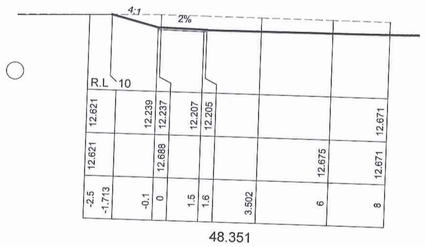

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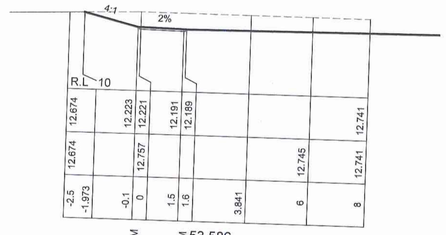
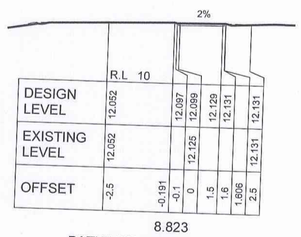


2.4 BERM
6.4 BERM
53.586



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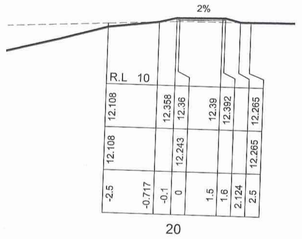
PATHWAY - CROSS SECTIONS

SCALE 1:100 NAT.

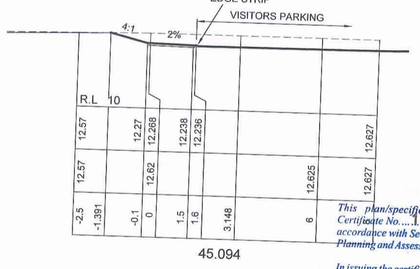


20

35.811

200x200mm
CONCRETE
EDGE STRIP

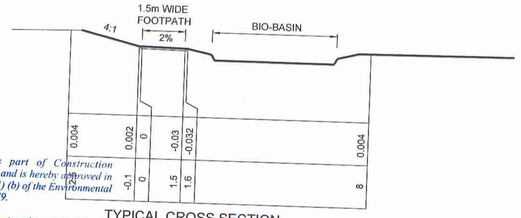
VISITORS PARKING



45.094

1.5m WIDE
FOOTPATH

BIO-BASIN



TYPICAL CROSS SECTION

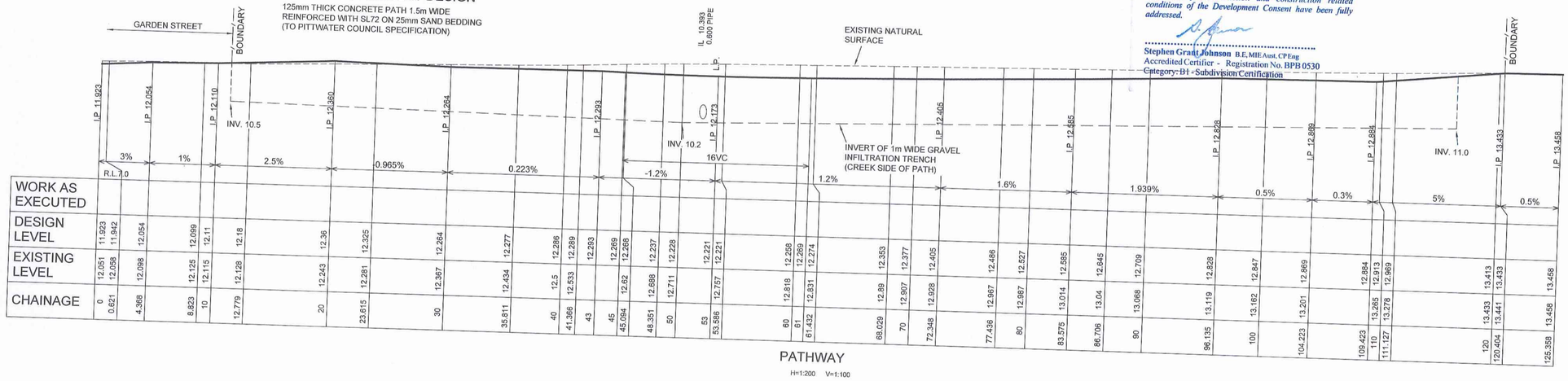
This plan/specification forms part of Construction Certificate No.....13...1...1.5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

PATHWAY PAVEMENT DESIGN

125mm THICK CONCRETE PATH 1.5m WIDE
REINFORCED WITH SL72 ON 25mm SAND BEDDING
(TO PITTWATER COUNCIL SPECIFICATION)



PATHWAY

H=1:200 V=1:100

1:100 @ A1

1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project:

PATHWAY
LONG SECTION, TYPICAL CROSS SECTIONS &
CROSS SECTIONS Ch8.82 TO Ch60

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: LONG SECT H.1:200 V.1:100 CROSS SECT 1:100 NAT.	Date: 24.6.14	Council Ref.	
	Datum: A.H.D.	L.G.A. PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref:

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ISO 9001 Approved Company

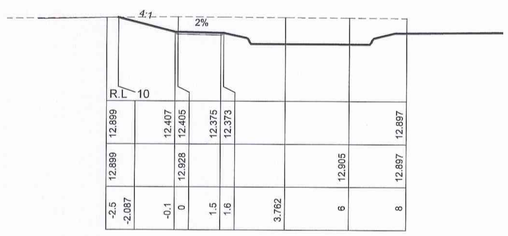
Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 014

CC

A1



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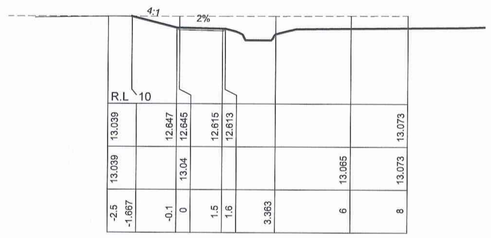

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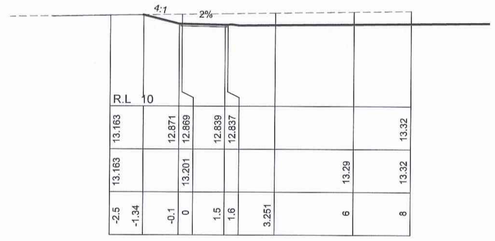

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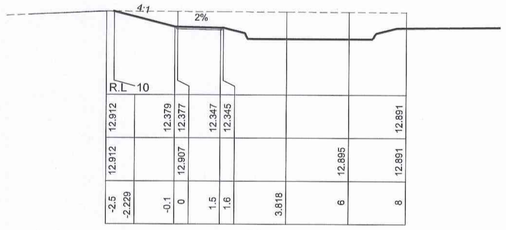

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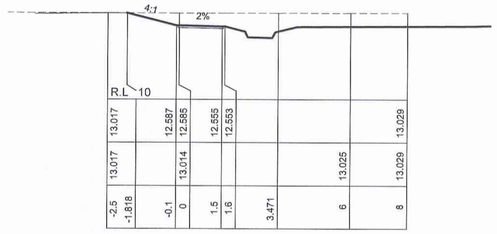

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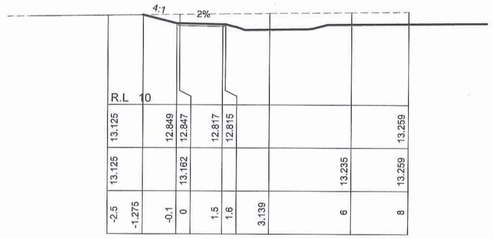

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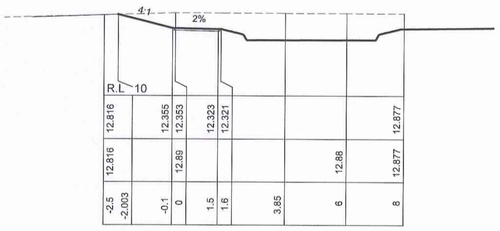
This plan/specification forms part of Construction Certificate No ...13..1..15... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



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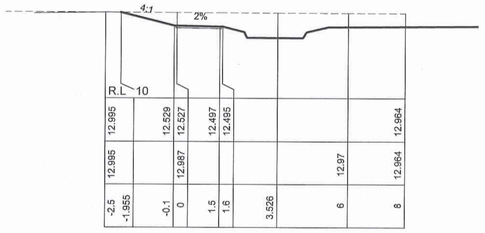

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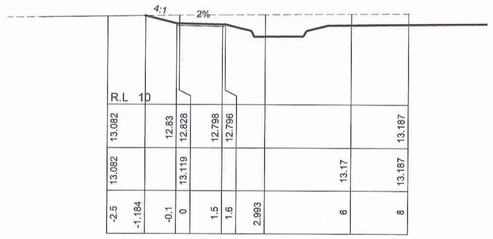

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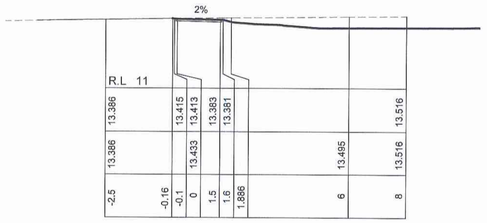

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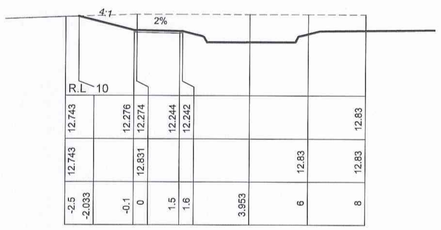
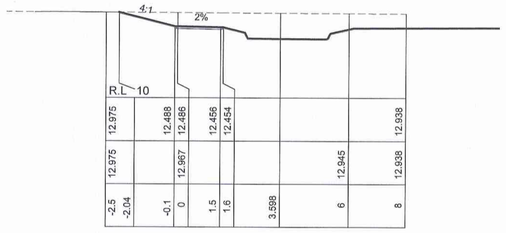


61.432

PATHWAY - CROSS SECTIONS

SCALE 1:100 NAT.



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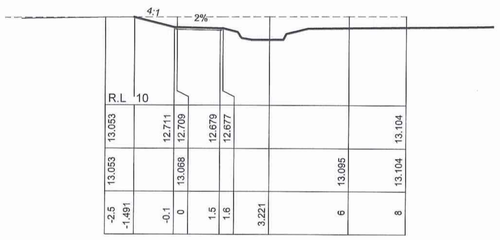

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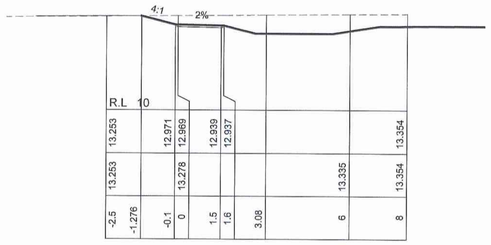

111.127

CC

5 4 3 2 1 0 5

1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project: PATHWAY
CROSS SECTIONS Ch61.43 TO Ch120

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
1:100 NAT.	24.6.14	
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D. Client Ref:

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Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 015

A1

ROAD No.7 (GARDEN ST) - CROSS SECTIONS

SCALE 1:100 NAT.

This plan/specification forms part of Construction Certificate No. ...13.1.15... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Jackson B.E. MIE Aust. CPEng

Accredited Certifier - Registration No. BPB 0530

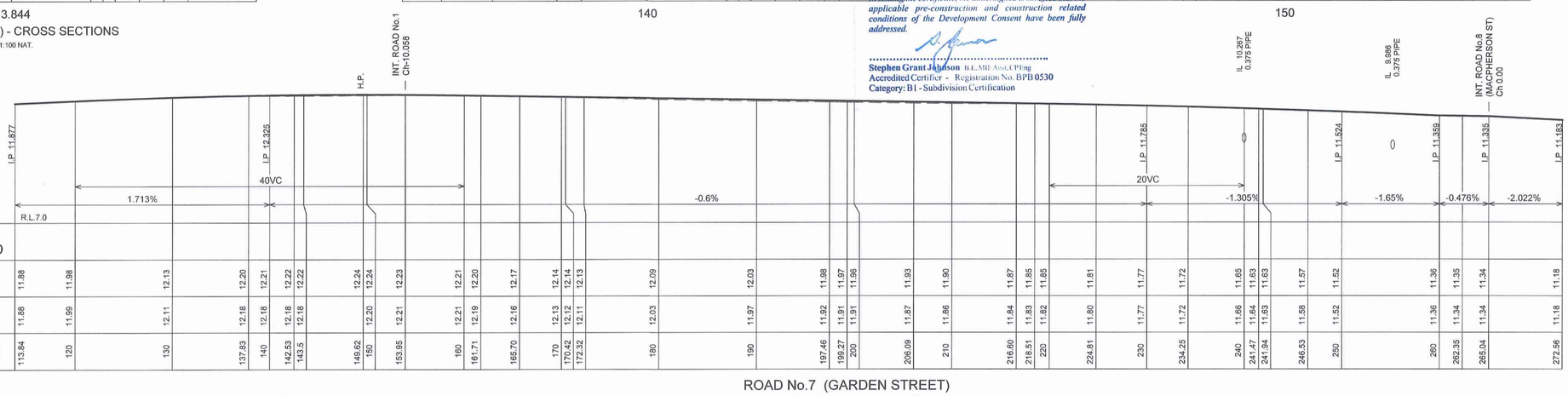
Category: B1 - Subdivision Certification

PAVEMENT DESIGN
GARDEN STREET (ROAD No.7)

DESIGN ESA's: $3x10^5$
CBR : 4
95% CONFIDENCE LEVEL

WEARING COURSE: 40mm COMPACTED THICKNESS ASPHALTIC CONCRETE - A.C.10
BASE COURSE: 200mm D.G.B.20
SUB-BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD

* FINAL PAVEMENT DEPTH SUBJECT TO TO GEOTECHNICAL ENGINEERS DESIGN



ROAD No.7 (GARDEN STREET)

H=1:250 V=1:100

5 4 3 2 1 0 5
1:100 @ A1

10 8 6 4 2 0 5 10
1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.7 (GARDEN STREET) LONG SECTION & CROSS SECTIONS Ch113.84 TO Ch165.69

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: LONG SECT H.1:250 V.1:100 CROSS SECT 1:100 NAT.	Date: 24.6.14	Council Ref.	
	Datum: A.H.D.	L.G.A. PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref:

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90th ANNIVERSARY 1923 - 2013

ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 016

CC

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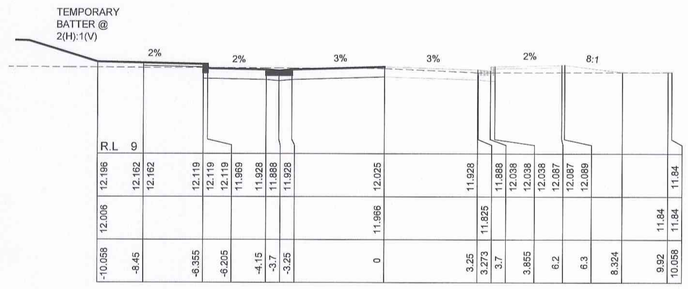

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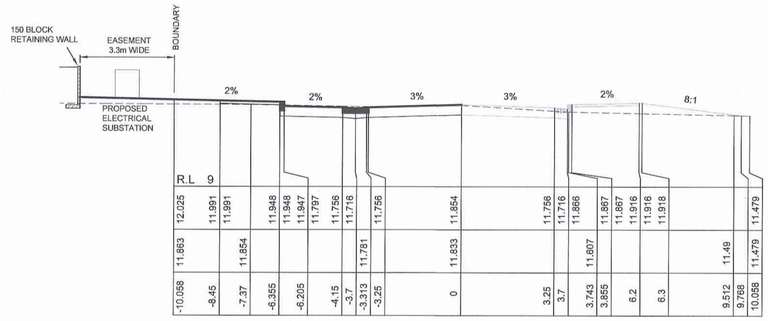

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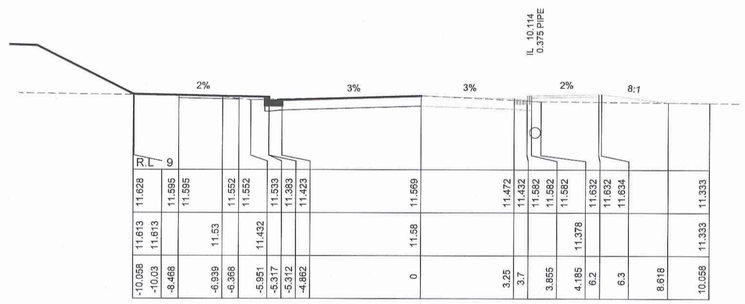

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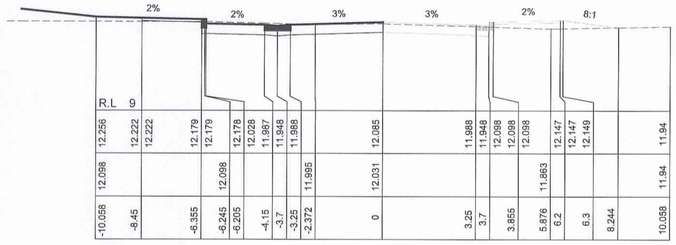

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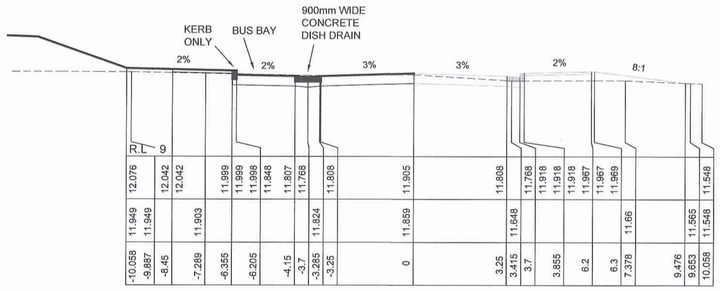

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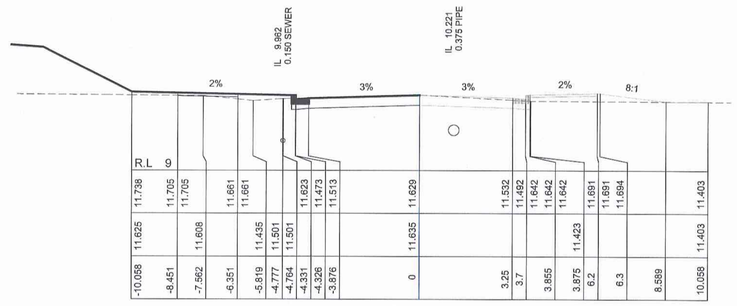

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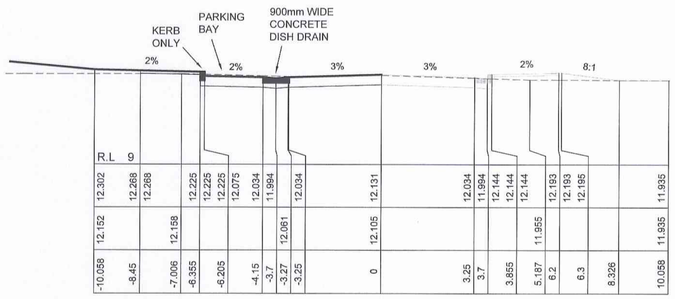

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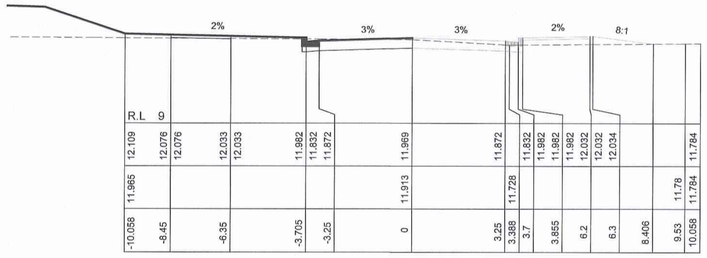

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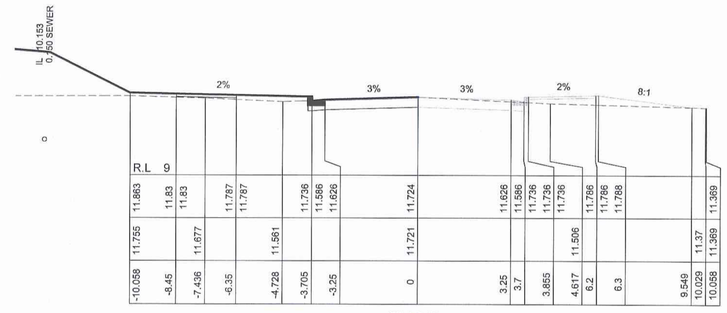

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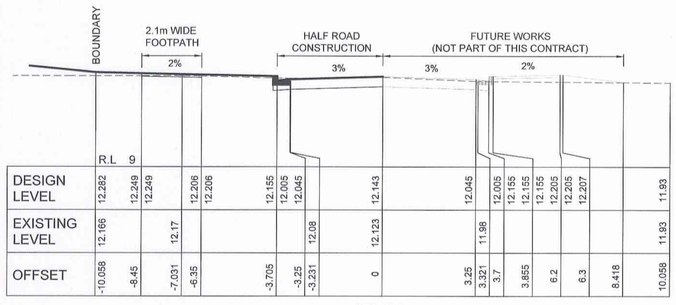
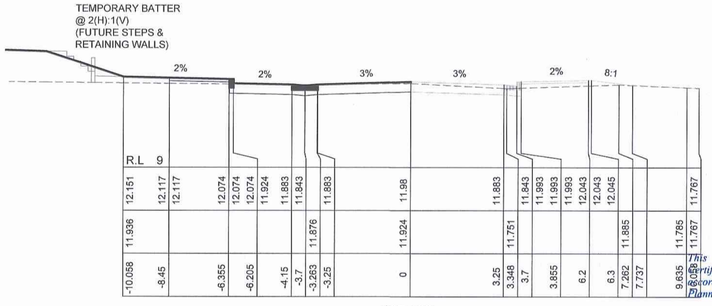


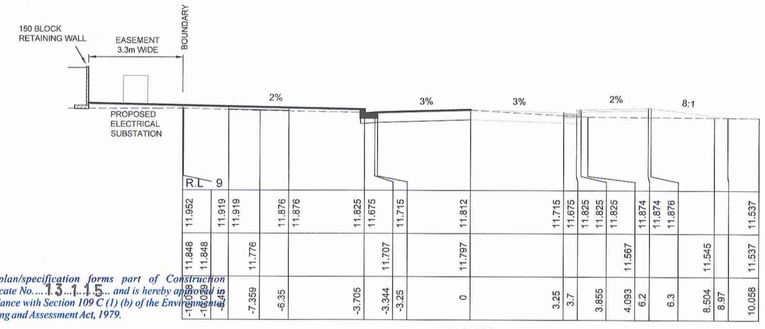
170.416

ROAD No.7 (GARDEN ST) - CROSS SECTIONS

SCALE 1:100 NAT.



197.463



224.808

This plan/specification forms part of Construction Certificate No.....13.115..... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E, MIEAust, CPEng
Accredited Certifier - Registration No. **BPB 0530**
Category: B1 - Subdivision Certification

5 4 3 2 1 0 5

1:100 @ A1

CC

DIAL 1100 BEFORE YOU DIG

Project:

ROAD No.7 (GARDEN STREET)
CROSS SECTIONS Ch170.41 TO Ch246.529

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:100 NAT.	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref:

CRAIG & RHODES

ABN 77 050 209 991
Level 4, Suite 400
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EPPING NSW 1710

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www.craigandrhodes.com.au

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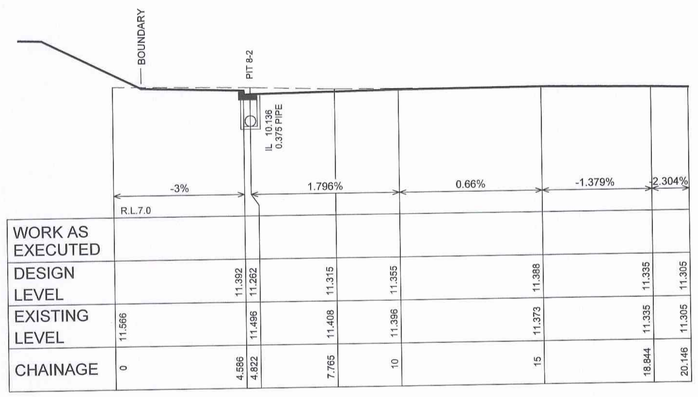
Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 017

A1



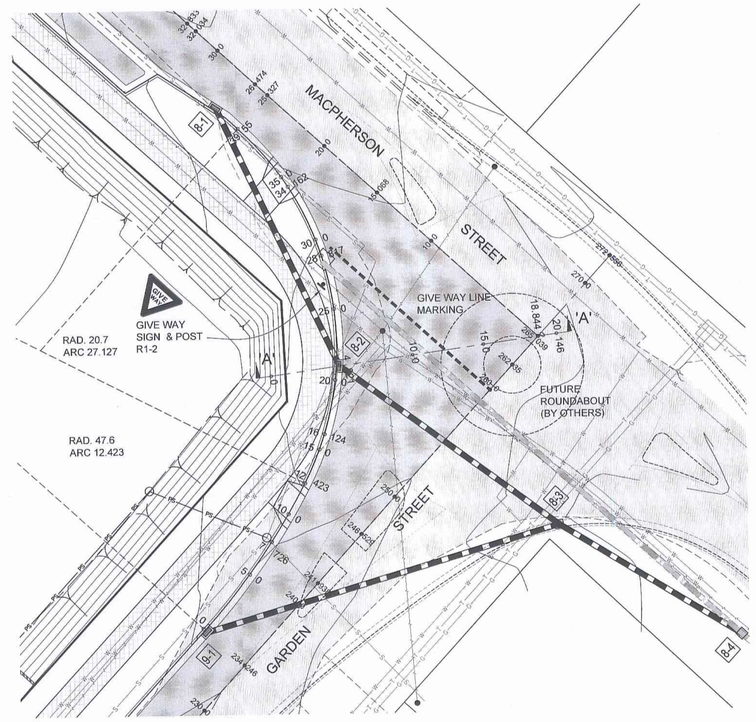
WORK AS EXECUTED								
DESIGN LEVEL		11.392	11.262	11.315	11.355	11.388	11.335	11.305
EXISTING LEVEL	11.566	11.496	11.408	11.396	11.373	11.335	11.305
CHAINAGE	0	4.586	4.822	7.765	10	15	18.844	20.146

SECTION 'A'-'A' THROUGH
MACPHERSON STREET / GARDEN STREET
INTERSECTION

H=1:100 V=1:100

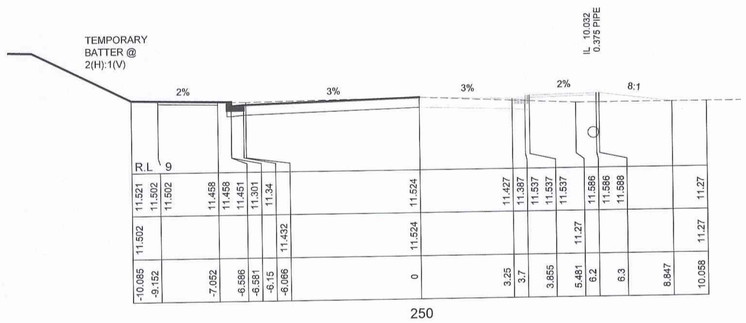
LEGEND

	EXISTING EDGE OF BITUMEN
	EXISTING KERB & GUTTER
	PROPOSED KERB & GUTTER
	FUTURE KERB & GUTTER (BY OTHERS)
K&G	150mm BARRIER KERB & GUTTER
RK	ROLL KERB
KO	KERB ONLY
ES	100mm WIDE CONCRETE EDGE STRIP
SS	SUBSOIL DRAINAGE LINE (2 x ø90mm IN SOCK)
	EXISTING DRAINAGE LINE
IAD	PROPOSED INTERALLOTMENT DRAINAGE
	PROPOSED DRAINAGE LINE
S	EXISTING SEWER
PS	PROPOSED SEWER
12.5	EXISTING CONTOURS (0.5m INTERVAL)
12.25	PROPOSED CONTOURS (0.25m INTERVAL)
W	EXISTING WATERMAIN
PW	PROPOSED WATERMAIN
T	EXISTING UNDERGROUND TELSTRA
E	EXISTING UNDERGROUND ELECTRICITY



PLAN

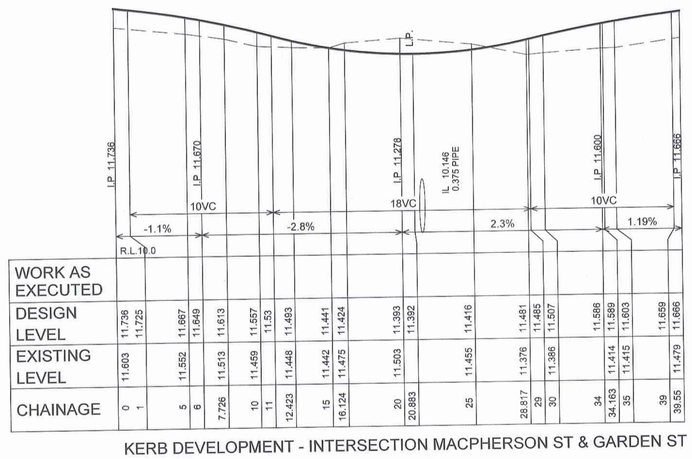
1:200



250

ROAD No.7 (GARDEN ST) - CROSS SECTIONS

SCALE 1:100 NAT.



WORK AS EXECUTED																						
DESIGN LEVEL	11.758	11.725		11.867	11.849	11.613	11.557	11.53	11.493	11.441	11.424	11.393	11.392	11.416	11.481	11.485	11.507	11.586	11.589	11.603	11.659	11.666
EXISTING LEVEL	11.603		11.552			11.513	11.459		11.448	11.442	11.475	11.503		11.455	11.376		11.386		11.414	11.415	11.479	11.479
CHAINAGE	0	1		5	6	7.726	10	11	12.423	15	16.124	20	20.883	25	28.817	29	30	34	34.163	35	39	39.55

KERB DEVELOPMENT - INTERSECTION MACPHERSON ST & GARDEN ST

H=1:200 V=1:20

This plan/specification forms part of Construction Certificate No.... 13.1.1.5 ... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

5 4 3 2 1 0 5 10
1:200 @ A1

0.5 0.4 0.3 0.2 0.1 0 0.5
1:20 @ A1

5 4 3 2 1 0 5
1:100 @ A1

CC

DIAL 1100 BEFORE YOU DIG

Project:
ROAD No.7 (GARDEN STREET)
CROSS SECTION Ch250,
KERB DEVELOPMENT INT. GARDEN ST & MACPHERSON ST

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale CROSS SECT 1:100 NAT. PLAN 1:200 KERB DEV H.1:200 V.1:20	Date 24.6.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref:

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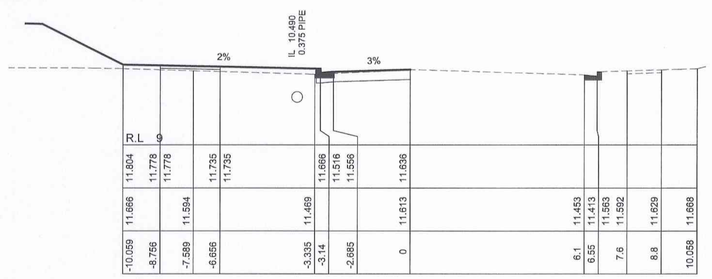
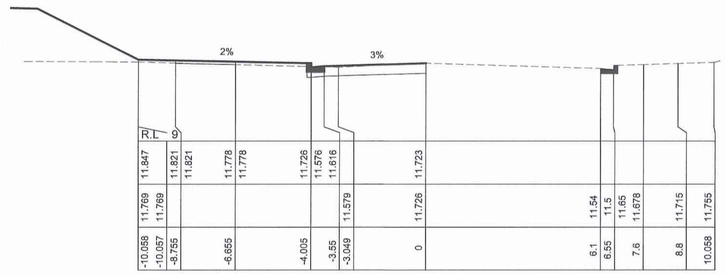
1736C CC 01 [E] - 018

A1



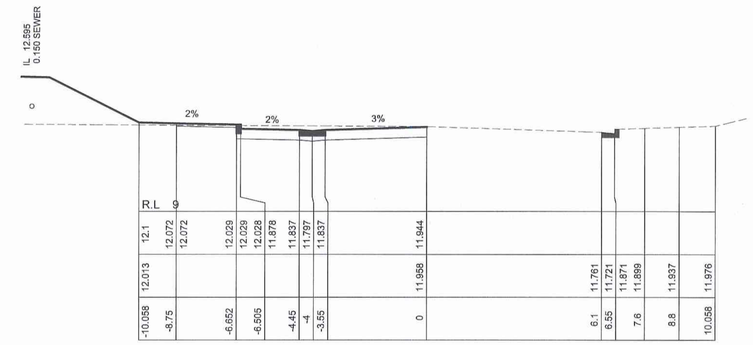
	11.804	11.778		11.735	11.735			11.666	11.516	11.556	11.636							
11.666			11.594				11.469						11.453	11.413	11.563	11.592	11.629	11.668
-10.059	-8.756		-7.589	-6.656			-3.335	-3.14		-2.885	0		6.1	6.55	7.6	8.8	10.058	

25.327



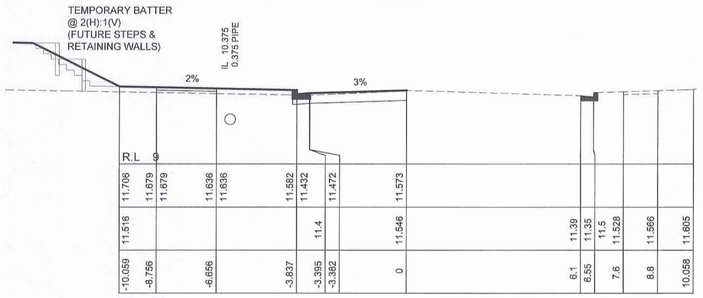
11.847			11.821		11.778	11.778		11.726		11.576	11.616		11.723					
	11.769	11.769													11.54			
-10.058	-10.057	-8.755		-6.655				-4.005		-3.55	-3.049	11.579	0	11.726	6.1	6.55	7.6	8.8	10.058	11.755

32.034



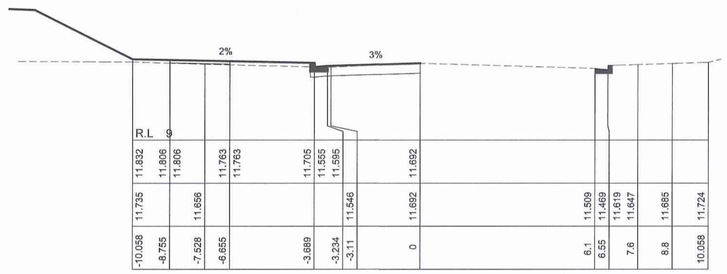
	12.1	12.072		12.029		11.878	11.837											
		12.072		12.029		12.028		11.797	11.837				11.944					
12.013															11.761			
-10.058	-8.75			-6.652		-6.505	-4.45	-4	-3.55		0	11.958	6.1	6.55	11.721	11.871	11.899	11.937	11.976

46.687



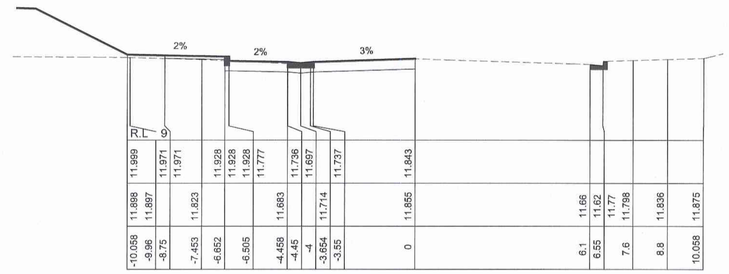
11.706	11.679	11.679		11.636	11.636		11.582	11.432	11.472		11.573							
11.516								11.4			11.546		11.39	11.35	11.5	11.528	11.566	11.605
-10.059	-8.756			-6.656			-3.837	-3.395	-3.382		0		6.1	6.55	7.6	8.8	10.058	

20



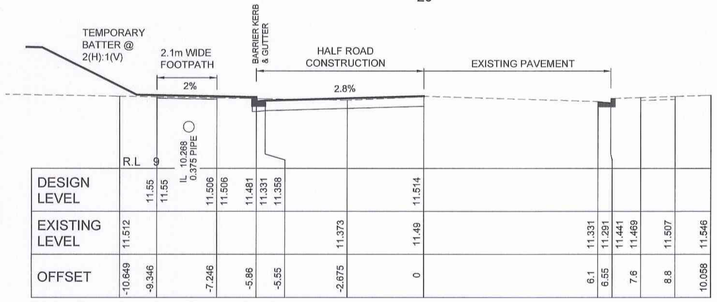
11.832	11.806	11.806		11.763	11.763		11.705	11.555	11.595		11.692							
11.735			11.656						11.546		11.692		11.509	11.469	11.619	11.647	11.685	11.724
-10.058	-8.755		-7.528	-6.655			-3.689	-3.234	-3.11		0		6.1	6.55	7.6	8.8	10.058	

30



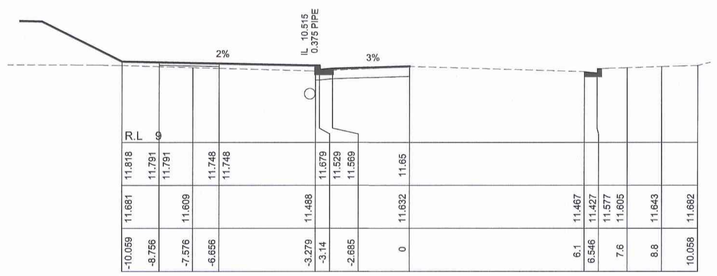
11.999	11.971	11.971		11.928	11.928		11.777											
11.888		11.897			11.823			11.736		11.697		11.737						
-10.058	-9.96	-8.75		-7.453		-6.652	-6.505	-4.458	-4.45	-4	-3.654	-3.55	0	11.855	6.1	6.55	11.62	11.77	11.798	11.836	11.875

40



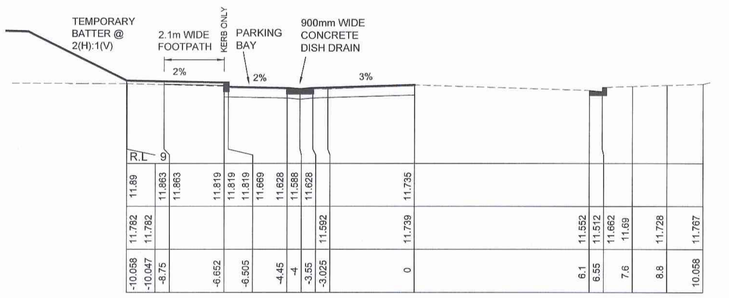
DESIGN LEVEL		11.55	11.55	11.506	11.506	11.481	11.331	11.358			11.514							
EXISTING LEVEL	11.512								11.373		11.49		11.331	11.291	11.441	11.469	11.507	11.546
OFFSET	-10.649	-9.346		-7.246		-5.86	-5.55		-2.675		0		6.1	6.55	7.6	8.8	10.058	

15.069



11.818	11.791	11.791		11.748	11.748			11.679	11.529	11.569	11.65							
11.681			11.609			11.488						11.632			11.467	11.427	11.577	11.605	11.643	11.682
-10.059	-8.756		-7.576	-6.656			-3.279	-3.14		-2.885	0		6.1	6.546	7.6	8.8	10.058	

26.474



11.89	11.863	11.863		11.819	11.819	11.819	11.669	11.628										
11.762	11.762							11.588	11.628									
-10.058	-10.047	-8.75		-6.652		-6.505	-4.45	-4	-3.55	11.592			11.739	11.735				
-10.058									-3.025		0		6.1	6.55	11.562	11.512	11.662	11.69	11.728	11.767

32.833

ROAD No.8 (MACPHERSON ST) - CROSS SECTIONS

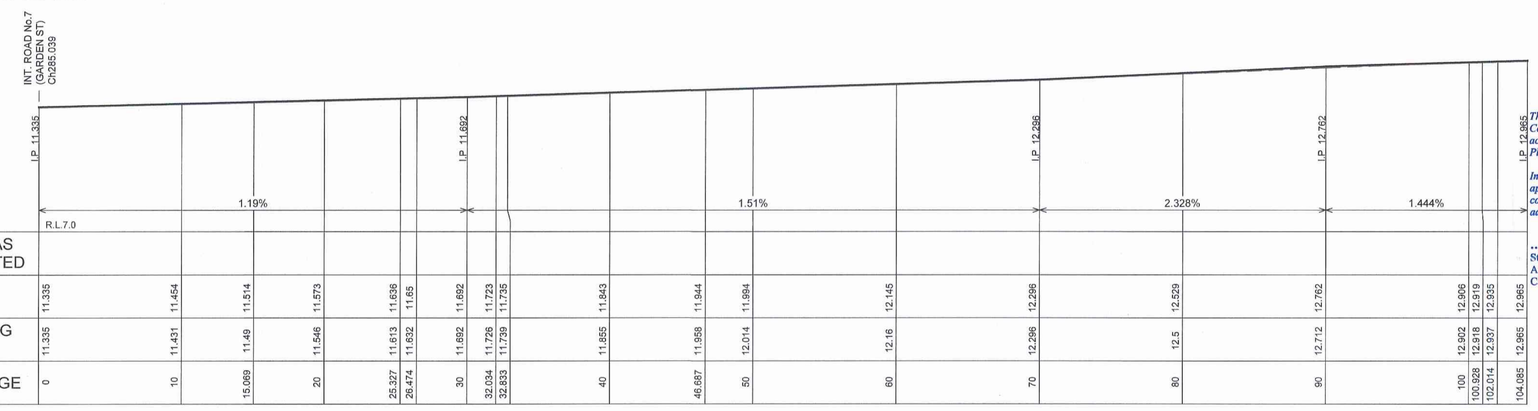
SCALE 1:100 NAT.

PAVEMENT DESIGN
MACHERSON STREET (ROAD No.8)

DESIGN ESA's: $3x10^5$
CBR : 4
95% CONFIDENCE LEVEL

WEARING COURSE: 40mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 200mm D.G.B.20
SUB–BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD

* FINAL PAVEMENT DEPTH SUBJECT TO TO GEOTECHNICAL ENGINEERS DESIGN



WORK AS EXECUTED																						
DESIGN LEVEL	11.335	11.454	11.514	11.573	11.636	11.65	11.692	11.723	11.735	11.843	11.944	11.994	12.145	12.296	12.529	12.762	12.906	12.919	12.935	12.965
EXISTING LEVEL	11.335	11.431	11.49	11.546	11.613	11.632	11.692	11.726	11.739	11.855	11.958	12.014	12.16	12.296	12.5	12.712	12.902	12.918	12.937	12.965
CHAINAGE	0	10	15.069	20	25.327	26.474	30	32.034	32.833	40	46.687	50	60	70	80	90	100	100.928	102.014	104.085

ROAD No.8 (MACPHERSON STREET)

H=1:200 V=1:100

This plan/specification forms part of Construction Certificate No.....1.9.....1.5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

1:100 @ A1 — 1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.8 (MACPHERSON STREET)
LONG SECTION &
CROSS SECTIONS Ch15.06 TO Ch46.68

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
LONG SECT H.1:200 V.1:100 CROSS SECT 1:100 NAT.	24.6.14	
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D. Client Ref:

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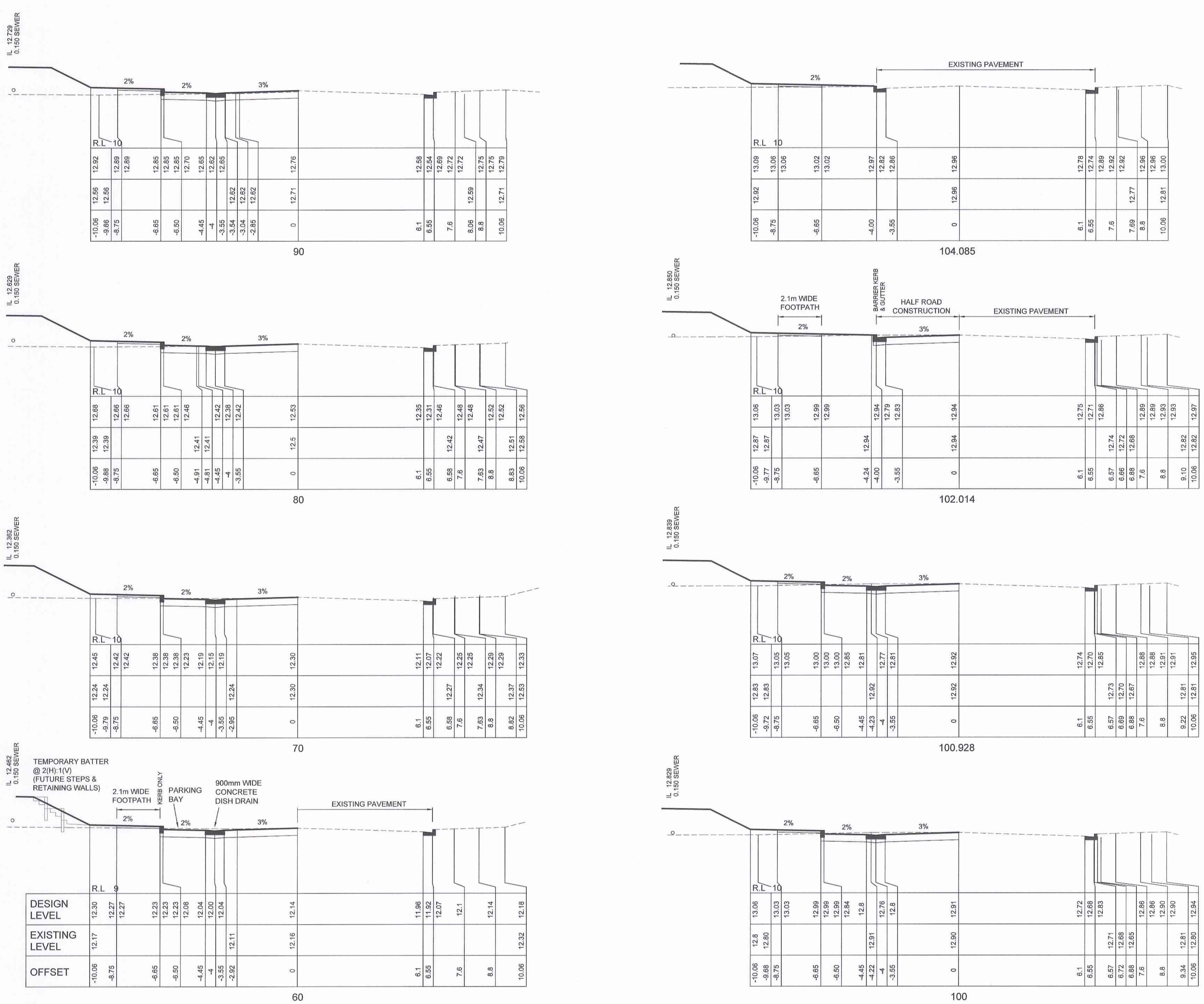

ROAD No.8 (MACPHERSON ST) - CROSS SECTIONS

SCALE 1:100 NAT.

5 4 3 2 1 0 5
1:100 @ A1

This plan/specification forms part of Construction Certificate No....13..1..15... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

....

Stephen Grant Johnson B.E, MIEAust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.8 (MACPHERSON STREET) CROSS SECTIONS Ch60 TO Ch104.08	Principal: WARRIEWOOD PROPERTIES PTY LTD				
	Scale 1:100 NAT.	Date 24.6.14	Council Ref.		
		Datum A.H.D.	L.G.A. PITTWATER		
	Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref:	

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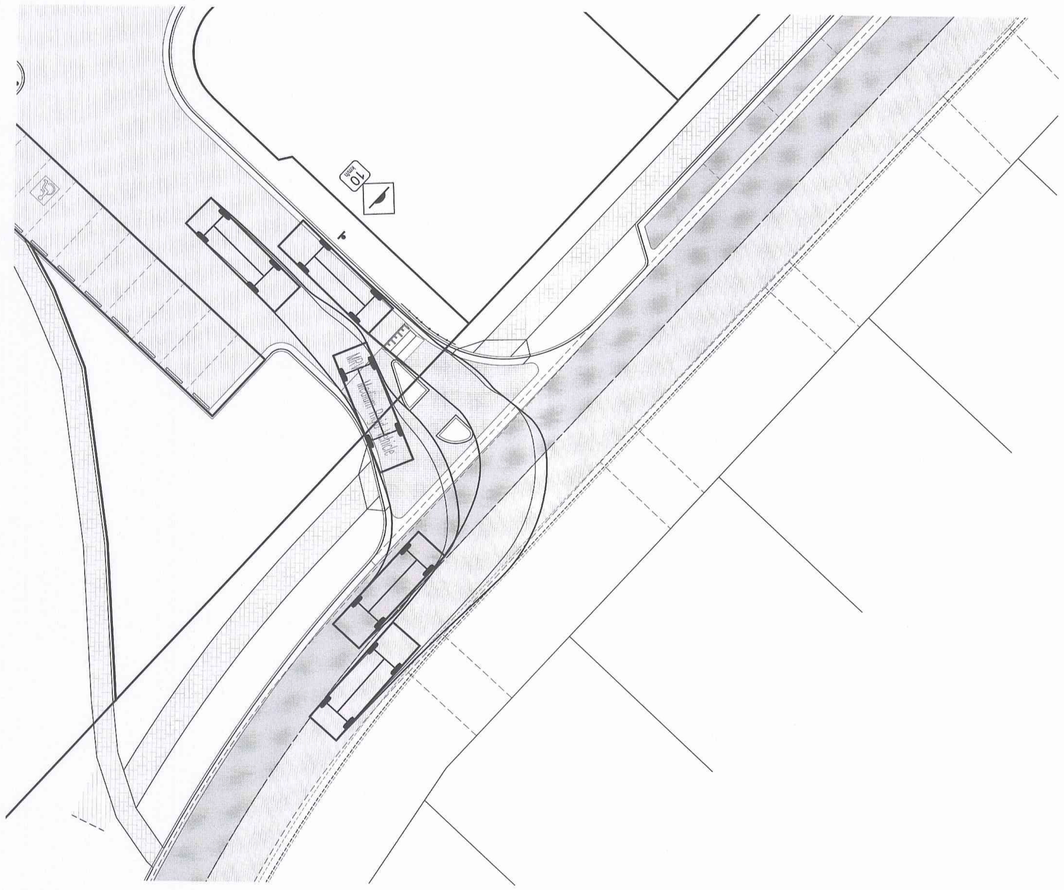
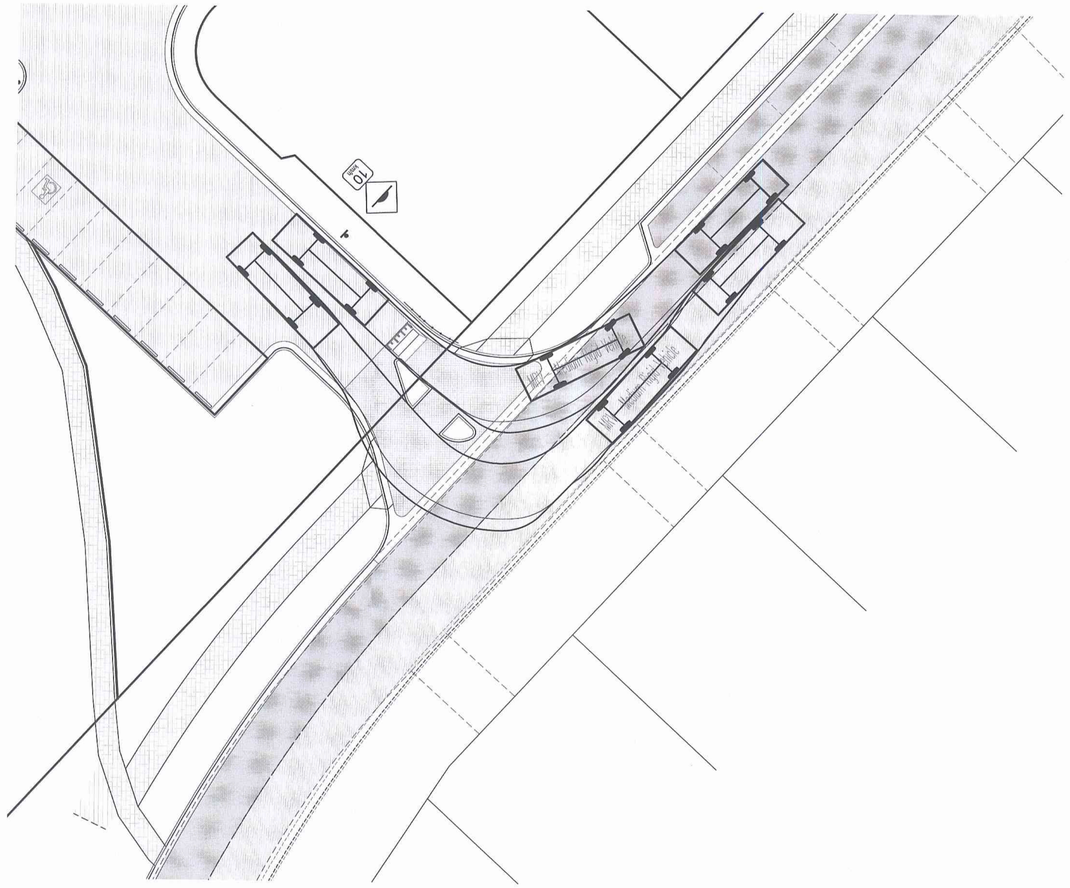
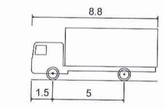
A1







MRV - Medium Rigid Vehicle

Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock to Lock Time	4.00s
Kerb to Kerb Turning Radius	10.000m

5 4 3 2 1 0 5 10

1:200 @ A1

This plan/specification forms part of Construction Certificate No....13...1.5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E. MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

DIAL 1100 BEFORE YOU DIG

Project: DESIGN VEHICLE TURN PATHS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:200	Date 24.6.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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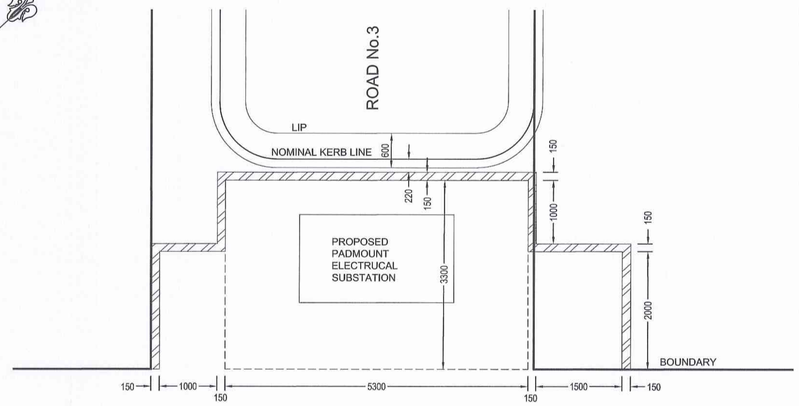
A1

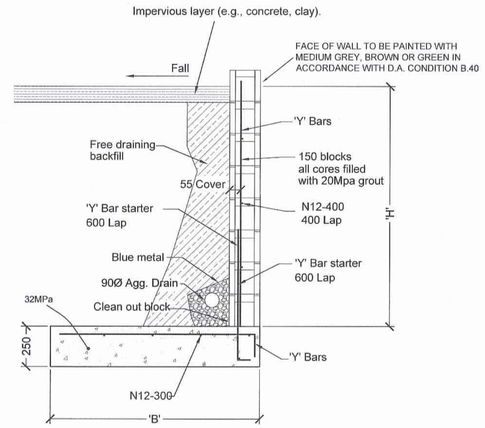


RETAINING WALL RW1 - PLAN

SCALE 1:50

Block Retaining Wall Schedule		
'H'	'B'	'Y' Bars
0 - 800	700	N12 - 400
800-1200	800	N12 - 400
1200-1800	1200	N16 - 400
1800-2200	1500	N16 - 400
2200-2600	1800	N16 - 400
2600-3000	2100	N20 - 400
3000-3400	2400	N20 - 400
3400-4000	2700	N24 - 400

retaining wall design based on 5kPa surcharge internal friction angle 30° refer to page 18 CMAA concrete retaining structures - reinforced masonry



RETAINING WALL RW1

for 'h' up to 1800

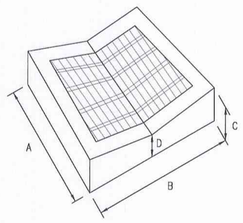
R.C. SPRINGETT
R. Springett
MIE Aust CPEng
Chartered Professional Engineer
NPER (12223)

This plan/specification forms part of Construction Certificate No.....13...1..1..5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

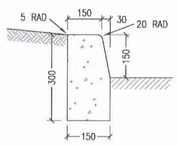
Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



Dimensions in mm				PIT SIZE
A	B	C	D	
900	900	200	165	600x600
1300	1000	200	165	900x600
1300	1300	200	145	900x900

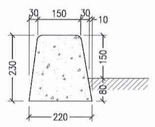
STANDARD V GRATE IN CONCRETE SURROUND

NOT TO SCALE



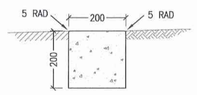
KERB ONLY

SCALE 1:10



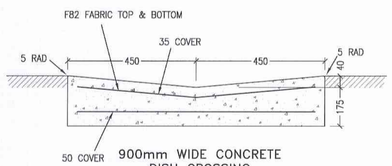
BARRIER KERB AT TRAFFIC ISLANDS

SCALE 1:10



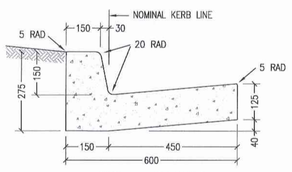
CONCRETE EDGE STRIP

SCALE 1:10



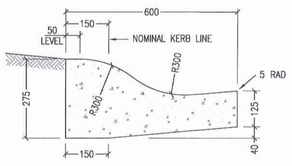
900mm WIDE CONCRETE DISH CROSSING

SCALE 1:10



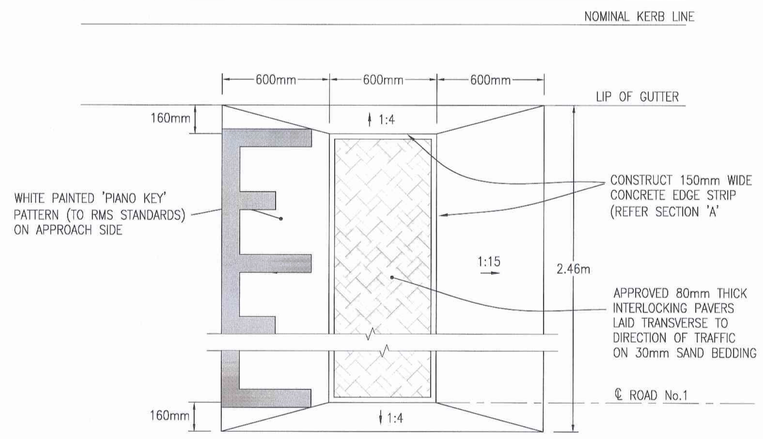
150mm BARRIER KERB & GUTTER

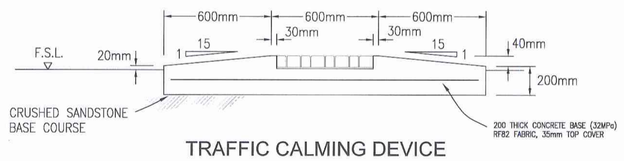
SCALE 1:10



150mm ROLL KERB & GUTTER

SCALE 1:10





TRAFFIC CALMING DEVICE

NOT TO SCALE

CC

DIAL 1100 BEFORE YOU DIG

Project:

TYPICAL KERB DETAILS
TRAFFIC CALMING DEVICE DETAILS
RETAINING WALL DETAILS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	N.T.S.	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref:

CRAIG & RHODES

ABN 77 050 209 991
Level 4, Suite 400
16-18 Cambridge St
EPPING NSW 2121
PO Box 233
EPPING NSW 1710

ACN 050 209 991
DX 4408 EPPING
Tel. 9868-1855
Fax. 9869-2341
reception@crhodes.com.au
www.craigandrhodes.com.au

90th ANNIVERSARY 1923 - 2013

ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 022

A1

D.C.4-1 371.4m²
D.C.6-1 134m²
D.C.4-2 427.5m²
D.C.4-3 596m²
D.C.4-4 298.2m²
D.C.6-2 265.6m²
D.C.4-5 303.2m²
D.C.4-6 301.2m²
D.C.7-1 179.7m²
D.C.4-7 346.6m²
D.C.4-8 16m²
D.C.5-2 177.7m²
D.C.7-2 1670m²
D.C.5-1 487.3m²
D.C.3-5 332.9m²
D.C.3-4 662.3m²
D.C.3-4 297.2m²
D.C.3-1 662.3m²
D.C.2-1 486.2m²
D.C.1-1 253.4m²
D.C.1-2 339.3m²
D.C.2-2 789.6m²
D.C.3-3 298m²
D.C.3-2 640.3m²

BIO BASIN No.1
BIO BASIN No.2
BIO BASIN No.3
BIO BASIN No.4
10kL UNDERGROUND RAINWATER TANK

GARDEN STREET
MACPHERSON STREET

This plan/specification forms part of Construction Certificate No. ....1.5...11.5... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E. MIE Aust. CPEng
Accredited Certifier - Registration No. **BPB 0530**
Category: B1 - Subdivision Certification

1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: CATCHMENT PLAN

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:250	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.
				Client Ref.	

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Our Ref. 1736

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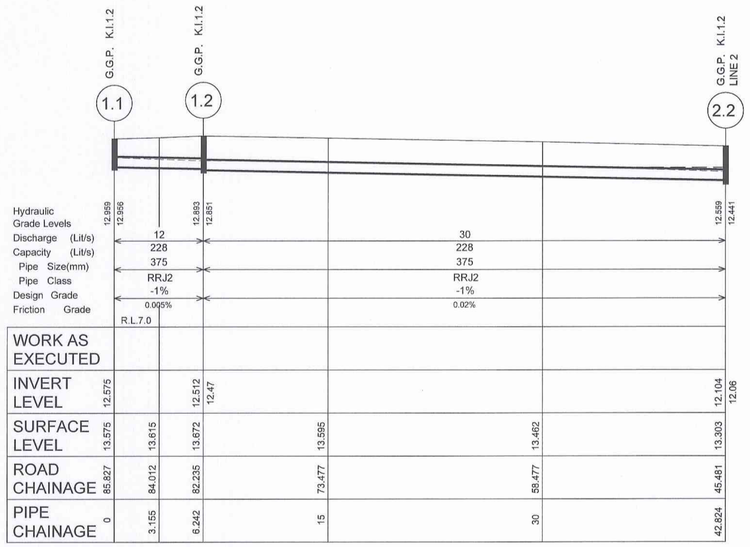
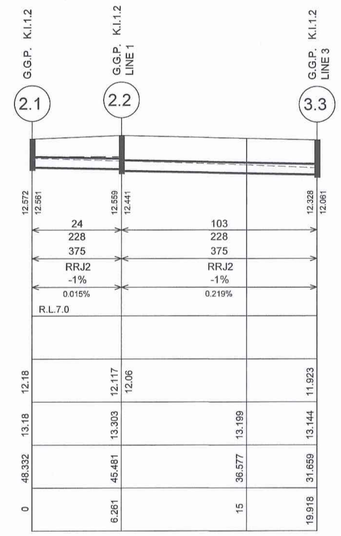
A1



LINE.1

H=1:200 V=1:100



LINE.2

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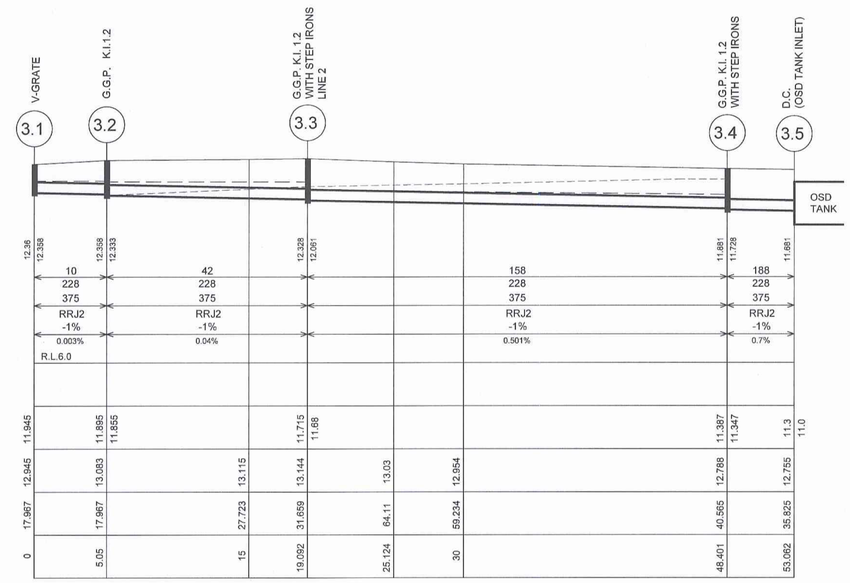


LINE.3

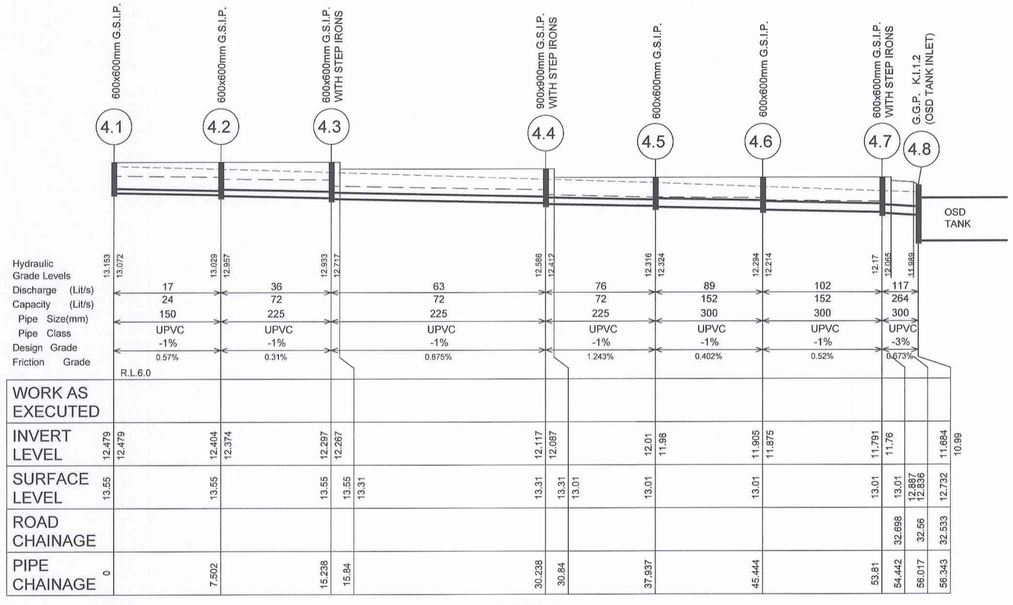
H=1:200 V=1:100

This plan/specification forms part of Construction Certificate No.....1.5.....1.1.5..... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E, MIEAust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



LINE.4

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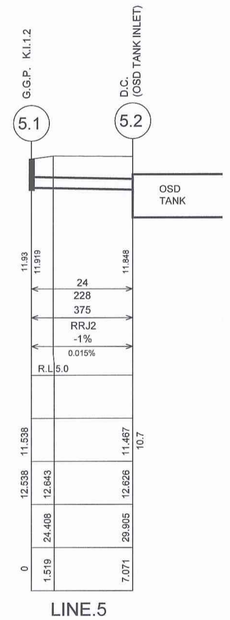
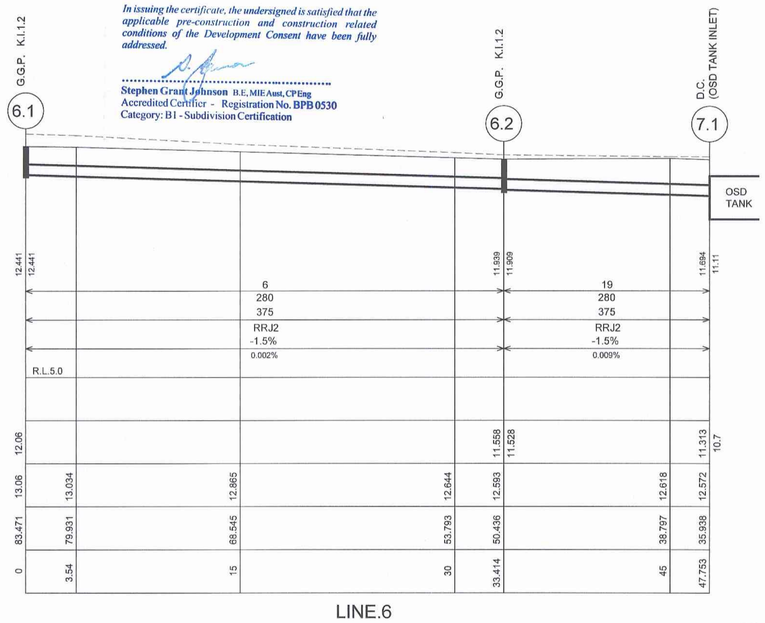


LINE.5

H=1:200 V=1:100



LINE.6

H=1:200 V=1:100

CC

1:100 @ A1 — 1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: DRAINAGE LINES 1 TO 6

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale H.1:200 V.1:100	Date 24.6.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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1736C CC 01 [E] - 024

A1

DRAINAGE NOTES

1. CALCULATIONS BASED ON AUSTRALIAN RAINFALL RUNOFF (1987)
2. DESIGN RECURRENCE INTERVAL FOR ROAD AND INTERALLOTMENT DRAINAGE IS 20 YEARS FOR THE PIPED SYSTEM
3. THE ROUGHNESS VALUE FOR THE COLEBROOK–WHITE EQUATION ADOPTED IS AS FOLLOWS: FOR THE UPVC PIPE = 0.6mm
4. PIT LOSS FACTORS BASED ON THE MISSOURI CHARTS
5. KERB INLET DIMENSIONS (e.g. K.I. 1.8m) REFER TO THE OPENING OF LINTELS
6. PRECAST PIT LINTELS ARE TO BE USED
7. ALL PITS ARE TO BE BENCHED WITH MASS CONCRETE TO HALF DIAMETER TO STREAMLINE FLOW
8. GULLY PIT CLOGGING FACTORS ARE: 0.7 FOR GRATES, 0.9 FOR LINTELS
9. CONCRETE BULK HEADS TO BE PROVIDED AT MAX. 3.6m SPACINGS WHERE PIPE GRADES EXCEED 12% OR AS DIRECTED

PIT TYPES

1 – G.G.P. – STANDARD GRATED GULLY PIT

4 – G.I.S.P. – GRATED SURFACE INLET PIT

5 – J.P. – JUNCTION PIT

7 – D.C. – DIRECT CONNECTION

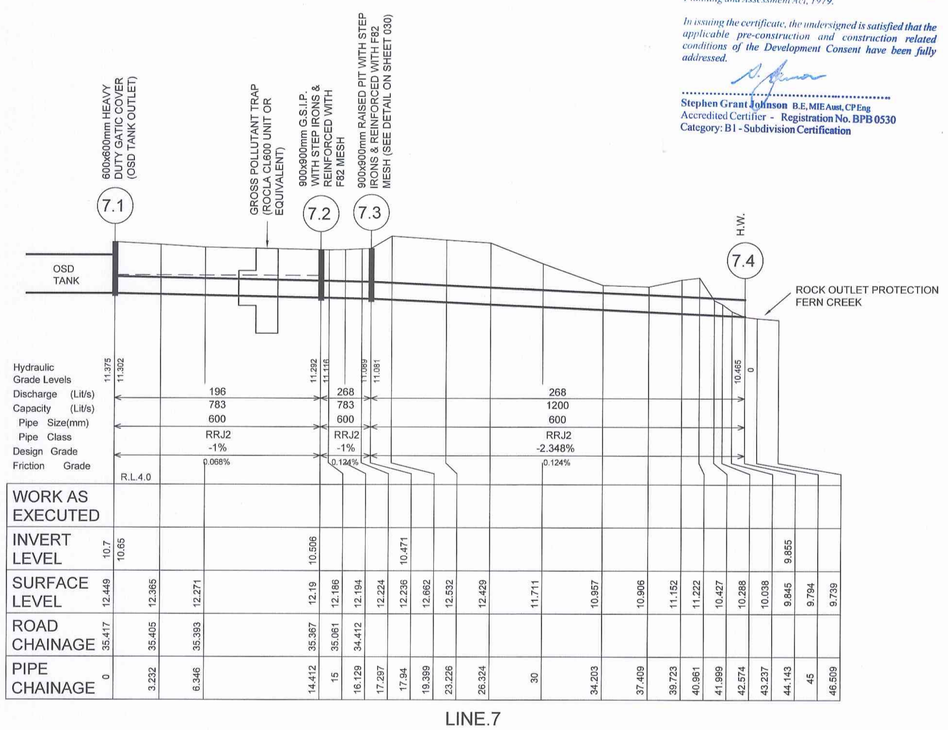
10 – G.P.T. – GROSS POLLUTANT TRAP

H.W. – HEAD WALL

This plan/specification forms part of Construction Certificate No 13115 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E.MIEAust.CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



LINE.7

H=1:200 V=1:100

HYDROLOGICAL DESIGN SHEET

PIT	LAND USE	FLOW LENGTH	SLOPE	"n"	TIME	TIME	INTENSITY	CODE	COEFF	AREA	C.A	SUM AREA	Q	BY PASS	TOTAL FLOW	GUTTER SLOPE	FLOW WIDTH	PIT TYPE	LINTEL	INFLOW	BY FLOW	BY PIT	KINEMATIC MIN TIME 5 MAX TIME 20 WARRIEWOOD REMARKS
		m	%		min	min	mm/h			ha	ha	ha	L/s	L/s	L/s	%	m		m	L/s	L/s		
1.1						5	203 20Yr	-0.9	0.908	0.025	0.023	0.023	13		13	1	1.096	1	1.2	13		2.1	
1.2						5	203 20Yr	-0.9	0.908	0.034	0.031	0.031	17		17	1	1.274	1	1.2	17		2.2	
2.1						5	203 20Yr	-0.9	0.908	0.049	0.044	0.044	25		25	1	1.512	1	1.2	25		4.8	
2.2	1	30.5	1	0.170	9.753	5 ADP	203 20Yr	-0.9 -0.650	0.908 0.815	0.079 0.027	0.072 0.022	0.094	53		53	1	2.1	1	1.2	53		3.3	
3.1						5	203 20Yr	-0.9	0.908	0.021	0.019	0.019	11		11	0.7	1.081 0.03PH	1 SAG		11			
3.2						5	203 20Yr	-0.9	0.908	0.064	0.058	0.058	33		33	0.5	1.985 0.03PH	1 SAG	1.2	33		3.2	
3.3						5	203 20Yr	-0.9	0.908	0.030	0.027	0.027	15		15	1	1.194	1	1.2	15		3.4	
3.4						5	203 20Yr	-0.9	0.908	0.066	0.060	0.06	34		34	0.5	2.014	1	1.2	34		5.2	
4.1						5	203 20Yr	-0.650	0.815	0.037	0.030	0.03	17		17			4		17		4.2	
4.2						5	203 20Yr	-0.650	0.815	0.043	0.035	0.035	20		20			4		20		4.2	
4.3	1	10	2	0.230	4.334	5	203 20Yr	-0.650	0.815	0.060	0.049	0.049	27		27		0.03PH	4 SAG		27		4.3	
4.4						5	203 20Yr	-0.650	0.815	0.030	0.024	0.024	14		14			4		14		4.5	
4.5						5	203 20Yr	-0.650	0.815	0.030	0.025	0.025	14		14			4		14		4.6	
4.6						5	203 20Yr	-0.650	0.815	0.030	0.025	0.025	14		14			4		14		4.7	
4.7						5	203 20Yr	-0.650	0.815	0.035	0.028	0.028	16		16			4		16		4.8	
5.1						5	203 20Yr	-0.9	0.908	0.049	0.044	0.044	25		25	1	1.514	1	1.2	25		5.2	
6.1						5	203 20Yr	-0.9	0.908	0.013	0.012	0.012	7		7	1	0.731	1	1.2	7		6.2	
6.2						5	203 20Yr	-0.9	0.908	0.027	0.024	0.024	14		14	1	1.124	1	1.2	14		7.1	
7.1						5	203 20Yr	-0.9	0.908	0.018	0.016	0.016	9		9	2	0.702 0.03PH	1 SAG	1.2	9			
7.2						5	203 20Yr	-0.650	0.815	0.167	0.136	0.136	77		77	1	4.826 0.03PH	4 SAG		77		7.2	
7.3						5	203 20Yr						268 ADP		268			4		ADP	268		

HYDRAULIC DESIGN SHEET

PIT	TIME	INTENSITY	AREAS	FLOW	LENGTH	DIAMETER	GRADE	H.G.L.GRADE	VEL Q/A	K	HEAD LOSS	VEL CAP	PIPE VEL	PIPE CAP	PIPE TIME	C=C.W., N=MANNINGS MAX TIME 20 WARRIEWOOD BY PASS=AREA AREA=SUM.CA REMARKS
	min	mm/hr	ha	L/s	m	mm	%	%	m/s		m	m/s	m/s	L/s	min	
LINE 1 1.1-1.2	5	202 20Yr	0.023	13	6.242 C0.0003	381	1	0.005	0.113	4.7	0.003	2.007	0.98	229	0.11	
1.2-2.2	5.1	201 20Yr	0.054	30	36.582 C0.0003	381	1	0.02	0.263	3	0.011	2.007	1.2	229	0.51	
LINE 2 2.1-2.2	5	202 20Yr	0.044	25	6.261 C0.0003	381	1	0.015	0.218	4.7	0.011	2.007	1.15	229	0.09	
2.2-3.3	5.6	194 20Yr	0.192	104	13.657 C0.0003	381	1	0.219	0.91	2.8	0.118	2.007	1.73	229	0.13	
LINE 3 3.1-3.2	5	202 20Yr	0.019	11	5.05 C0.0003	381	1	0.003	0.093	4.7	0.002	2.007	0.94	229	0.09	
3.2-3.3	5.1	201 20Yr	0.077	43	14.042 C0.0003	381	1	0.04	0.377	3.4	0.025	2.007	1.31	229	0.18	
3.3-3.4	5.7	193 20Yr	0.296	159	29.309 C0.0003	381	1	0.501	1.391	2.7	0.267	2.007	1.97	229	0.25	
3.4-3.5	6	190 20Yr	0.356	188	4.661 C0.0003	381	1	0.7	1.65	1.1	0.153	2.007	2.07	229	0.04	
LINE 4 4.1-4.2	5	202 20Yr	0.03	17	7.502 C0.00006	152	1	0.57	0.938	1.8	0.081	1.371	1.34	25	0.09	
4.2-4.3	5.1	201 20Yr	0.065	36	7.736 C0.00006	229	1	0.31	0.884	1.8	0.072	1.759	1.57	72	0.08	
4.3-4.4	5.2	200 20Yr	0.114	63	15 C0.00006	229	1	0.875	1.535	1.8	0.216	1.759	1.85	72	0.14	
4.4-4.5	5.3	198 20Yr	0.138	76	7.699 C0.00006	229	1	1.243	1.846	1	0.174	1.759	1.9	72	0.07	
4.5-4.6	5.4	197 20Yr	0.163	89	7.507 C0.00006	305	1	0.402	1.222	-0.1	-0.008	2.09	1.95	153	0.06	
4.6-4.7	5.4	196 20Yr	0.187	102	8.368 C0.00006	305	1	0.52	1.4	0.8	0.08	2.09	2.04	153	0.07	
4.7-4.8	5.5	195 20Yr	0.215	117	2.533 C0.00006	305	3	0.673	1.605	0.8	0.105	3.621	3.11	265	0.01	
LINE 5 5.1-5.2	5	202 20Yr	0.044	25	7.071 C0.0003	381	1	0.015	0.218	4.7	0.011	2.007	1.15	229	0.1	
LINE 6 6.1-6.2	5	202 20Yr	0.012	7	33.414 C0.0003	381	1.5	0.002	0.06	4.7	0.001	2.458	0.97	280	0.57	
6.2-7.1	5.6	195 20Yr	0.036	20	14.339 C0.0003	381	1.5	0.009	0.172	3.8	0.006	2.458	1.28	280	0.19	
LINE 7 7.1-7.2	5.8	192 20Yr	0.053	196 ADP	14.412 C0.0003	610	1	0.068	0.671	3.2	0.073	2.681	1.92	784	0.13	
7.2-7.3	5.9	191 20Yr	0.189	268 ADP	3.528 C0.0003	610	1	0.124	0.917	4.1	0.176	2.681	2.12	784	0.03	
7.3-7.4	5.9	191 20Yr	-0.287 -0.476	268 ADP	26.203 C0.0003	610	2.348	0.124	0.917	0.2	0.009	4.108	2.85	1201	0.15	

CC

1:100 @ A1 1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: DRAINAGE LINE 7
DRAINAGE NOTES & CALCULATION SHEETS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
H.1:200 V.1:100	24.6.14	
	Datum A.H.D.	L.G.A. PITTWATER

Calc's A.D. Drawn. C.G.H. Proj.Man. A.D. Client Ref:

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1736C CC 01 [E] - 025

A1

HYDROLOGICAL DESIGN SHEET

PIT	LAND USE	FLOW LENGTH	SLOPE	"n"	TIME	TIME	INTENSITY	CODE	COEFF	AREA	C.A	SUM AREA	Q	BY PASS	TOTAL FLOW	GUTTER SLOPE	FLOW WIDTH	PIT TYPE	LINTEL	INFLOW	BY FLOW	BY PIT	KINEMATIC MIN TIME 5 MAX TIME 20 WARRIEWOOD REMARKS
		m	%		min	min	mm/h			ha	ha	ha	L/s	L/s	L/s	%	m		m	L/s	L/s		
9.1						5	203 20Yr	-0.650	0.815	0.140	0.114	0.114	64		64	1	2.272	1	1.8	64		8.2	
8.1						5	203 20Yr	-0.650	0.815	0.169	0.138	0.138	78		78	0.7	2.639	1	1.8	78		8.2	
8.2						5	203 20Yr	-0.9	0.908	0.070	0.064	0.064	36		36	0.7	2.459 0.03PH	1 SAG	1.2	36			
8.3						5	203 20Yr									1.4		1	1.2	ADP			
8.4						5	203 20Yr									1.4		5		ADP			

HYDRAULIC DESIGN SHEET

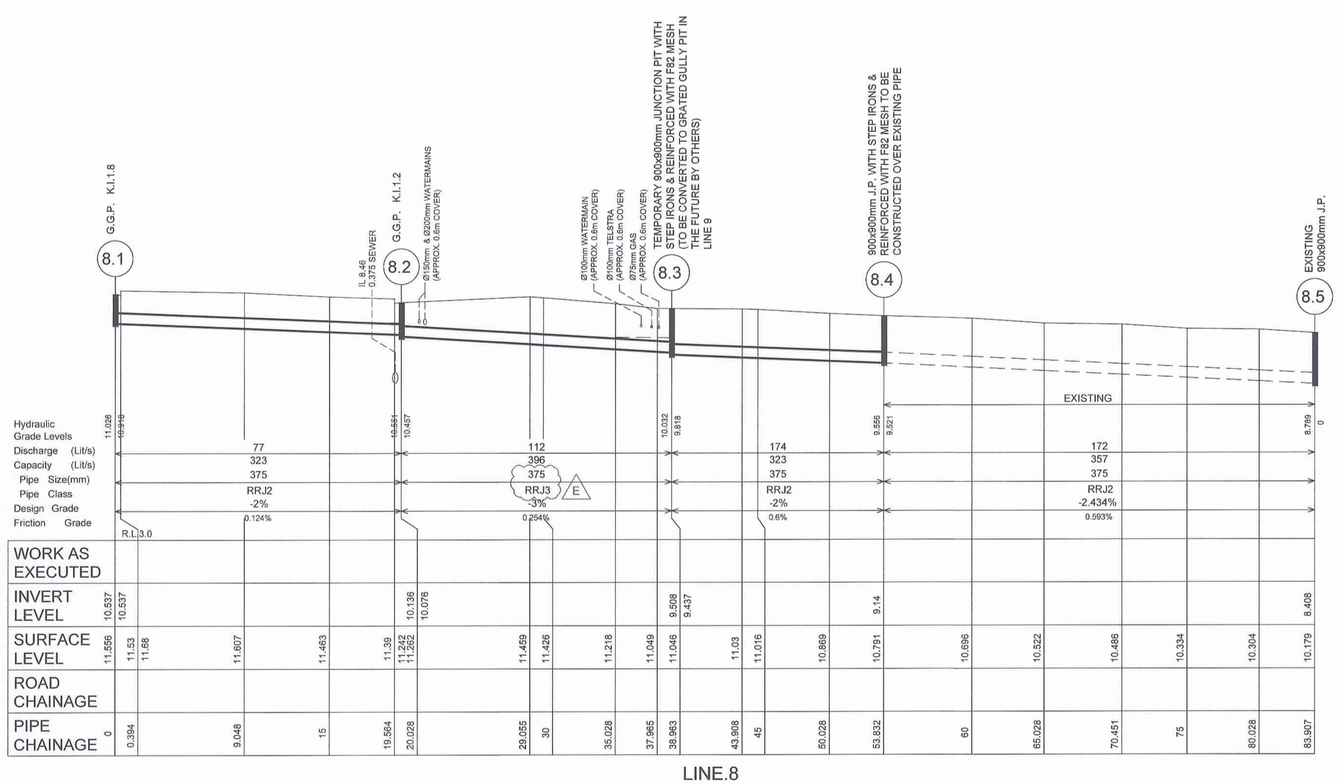
PIT	TIME	INTENSITY	AREAS	FLOW	LENGTH	DIAMETER	GRADE	H.G.L.GRADE	VEL Q/A	K	HEAD LOSS	VEL CAP	PIPE VEL	PIPE CAP	PIPE TIME	C=C.W., N=MANNINGS MAX TIME 20 WARRIEWOOD BY PASS=AREA AREA=SUM.CA REMARKS
	min	mm/hr	ha	L/s	m	mm	%	%	m/s		m	m/s	m/s	L/s	min	
LINE 9 9.1-8.3	5	202 20Yr	0.114	64	25.699 C0.0003	381	2	0.086	0.561	3.2	0.051	2.839	1.89	324	0.23	
LINE 8 8.1-8.2	5	202 20Yr	0.138	78	20.028 C0.0003	381	2	0.124	0.68	4.6	0.109	2.839	2.01	324	0.17	
8.2-8.3	5.2	200 20Yr	0.202	112	18.935 C0.0003	381	3	0.254	0.984	1.9	0.094	3.477	2.6	396	0.12	
8.3-8.4	5.3	198 20Yr	0.315	174	14.869 C0.0003	381	2	0.6	1.526	1.8	0.214	2.839	2.59	324	0.1	
8.4-8.5	5.4	197 20Yr	0.315	173	30.075 C0.0003	381	2.434	0.593	1.517	0.3	0.035	3.131	2.76	357	0.18	

This plan/specification forms part of Construction Certificate No.....15.1.15..... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

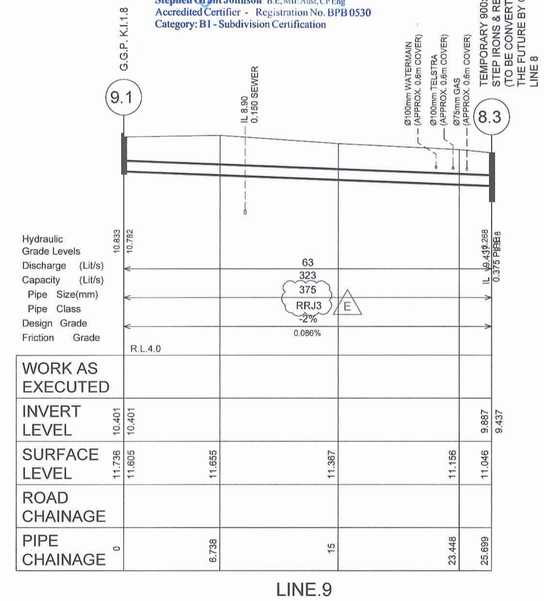
.....

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



LINE.8

H=1:200 V=1:100



LINE.9

H=1:200 V=1:100

CC

1:100 @ A1

1:200 @ A1

AMEND No. E DATE 24.6.14 DETAILS PIPE CLASS AMENDED FROM PIT 8.2 TO PIT 8.3 & PIT 9.1 TO PIT 8.3

DIAL 1100 BEFORE YOU DIG

Project: DRAINAGE LINES 8 & 9
DRAINAGE CALCULATION SHEETS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
H.1:200 V.1:100	24.6.14	
Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.
Client Ref:		

CRAIG & RHODES

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ACN 050 209 591
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90th ANNIVERSARY 1923 - 2013

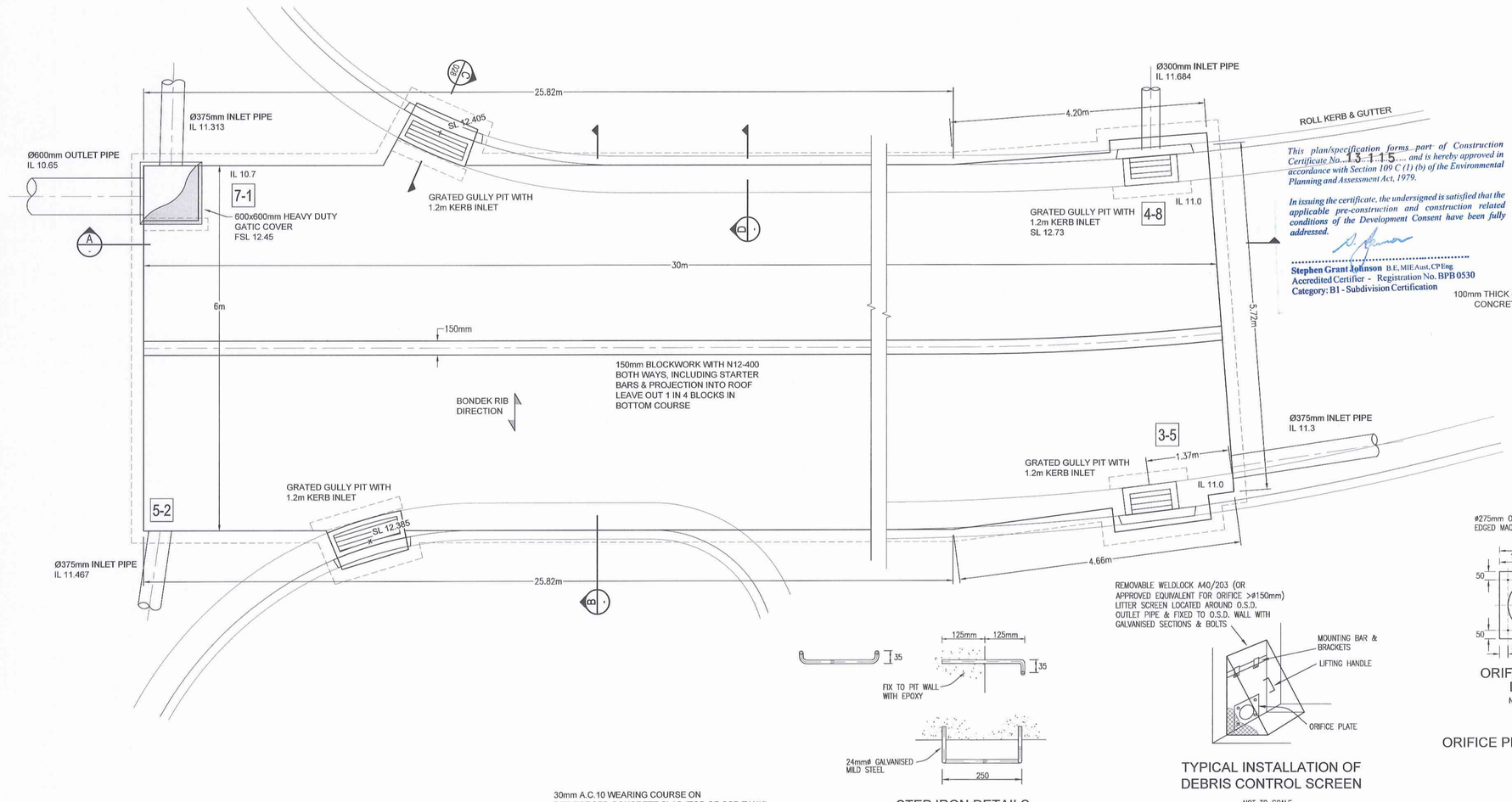
ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 026

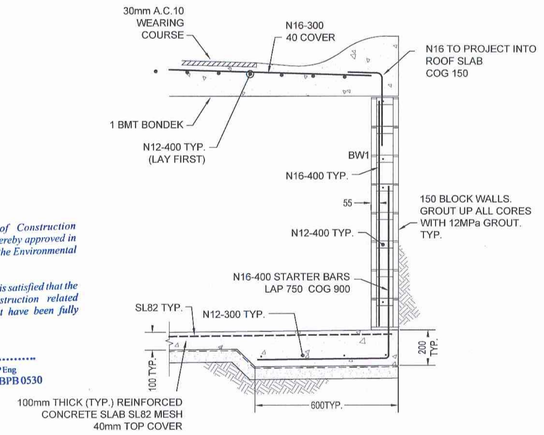
A1



This plan/specification forms part of Construction Certificate No. 1.3.1.1.5 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

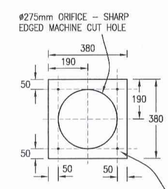
Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



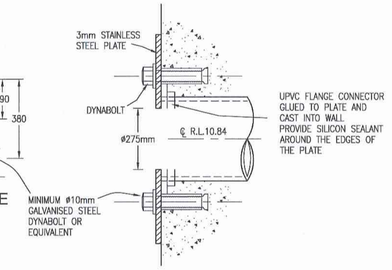
D - OSD TANK - DETAIL
TYPICAL WALL SECTION
NOT TO SCALE

STEP IRON DETAILS
NOT TO SCALE

TYPICAL INSTALLATION OF
DEBRIS CONTROL SCREEN
NOT TO SCALE



ORIFICE PLATE
DETAIL
NOT TO SCALE



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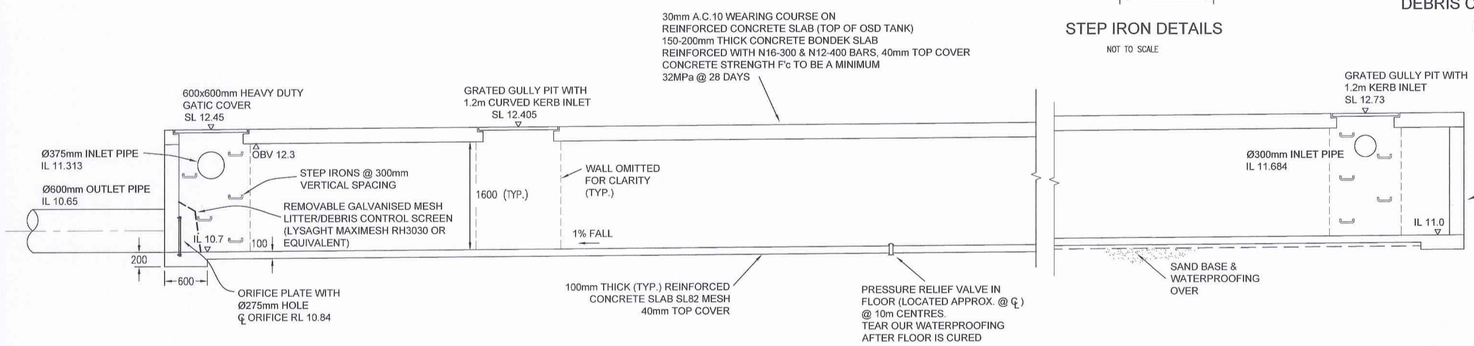
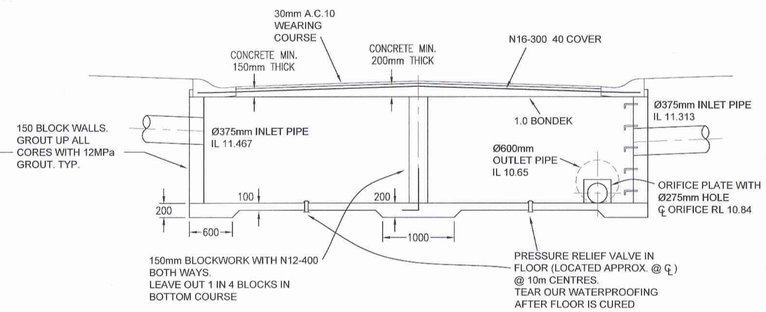
NOT TO SCALE



A - ON-SITE DETENTION TANK
SECTION
NOT TO SCALE



B - ON-SITE DETENTION TANK
SECTION
NOT TO SCALE

DANGER
CONFINED SPACE
NO ENTRY WITHOUT
CONFINED SPACE
TRAINING

CONFINED SPACE DANGER SIGN
COLOURS – 'DANGER' & BACKGROUND – WHITE
ELIPTICAL AREA – RED
RECTANGLE CONTAINING ELIPSE – BLACK
OTHER LETTERING & BORDER – BLACK

A) A CONFINED SPACE DANGER SIGN SHALL BE POSITIONED IN A LOCATION AT ALL ACCESS POINTS SUCH THAT IT IS CLEARLY VISIBLE TO PERSONS PROPOSING TO ENTER THE BELOW GROUND TANK/S CONFINED SPACE

B) MINIMUM DIMENSIONS OF THE SIGN
– 300mm x 450mm (LARGE ENTRIES SUCH AS DOORS)
– 250mm x 180mm (SMALL ENTRIES SUCH AS GRATES & MAN-HOLES)

C) THE SIGN SHALL BE MANUFACTURED FROM COLOUR BONDED ALUMINIUM OR POLYPROPYLENE

D) SIGN SHALL BE AFFIXED USING SCEWS AT EACH CORNER OF THE SIGN AND/OR SUITABLE EPOXY GLUE/CEMENT

ENGINEERS AUSTRALIA
R.C. SPRINGETT
R. Springett
BE(Aust) CPEng
Chartered Professional Engineer
NPER (122223)

CC

DIAL 1100 BEFORE YOU DIG

Project: O.S.D. TANK DETAILS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date 24.6.14	Council Ref.
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref:

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1736C CC 01 [E] - 027

A1

GENERAL

1) THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS, SPECIFICATIONS AND OTHER INSTRUCTIONS ISSUED FOR THE WORKS. ANY DISCREPANCIES SHALL BE REFERRED TO THE ARCHITECT IMMEDIATELY FOR RESOLUTION.
2) DIMENSIONS SHALL NOT BE OBTAINED BY SCALING.
3) DIMENSIONS FOR SETTING OUT AND OF EXISTING WORKS SHALL BE VERIFIED BY THE BUILDER.
4) THE BUILDER SHALL AT ALL TIMES OBSERVE RECOGNISED GOOD BUILDING PRACTICE, CONFORMING TO ALL RELEVANT CODES. HE SHALL MAINTAIN THE WORKS IN A SAFE AND STABLE CONDITION AT ALL TIMES.
5) TRUSS LAYOUT AND/OR PITCHING POINTS FOR ROOF LOADS TO BE APPROVED BY ENGINEER BEFORE CONSTRUCTION.

FOOTINGS

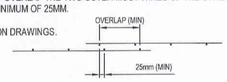
1) THE FOOTINGS HAVE BEEN DESIGNED FOR MATERIAL WITH A MINIMUM BEARING CAPACITY OF 1000 KPA UNLESS OTHERWISE NOTED. THIS IS TO BE CONFIRMED BY A QUALIFIED GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF CONCRETE.

EXCAVATION & FILLING

1) TOP SOIL CONTAINING GRASS, ROOTS OR OTHER ORGANIC MATERIAL SHALL BE REMOVED FROM THE AREA ON WHICH THE SLAB IS TO BE CONSTRUCTED.
2) IF THE SITE CONDITIONS ENCOUNTERED VARY FROM THE CONDITIONS INDICATED ON THE DRAWINGS OR REPORTED IN THE GEOTECHNICAL REPORT, THE STRUCTURAL ENGINEER AND/OR THE GEOTECHNICAL ENGINEER SHOULD BE NOTIFIED IMMEDIATELY.
3) FILL USED IN THE CONSTRUCTION OF A SLAB EXCEPT WHERE THE SLAB IS SUSPENDED SHALL CONSIST OF CONTROLLED FILL OR ROLLED FILL IN ACCORDANCE WITH AS 2870 CLAUSE 6.4.2.
4) CONTROLLED FILL
4.A) SAND FILL UP TO 800MM DEEP COMPACTED IN LAYERS NOT MORE THAN 300MM THICK USING A VIBRATING PLATE OR VIBRATING ROLLER.
4.B) NON-SAND FILL UP TO 400MM THICK COMPACTED IN LAYERS NOT MORE THAN 150MM THICK USING A MECHANICAL ROLLER. CLAY FILL SHALL BE MOIST DURING COMPACTION.
5) ROLLED FILL CONSISTS OF MATERIAL COMPACTED IN LAYERS BY REPEATED ROLLING WITH AN EXCAVATOR. SAND FILL UP TO 600MM DEEP COMPACTED IN LAYERS NOT MORE THAN 300MM THICK. NON-SAND FILL UP TO 300MM DEEP COMPACTED IN LAYERS NOT MORE THAN 150MM THICK.
6) BACK FILL MATERIAL SHALL BE COMPACTED TO A DENSITY EQUIVALENT TO AT LEAST 95% OF ITS MAXIMUM DRY DENSITY.

REINFORCEMENT

1) ALL REINFORCING BAR AND FABRIC IS DESIGNATED AS INDICATED BELOW:
R - DENOTES GRADE 250 HOT ROLLED PLAIN BARS TO AS/NZS 4671-2001.
S - DENOTES GRADE 250 HOT ROLLED DEFORMED BARS TO AS/NZS 4671-2001.
N - DENOTES GRADE D500N DEFORMED BARS TO AS/NZS 4671-2001.
SL/RL - DENOTES GRADE D500L SQUARE/RECTANGULAR MESH TO AS/NZS 4671-2001.
TM - DENOTES TRENCH MESH TO AS/NZS 4671-2001.
2) THE FIGURES FOLLOWING THE MESH DESIGNATION IS THE REFERENCE NUMBER FOR FABRIC TO AS/NZS 4671-2001.
3) REINFORCEMENT IS SHOWN DIAGRAMMATICALLY AND NOT NECESSARILY IN TRUE PROJECTION.
4) SLAB REINFORCEMENT SHALL EXTEND AT LEAST 75MM ONTO MASONRY SUPPORT WALLS AND 50 PERCENT OF THE BOTTOM REINFORCEMENT SHALL BE COGGED TO ACHIEVE ANCHORAGE AT SIMPLY SUPPORTED ENDS.
5) FABRIC SHALL BE LAPPED SUCH THAT THE TWO OUTER MOST WIRES OF ONE SHEET OVERLAP THE TWO OUTER MOST WIRES OF THE OTHER SHEET BY A MINIMUM OF 25MM.
6) NOTATION ON DRAWINGS.



N12-300
- SPACING (mm)
- BAR SIZE (mm)
- TYPE OF REINF.

3N24
- BAR SIZE (mm)
- TYPE OF REINF.
- NUMBER OF BARS.

7) SPLICES IN REINFORCEMENT SHALL NOT BE MADE EXCEPT AS INDICATED ON THE DRAWINGS OR APPROVED BY THE ENGINEER.
8) ALL REINFORCEMENT SHALL BE ADEQUATELY SUPPORTED TO ENSURE POSITION IS MAINTAINED DURING PLACEMENT OF CONCRETE. THIS MAY BE ACHIEVED BY USING PURPOSE MADE STEEL OR PLASTIC SUPPORTS DEPENDING ON THE EXPOSURE CONDITION TO ACHIEVE THE REQUIRED CONCRETE COVER TO REINFORCEMENT. SUPPORTS SHALL BE LOCATED AT NOT MORE THAN 50 BAR DIAMETERS EACH WAY FOR BARS AND NOT MORE THAN 800MM EACH WAY FOR MESH.
9) A MINIMUM OF 24 HOURS NOTICE SHALL BE GIVEN FOR INSPECTION OF THE REINFORCEMENT BY THE ENGINEER AS REQUIRED BY THE SPECIFICATION.

CONCRETE

1) ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3600.
2) CONCRETE QUALITY

ELEMENT	STRENGTH (MPa)	MAX. AGG. SIZE (mm)	SLUMP (mm)
FOOTINGS	20	20	80
SLAB ON GROUND	25	20	80
PIERS	20	20	60
SUSPENDED SLABS	40	20	80
COLUMNS	40	20	80

3) NO ADMIXTURES SHALL BE USED IN CONCRETE UNLESS APPROVED BY THE ENGINEER. ADMIXTURES CONTAINING CHLORIDES WILL NOT BE APPROVED.
4) SIZES OF CONCRETE ELEMENTS DO NOT INCLUDE APPLIED FINISHES.
5) DEPTH OF BEAMS AND BANDS ARE GIVEN FIRST AND INCLUDE SLAB THICKNESS.
6) NO HOLES, CHASES OR EMBEDMENT OF PIPES OR OTHER REDUCTION IN MEMBER DIMENSIONS OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS WITHOUT THE PRIOR WRITTEN APPROVAL OF THE ENGINEER.

CONCRETE (CONT')

7) CLEAR CONCRETE COVER TO REINFORCEMENT FOR DURABILITY AND FIRE RESISTANCE SHALL BE AS FOLLOWS UNLESS SHOWN OTHERWISE.

ELEMENT	INTERNAL ENVIRONMENT	EXTERNAL ENVIRONMENT	CAST AGAINST GROUND
FOOTINGS	-	-	40
SLAB ON GROUND	20	45	30*+
PIERS	-	-	60
SLABS	20 TOP 30 BTM	45	30*+
COLUMNS	45	45	-

*+ IF PROTECTED BY A VAPOUR PROOF MEMBRANE OTHERWISE 40MM.

8) CONDUITS, PIPES ETC. WILL ONLY BE ALLOWED TO BE LOCATED IN THE MIDDLE ONE THIRD OF THE SLAB DEPTH AND SPACED AT NOT LESS THAN THREE DIAMETERS. PIPES OR CONDUITS SHALL NOT BE PLACED IN THE COVER ZONE TO THE REINFORCEMENT.
9) CONSTRUCTION JOINTS SHALL BE AS SHOWN OR TO THE APPROVAL OF THE ENGINEER.
10) SLABS AND BEAMS SHALL BE CONSTRUCTED TO ONLY BE SUPPORTED ON THE BEAMS, WALLS, COLUMNS ETC. AS SHOWN ON THE STRUCTURAL DRAWINGS. ALL OTHER BUILDING ELEMENTS SHALL BE KEPT A MINIMUM OF 15MM CLEAR FROM THE SOFFITS OF THE STRUCTURE UNLESS NOTED OTHERWISE.
11) THE FINISHED CONCRETE SHALL BE A HOMOGENEOUS MASS FREE OF POCKETS, COMPLETELY FILLING THE FORMWORK AND THOROUGHLY EMBEDDING THE REINFORCEMENT. ALL CONCRETE SHALL BE COMPACTED USING MECHANICAL VIBRATORS.
12) WHERE THE VERTICAL FACE CONCRETE IS PLACED AGAINST BRICKWORK, A 10MM JOINT OF COMPRESSIBLE MATERIAL SHALL BE PLACED AGAINST THE BRICKWORK FOR THE FULL DEPTH OF THE CONCRETE.
13) CURING OF ALL CONCRETE IS TO BE ACHIEVED BY KEEPING SURFACES CONTINUOUSLY WET FOR A PERIOD OF 7 DAYS, UNLESS SPECIFIED OTHERWISE. APPROVED SPRAY ON CURING COMPOUNDS THAT COMPLY WITH AS3799 MAY BE USED WHERE FLOOR FINISHES WILL NOT BE AFFECTED. POLYTHENE SHEETING OR WET HESSIAN MAY BE USED TO RETAIN CONCRETE MOISTURE WHERE PROTECTED FROM WIND AND TRAFFIC. CURING IS TO COMMENCE IMMEDIATELY AFTER CONCRETE PLACEMENT.
14) CONSTRUCTION SUPPORT PROPPING IS TO BE LEFT IN PLACE WHERE NEEDED TO AVOID OVERSTRESSING THE STRUCTURE DUE TO CONSTRUCTION LOADING. NO BRICKWORK OR PARTITION WALLS ARE TO BE CONSTRUCTED ON SUSPENDED LEVELS UNTIL ALL PROPPING IS REMOVED AND THE SLAB HAS DEFLECTED UNDER ITS SELF WEIGHT.

REINFORCED BLOCKWORK

1) MASONRY BLOCKS SHALL BE GRADE 12 (AS/NZS 4455), LAID WITH MORTAR MIXED 1 CEMENT, 0.1 LIME AND 3 SAND. CORE GROUT SHALL HAVE MAX. 10MM AGGREGATE IN A 20MPA MIX, 230 SLUMP.
2) ALL BLOCKS SHALL BE DOUBLE 'U' BLOCKS U.N.O.
3) PROVIDE CLEAN-OUT SPACE AT THE BASE OF EACH CORE. GROUTING SHOULD NOT EXCEED LIFTS OF 800MM. LIFT STAGES SHOULD BE AT LEAST 30MINUTES APART.
4) FILL SHALL NOT BE PLACED BEHIND BLOCKWORK WALLS UNTIL THE CORE GROUT IS AT LEAST 7 DAYS OLD, AND SHALL NOT PROCEED PAST HALF DEPTH UNTIL CORE GROUT IS 21 DAYS OLD.

STRUCTURAL STEELWORK

1) ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS4100 AND AS1554 EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
2) UNLESS OTHERWISE NOTED, ALL STEEL SHALL BE:
- GRADE 250 HOT ROLLED PLATES, ANGLES 100X100 EA OR 125X75 UA AND SMALLER.
- GRADE 300 FOR UB'S, UC'S, PFC'S AND LARGER ANGLES.
- GRADE 300 FOR WB'S AND WC'S.
- GRADE 350 FOR RHS, SHS AND CHS.

3) UNLESS OTHERWISE NOTED, ALL WELDS SHALL BE 6MM CONTINUOUS FILLET FROM E48XX ELECTRODES. ALL WELDS SHALL BE CATEGORY GP, ALL BOLTS M16 COMMERCIAL GRADE AND ALL CLEATS AND GUSSETS 8MM PLATE.
4) FOR BOLTS OTHER THAN AS NOTED ABOVE, THE FOLLOWING NOTATION IS USED: BOLTS - DESIGNATED BY THE NUMBER, DIAMETER, GRADE AND TIGHTENING PROCEDURE.
EG. 4M16 4.6/S DENOTES 4 NO. M16Ø COMMERCIAL GRADE BOLTS, SNUG TIGHT.
6M20 8.8/TF DENOTES 6 NO. M20Ø HIGH STRENGTH STRUCTURAL BOLTS FULLY TENSIONED IN A NO SLIP JOINT.
6M24 8.8/TB DENOTES 6 NO. M24Ø HIGH STRENGTH STRUCTURAL BOLTS FULLY TENSIONED IN A BEARING JOINT (SOME SLIP ALLOWED)
5) COMMERCIAL GRADE BOLTS SHALL CONFORM TO AS1111 AND AS4100. HIGH STRENGTH STRUCTURAL BOLTS SHALL CONFORM TO AS1252 AND AS4100. WELDS SHALL CONFORM TO AS1554 AND WELDING ELECTRODES TO AS1553.
6) STRUCTURAL STEELWORK SHALL HAVE THE FOLLOWING SURFACE TREATMENT IN ACCORDANCE WITH AS2312 AND THE SPECIFICATION: ALL EMBEDDED STRUCTURAL STEELWORK SHALL BE HOT-DIP GALVANISED. ALL EXPOSED STRUCTURAL STEELWORK SHALL BE GALVANISED OR EQUIVALENT. SHELTERED STEELWORK SHALL BE GALVANISED OR PAINTED WITH A PRIMER AND A ZINC-RICH PAINT. ALL SITE WELDS SHALL BE CLEANED AND MADE GOOD WITH TWO COATS OF A ZINC-RICH PAINT.

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R.C. SPRINGETT
R. Springett
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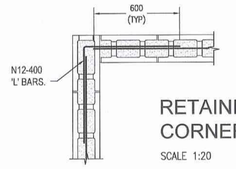
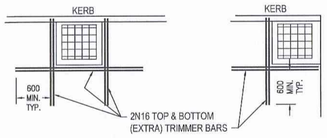
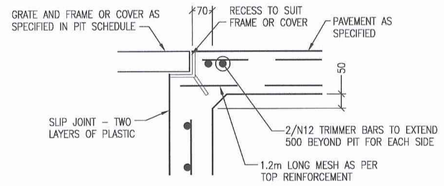
Chartered Professional Engineer
NPER (172273)



RETAINING WALL CORNER DETAIL
SCALE 1:20



TYPICAL TRIMMER BARS AROUND PIT
SCALE 1:50



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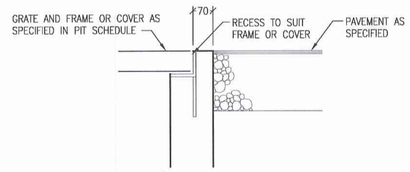

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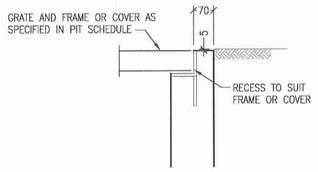

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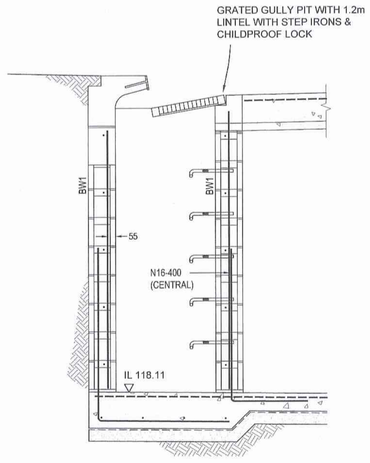
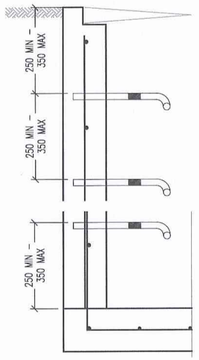


C
027

BELOW GROUND OSD
SECTION
SCALE 1:20



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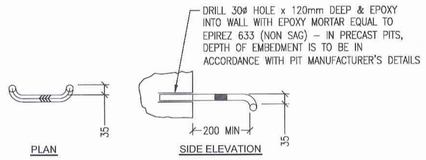
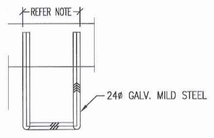


PLAN
SIDE ELEVATION



PLAN
SCALE 1:10

PIT ACCESS STEP DETAILS

NOTES
1. WHEN POSITIONED IN STRAIGHT ALIGNMENT, STEP TO BE 400 WIDE.
2. STAGGERED STEPS TO BE 200 WIDE, STEPS TO BE STAGGERED 200. CENTRE TO CENTRE FOR ALTERNATE STEPS.
3. SPACING OF STEPS TO BE UNIFORM TO WITHIN ±8mm IN EACH PIT.

This plan/specification forms part of Construction Certificate No. ...13..1..15... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

DIAL 1100 BEFORE YOU DIG

Project: O.S.D. TANK DETAILS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date 24.6.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj Man. A.D.	Client Ref:

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Our Ref. 1736
Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [E] - 028

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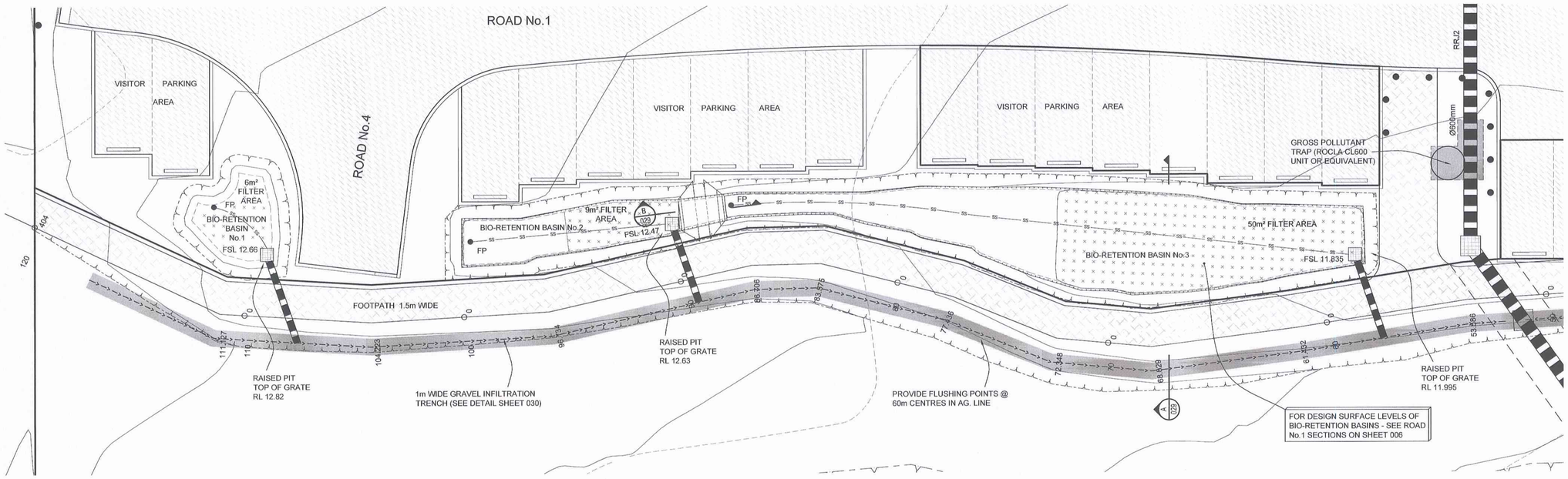
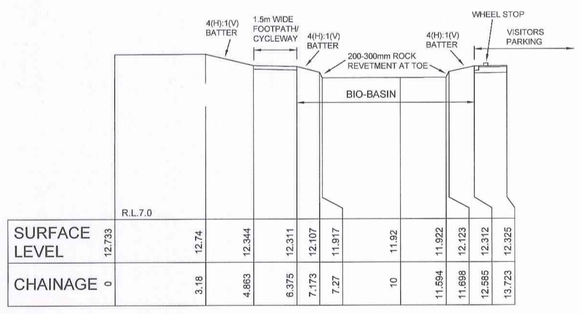


This plan/specification forms part of Construction Certificate No.....1.5.1.1.5..... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

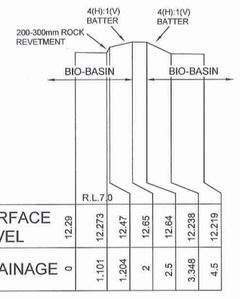
In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification



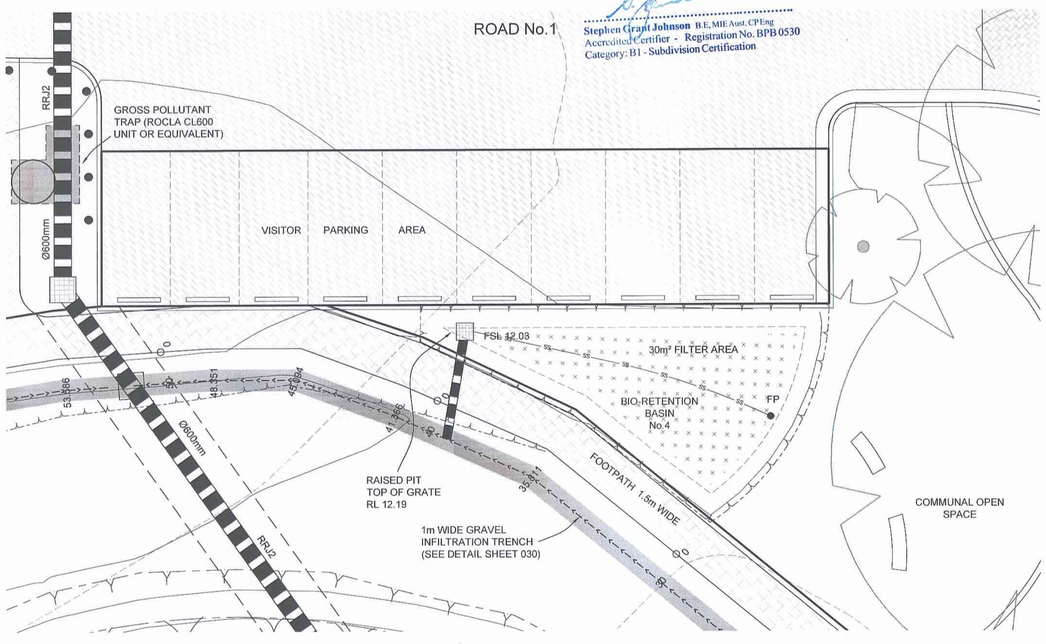
SURFACE LEVEL	12.733	12.74	12.344	12.311	12.107	11.917	11.92	11.922	12.123	12.312	12.325
CHAINAGE	0	3.18	4.863	6.375	7.173	7.27	10	11.594	11.698	12.585	13.723

A 029 BIO-BASIN TYPICAL SECTION
H=1:100 V=1:100



SURFACE LEVEL	12.29	12.273	12.47	12.65	12.64	12.238	12.219
CHAINAGE	0	1.101	1.204	2	2.5	3.348	4.5

B 029 BIO-BASIN SEPARATION MOUND SECTION
H=1:100 V=1:100



CC

ORIGIN OF LEVELS: P.M.6871 R.L.11.04 (A.H.D.) VIDE SCIMS DATED 21/11/07

5 4 3 2 1 0 5
1:100 @ A1

Civil Cert

DIAL 1100 BEFORE YOU DIG

Project: BIO RETENTION BASIN PLAN & SECTIONS

Principal:	WARRIEWOOD PROPERTIES PTY LTD				
Scale	1:100	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.
Client Ref:					

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Our Ref. 1736

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1736C CC 01 [E] - 029

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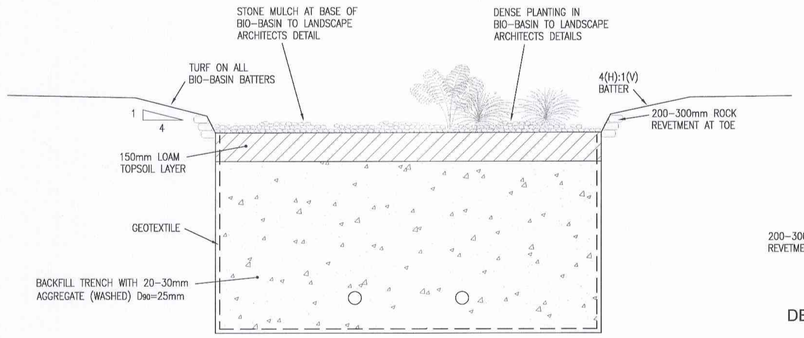
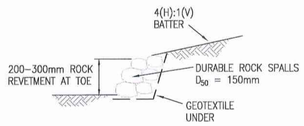


2 x ø90 SUBSOIL LINES CONNECTED TO NEXT DOWNSTREAM PIT. BOTH LINES RETURNED AT UPSTREAM END AND CONNECTED TO FLUSHING POINT (FP)

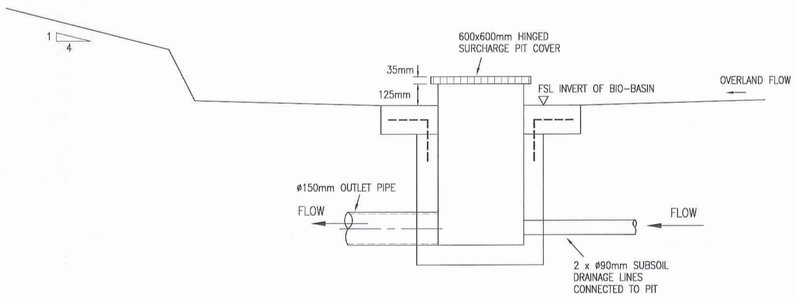
TYPICAL BIO-RETENTION BASIN DETAIL

NOT TO SCALE



DETAIL FOR ROCK REVETMENT

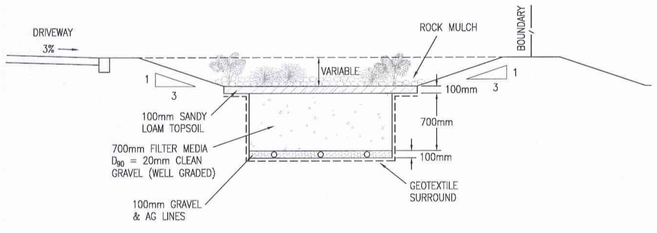
NOT TO SCALE



TYPICAL RAISED PIT DETAIL

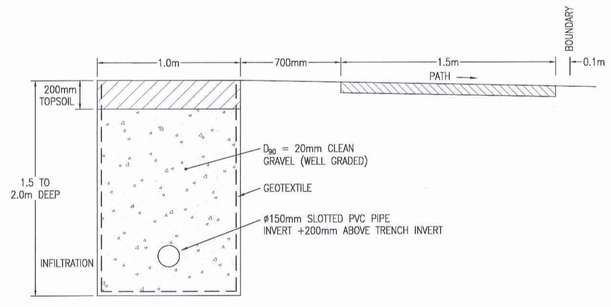
(BIO-RETENTION BASIN OUTLETS)

NOT TO SCALE



TYPICAL LOT RAIN GARDEN DETAIL

NOT TO SCALE



TYPICAL GRAVEL INFILTRATION TRENCH DETAIL

NOT TO SCALE

BIO-RETENTION BASIN TABLE

MEASURE TYPE	SURFACE AREA (m²)	INVERT LEVEL (m AHD)	PONDING DEPTH (mm)	FILTER AREA (m²)	TOTAL FILTER DEPTH (m)	PONDING VOLUME (m³)
BIO-BASIN No.1	10	12.500	400	5	1	3.2
BIO-BASIN No.2	25		400	13	1	6.6
BIO-BASIN No.3	120		400	60	1	19.2
BI-BASIN No.4	45		400	23	1	6.6
LOT 9-25 FRONTYARD BIO-BASINS (17 No.)	3m²/LOT	VARIES	200	1.5m²/LOT	0.9	0.6m³/LOT
LOT 9 - 25 BACKYARD BIO-BASINS (17 No.)	6m²/LOT	VARIES	400	3m²/LOT	0.9	2.4m³/LOT
LOT 26 - 38 FRONTYARD BIO-BASINS (13 No.)	5m²/LOT	VARIES	400	2.5m²/LOT	0.9	2m³/LOT

O.S.D. TABLE

MEASURE TYPE	STORAGE VOLUME (m³)	EFFECTIVE DETENTION (%)	O.S.D. VOLUME (m³)
LOT 9 - 25 RAINWATER TANKS (3kL)	51	25	12.75
FOCAL NEIGHBOURHOOD CENTRE RAINWATER TANK (10kL)	10	25	2.500
LOT 39-46 RIANWATER TANKS (1kL)	8	25	2
LOT 26-38 RAINWATER TANKS (3kL)	39	25	9.75
BIO-BASIONS 1-4	35.6	100	35.6
ABOVE GROUND PONDING ROAD No.1 SAG	71.7	100	71.7
ROAD No.2 U/G O.S.D. TANK	255	100	255
LOT 9 - 25 FRONTYARD BIO-BASINS (3m² x 0.2m DEEP)	10.2	100	10.2
LOT 9 - 25 BACKYARD BIO-BASINS (6m² x 0.4m DEEP)	40.8	100	40.8
LOT 26 - 38 FRONTYARD BIO-BASINS (5m² x 0.4m DEEP)	26	100	26
TOTAL			466.3m³
TOTAL REQUIRED			464m³

This plan/specification forms part of Construction Certificate No. 15.1.15 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E. MIEAust CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

CC

Civil Cert

DIAL 1100 BEFORE YOU DIG

Project: BIO-BASIN & RAIN GARDEN DETAILS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
N.T.S.	24.6.14	
	Datum A.H.D.	L.G.A. PITTWATER

Calc's A.D. | Drawn. C.G.H. | Proj.Man. A.D. | Client Ref:

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Our Ref. 1736

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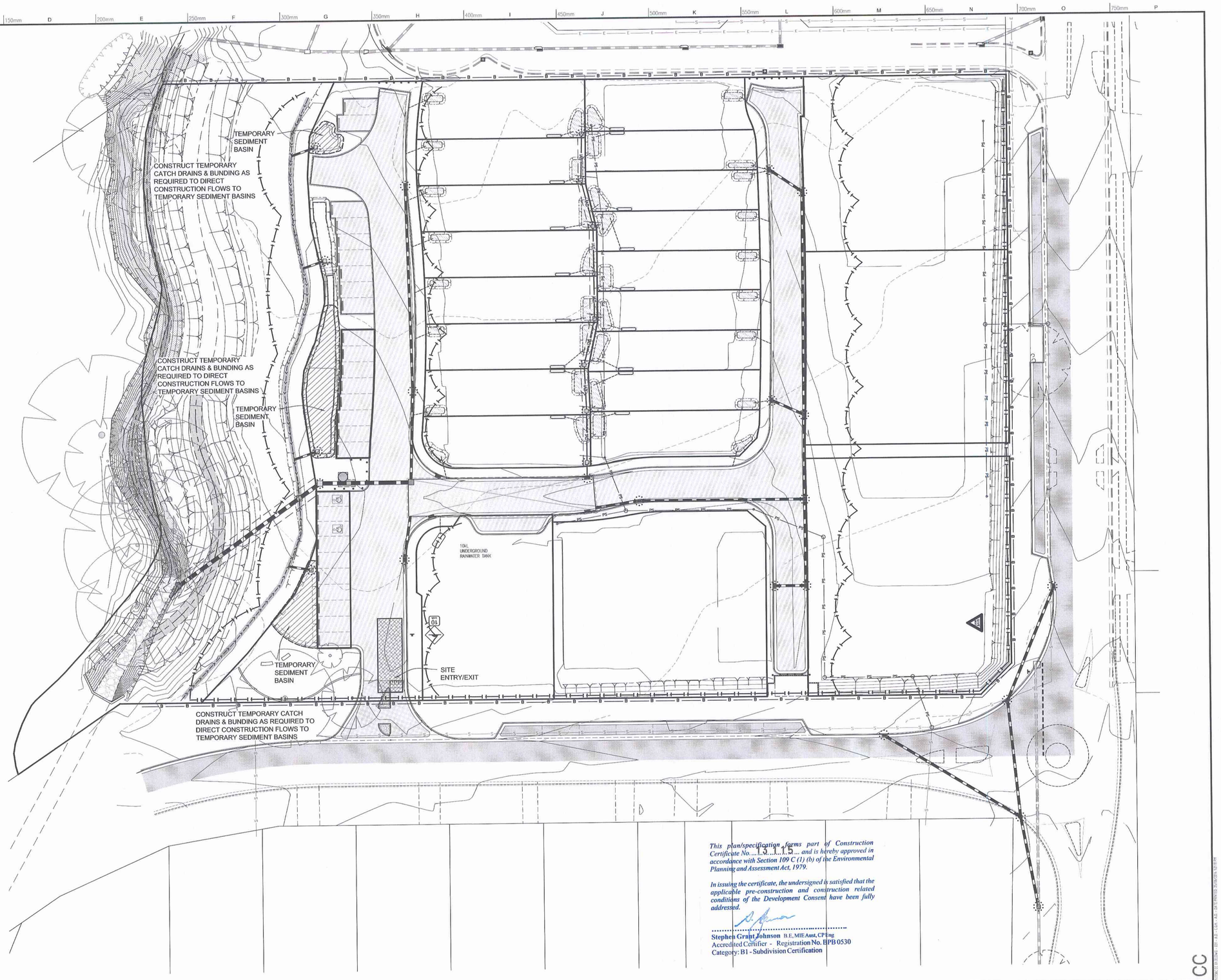
LEGEND

- SEDIMENT FENCE
- BARRIER FENCE
- i) GEOTEXTILE INLET FILTER DURING CONSTRUCTION
- ii) MESH & GRAVEL INLET FILTER AFTER CONSTRUCTION
- STRAW BALE FILTER
- STABILISED SITE ACCESS

10 8 6 4 2 0 15

1:300 @ A1



This plan/specification forms part of Construction Certificate No. 15 and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E, MIE Aust, CPEng
Accredited Certifier - Registration **No. BPB 0530**
Category: **B1 - Subdivision Certification**

CC

DIAL 1100 BEFORE YOU DIG

Project: SEDIMENT & EROSION CONTROL PLAN

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:300	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref.

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90th ANNIVERSARY 1923 - 2013

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Our Ref. 1736

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1736C CC 01 [E] - 031

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NOTES

1. THIS PLAN IS TO BE READ IN CONJUNCTION WITH OTHER ENGINEERING PLANS AND ANY WRITTEN INSTRUCTIONS THAT MAY BE ISSUED.

2. PITTWATER COUNCIL IS TO RE-INSPECT TREES PRIOR TO THE CONSTRUCTION WORKS COMMENCING.

3. THE CONTRACTOR SHALL IMPLEMENT ALL SOIL EROSION AND SEDIMENT CONTROL MEASURES PRIOR TO DISTURBANCE OF THE RELATED CATCHMENT AREA AND TO THE STANDARDS OF 'MANAGING URBAN STORMWATER, SOILS & CONSTRUCTION' & PITTWATER COUNCIL SPECIFICATIONS

4. ALL SUBCONTRACTORS SHALL BE INFORMED OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWN SLOPE AREAS.

5. LAND DISTURBANCE SHALL BE LIMITED TO THAT NECESSARY FOR IMPLEMENTATION OF THE PLANS OF WORKS. BUFFER ZONES AND LANDS NOT TO BE DISTURBED SHALL BE CLEARLY MARKED WITH BARRIER FENCES. "SILT" FENCES OR STRAW BALE SEDIMENT TRAPS SHALL BE PLACED AT REGULAR INTERVALS IMMEDIATELY DOWNSLOPE OF ALL UNPROTECTED DISTURBED LANDS.

6. THE LOCATION OF "SILT" FENCES, BARRIER FENCES, SEDIMENT TRAPS AND OTHER DEVICES ARE INDICATIVE ONLY AND FINAL LOCATIONS ARE TO BE DECIDED ON SITE. VARIATIONS WILL BE PERMITTED TO BEST SUIT THE CIRCUMSTANCES.

7. ALL SOIL EROSION AND SEDIMENT CONTROL STRUCTURES SHALL BE INSPECTED FOLLOWING EACH STORM EVENT AND ANY NECESSARY MAINTENANCE WORK SHALL BE UNDERTAKEN TO ENSURE THEIR CONTINUED PROPER OPERATION. SEDIMENT SHALL BE REMOVED FROM THE THE SOIL EROSION & SEDIMENT CONTROL STRUCTURES WHEN NO MORE THAN 40% CAPACITY HAS BEEN REACHED. THESE STRUCTURES SHALL CONTINUE IN PROPER OPERATION UNTIL ALL DEVELOPMENT ACTIVITIES HAVE BEEN COMPLETED AND THE SITE FULLY STABILISED.

8. TEMPORARY REHABILITATION SHALL BE UNDERTAKEN WITHIN 14 WORKING DAYS ON DISTURBED AREAS WHERE WORKS HAVE STOPPED AND SOILS ARE EXPECTED TO REMAIN EXPOSED FOR MORE THAN 14 DAYS BEFORE EITHER WORKS CONTINUE OR PERMANENT REHABILITATION IS UNDERTAKEN.

9. A 300mm WIDE STRIP OF TURF IS TO BE LAID BEHIND ALL KERBS.

10. 1.0m WIDE TURFING IS TO BE PLACED AROUND ALL SURFACE INLET PITS.

11. AT LEAST WEEKLY, THE CONTRACTOR WILL INSPECT THE SITE, PROVIDING PARTICULAR ATTENTION TO THE FOLLOWING MATTERS :
(A) ENSURE DRAINS OPERATE EFFECTIVELY AND INITIATE REPAIR AS REQUIRED.
(B) REMOVE SPILLED SAND (OR OTHER MATERIALS) FROM HAZARD AREAS, INCLUDING LANDS CLOSER THAN 5 METRES FROM LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS AND PAVED AREAS.
(C) REMOVE TRAPPED SEDIMENT WHENEVER LESS THAN DESIGN CAPACITY REMAINS.
(D) ENSURE REHABILITATED LANDS HAVE EFFECTIVELY REDUCED THE EROSION HAZARD AND INITIATE UPGRADING OR REPAIR AS APPROPRIATE.
(E) CONSTRUCT ADDITIONAL EROSION AND/OR SEDIMENT CONTROL WORKS AS MIGHT BECOME NECESSARY TO ENSURE THE DESIRED PROTECTION IS GIVEN TO DOWNSLOPE LANDS AND WATERWAYS, i.e. MAKE ONGOING CHANGES TO THE PLAN.
(F) MAINTAIN EROSION AND SEDIMENT CONTROL MEASURES IN A FUNCTIONING CONDITION UNTIL ALL EARTHWORK ACTIVITIES ARE COMPLETED AND THE SITE IS REHABILITATED.
(G) REMOVE TEMPORARY SOIL CONSERVATION STRUCTURES AS A LAST ACTIVITY IN THE REHABILITATION PROGRAM.

12. THE CONTRACTOR WILL KEEP A LOG BOOK, MAKING ENTRIES AT LEAST WEEKLY AND IMMEDIATELY PRIOR TO FORECAST RAINFALL AND/OR SITE CLOSURE. RECORD:
(I) THE VOLUME OF ANY RAINFALL EVENTS;
(II) THE CONDITION OF ANY SOIL AND WATER MANAGEMENT WORKS;
(III) APPLICATIONS OF FLOCCULATING AGENTS TO SEDIMENT RETENTION SYSTEMS:
(IV) VOLUMES OF WATER DISCHARGED FROM SEDIMENT RETENTION SYSTEMS; AND
(V) REMEDIAL WORKS. THE BOOK WILL BE KEPT ON-SITE AND MADE AVAILABLE TO ANY AUTHORISED PERSON ON REQUEST. IT WILL BE GIVEN TO THE PROJECT MANAGER AT THE CONCLUSION OF WORKS. COPIES OF MONTHLY ENTRIES ARE TO BE PROVIDED WITH PROGRESS CLAIMS.

13. DO NOT TAINT CLEAN CATCHMENT WATER WITH SILT FROM THE WORKS.

14. FACILITIES AND/OR EQUIPMENT MUST BE PROVIDED FOR THE APPLICATION OF WATER TO DISTURBED AREAS TO MINIMISE THE GENERATION OF AIRBORNE DUST FROM ANY AREA DISTURBED BY CONSTRUCTION ACTIVITIES. DUST CONTROL MEASURES SHALL BE IMPLEMENTED CONTINUOUSLY DURING CONSTRUCTION WORKS TO THE SATISFACTION OF THE SUPERINTENDENT AND COUNCIL.

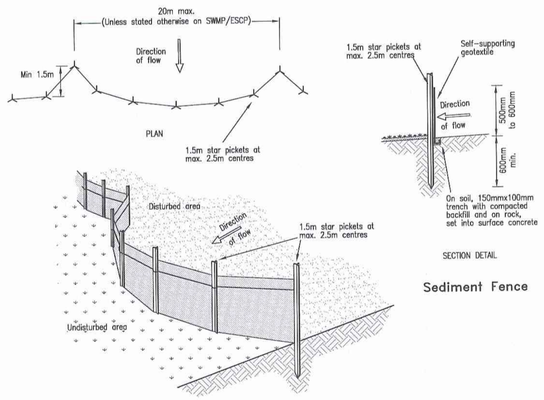
15. MATERIAL REMOVED FROM SEDIMENT CONTROL STRUCTURES MUST BE DISPOSED OF IN A WAY THAT DOES NOT POLLUTE WATERS OR BUSHLAND AND DISPOSED OF TO AN APPROVED DUMP SITE.

16. RUNOFF FROM VEHICLE OR CONSTRUCTION PLANT MAINTENANCE AND CLEANING AREAS SHALL BE COLLECTED AND DISPOSED OF IN A MANNER THAT DOES NOT POLLUTE.

17. CONFORMITY WITH THIS PLAN SHALL IN NO WAY REDUCE THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT AGAINST WATER DAMAGE DURING THE COURSE OF THE CONTRACT.

18. ALL POSITIONS SHOWN ARE APPROXIMATE AND ARE BEST DETERMINED ON SITE IN CONJUNCTION WITH THE SUPERINTENDENT.

19. DUST SCREENS ARE TO BE ERECTED AROUND THE PERIMETER OF THE WORK SITE DURING LAND CLEARING, EXCAVATIONS & CONSTRUCTIONS AS DIRECTED BY THE SITE SUPERVISOR.

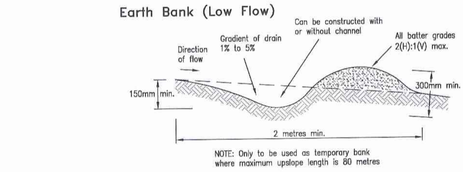


Sediment Fence

CONSTRUCTION NOTES

SEDIMENT FENCE

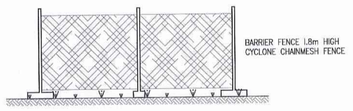
1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BE PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING, TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 litres/sec IN THE DESIGN STORM EVENT, USUALLY THE 10 YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX.) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS, ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES, OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.



CONSTRUCTION NOTES

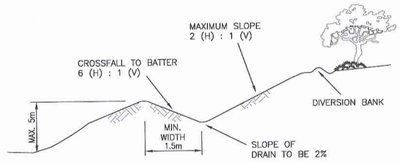
EARTH BANK (LOW FLOW)

1. BUILD WITH GRADIENTS BETWEEN 1% AND 5%.
2. AVOID REMOVING TREES AND SHRUBS IF POSSIBLE – WORK AROUND THEM.
3. ENSURE THE STRUCTURES ARE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT COULD IMPEDE WATER FLOW.
4. BUILD THE DRAINS WITH CIRCULAR, PARABOLIC OR TRAPEZOIDAL CROSS SECTIONS, NOT V SHAPED.
5. ENSURE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE.
6. COMPLETE PERMANENT OR TEMPORARY STABILISATION WITHIN 10 DAYS OF CONSTRUCTION.



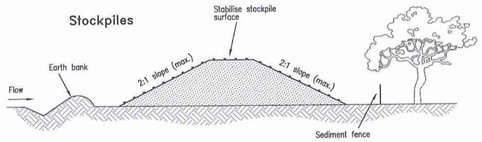
BARRIER FENCE

NOT TO SCALE



Specification for Batter Construction

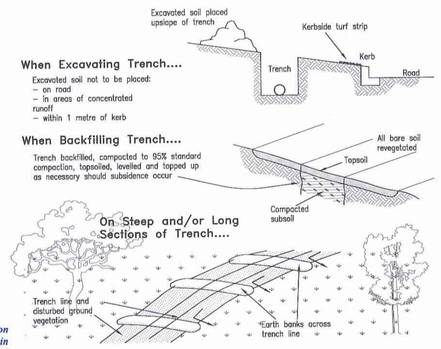
NOT TO SCALE



CONSTRUCTION NOTES

STOCKPILES

1. PLACE STOCKPILES MORE THAN 2 (PREFERABLY 5) METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.
2. CONSTRUCT THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT.
4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LESS THAN 0.10
5. CONSTRUCT EARTH BANKS ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES 1 TO 2 METRES DOWNSLOPE.

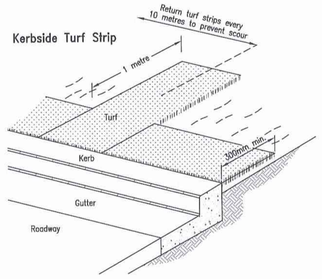


Utility Construction

CONSTRUCTION NOTES

UTILITY CONSTRUCTION

1. DO NOT OPEN ANY TRENCH UNLESS IT IS LIKELY TO BE CLOSED IN THREE DAYS.
2. PLACE EXCAVATED MATERIAL UPSLOPE OF TRENCH.
3. STOCKPILE TOPSOIL SEPARATELY FROM SUBSOIL.
4. DIVERT RUNOFF FROM THE LINE OF CUT WITH DIVERSIONS AS DIRECTED BY STANDARD DRAWING 5-2 (RECP SHEET FLOW).
5. REHABILITATE IN ACCORDANCE WITH SPECIFICATION.



CONSTRUCTION NOTES

KERBSIDE TURF STRIPS

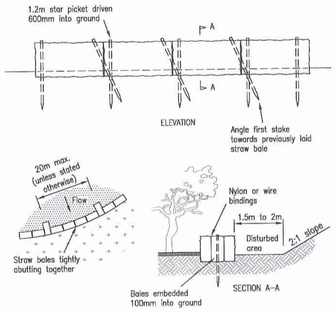
1. INSTALL A 300mm MINIMUM WIDE ROLL OF TURF ON THE FOOTPATH NEXT TO THE KERB AND AT THE SAME LEVEL AS THE TOP OF THE KERB.
2. LAY 1.4m LONG TURF STRIPS NORMAL TO THE KERB EVERY 10m.
3. REHABILITATE DISTURBED SOIL BEHIND THE STRIP FOLLOWING THE ESCP/SWMP.

This plan/specification forms part of Construction Certificate No ....5.....1.....5..... and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

Stephen Grant Johnson B.E. MIEAust, CPEng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

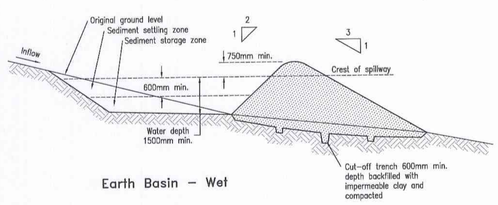
Straw Bale Filter



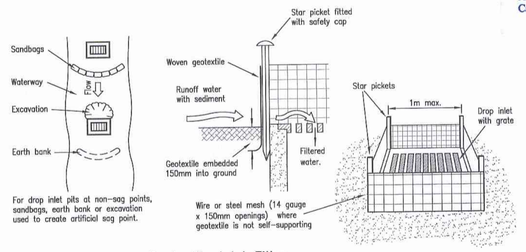
CONSTRUCTION NOTES

STRAW BALE FILTERS

1. CONSTRUCT THE STRAW BALE FILTER AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DIAGRAM TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN THE BALES. THE STRAWS IN EACH BALE ATE TO BE ALIGNED PARALLEL TO THE GROUND.
3. ENSURE THAT THE MAXIMUM HEIGHT OF THE FILTER IS ONE BALE.
4. EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH 1.2m STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm INTO THE GROUND AND, IF POSSIBLE, FLUSH WITH THE TOP OF THE BALES. WHERE STAR PICKETS ARE USED AND THEY PROTRUDE ABOVE THE BALES, ENSURE THEY ARE FITTED WITH SAFETY CAPS.
5. WHERE A STRAW BALE FILTER IS CONSTRUCTED DOWNSLOPE FROM A DISTURBED BATTER, ENSURE BALES ARE PLACED 1m TO 2m DOWNSLOPE FROM THE TOE.
6. ESTABLISH A MAINTENANCE PROGRAM THE ENSURES THE INTEGRITY OF THE BALES IS RETAINED – THEY COULD REQUIRE REPLACEMENT EACH TWO TO FOUR MONTHS.



Earth Basin – Wet

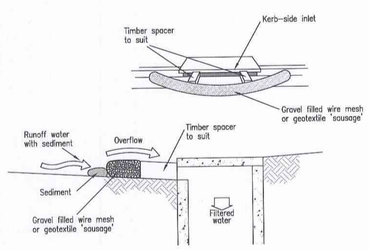


Geotextile Inlet Filter

CONSTRUCTION NOTES

DROP INLET FILTERS

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OF STRAW BALES.
2. FOLLOW STANDARD DRAWINGS OF STRAW BALE FILTERS AND SEDIMENT FENCES FOR INSTALLATION PROCEDURES FOR THE STRAW BALES OR GEOFABRIC. REDUCE THE PICKET SPACING TO 1m CENTRES.
3. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
4. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.



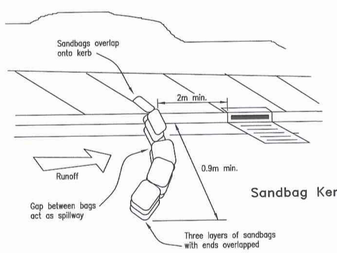
Note: This practice only to be used where specified in an approved SWMP/ESCP

Mesh and Gravel Inlet Filter

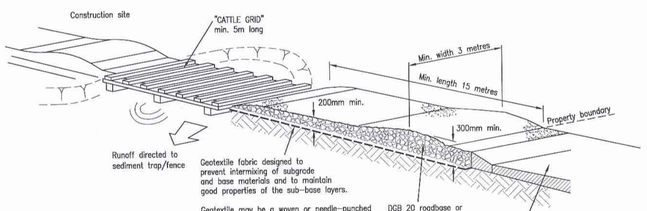
CONSTRUCTION NOTES

KERB INLET FILTERS

1. INSTALL FILTERS TO KERB INLETS ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH BY 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET. MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING THE FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OF GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN THEM.



Sandbag Kerb Inlet Sediment Trap



Stabilised Site Access

CONSTRUCTION NOTES

STABILISED SITE ACCESS

1. STRIP THE TOPSOIL, LEVEL THE SITE & COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15 METRES LONG OR TO BUILDING ALIGNMENT AND AT LEAST 3 METRES WIDE.
5. WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.

CC

DIAL 1100 BEFORE YOU DIG

Project: SEDIMENT & EROSION CONTROL NOTES

Principal:	WARRIEWOOD PROPERTIES PTY LTD				
Scale	N.T.S.	Date	24.6.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref.

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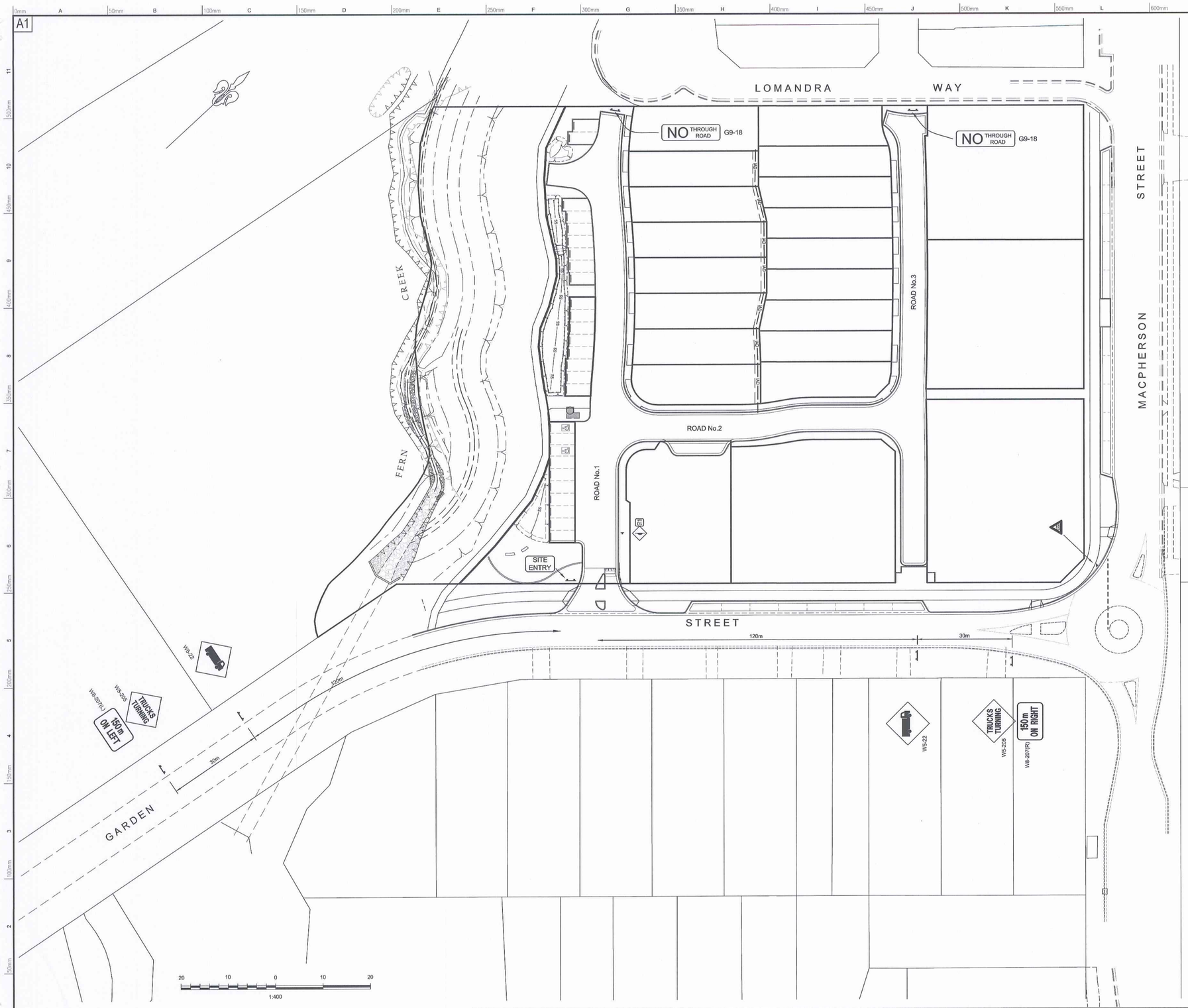
90th ANNIVERSARY 1923 - 2013

ISO 9001 Approved Company

Our Ref.	1736
Dwg File Ref. [Rev] - Sheet Ref.	1736C CC 01 [E] - 032



This plan/specification forms part of Construction Certificate No.....13/115..., and is hereby approved in accordance with Section 109 C (1) (b) of the Environmental Planning and Assessment Act, 1979.

In issuing the certificate, the undersigned is satisfied that the applicable pre-construction and construction related conditions of the Development Consent have been fully addressed.

.....

Stephen Grant Johnson B.E, MIE Aust, CP Eng
Accredited Certifier - Registration No. BPB 0530
Category: B1 - Subdivision Certification

TRAFFIC CONTROL PLAN NOTES

1. ALL WORK IS TO BE UNDERTAKEN DURING HOURS AS STATED IN THE CONDITIONS OF CONSENT BY PITTWATER COUNCIL.
2. ALL TRAFFIC CONTROL DEVICES MUST BE REMOVED & SIGNS TO BE COVERED AND/OR REMOVED OUTSIDE OF THESE TIMES & ALL LANES MUST REMAIN OPEN.
3. SIGNAGE TO BE PLACED SO AS TO ALLOW NORMAL VEHICULAR & PEDESTRIAN ACCESS AT ALL TIMES.
4. PLANT AND/OR MATERIAL TO BE STORED ON SITE & NOT ON THE GRASSED VERGE.
5. ALL SIGN SIZES TO BE CLASS A
6. PROVIDE A CONTAINMENT FENCE TO PREVENT WORKERS ENTERING THE FLOW OF TRAFFIC.
7. PROVIDE A TEMPORARY RAMP FOR PRAMS & A SAFE PATH FOR PEDESTRIANS AT ALL CROSSING POINTS & ENSURE A SAFE CROSSING POINT FOR ALL PEDESTRIAN TRAFFIC.
8. ARRANGE VEHICULAR ACCESS ACROSS THE WORK AREA USING PORTABLE BARRIERS OR PLASTIC MESH FENCING.
9. METAL PLATES AND/OR ALL-WEATHER MATERIAL (e.g. GRAVEL) TO BE PLACED OVER ANY EXCAVATIONS WHEN WORKS ARE NOT IN PROGRESS. ROAD SURFACE TO BE REINSTATED TO COUNCIL'S SATISFACTION AS SOON AS PRACTICABLY POSSIBLE.
10. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH A.S.1742.3 MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, PART 3: TRAFFIC CONTROL DEVICES FOR WORKS ON ROADS & THE R.T.A TRAFFIC CONTROL AT WORK SITES MANUAL, VERSION 4.0
11. ALL RELEVANT AUTHORITIES MUST BE NOTIFIED BEFORE COMMENCEMENT OF WORK.
12. THIS TRAFFIC CONTROL PLAN HAS BEEN SELECTED & MODIFIED IN ACCORDANCE WITH SECTION 4.2 OF THE R.T.A. TRAFFIC CONTROL AT WORK SITES MANUAL, VERSION 4.0

Fiona Gilbert

FIONA GILBERT DATED: 20.12.2013
(R.T.A. CERTIFICATE No. - 4162047451)
TRAFFIC CONTROL AT WORK SITES
SELECT/MODIFY TRAFFIC CONTROL PLANS

CC

DIAL 1100 BEFORE YOU DIG

Project: TRAFFIC CONTROL PLAN

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:400	Date 24.6.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref:

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Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [E] - 033

Civil Cert

WARRIEWOOD PROPERTIES

WARRIEWOOD VALLEY
23B MACPHERSON STREET (*PART OF SECTOR 8*)

Water Management Report
Construction Certificate Stage

Issue No. 3
JANUARY 2014

Civil Cert

WARRIEWOOD PROPERTIES

Warriewood Valley
23B Macpherson Street (*Part of Sector 8*)

Water Management Report
Construction Certificate Stage

Issue No. 3
JANUARY 2014

Document Amendment and Approval Record

Issue	Description of Amendment	Prepared by [date]	Verified by [date]	Approved by [date]
1	Final DA WMR	Mike Shaw	Mike Shaw	Mike Shaw
2	Final DA WMR	Mike Shaw	Mike Shaw	Mike Shaw
3	CC WMR	Mike Shaw	Mike Shaw	Mike Shaw

Note: This document is preliminary unless it is approved by a principal of Civil Certification.

Document Reference: **003 - civ cert -mjs -6-1-14 sect8 CC wmr (v3 final).doc**
Time and Date Printed: 6/01/2014 3:00:20 PM

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1 EXECUTIVE SUMMARY

This report is the Construction Certificate (*CC*) stage Water Management Report (*WMR*) for the proposed Warriewood Properties development of Sector 8, Warriewood Valley. It follows on from the Development Application (*DA*) issue water management report (*March 2011 and addendum dated May 2011*) detailing additional information gathered during the design process and where necessary recalibration of previously developed models.

1.1 CERTIFICATION

The contents of this report are certified by Michael Shaw, who is a registered NPER engineer with the Institution of Engineers, to comply with the requirements of Pittwater Council's WMS (*February 2001*).

Appendix A includes a signed copy of Councils CC document checklist.

1.2 WATER MANAGEMENT OBJECTIVES

Pittwater Council require consideration of the following elements of water management for any new development in Warriewood Valley:

- stormwater quantity management (*ie detention*);
- water quality monitoring;
- stormwater quality management;
- water balance (*ie. runoff volumes and reuse*);
- stormwater conveyance;
- flooding; and
- and stormwater drainage concept.

The objective is to create a Water Sensitive Urban Design (*WSUD*) that not only minimises impact but mimics the natural water cycle.

In consideration of this, the subject site has been designed with the following objectives:

- Ensuring peak runoff flow rates from the developed site do not exceed existing values;
- Ensuring the annual runoff volume generated by the development does not exceed existing values;
- Ensuring annual pollutant loads discharged from the developed site do not exceed existing values;
- Ensuring nil flood impact as a result of the development;
- Provision of safe and flood free development; and

- Minimising reliance on potable water for non-potable uses.

1.3 PROPOSED DEVELOPMENT

The proposed development is illustrated in **Appendix B** and in summary consist of the following:

- 38 residential lots incorporating attached dwellings;
- A Focal Neighbourhood Centre (*FNC*);
- Internal roads and visitor parking (*26 spaces*);
- A rehabilitated creek frontage; and
- All required servicing infrastructure.

It is proposed that the development would be created on a "*Community Title*" basis and hence the internal road and all other site infrastructure would be owned and maintained by the lot owners and not Pittwater Council.

The proposed development extent for the site achieves an impervious fraction of 56%, however when combined with the impervious areas for the remaining Sector, achieves a total impervious fraction of less than 50%.

1.4 CREEKLINE CORRIDOR

The proposed creekline corridor adjacent to the site will be rehabilitated resulting in an undisturbed average offset width of greater than 25m from the creek centreline (*ie calculated from the cadastral boundary*). No treatment facilities or roads will be located within this rehabilitated zone. The minimum offset from the creek centreline to any proposed hard surfaces is 22m and the maximum 30m. In addition, a second average 25m setback will be provided from this first zone which is to be clear of any new dwellings.

Unlike previous proposals for this site, no compensatory or online storage is proposed within the riparian corridor. Instead it is proposed that the northern half of the creekline be rehabilitated in line with Council's standard geometry as specified in the Water Management Specification.

The result will be similar to the already rehabilitated section of creek both upstream and downstream of the site.

Due to the narrow and restricted geometry of the existing creekline, the proposed reconstruction to Councils standard geometry will result in a significant increase in available waterway area (*estimated to increase by more than 200%)* and hence greatly improved flood conveyance.

Furthermore, the proposed rehabilitation and revegetation of this existing weed infested section of Creek will transform the area into a healthy and valuable riparian corridor.

1.5 STORMWATER QUANTITY

The integrated strategy for stormwater quantity management on the site is comprised of the following:

- source control which includes:
  - the use lot based rainwater tanks (*3KL for large lots (x30), 1KL for medium lots (x8) and 10KL tank for the Focal Neighbourhood Centre)* of which 25% will be utilised as OSD storage, therefore providing **27m^3** of detention volume. The rainwater tanks will not only aid in the reduction of runoff volume and minimise peak flows for more frequent storm event but they will also minimise reliance on use of potable water for non-potable uses;
  - the use of bio-retention swales/basins (*ie adjacent to the creek*) to promote infiltration and provide an effective detention volume of approximately **36m^3**;
  - the use of lot based raingardens to promote infiltration and provide an effective detention volume of approximately **77m^3**;
  - use of a 100m long infiltration trench adjacent to the creekside pathway; and
  - the use of landscaping which encourages the maximisation of infiltration.

- formal stormwater detention facilities which include:
  - A below ground stormwater detention tank under Road No. 3 resulting in a total detention volume of **255m^3**;
  - Creation of a shallow above ground storage volume (*active in 20-100yr ARI events only*) between the edge of the shared cyclepath and the creekside road (**71m^3**).

The total stormwater detention volume proposed for site is **466m^3**. Hence, stormwater detention storage is proposed at a rate of **402m^3/ha** (*based on a developable area of 1.159ha*). The proposed storage meets the detention rate of **400m^3/ha** stipulated in Council's WMS.

DA stage RAFTS modelling was used to assess the hydrology of the site under both pre and post development scenarios for a range of storm events and durations. This modelling showed that the proposed detention measures are effective in ensuring peak runoff flow rates from the developed site do not exceed existing values. No additional modelling was required for this CC stage report.

1.6 MONITORING STRATEGY

A water quality monitoring strategy has been formulated for the site in accordance with Council's Water Management Specification, to develop an understanding of the runoff water quality from the site in existing conditions and to measure the effectiveness of the stormwater quality treatment measures proposed to be implemented as part of the development.

Three monitoring sites have been established along Fern Creek. Results of the pre development phase water quality monitoring and biological indicators are provided in this report.

In the post-development phase it is proposed to continue monitoring at the above sites as well as the major inflow and outlet locations of the sites major treatment facilities.

1.7 STORMWATER QUALITY

A stormwater quality treatment strategy has been formulated for the proposed development that caters for both the construction phase and ultimate conditions.

During the construction phase, sediment and erosion control facilities will be designed and installed in accordance with the Council's specifications and the requirements of the publication titled "*Managing Urban Stormwater – Soils and Construction*" DECC NSW January 2008.

For ultimate conditions the proposed stormwater strategy incorporates the following elements:

- Three creek side bio-retention swales/basins (*total surface area of 200m^2*);
- A below ground gross pollutant trap (*GPT*);
- An infiltration trench (*100m long x 1m wide x 1.5 m deep*);
- Lot based raingardens;
- Lot based rainwater tanks and associated reuse; and
- Future neighbourhood shop rainwater tank (*10KL*) and associated reuse.

Long-term historical time series modelling of the performance of the proposed treatment train using MUSIC (ie over *dry, wet and average years*) demonstrates that the annual pollutant loads discharged from the developed site do not exceed existing values.

1.8 WATER BALANCE

The same MUSIC model that was used to simulate the performance of the sites stormwater treatment system was also used to assess the sites water balance. This modelling shows that the annual runoff volume generated by the development does not exceed existing values (*ie a Cv of 0.26)*.

1.9 STORMWATER CONVEYANCE AND FLOODING

The site is currently bounded by Fern Creek to the south which conveys flows from a moderately sized upstream catchment. The existing site is very flat and it appears that flows currently generated by the site would flow to Macpherson Street, Garden Street and Fern Creek.

It is proposed to fill the site and grade it so that the majority (*greater than 97%)* of the site will drain towards Fern Creek. This is in line with the assumptions of Council's Integrated Water Management Strategy (*IWMS*) for Warriewood Valley. It also reduces the quantity of flow and hence flooding experienced in Macpherson Street and redirects this flow to a purpose designed riparian/floodway corridor (*ie Fern Creek*).

A fill platform has been created across the site that ensures all new development is sited a minimum of 700mm above the 100yr ARI (*ie the FPL plus a 200mm allowance for climate change*). Hence no FC1 Section 149 flood notations would be required for the development.

The northern half of the existing creekline is proposed to be reconstructed in accordance with the standard dimensions specified in Council's Water Management Specification.

These works lead to a substantial increase in waterway area (ie *flood conveyance*) compared with existing conditions. This would lead to a marked decrease in 100yr ARI flood levels. However, for conservatism the existing July 2005 CLT derived 100yr ARI flood levels have been adopted to set floor levels for the proposed development.

The 100yr ARI and the majority of the PMF flows are fully contained within the reconstructed riparian corridor.

Previous modelling undertaken for the entire area of Sector 8 (*developed state*) by Lawson & Treloar shows that the proposed filling has no detrimental impact on PMF flooding for properties directly adjacent to or downstream of 23B Macpherson Street.

The floor levels of both the residential lots and focal neighbourhood centre have been sited above the flood planning level (*ie 100yr ARI plus 0.7m*).

A flood management/evacuation strategy is proposed for the site that ensures safety of all building occupants.

1.10 STORMWATER DRAINAGE CONCEPT PLAN

The elements of the proposed Stormwater Drainage Concept Plan (SDCP) for the subject site are illustrated in **Figure 1** and summarised as follows:

- The initial phases of the SDCP for the site have a significant emphasis on source control;
- All roof water is firstly captured by rainwater tanks on each site and then reused for toilet flushing, garden irrigation, car washing and laundry cold water;
- For the larger lots overflow from each rainwater tank and the majority of pervious surfaces on site are then directed to lot based raingardens which provide both a water quality and detention function;
- Runoff leaving each site then connects directly to the community road kerb and gutter and/or kerb side pits;
- A minor/major storm drainage philosophy has been adopted for the community component of the site;
- A 20yr ARI capacity trunk drainage line will convey flows to the single outlet in Fern Creek. Flows in excess of the 20yr ARI up to the 100yr ARI will be safely conveyed aboveground within the community road;
- The majority of the sites runoff enters a large underground detention tank ($255m^3$) located near the trunk pipe outlet beneath Road No. 3;

- Piped runoff will then be treated in a single GPT (*Rocla Cleansall CL600 or equivalent*) near the outlet of the site. For ease of maintenance access the GPT will be sited on the edge of Road No. 1;
- Low flow outflow from the GPT will be directed into a 100 long infiltration trench to aid in achievement of the pre development volumetric runoff coefficient. The trench is 1m wide and 1.5 m deep and is located along the batter on the creek side of the shared path. Water that cannot enter the trench will then flow directly to the outlet into Fern Creek;
- Runoff from the local catchment of the creekside component of the community road will be directed via 1 way cross fall (*av. 3%*) to a series of bio-swales/basins located between the road and the shared path. This runoff will then be treated by the swale and discharge via an underdrain to the main 20yr ARI capacity trunk drainage line for the site;
- Runoff from the local catchment of the focal neighbourhood centre will be directed to a 10KL rainwater tank and then overflow to the main detention tank beneath Road No. 3;
- It is proposed to construct the southern edge of the shared pathway running parallel to the creek approximately 150mm higher than the southern edge of the creekside community road. In larger storms (*20yr-100yr ARI*) this will provide above ground storage that will pond across the swales and part of the road to add to the sites stormwater detention (*approx. 71m^3*); and
- A change to the existing Sector 8 catchment draining to Fern Creek, will result following filling/development of the site. Under existing conditions a proportion of the site (*approximately 40%)* drains to Macpherson Street and Garden Street. In the proposed development of Sector 8, site regrading will be undertaken to direct around 97% of the sector to Fern Creek. A minor area of Sector 8 catchment will continue to drain to Macpherson Street , however it is so small that it does not warrant construction of additional drainage infrastructure. As detailed in **Section 4.2** of this report, flows under the post development scenario draining to the existing pit in Macpherson Street will be greatly reduced when compared to existing conditions (*ie in the 20yr ARI the flows to Macpherson are reduced from 0.096m^3/s under existing conditions to 0.001m^3/s under post development conditions*).

2 BACKGROUND

The proposed site (*23B Macpherson Street*) is located on the corner of Garden Street and Macpherson Street, Warriewood and is part of an area defined by Council for planning purposes as Sector 8.

The site is currently zoned as mixed residential with a total area of approximately 1.434 ha. The developable portion of the site is approximately 1.159ha.

Civil Certification has been engaged by Warriewood Properties to prepare a stormwater management report in support of the CC for the site.

This report provides details on how the sites stormwater is proposed to be managed in accordance with Pittwater Council's guidelines titled "Warriewood Valley Urban Land Release – Water Management Specifications (WMS)", (February, 2001).

This current report is for the CC stage and has been prepared based on the latest development layout (*refer to **Appendix B***) being constructed in a single stage.

A number of previous water management reports have been prepared for this site and Sector 8 as a whole. This report has been prepared in consideration of all these previous reports and in consultation with Pittwater Council.

3 EXISTING SITE CONDITIONS

The site is located at 23B Macpherson Street, Warriewood Valley and is bounded by Lomandra Way, Garden Street, Macpherson Street and Fern Creek.

The existing site is cleared land previously used for horticultural purposes.

An illustrating of the site and surrounding areas is contained in **Diagram 1**.

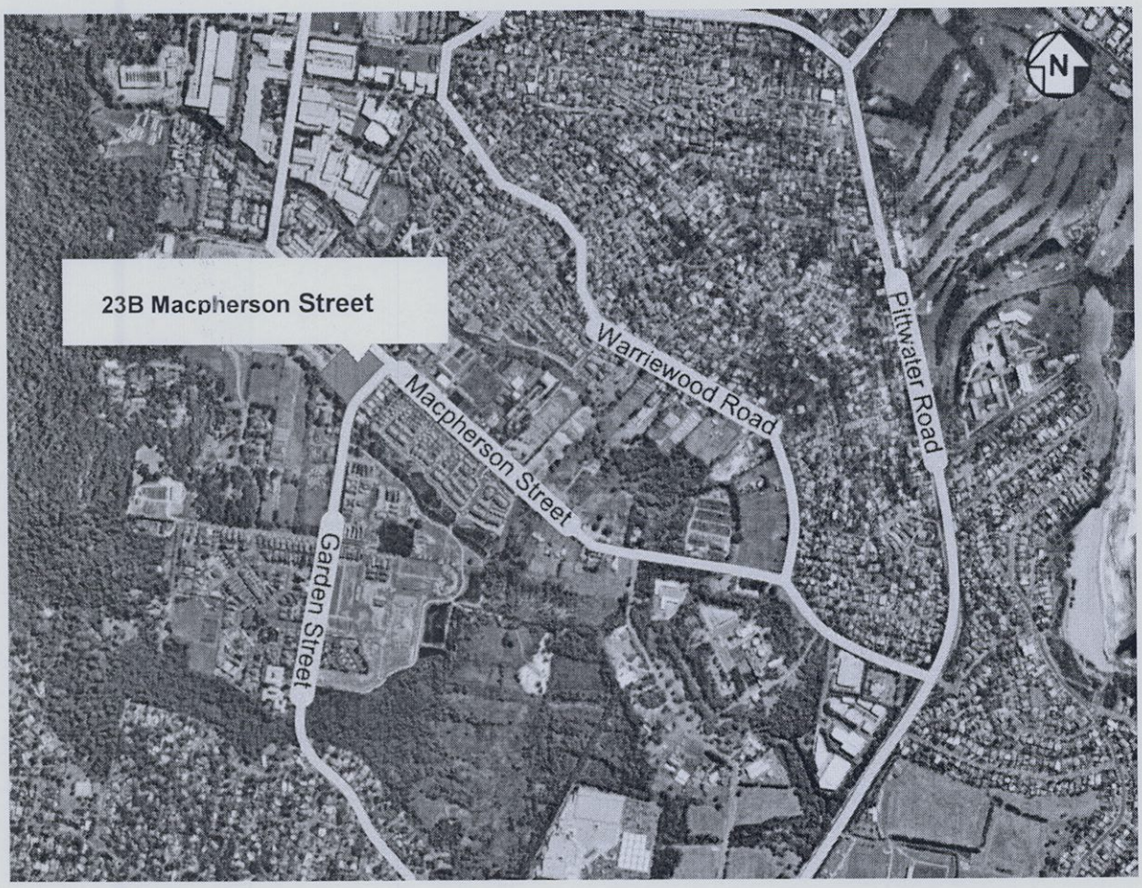


Diagram 1 - Locality Plan (*Not to Scale*)

3.1 EXISTING TOPOGRAPHY

The existing site is relatively flat and currently drains in three directions to Fern Creek, Garden Street and Macpherson Street.

The levels of the existing site are illustrated in **Diagram 2** and range from RL 13.2m AHD at the north western corner of the site to RL 11.5m AHD to the southeast. The highest level on the site is

RL 13.7m AHD and the lowest point is approximately 8.9m AHD at the culvert entrance at the downstream end of the site.

The vectored average slope for the site as a whole was calculated to be approximately 3%.

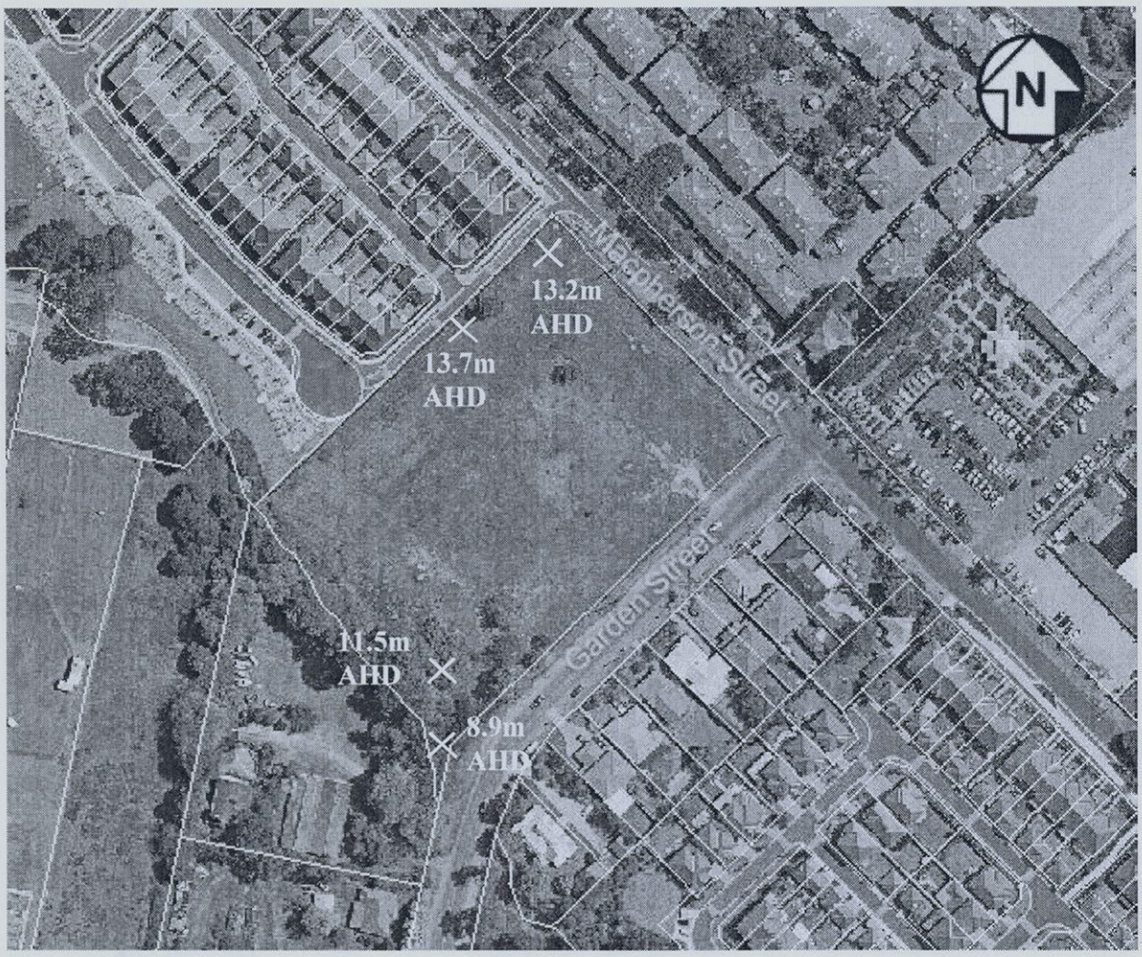


Diagram 2 - Site Topography (*Not to Scale*)

3.2 EXISTING GEOTECHNICAL CONDITIONS

A preliminary geotechnical investigation was undertaken by Jeffery and Katauskas (*JK*) for the purposes of determining the subsurface profile of the site and to estimate soil infiltration rates. A 1.8m deep borehole was dug by JK in the north western corner of the site where the following information was collected and presented in **Table 1**.

Table 1 - Summary of J&K Geotechnical Investigation

Depth to Strata	Description
0.0-0.2	Silty sand, dark grey, fine to medium grained topsoil with roots and traces of clay appearing poorly compacted
0.2-0.6	Sand, grey, fine to medium grained with traces of silt
0.6-1.0	Silty sand, brown to orange brown, with cemented sand nodules and with traces of clay
1.0-1.8	Silty sand, yellow brown to orange brown, fine to medium grained with shell fragments and cemented sand nodules and medium grained coffee rock gravel

JK conducted both a falling head test and a double ring infiltrometer tests to estimate the infiltration capacity of the sites soils. The resultant infiltration rates for the falling head and double ring infiltration test were 36mm/hr and 54mm/hr respectively.

Geotechnical testing has also been carried out by GeoEnviro on the nearby Australand component of Sector 8 as part of the previous development application for that site. A summary of some of the key findings relevant to 23B Macpherson Street is summarised below.

- That "*the site is generally underlain by sandy profile with variable relative density at the upper 2.0m ranging from very loose to medium dense. The sub-surface profile was found to be more clayey at lower depths. The investigation infers medium dense sand or very stiff clay at lower depth*" GeoEnviro July 2000;
- The "*natural soil beneath the fill and topsoil was found to consist predominantly of sand and silty clayey sand*" GeoEnviro July 2002;
- The calculated permeability rates for the natural soil encountered on site ranged from 90mm/h for the sands to 2.9mm/h for the silty clay sand/sandy clays, with an average infiltration rate of 34.7mm/h (*83.4cm/d*) and median value of 25.6mm/h(*61.3cm/d*) (*GeoEnviro July 2002*).; and
- "*Based on the laboratory test results, potential acid sulphate soil or acid sulphate soil was not encountered. As the results of the analysis were below the ASSMAC action criteria, an acid sulphate management plan is not required*" GeoEnviro July 2002.

3.3 EXISTING CATCHMENTS

The existing catchment boundaries were determined based on review of existing orthophoto maps of the site and survey data. This information shows that no external catchments currently drain into the proposed site, as upslope catchments are intercepted either within Council's existing stormwater network or within Macpherson Street/ Lomandra Way and diverted away from the site.

The existing site grade directs approximately 60% of runoff from the 1.434ha site into Fern Creek whilst the remaining 40% is expected to enter Macpherson Street and Garden Street.

The site is currently cleared grassland containing minimal impervious surfaces, as such the impervious fraction of the site was adopted to be 5% (*ie to align with Councils predevelopment RAFTS modelling assumptions*).

The estimated predevelopment catchment for the site is illustrated in **Diagram 3.**

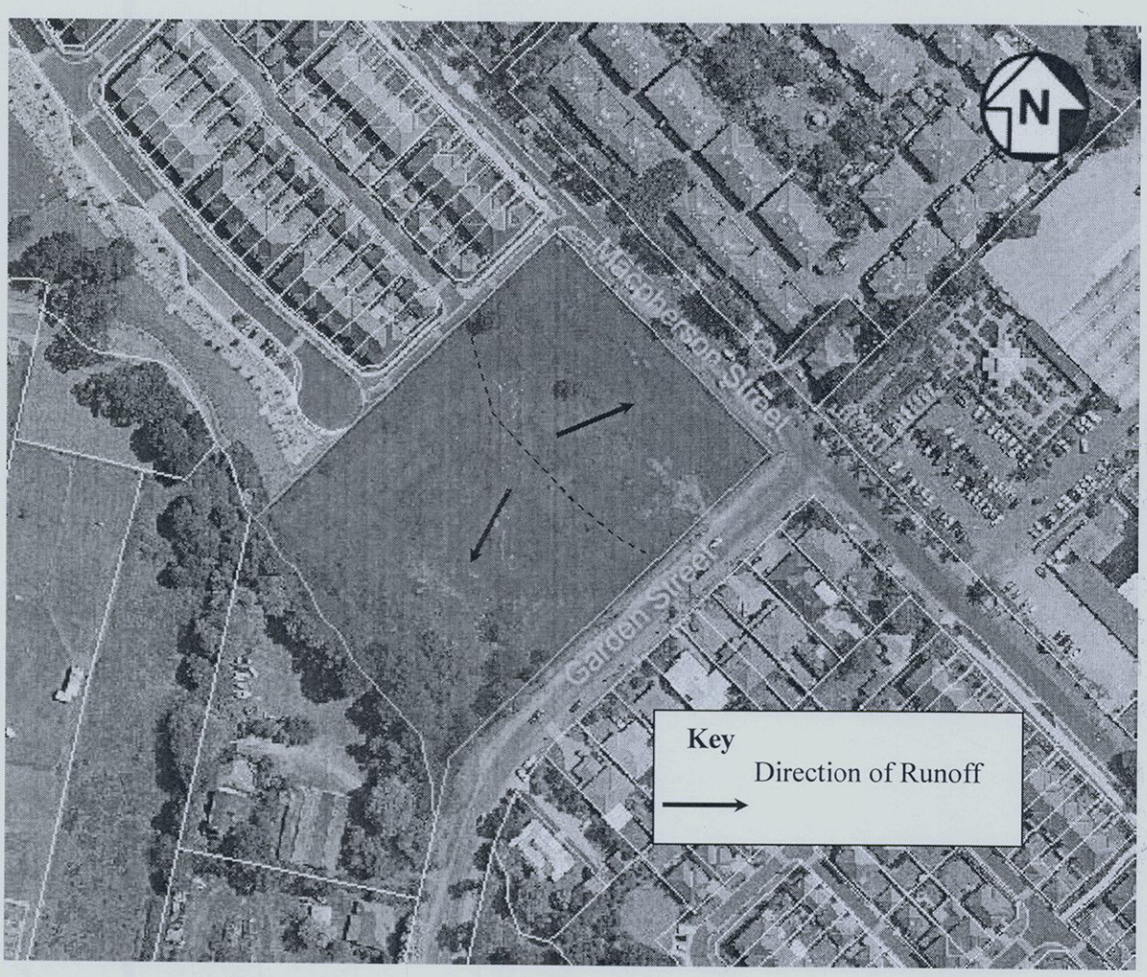


Diagram 3 - Existing Catchment (*Not to Scale*)

3.4 EXISTING FLORA AND FAUNA

A flora and fauna assessment was previously undertaken for the nearby Australand component of Sector 8 by Gunninah.

Some of the key findings relevant to 23B Macpherson Street are summarised below:

- *"The subject site ..... represents a rural and horticultural environment in which market gardens and associated horticultural pursuits have significantly altered the former natural*

habitats of the area. The subject site is largely cleared, and the habitats it supports are highly degraded……..

- *Very little native vegetation is present on the subject site, with only small fragmented stands of Swamp Forest Complex remaining along parts of Fern Creek……*
- *No threatened flora or fauna were recorded……*
- *The proposed sub-division and subsequent development of Sector 8 Warriewood Valley will not impose any adverse impacts on locally occurring flora and fauna, nor the imposition of a significant effect on any threatened species, populations or ecological communities. A species Impact Statement is not required for the proposal*" Gunninah, January 2002.

4 PROPOSED DEVELOPMENT

The proposed development layout is shown in ***Appendix B.***

In summary, the proposed development consists of the following:

- 38 residential lots incorporating attached dwellings;
- A Focal Neighbourhood Centre (*FNC*);
- Internal roads and visitor parking (*26 spaces*);
- A rehabilitated creek frontage; and
- All required servicing infrastructure.

It is proposed that the development would be created on a "*Community Title*" basis and hence the internal road and all other site infrastructure would be owned and maintained by the lot owners and not Pittwater Council.

It is proposed to dedicate the first 25m of riparian corridor fronting the site back to the public under management by Pittwater Council.

4.1 SITE REGRADING

Site regrading works are proposed as part of the development. Currently overland flows discharge in multiple directions with approximately 40% entering Macpherson and Garden Street and the rest discharging directly to Fern Creek.

Following development, it is proposed that approximately 97% of the site runoff would discharge into Fern Creek with the majority of catchment runoff captured by swales located at sides of the creekline.

The extent of the proposed regrading works are detailed in the CC stage civil design drawings by Craig and Rhodes (*under separate cover*). In summary, this will result in the following levels across the site:

- North west corner – RL 13.8mAHD (*compared with existing RL 13.20mAHD*);
- North east corner – RL 13.2mAHD (*compared with existing RL 11.50mAHD*);
- South east corner at shared path – 12.10mAHD (*compared with existing RL 12.10mAHD*);
- South west corner at shared path – 13.50mAHD (*compared with existing RL 13.50mAHD*).

4.2 PROPOSED CATCHMENTS

All the catchments outside of the site have been assumed to remain as they do under the predevelopment conditions.

The catchment of the site will be altered in both its grading/levels and impervious fraction. Based on the current architectural layout approximately 56% of the site will consist of impervious surface and will be graded at a vectored average slope of approximately 1 percent toward Fern Creek. The total area of 1.434 ha shall remain unchanged thus having the same extents as those shown in **Diagram 3**.

It has been calculated that when the proposed impervious fraction for the site of 56% is combined with the impervious area for the remaining parts of Sector 8 that an overall impervious fraction of just under 50% is achieved. This aligns with the assumptions of Councils WMS and associated models.

The post development catchments result in approximately 97% of the site draining into Fern Creek with 3% draining into Macpherson Street

The impact of the 3% (*approximately 500m^2*) draining into Macpherson street under 20 year ARI is negligible and represents a considerable reduction in flows (*ie an improvement on existing conditions*). Preliminary calculations show that during the 20 year ARI storm, total flows to Macpherson/Garden St are reduced by 0.085m^3/s from 0.096m^3/s to 0.001m^3/s.

4.3 CREEKLINE CORRIDOR

The proposed creekline corridor adjacent to the site will be rehabilitated resulting in an undisturbed average width of greater than 25m from the creek centreline (*ie calculated from the cadastral boundary*). No treatment facilities or roads will be located within this rehabilitated zone. The minimum offset from the creek centreline to any proposed hard surfaces is 22m and the maximum 30m. In addition, a second average 25m setback will be provided from this first zone which is to be clear of any new dwellings.

Unlike previous proposals for this site, no compensatory or online storage is proposed within the riparian corridor. Instead it is proposed that the northern half of the creekline be rehabilitated in line with Council's standard geometry as specified in the Water Management Specification. The result will be similar to the already rehabilitated section of creek both upstream and downstream of the site.

5 WATER QUALITY MONITORING

5.1 MONITORING PLAN OBJECTIVES

Prior to development of the site, a monitoring plan has been developed in accordance with Council's WMS and AS/NZ 5667.6: 1998 "*Water Quality Sampling – Guidance on Sampling of Rivers and Streams*".

The objectives of the monitoring plan are to:

- Develop an understanding of the predevelopment conditions present in the waterways of the development;
- Continually assess the quality of these waterways during the construction phase of the development; and
- Assess the impact of constructed water quality measures following construction to ensure the development is ecologically sustainable.

Extensive monitoring has been undertaken to date as part of both the Mirvac/Warriewood Properties Sector 8 and Australand Sector 8 development applications. The results of this monitoring are more than sufficient to establish present water quality within the site (*termed: "baseline data"*). This data can be compared with future results to determine whether pollution controls are operating adequately and if the water quality is satisfactory.

Appendix E includes a summary of the sampling results collected to date along with a discussion of the findings.

Note that further monitoring shall commence at the beginning of construction stage. During the construction stage, implementation of the monitoring plan will also allow early detection of any adverse impacts likely to risk the health of the public or the quality of receiving waters.

Monitoring will also continue for a period of 2 years after construction has been completed to ensure treatment measures are performing adequately.

5.2 SCOPE OF MONITORING PLAN

5.2.1 Monitoring Locations

Three monitoring locations have been selected at the upstream (*U/S*), intermediate and downstream(*D/S*) ends of the site along Fern Creek. The approximate locations are shown in **Diagram 4**.

These three sites have been selected so that any major outside sources of stormwater pollution can be isolated from those loads being generated by the site alone.

All three sites will continue to be monitored during and following development.

Diagram 4 - Approximate Locations of Water Quality Testing Sites (*Not to Scale*)

5.2.2 Types of Monitoring

The monitoring plan for the site consists of three main categories:

- physio-chemical water quality monitoring;
- ecosystem/rapid biological assessment monitoring; and
- bed sediment toxicant monitoring.

5.2.3 Water Quality Monitoring (*Discrete Sampling*)

The water quality monitoring component of the plan consists of:

- dry weather sampling undertaken quarterly; and
- wet weather sampling undertaken for at least 3 events (*recording a rainfall depth greater than 20mm over the catchment in a 24 hour period*) spread evenly over the year and sampling throughout the rainfall event (*rising and falling limbs of storm hydrograph*).

Samples are tested for the constituents listed in Council's WMS and reported to conform with Council's specification.

Following construction of the proposed stormwater treatment devices, sampling will be undertaken at the major inflow points to the major treatment systems and at the main discharge points into Fern Creek to monitor water quality during wet weather. A wet weather event will be monitored for these treatment devices at least once every 4 months (*dependant on rainfall*) and reported to conform with the Council's specification.

5.2.4 Rapid Biological Assessment Monitoring

Habitat monitoring has been undertaken for predevelopment conditions. Habitat monitoring uses the Biotic Index Signal 2.0 to measure biological activity. Biosis Research undertook a rapid biological assessment of the Sector 8 site and conclude that a Signal 2.0 score of 3.2 (*Original SIGNAL score of 4.8*) with a relatively low number of taxa (*14 present*) which indicates poor water quality.

At the time of testing culvert work was being undertaken which made D/S sampling impossible. Further sampling will be undertaken at the U/S and D/S locations immediately prior to construction.

Refer to **Appendix F** for results.

5.2.5 Sediment Toxicant Monitoring

Sampling and testing of bed sediment in Fern Creek has been undertaken on an annual basis. Further sampling will be undertaken immediately prior to commencement of construction, during construction and following completion of construction.

All sediment samples will be tested for metals, pesticides and oils/greases.

All reporting shall conform to Council's specifications.

5.2.6 SQID Monitoring

Following completion of the subdivision construction, all stormwater quality improvement devices (*SQID's*) will be monitored for a period of 2 years to assess performance. This will include:

- Measurement of volume/mass of material removed from GPT's and an assessment of its relative composition;
- Discrete sampling at the major inlets/outlets of the proposed bio-retention swales; and
- Qualitative assessment of effectiveness of other proposed water quality control measures.

All reporting shall conform to Council's specifications.

5.2.7 Flow Gauging for Monitoring

To assess the magnitude of wet weather events and determine the position of a particular sample within a storm event, both the rainfall depth and flood depth has been recorded. Rainfall depth data was obtained from the Bureau of Meteorology (*BoM*), whilst flood depths have been recorded at the upstream and downstream sampling sites.

The total depth of rainfall experienced during the event will allow determine if the event sampled will comply with Council's minimum 20mm depth over 24 hours criteria and a sustained length of record of the water levels at the downstream and upstream sites will allow the consultant to determine if the sample has been taken on either the rising or falling limb of the regional storm hydrograph.

5.2.8 Quality Assurance/Measurement Accuracy

All samples collected as part of this monitoring plan will be tested by a NATA certified laboratory. Copies of all original data testing certificates will be provided along with information detailing the collection and preservation status upon delivery at the laboratory. The laboratory testing detection limits will also be included on all test certificates.

5.3 BASELINE SAMPLE RESULTS

Refer to **Appendix E** and **Appendix F** for all baseline water quality monitoring testing results collected to date for the site.

6 WATER QUALITY MANAGEMENT

6.1 CONSTRUCTION PHASE

During the bulk earthworks and construction phase of the development, sediment and erosion control facilities will be designed and constructed/installed in accordance with Council's specifications and requirements of the NSW DECC publication titled "*Managing Urban Stormwater – Soils and Construction*" January 2008.

A sediment and erosion control plan has been prepared by Craig and Rhodes for the construction phase, outlining the strategies proposed to prevent excessive pollutant loads being exported from the site in runoff during and immediately following construction. Refer to **Appendix I** for details.

A summary of the principle elements of the sediment and erosion control plan for the site is summarised below:

- Minimising the extent of disturbed surfaces at any one time (*i.e. staging of earthworks etc*);
- Stabilising disturbed surfaces immediately upon completion of works (*i.e. hydromulch or vegetation*);
- Diverting clean runoff around disturbed work areas (*i.e. using earth bunds/diversion mounds/channels*);
- Protecting stockpiles (*i.e. using silt fence, diversion bunds, temporary vegetative cover etc*);
- Implementation of dust control/suppression measures during works(*i.e. perimeter fencing, wind velocity monitoring, cessation of earthworks activities during high wind conditions, watering down disturbed areas, setup of recycled water irrigation sprays etc*);
- Use of sediment basins;
- Use of silt fencing downslope of disturbed surfaces;
- Use of silt socks or equivalent around existing drainage structures;
- Use of rock/haybale/mulch check dams along designated overland flow paths;
- Use of floating silt curtains /floating booms in the creek;
- Protection of exposed slopes;
- Restriction of vehicle entry/exit points to construction zones;
- Setup of stabilised site access points; and
- Setup of vehicle washdown/wheel wash baths at exit points of disturbed areas.

6.2 POST DEVELOPMENT PHASE

The proposed water quality treatment train on the site consists of the following elements (*refer to **Figure 1** for details*):

- Three creek side bio-retention swales/basins (*total surface area of 200m^2*);
- A below ground gross pollutant trap (*GPT*);
- An infiltration trench (*100m long x 1m wide x 1.5 m deep*);
- Lot based rainwater gardens;
- Lot based rainwater tanks and associated reuse; and
- Future neighbourhood shop rainwater tank (*10KL*) and associated reuse.

The software package developed by the CRC for Catchment Hydrology termed "MUSIC" (*Model for Urban Stormwater Improvement Conceptualisation*) was used to assess the effectiveness of the proposed "*treatment train*" under the following scenarios :

- Existing conditions;
- Post development conditions with no treatment measures; and
- Post development conditions with treatment measures.

The DA MUSIC model was updated for this CC report to reflect the latest design.

Details of the CC stage MUSIC modelling exercise (*including results*) are included at **Appendix D** and summarised in the following sections.

6.3 MUSIC

"MUSIC simulates the performance of a group of stormwater management measures, configured in series or in parallel to form a treatment train." In this case, MUSIC has been run on a continuous basis (*30 minute intervals from January 1996 to December 1999*), allowing rigorous analysis of the merit of proposed strategies over the long-term.

"the adoption of a continuous simulation approach is recommended in water quality modelling. This stem from the fact that impacts of poor stormwater quality on aquatic ecosystem health are associated with cumulative pollutant loads and frequency of aquatic ecosystem "exposure" to poor water quality. Pollutant loads delivered to receiving waters from many of the small storm events (e.g. of magnitude less than the 3 month ARI peak discharge) can make up in excess of 90% of the annual loads discharged from the catchment.

The evaluation of the adequacy's of the stormwater management systems is based on a risk-based approach associated with examination of the long-term mean annual pollutant load delivered to the receiving waters.

MUSIC is designated to simulate stormwater systems in urban catchments and have the capability to operate at a range of temporal and spatial scales, suitable for catchment areas from 0.01km^2 to

100km^2. Modelling time step can range from 6 minutes to 24 hours to match the range of spatial scale.

The model's algorithms are based on the known performance characteristics of common stormwater quality improvement measures. These data, derived from research undertaken by CRCCH and other organisations, represent the most reliable information currently available in our industry" MUSIC Manual, CRC for Catchment Hydrology.

6.3.1 Site Sub-Catchment Areas

The total catchment for the subject site as shown in **Figure 1** was divided into separate sub-catchments to represent the different land uses of each developed scenario and the catchments of each treatment measure.

For the existing scenario the total site was divided into two sub-catchments, one to represent the existing creekline corridor and the other to represent the remaining cleared land.

The post development condition (*no treatment*) scenario was divided into four sub-catchments which comprised the increased creekline corridor area, the combined total roof area, the combined road, carpark & shared path area and the remaining lot area.

The post development condition (*with treatment*) scenario was further divided to represent those areas served by treatment measures and those that bypassed treatment measures.

A summary of the sub-catchment properties for the existing, post development (*no treatment)* and post development (*with treatment)* is contained in **Tables 2. 3and 4** respectively.

Table 2 – Existing Sub-Catchment Properties

Sub Catchment	Area (ha)	Impervious Fraction
Riparian	0.137	0
Cleared Land	1.297	0
Total	**1.434**	**0**

Table 3 – Post Development (*No Treatment*) Sub-Catchment Properties

Sub Catchment	Area (ha)	Impervious Fraction
Riparian	0.275	0
Roads, Carparking, Shared Path	0.251	90
Roofs	0.480	100
Lot Area	0.428	22
Total	**1.434**	**56**

Table 4 – Post Development (*With Treatment*) Sub-Catchment Properties

Sub Catchment	Area (ha)	Impervious Fraction
Riparian	0.275	0
Roads with No Treat	0.107	100
Roofs to 3KL Tanks	0.235	100
Roofs to 1KL Tanks	0.215	100
Roofs to 10KL Tanks	0.030	100
Lot Area to Raingardens	0.250	22
Lot Area not Draining to Raingarden	0.178	22
Carpark/Road1 to Swale	0.077	100
Carpark/Road2 to Swale	0.017	100
Bio swale and cyclepath	0.050	30
Total	**1.434**	**56**

6.3.2 Rainfall and Evaporation

Rainfall and evaporation data was sourced from MHL (*Manly Hydraulics Lab - Department of Commerce*) and the Bureau of Meteorology (*BoM*) respectively

Thirty minute rainfall data was utilised in the MUSIC models for a range of rainfall years representing a mix of average, wet and dry years for the region (*1996 to 1999*). The closest rainfall station to the site with reliable pluvio. data was Middle Creek (*uses a 15 minute logger*).

Details of the rainfall records are illustrated in **Diagram 5**. A thirty minute time step was adopted in this instance as MUSIC accepts 6,12, 30 minute and greater time step intervals and as the Middle Creek logger was for 15 minutes the smallest increment that would be accepted using this data was 30 minutes.

The average annual rainfall depth for the area between 1996 to 1999 was 1,402mm. The long term average for the region is approximately 1,230 mm/yr. Hence, the historical period assessed was marginally wetter than the average.

Evaporation data was extrapolated for the site using the BoM publication titled "*Climatic Atlas of Australia - Evapotranspiration*" (*BoM 2001*).

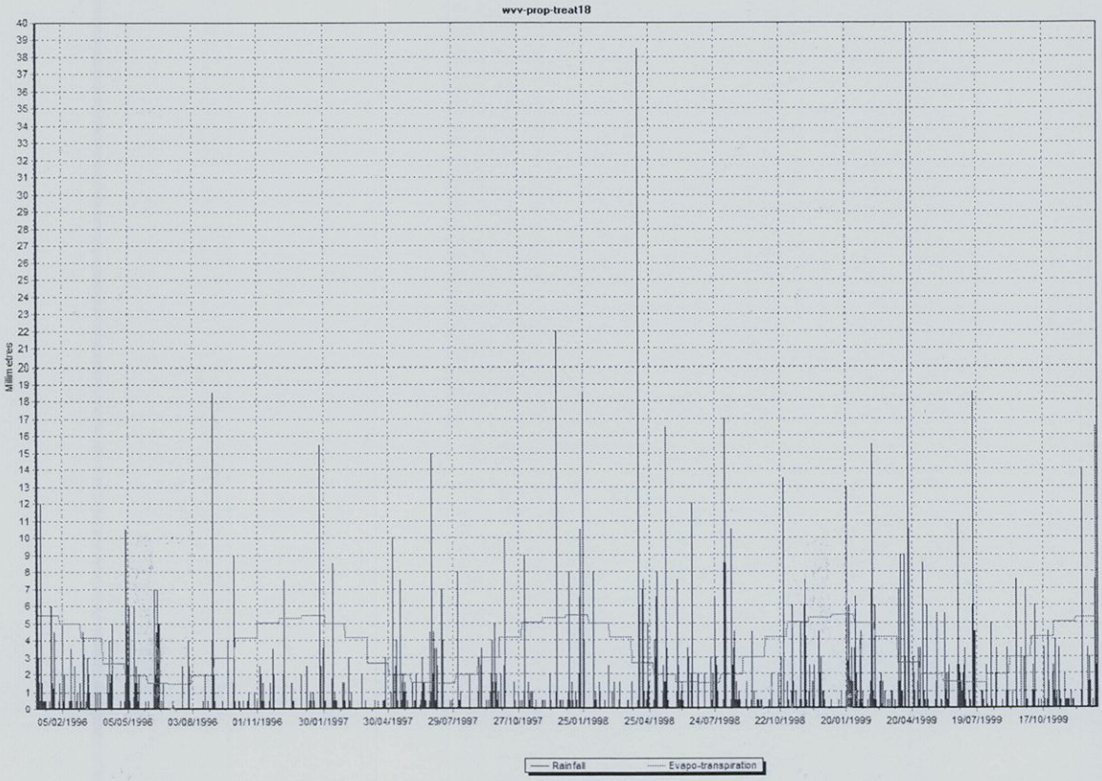


Diagram 5 – Rainfall Period Adopted in MUSIC

6.3.3 Soil Properties

The soil property parameters adopted for all MUSIC modelling have been based on values used for similar sites and as a result of the comparison of the resultant volumetric runoff coefficients. A summary of the adopted soil properties inputted into the runoff module are shown in **Table 5**.

Table 5 – Adopted MUSIC Soil Parameters

Parameter	Adopted
Impervious Area rainfall threshold (mm/d)	1.5
Perv area soil storage capacity	400
Initial storage (%cap)	25
Field Capacity (mm)	150
Infiltration capacity co-efficient "a"	100
Infiltration capacity co-efficient "b"	0.65
Groundwater initial depth (mm)	20
Groundwater daily recharge rate	0.55

Parameter	Adopted
Groundwater daily baseflow rate	0.65
Daily deep seepage rate (%)	0

6.3.4 Pollutant Loads

The Event Mean Concentrations (EMC's) adopted for total suspended solids (*TSS*), total phosphorus (*TP*) and total nitrogen (*TN*) are given in **Table 6** and are based on Council's WMS.

The existing condition EMC adopted for the non-riparian component of the site was based upon a horticultural landuse which reflects the historical usage of the site, whilst the creekline corridor area was modelled under all scenarios using a natural or forested EMC. The majority of the surface area under post development conditions was defined as urban landuse except for the creekline corridor area which following rehabilitation will be equivalent to a natural/forested area.

Only storm flows were modelled in MUSIC (*ie baseflow loads were set to zero*) using the mean estimation method.

The default MUSIC standard deviation was adopted for each landuse.

Table 6 – Runoff Pollutant Event Mean Concentrations (EMC)

Land Use	TSS	TP	TN
	Mg/L	Mg/L	Mg/L
Riparian	10	0.03	0.32
Existing	45	0.2	2.5
Urban	100	0.30	1.5
Roof	20	0.13	2.0

6.3.5 MUSIC Network Layout

The MUSIC model networks assembled to represent the existing, post development (*no treatment*) and the post development (*with treatment*) scenarios are shown in **Diagrams 6, 7 and 8** respectively.

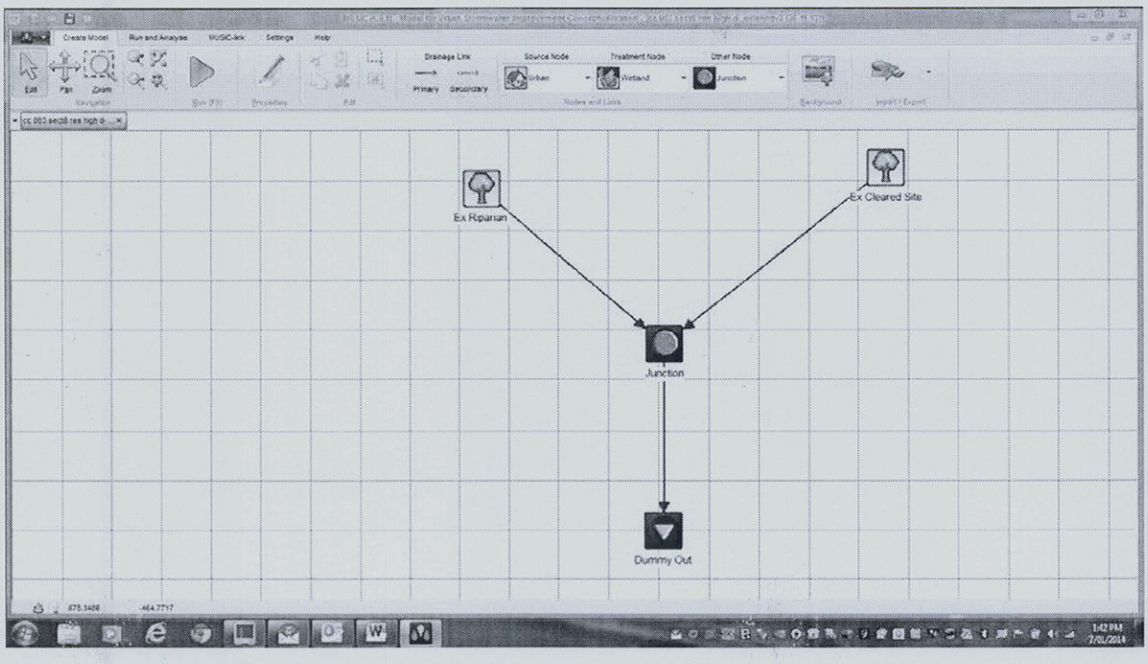


Diagram 6 – Existing MUSIC Network

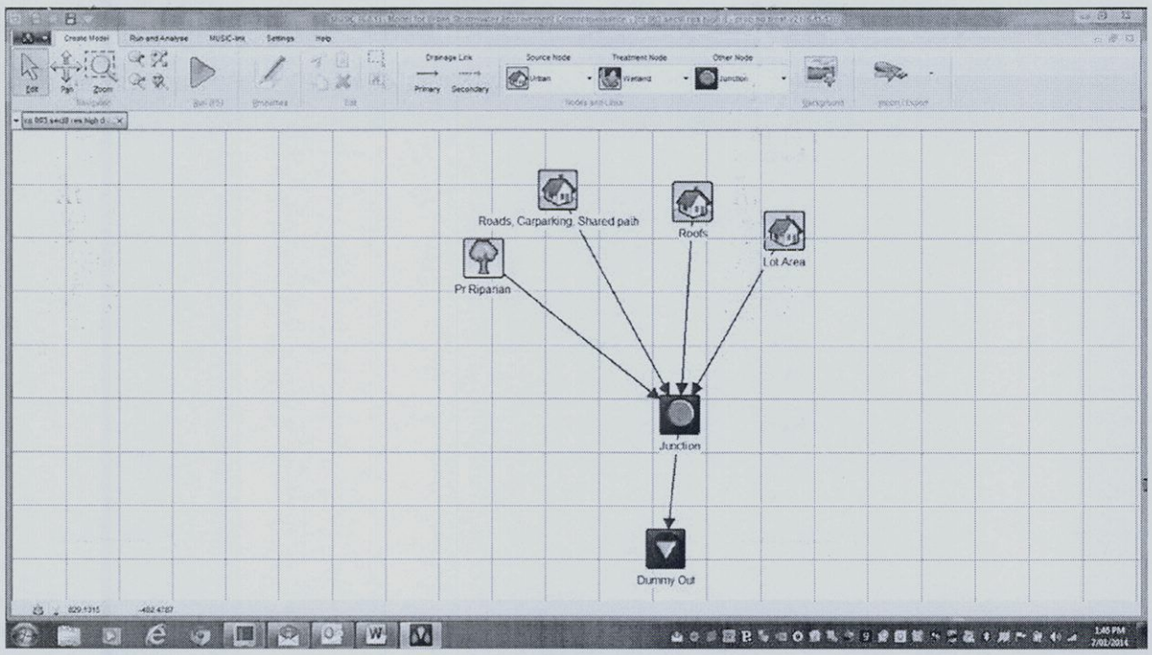


Diagram 7 – Proposed (*No Treatment*) MUSIC Network

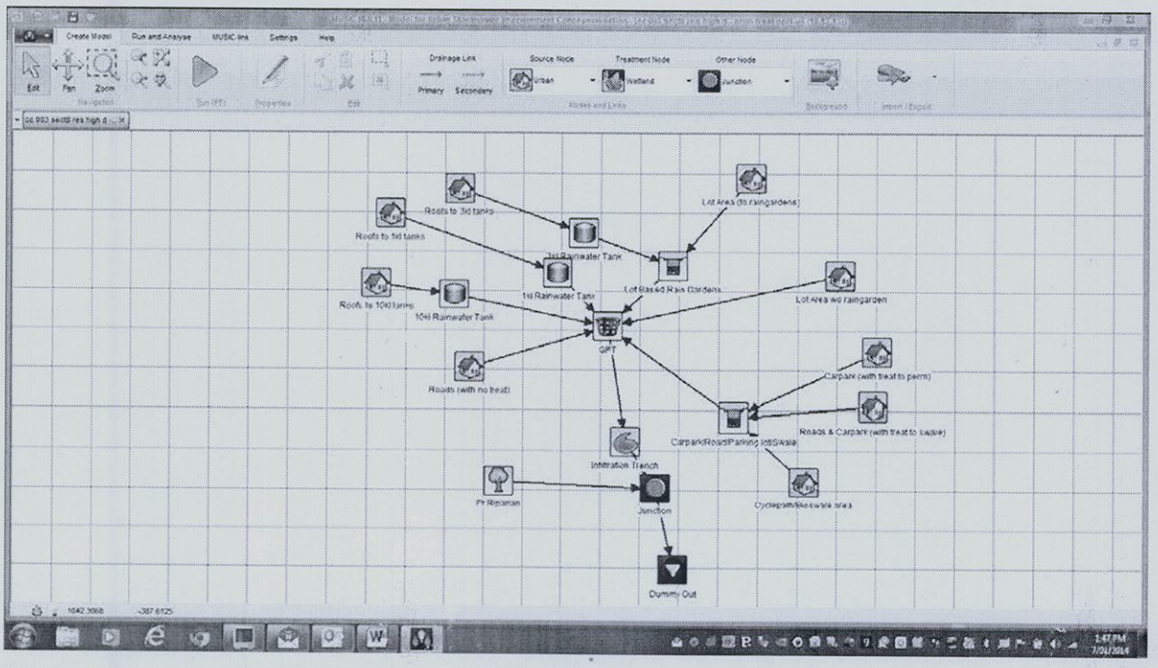


Diagram 8 – Proposed (*With Treatment*) MUSIC Network

6.3.6 Treatment Objectives

A common and practical guideline that is often used throughout NSW (*and is recognised by the NSW DECC)* is the setting of treatment objectives that are achievable using best practice. These best practice treatment objective are summarised **Table 7**.

Table 7 – Best Practice Treatment Objectives

Pollutants	Reduction Targets
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	80%
Total Phosphorous (TP)	65%
Total Nitrogen (TN)	45%

However, Pittwater Council's WMS clearly sets the requirement that all post development loads must be equal to or less than existing conditions. Based on this, the "*post back to existing*" objective has been adopted for this study. But as a reference the outcomes of the MUSIC modelling will also be compared to the best practice objectives highlighted in **Table 7**.

6.3.7 Treatment Measure Assumptions

6.3.7.1 Lot Based Rainwater Tanks

3kL and 1 KL rainwater tanks (*no air void*) are proposed on the large and medium sized lots respectively and one 10KL (*no air void*) rainwater tank is proposed for the focal neighbourhood centre. All tanks will reduce runoff volume, maximise non-potable supply/re-use and minimise peak flows for more frequent storm events by capturing the majority of roof water.

Roof runoff will be reused for toilet flushing, garden irrigation, car washing and cold water laundry.

It is assumed that 25% of the permanent storage of each tank will act as effective detention for the all tanks.

An assumed average reuse rate of 6KL/day has been adopted based on review of data collected by Sydney Water and the Department of Planning for both residential and commercial applications.

6.3.7.2 Lot Based Raingardens

Raingardens are proposed on the large lots to provide a dual function of stormwater detention and water quality treatment for more frequent storm events. It is assumed that the majority of the non roof area of each large lot would drain to the raingardens.

The parameters adopted in the MUSIC modelling to represent the accumulation of all lot based raingardens is summarised in **Tables 8**.

Table 8 – Raingarden Parameters

Av. Ext. Det. depth (m)	Total Surface Area (m^2)	Av. Seepage Loss * (mm/hr)	Total Filter Area (m^2)	Av. Filter depth (m)	Ag. Size (mm) D90	Media Inf. Rate (mm/h)
0.4m	215	36	108	0.7	5mm	100

* Seepage loss rates are based on field testing results undertaken by JK (*see **Section 3.2***)

6.3.7.3 Bio-Retention Swales/Basins

The creekside bio-retention swales will provide a dual function of stormwater detention and water quality treatment for nearby hardstand in more frequent storm events. The parameters adopted in the MUSIC modelling for the combined swales is presented in **Table 9**.

Table 9 – Creekside Bio-Retention Swale/Basin Parameters

Av. Ext. Det. depth (m)	Total Surface Area (m^2)	Seepage Loss * (mm/hr)	Av. Filter Area (m^2)	Av. Filter depth (m)	Ag. Size (mm) D90	Media Inf. Rate (mm/h)
0.4	200	36	100	1.0	5	100

* Seepage loss rates are based on field testing results undertaken by JK (*see **Section 3.2***)

6.3.7.4 Gross Pollutant Trap (GPT)

The proposed GPT will be used to capture litter and coarse sediment from a majority of the site. It has been modelled in MUSIC in accordance with capture rates determined in the report, *Removal of Suspended Solids and Associated Pollutants by a Gross Pollutant Trap - Cooperative Research Centre for Catchment Hydrology (1999)*. These capture rates are:

- TSS 80%
- Litter 95%
- TP 30%
- TN 0%

6.3.8 Music Modelling Results

The results from the MUSIC model for the three development scenarios are shown in **Table 10.**

Table 10 – MUSIC Results

Scenario & Node	Runoff (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Existing					
Out	5.21	126	0.556	6.94	0
Cv	0.26				
Post development without treatment					
Out	12.1	598	2.20	19.0	258
Increase (%)*	132%	375%	295%	174%	-
Cv	0.60				
Post development with treatment					
Out	4.81	38.9	0.474	6.24	0
Decrease(%)*	-7.7%	-69.1%	-14.7%	-10.1%	-
Decrease(%)# -ie Treatment Train Effectiveness	-59%	-93.2%	-77.4%	-65.7%	-100%
Cv	0.24				
Compliant with best practice objective (Yes/No)	Yes	>-80% Yes	>-65% Yes	> -45% Yes	>-90% Yes
Compliant with Council post to ex objective (Yes/No)	<Ex Yes	<Ex Yes	<Ex Yes	<Ex Yes	<Ex Yes

*Compared with existing *(-ve is below existing)*
Compared with post development without treatment *(-ve is below post development)*

The results in **Table 10** show a significant reduction in pollutants from developed conditions in line with best practice objectives. The results also show full compliance with Councils WMS objective of post development loads less than or equal to existing conditions.

Refer to **Appendix D** for further modelling details and results.

6.4 SQID MAINTENANCE PROGRAMME

The proposed maintenance program for the sites water quality control measures will consist of the following (*undertaken by land owner*);

- Periodic (*6 monthly*) inspection and removal of any gross pollutants & coarse sediment that is deposited in the bio-retention swales/basins and raingardens and replacement of vegetation as necessary;
- Periodic (*3 monthly*) and episodic (*post storm greater than 1 year ARI*) inspection and removal of trapped pollutants from GPT;
- Periodic (*annually*) inspection (*and flushing if required*) of the infiltration trench; and
- Periodic (*annually*) inspection (*and flushing if required*) of the below ground OSD tank;

6.5 PRELIMINARY MOSQUITO RISK ASSESSMENT

No permanent waterbodies have been proposed for this development therefore the risk of increasing mosquito activity is low. However, as part of the water quality management system that will be implemented consideration should be given to the potential for measures acting as pest mosquito breeding areas.

With regards to the proposed treatment train, the bio-retention gardens on individual lots and the swales adjacent to the creekside road are not expected to contain storage for extended lengths of time. If this measure is properly designed and maintained there is a low risk that these will act as a pest habitat.

Lot based rainwater tanks pose a minimal risk for becoming mosquito breeding areas however they must be adequately maintained with emphasis on the inlet screening which will prevent pests from entering the device.

The GPT is not expected to contain any significant quantity of standing water which will result in this measure having a low risk as a mosquito breeding area.

At this stage it is expected that the low risk of providing habitat for pest mosquitoes shall remain the same before and after the proposed works.

6.6 SIZING OF GPT

The proposed GPT will be designed to treat all peak flows up to and including the 1 in 3 month ARI event (*ie approximately 90% of the annual flow volume*).

Detailed calculations have shown that a CDS/Rocla CL600 or equivalent would be required for the subject site.

7 WATER BALANCE

The same MUSIC model that was used to simulate the performance of the proposed stormwater treatment devices as detailed in **Section 6** was also used to assess the sites water balance.

With an increase in impervious surfaces comes a respective decrease in infiltration and hence additional surface runoff volume.

To counter this additional storage, reuse, and infiltration is proposed as part of the development. Reuse of roof runoff for toilet flushing, lawn/garden irrigation, car washing, cold water laundry and high pressure cleaning of external walls, pathways and pavements is proposed. Assumptions for demand in the focal neighbourhood centre have been based on general shopping centre wateruse . Assumptions for residential reuse rates have been based on data from Sydney Water and the Department of Planning. Infiltration loss from proposed bio-retention and permeable paving systems has also been enhanced (*ie based on the knowledge of the inherent infiltration capacity of the sites underlying soils*).

Infiltration measures include the sites unlined bio-retention systems and the 100m long creekline pathway infiltration trench.

The reduction in runoff volumes as a result of all reuse/infiltration measures has been calculated to be a reduction in runoff coefficient (*Cv*) from a value of 0.60 to 0.24 (*ie. compared with an estimated Cv of 0.26 under existing conditions*). This is considered an excellent result for the site and in actual fact marginally less than existing conditions.

For details of the MUSIC water balance assumptions and results refer to **Section 6** and **Appendix D.**

8 STORMWATER QUANTITY MANAGEMENT

The integrated strategy for stormwater quantity management on the site is comprised of the following:

- source control which includes:
  - the use lot based rainwater tanks (*3KL for large lots (x30), 1KL for medium lots (x8) and 10KL tank for the Focal Neighbourhood Centre)* of which 25% will be utilised as OSD storage, therefore providing **27m^3** of detention volume. The rainwater tanks will not only aid in the reduction of runoff volume and minimise peak flows for more frequent storm event but they will also minimise reliance on use of potable water for non-potable uses;
  - the use of bio-retention swales/basins (*ie adjacent to the creek*) to promote infiltration and provide an effective detention volume of approximately **36m^3**;
  - the use of lot based raingardens to promote infiltration and provide an effective detention volume of approximately **77m^3**;
  - use of a 100m long infiltration trench adjacent to the creekside pathway; and
  - the use of landscaping which encourages the maximisation of infiltration.

- formal stormwater detention facilities which include:
  - A below ground stormwater detention tank under Road No. 3 resulting in a total detention volume of **255m^3**;
  - Creation of a shallow above ground storage volume (*active in 20-100yr ARI events only*) between the edge of the shared cyclepath and the creekside road (**71m^3**).

The total stormwater detention volume proposed for site is **466m^3**. Hence, stormwater detention storage is proposed at a rate of **402m^3/ha** (*based on a developable area of 1.159ha*). The proposed storage meets the detention rate of **400m^3/ha** stipulated in Council's WMS.

Areas of the site where detention volume will exist to assist in stormwater quantity management but has not been included in the calculations includes:

- Infiltration media voids beneath bio-retention swales/basins, raingardens, and infiltration trench (*active for frequent events*);
- Floodway storage in roads and creekline (*active for events in excess of 20yr ARI*); and
- Storage in piped drainage system.

A significant change to the existing catchment draining to Fern creek, will occur as a result of the proposed development. Under existing conditions a moderate proportion of the site (*approximately 40%)* drains to Macpherson Street and Garden Street. In the proposed

development of Sector 8, site regrading will be undertaken to direct around 97% of the sector to Fern Creek. This alteration to the post development catchment is considered satisfactory for the following important reasons:

- Macpherson Street is currently limited in its drainage capacity both in the 20yr and 100yr ARI;
- The post development Fern Creek design and its 50m corridor has more than sufficient capacity to fully cater for the post development 100yr ARI flows for this development; and
- The base conditions model in Councils WMS (*February 2001*) assumes that the entire area of Sector 8 drains to Fern Creek. Hence, all downstream facilities have been designed to cater for these flows.

8.1 HYDROLOGICAL MODELLING

No change has been made to the DA stage RAFTS modelling for the site.

9 FLOODING AND RIPARIAN CORRIDOR

9.1 FERN CREEK FLOOD LEVELS

The subject site is primarily impacted by floodwaters generated in Fern Creek, however it is likely that interaction with Narrabeen Creek/Macpherson Street will occur in the much larger PMF event.

For this CC stage water management report we have relied on the detailed 2D flood modelling of Warriewood Valley undertaken by Council's consultant Cardno Lawson & Treloar (C*LT*). Flood levels in the vicinity of the site in both the 100yr ARI and PMF events have been obtained from the CLT report titled "*Warriewood Valley Flood Study Addendum 1*", July 2005. A summary of the levels relevant to the site are summarised in **Table 11**.

Table 11 – Site Flood Levels

Location	100yr ARI Flood Level (mAHD)	FPL (mAHD)	PMF Level (mAHD)
Fern Creek – US end of Site (G-Fern 11)	12.99	13.49	13.95
Fern Creek – DS end of Site at Garden Street (G-Fern 15)	11.76	12.26	12.30
Macpherson Street – US end of Site	-	-	13.10
Cnr Macpherson and Garden Street	-	-	11.63

The CLT July 2005 also reveals the following important modelling results:

- The existing 100yr ARI Fern Creek flood extents are fully contained within the existing Fern Creek riparian corridor;
- The existing PMF flood inundates the entire site;
- The existing PMF flood hazard across the site is classified as "low";
- The existing 100yr ARI flood hazard is limited to the Fern Creek riparian corridor and is also classified as "low"; and
- The existing PMF floodways in the vicinity of the site are limited to the Fern Creek riparian corridor, Garden Street and Macpherson Street.

Under the developed scenario, the riparian corridor is proposed to be widened to meet Council's WMS creekline geometry and minor fill works will be undertaken across the site to raise the majority of the site above the FPL.

The extent of the proposed creekworks is illustrated in the CC civil design drawings by Craig and Rhodes (*contained under separate cover*). These works primarily involve cut and hence will increase flood conveyance. This has been demonstrated by HEC RAS modelling to reduce both 100yr ARI and PMF flood levels compared to existing conditions.

The proposed filling across the site is also illustrated in the CC civil design drawings by Craig and Rhodes (*contained under separate cover*). Only minimal fill (*in the order of 300-400mm*) is required across the majority of the site to get above the FPL. However, up to 1200mm of fill is proposed in the North East corner of the site so this area can drain back to Fern Creek. Regardless it is unlikely that these fill works will have a marked impact on increase in PMF flood levels as the area in question (*ie the site*) is not part of the PMF floodway.

The net effect of the increase in flood conveyance in Fern Creek and minor filling of the site under proposed conditions has previously been shown to be negligible compared with existing conditions.

Hence, for this DA assessment it is considered appropriate that the flood levels reported in the CLT July 2005 are equally applicable to the post development conditions.

An illustration of the proposed 100yr ARI and PMF flood extents for the site are contained at **Figure 2**.

9.2 FILLING AND PMF IMPACT

In 2004 Lawson & Treloar undertook an assessment of PMF flood impact due to filling over the entire area of Sector 8 as part of the Australand development approval process.

The results of this assessment are detailed in the September 2004 Lawson and Treloar letter to Pittwater Council titled "*Sector 8 PMF Impact*".

A summary of the L&T assessment is contained below.

Existing PMF Flood Behaviour (*ie pre filling on Sector 8*)

- *"Sector 8 is affected by flooding behaviour from both Fern and Narrabeen Creek. Flooding from Fern Creek results in a cross catchment flow towards Narrabeen Creek. After crossing Sector 8, the overland flow travels down Macpherson Street before flowing through Sector 11 and returning to Fern Creek (this behaviour is pre-Sector 11 development….). Flooding from Narrabeen Creek results in overland flow (peak is approximately 18.5m^3/s) that travels south down Ponderosa Parade before being diverted onto Macpherson Street. The momentum of flow along Ponderosa forces it onto Sector 8….*";

Post Development PMF Flood Behaviour

- a "*……model run was carried out where the* ***entire*** *Sector 8 was raised out of the flood plain.*";
- The model showed localised PMF impact at the corner of Macpherson Street and Ponderosa Avenue (*ie in the order of 0.2m*);

- However, in the vicinity of 23B Macpherson Street, the model showed a decrease in PMF flood levels (*refer to **Appendix H***).

The Australand component of Sector 8 was subsequently approved and has been constructed with the fill extents as incorporated in the L&T 2004 PMF model.

The fill proposal on 23B Macpherson Street does not differ to that incorporated in the L&T 2004 PMF model.

Based on the above it is considered that the proposed fill works on Sector 8 will have no detrimental PMF flood impact on surrounding properties.

9.3 FERN CREEK DESIGN

A design for Fern Creek is proposed for the site as detailed in the CC civil design drawings by Craig and Rhodes (*contained at the rear of this* report).

As the creekline forms the boundary between Sector 8 and Sector 9, ultimately a joint approach to rehabilitation of this creek will be required. At this stage only the northern half of the creek is proposed to be reconstructed (*ie no works are proposed on neighbouring private land*).

No creek crossings are proposed for Fern Creek as part of the proposed development.

The proposed creek centreline generally aligns with existing. The overall design alignment results in a gentle meander, which will allow development of a stable geomorphologic form using natural bed and bank stabilisation measures.

A pool and riffle system will be incorporated within the low flow channel of the rehabilitated Fern Creek to assist in bed stabilisation, improve water quality and to provide habitat. The proposed rock riffles will be equivalent to those used in the upper sections of Fern Creek and will be implemented at approximately 25m intervals along the reconstructed reach.

The proposed creek bank slopes all conform to Councils WMS requirements, apart from minor deviations at the locations of existing trees to be retained . Bank batters grades are typically:

- 1(v) in 3(h) – up to 2yr ARI;
- 1(v) in 6(h) – up to 5yr ARI; and
- 1(v) in 8(h) – greater than 5yr ARI.

The combination of generous creekline corridor widths and batter grades and the proposed planting schedule will ensure stable bank conditions.

No structures, online storage or any other man made barrier is proposed within or near the new creekline corridor.

A high flow channel has been incorporated as part of the design in areas constricted by existing retained trees.

9.4 CREEK CORRIDOR WIDTH CALCULATIONS

Calculations of the proposed riparian corridor width allocations illustrating compliance with the average 25m wide width in public ownership are provided in the DA package under separate cover by Craig and Rhodes.

The minimum offset from the creek centreline to any proposed hard surfaces is 22m and the maximum 30m. In addition, a second 25m setback will be provided from this first zone which is to be clear of any new dwellings.

9.5 CREEKLINE CORRIDOR PLANTING

The proposed creekline corridor landscaping has been prepared by Umbaco and is included under separate cover within the CC documentation submitted to Council.

The planting proposed has been based on Council WMS.

The current creek design has been developed to minimise any disturbance to existing critical trees (*ie creek batters finish clear of trees and their root zone*).

9.6 NSW OFFICE OF WATER CONTROLLED ACTIVITY PERMIT

A Controlled Activity Application (*CAA*) application has already been approved by the NSW Office of Water.

9.7 ACID SULPHATE SOILS

An investigation of the presence of acid sulphate soils within the upstream component of Sector 8 was undertaken by GeoEnviro in July 2002.

GeoEnviro conclude that "*Based on the laboratory test results, potential acid sulphate soil or acid sulphate soil was not encountered. As the results of the analysis were below the ASSMAC action criteria, an acid sulphate management plan is not required*" GeoEnviro July 2002.

Due to its proximity to the site in question it is considered that this finding is equally applicable to the section of Fern Creek to be reconstructed as part of this development application.

9.8 FLOOD PLANNING LEVELS

The predicted ultimate post-development conditions 100 year ARI and PMF flood extents for the site are generally contained within the 50m creekline corridor (*refer to **Figure 2***).

The earthworks regrading within 23B Macpherson Street and proposed Fern Creek reconstruction ensures that all habitable floors will be located 700mm above the Fern Creek and Macpherson Street flood levels.

Note that no basement entries are proposed.

No interim flood protection measures were determined to be required for the site.

9.9 FLOOD CATEGORY NOTATIONS

As the developable portion of the site will be filled above the FPL no FC1 Section 149 Flood Notations will be required for the site.

The PMF impacts on only Lot 40 to 48 hence an FC2 Section 149 Flood Notation will apply for these lots

Refer to **Figure 2** for more details.

9.10 CONSIDERATION OF CLIMATE CHANGE

Climate change consideration has been undertaken for this site in accordance with the DECC publication titled "F*loodplain Risk Management Guidelines, Practical Consideration of Climate Change*", October 2007.

This guideline provides advice on the assessment of climate change on flood estimation and calls for a sensitivity testing of flood levels resulting from a range of predicted sea level rises and increases in rainfall intensity predicted to occur up to 2100.

The guideline suggests that sea levels will rise and rainfall intensities will increase as a result of climate change. For the purposes of this DA assessment we have considered the worst case climate change impact as per the guideline, which estimates an increase in rainfall intensity of 30% and an increase in sea level elevation of 0.91m.

In the case of 23B Macpherson Street, the site is located approximately 2km from the sea and at an elevation above RL 8m AHD, therefore it is not expected that even a 0.91m rise in tailwater levels of the ocean will directly impact on flood levels at the subject site.

A sensitivity analysis has been undertaken by assessing an increase in rainfall intensity of 30% using RAFTS. For the sites localised catchment, the intensity of critical 90 minute 100 year ARI storm was 71.034mm/h which was increased by 30% to yield an intensity of 92.344mm/h and the subsequent hydrograph for this possible future storm was inputted into a simple HEC RAS model.

It was found that the water levels at the site increased from the post development water level by approximately 200mm. This is well within the 500mm freeboard component of the FPL and hence in the worst case climate change scenario will not inundate floor levels.

9.11 FLOOD EMERGENCY RESPONSE PLAN

A flood emergency response plan has been developed for the site considering all major flood events up to and including the Probable Maximum Flood (*PMF*).

During the peak of extreme events such as the PMF, the existing escape route crossings of Narrabeen and Fern Creek will be overtopped. The average flood depth and velocity for these events is likely to be hazardous and accordingly would be unsuitable for use as an evacuation route.

However, direct access to PMF flood free land is available as an evacuation site at the east of the site (*ie at the eastern end of Forest Road*).

To assist the safe and orderly evacuation of residents to higher ground, signage will be provided defining the safe evacuation route to the higher ground to the east.

Warriewood Properties will liaise with Council, the Mater Maria Catholic College and the local Emergency Management Committee to ensure that this proposal is satisfactory in the context of Councils wider floodplain management activities.

10 STORMWATER DRAINAGE CONCEPT PLAN

The elements of the proposed Stormwater Drainage Concept Plan (SDCP) for the subject site are illustrated in **Figure 1** and summarised as follows:

- The initial phases of the SDCP for the site have a significant emphasis on source control;
- All roof water is firstly captured by rainwater tanks on each site and then reused for toilet flushing, garden irrigation, car washing and laundry cold water;
- For the larger lots overflow from each rainwater tank and the majority of pervious surfaces on site are then directed to lot based raingardens which provide both a water quality and detention function;
- Runoff leaving each site then connects directly to the community road kerb and gutter and/or kerb side pits;
- A minor/major storm drainage philosophy has been adopted for the community component of the site;
- A 20yr ARI capacity trunk drainage line will convey flows to the single outlet in Fern Creek. Flows in excess of the 20yr ARI up to the 100yr ARI will be safely conveyed aboveground within the community road;
- The majority of the sites runoff enters a large underground detention tank (*255m^3*) located near the trunk pipe outlet beneath Road No. 3;
- Piped runoff will then be treated in a single GPT (*Rocla Cleansall CL600 or equivalent*) near the outlet of the site. For ease of maintenance access the GPT will be sited on the edge of Road No. 1;
- Low flow outflow from the GPT will be directed into a 100 long infiltration trench to aid in achievement of the pre development volumetric runoff coefficient. The trench is 1m wide and 1.5 m deep and is located along the batter on the creek side of the shared path. Water that cannot enter the trench will then flow directly to the outlet into Fern Creek;
- Runoff from the local catchment of the creekside component of the community road will be directed via 1 way cross fall (*av. 3%*) to a series of bio-swales/basins located between the road and the shared path. This runoff will then be treated by the swale and discharge via an underdrain to the main 20yr ARI capacity trunk drainage line for the site;
- Runoff from the local catchment of the focal neighbourhood centre will be directed to a 10KL rainwater tank and then overflow to the main detention tank beneath Road No. 3;
- It is proposed to construct the southern edge of the shared pathway running parallel to the creek approximately 150mm higher than the southern edge of the creekside community road. In larger storms (*20yr-100yr ARI*) this will provide above ground storage that will pond across the swales and part of the road to add to the sites stormwater detention (*approx. 71m^3*); and

- A change to the existing Sector 8 catchment draining to Fern Creek, will result following filling/development of the site. Under existing conditions a proportion of the site (*approximately 40%)* drains to Macpherson Street and Garden Street. In the proposed development of Sector 8, site regrading will be undertaken to direct around 97% of the sector to Fern Creek. A minor area of Sector 8 catchment will continue to drain to Macpherson Street , however it is so small that it does not warrant construction of additional drainage infrastructure. As detailed in **Section 4.2** of this report, flows under the post development scenario draining to the existing pit in Macpherson Street will be greatly reduced when compared to existing conditions (*ie in the 20yr ARI the flows to Macpherson are reduced from 0.096m^3/s under existing conditions to 0.001m^3/s under post development conditions*).

Stormwater detention measures are proposed to be implemented through a combination of on lot and subdivision scale measures. Proposed detention measures include a community below ground detention tank, rainwater tanks and above ground storage in swale/parking areas. These measures ensure post development flows generated by the site do not exceed those under existing conditions.

Runoff water quality is proposed to be managed through a combination of treatment measures, with special emphasis on source control. Proposed treatment measures include a gross pollutant trap, bio-retention swales/basins, raingardens., an infiltration trench and rainwater collection/reuse. These measures ensure post development stormwater loads generated by the site do not exceed those under existing conditions.

No structures are proposed within the site that do not comply with Councils flood planning levels. No FC1 flood related Section 149 notations would apply to the proposed allotments within the community subdivision. An additional 200mm of fill has been allowed across the site to cater for any potential impacts die to Climate Change.

We conclude that the proposed development attains it's goals to achieve industry best practice standards in sustainability and stormwater management. In most facets, the development under ultimate conditions, not only meets, but improves upon existing conditions.

11 REFERENCES

"*Warriewood Valley Urban Release Water Management Specification*", Pittwater Council, February 2001;

"*Warriewood Valley 23B Macpherson Street (Part of Sector 8) Water Management Report – Development Application Stage*" Civil Certification, Issue 3, January 2011;

"*Sector 8 Focal Neighbourhood Centre Revised Stormwater Management Report*" WorleyParsons, 16 December 2009;

"*Application N0400/08 – Comments Arising from Water Management Report*" Cardno Lawson & Treloar on behalf of Pittwater Council, 26 June 2009

"*Sector 8 Focal Neighbourhood Centre Stormwater Management Report, Development Application Stage*", WorleyParsons, 27 May 2009;

"*Sector 8, Warriewood (Mirvac Component) Stormwater Management Report, Development Application Stage Addendum #2*", WorleyParsons, May 2009;

"*Sector 8, Warriewood (Mirvac Component) Stormwater Management Report, Development Application Stage Addendum #1*",WorleyParsons, January 2009;

"*Sector 8, Warriewood (Mirvac Component) Stormwater Management Report, Development Application Stage"*, WorleyParsons, 19 August 2008;

"*Warriewood Valley Sector 8 Water Management Report Development Application Stage*" Patterson Britton & Partners, October 2003;

"*Warriewood Valley Sector 8 Water Management Report Rezoning Application Stage*" Patterson Britton & Partners, October 2003; May 2003;

"*Warriewood Valley Sector 8 Rezoning Application Water Management Report – updated for Revised Masterplan*" GHD November 2002;

"*Spatial Information Exchange (Website: http://imagery.maps.nsw.gov.au/)*", NSW Department of Planning, May 2009;

"*Best Practice Guidelines for Water Conservation in Commercial Office Buildings and Shopping Centres*", Sydney Water, December 2007

"*Urban Stormwater Quality: A Statistical Overview*", Duncan, H. P.,1999;

"*Floodplain Development Manual*", NSW Department of Infrastructure, Planning and Natural Resources, 2005;

"*Floodplain Risk Management Guidelines, Practical Consideration of Climate Change*", DECC, October 2007;

"*Draft Sea Level Rise Policy Statement* " Department of Planning, February 2000;

"*Warriewood Valley Flood Study Addendum 1*", Cardno Lawson and Treloar, July 2005;

"*Australian Rainfall and Runoff, a Guide to Flood Estimation*" Institution of Engineers, Australia;

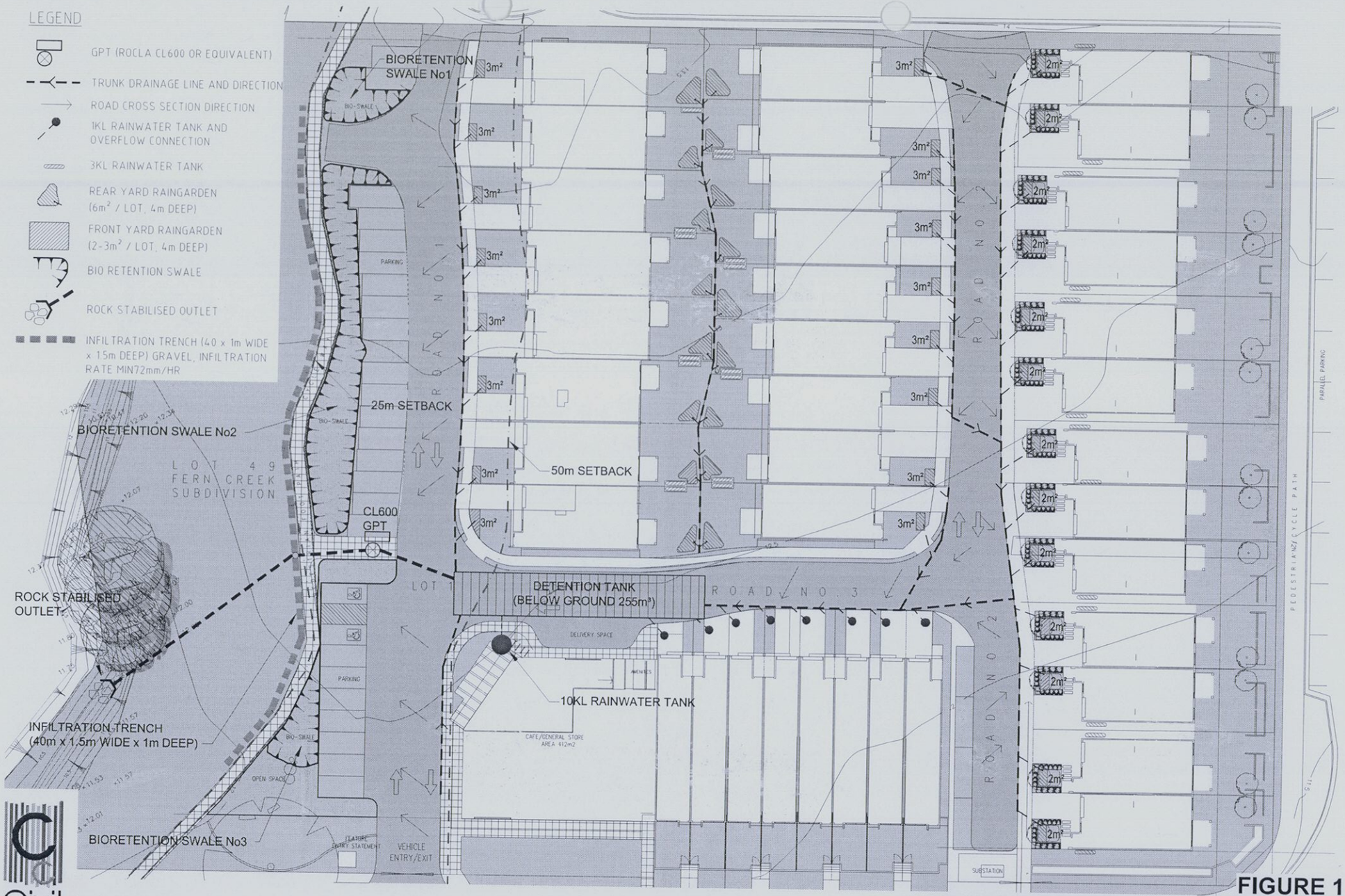
"*Warriewood Valley Integrated Water Management Strategy – Justification of Corridor Widths and Cost Estimates*", Lawson & Treloar Pty Ltd, March 1998

"*Integrated Water Management Strategy – Warriewood Valley* ", Lawson & Treloar Pty Ltd, November 1997

"*Narrabeen Lagoon Flood Study*", NSW Department of Public Works, January 1990

"Sector 8 PMF Impact", Lawson & Treloar, 23 September, 2004

FIGURES



Civil Cert

Source: i2CD-8.3.11
Date: 13 JANUARY 2014
Issue B

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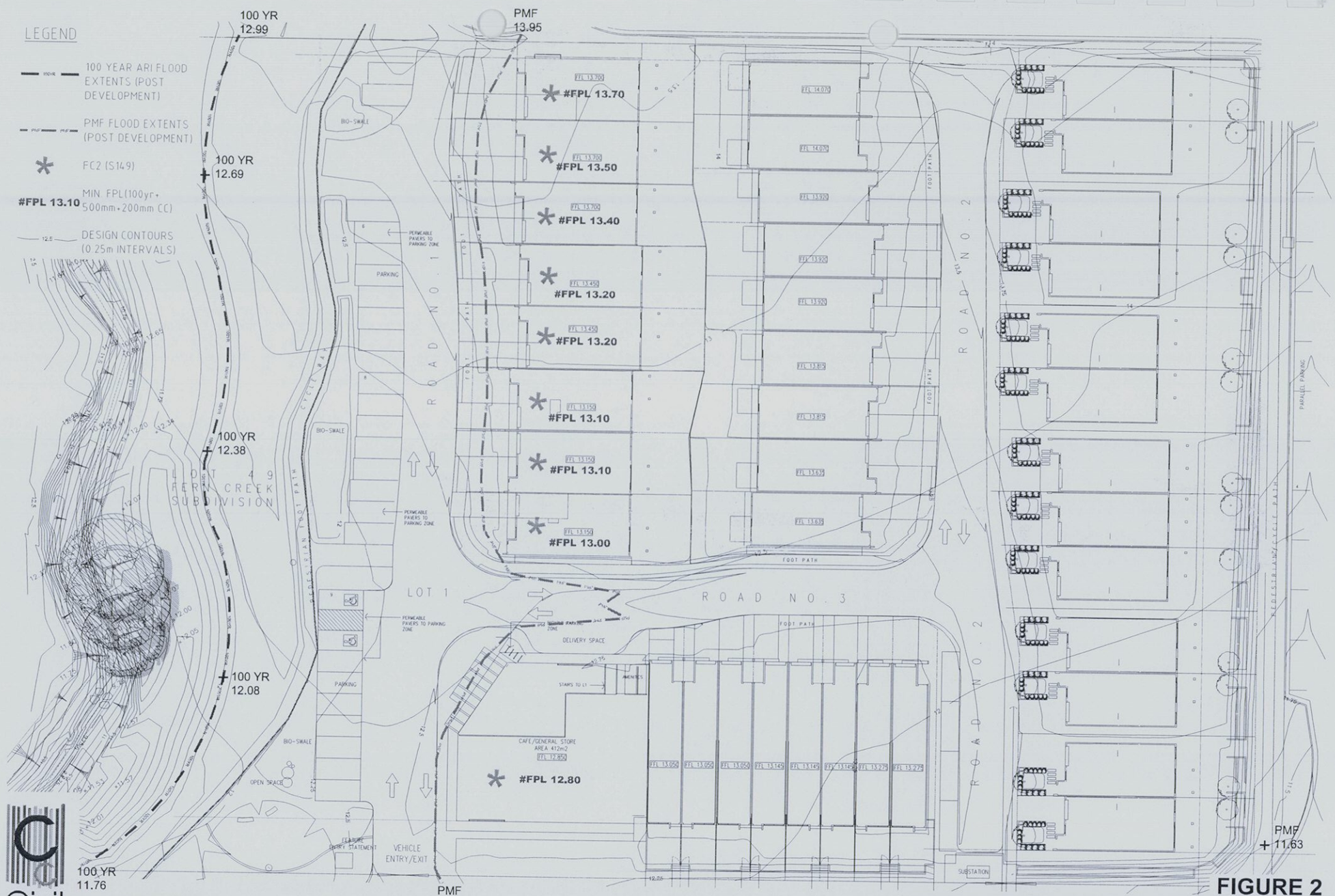
FIGURE 1
23B MCPHERSON ST, WARRIEWOOD
STORMWATER DRAINAGE CONCEPT PLAN
CC WMR



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Source: Craig & Rhodes
Date: 13 JANUARY 2014
Issue C

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FIGURE 2
23B MCPHERSON ST, WARRIEWOOD
FLOOD LEVELS
CC WMR

Civil
Cert

CC CIVIL DRAWINGS

A1

the grove

WARRIEWOOD PROPERTIES Pty Ltd

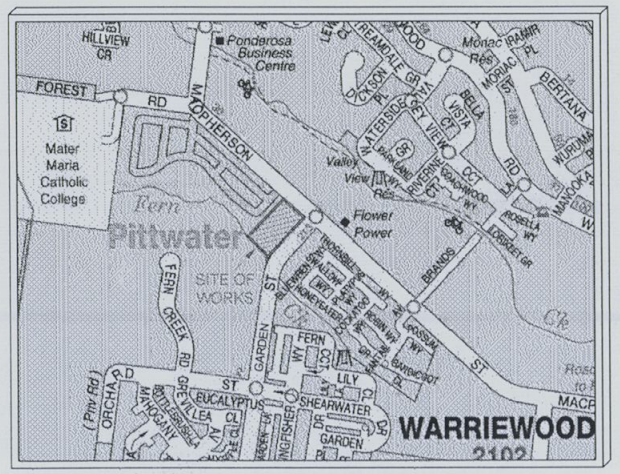
PROPOSED SUBDIVISION OF

LOT 11 SECTION C D.P.5464

corner GARDEN & MACPHERSON STREETS, WARRIEWOOD

WARRIEWOOD VALLEY SECTOR 8

ROAD & DRAINAGE DESIGN



LOCALITY DIAGRAM
NOT TO SCALE

INDEX TO SHEETS

SUBDIVISION ROAD & DRAINAGE

1. COVER SHEET - SHEET INDEX, LOCALITY SKETCH, LEGEND & GENERAL NOTES
2. LAYOUT PLAN (SHEET 1 OF 2)
3. LAYOUT PLAN (SHEET 2 OF 2 - GARDEN ST & MACPHERSON ST INTERSECTION)
4. LOT FILL PLAN
5. ROAD No.1 - LONG & CROSS SECTIONS Ch2.64 TO Ch35.03
6. ROAD No.1 - CROSS SECTIONS Ch35.53 - Ch99.31
7. ROAD No.2 - LONG & CROSS SECTIONS Ch8.75 TO Ch45
8. ROAD No.2 - CROSS SECTIONS Ch55.21 TO Ch59.50
9. ROAD No.3 - LONG & CROSS SECTIONS Ch4.66 TO Ch75
10. ROAD No.3 - CROSS SECTIONS 83.43 TO Ch99.58
11. ROAD No.4 - LONG & CROSS SECTIONS
12. KERB RETURNS 1 TO 6
13. KERB DEVELOPMENT - TURNING HEAD ROAD No.3
14. PATHWAY - LONG & CROSS SECTIONS Ch8.82 TO Ch60 & TYPICAL SECTION
15. PATHWAY - CROSS SECTIONS Ch61.43 TO Ch120
16. ROAD No.7 (GARDEN STREET) - LONG & CROSS SECTIONS Ch113.84 TO Ch165.69
17. ROAD No.7 (GARDEN STREET) - CROSS SECTIONS Ch170.41 TO Ch246.529
18. ROAD No.7 (GARDEN STREET) - CROSS SECTION Ch250, INTERSECTION KERB DEVELOPMENT
19. ROAD No.8 (MACPHERSON STREET) - LONG & CROSS SECTIONS Ch15.06 TO Ch46.68
20. ROAD No.8 (MACPHERSON STREET) - CROSS SECTIONS Ch60 TO Ch104.0
21. DESIGN VEHICLE TURNING PATHS
22. TRAFFIC CALMING DEVICE DETAIL, RETAINING WALL & TYPICAL KERB DETAILS
23. CATCHMENT PLAN
24. DRAINAGE LINES 1 TO 6
25. DRAINAGE LINE 7 & CALC SHEETS
26. DRAINAGE LINES 8 & 9 AND CALC SHEETS
27. OSD TANK DETAILS
28. OSD TANK & RETAINING WALL STRUCTURAL NOTES
29. BIO-RETENTION BASIN PLAN & SECTIONS
30. BIO-RETENTION BASIN, RAIN GARDEN & GRAVEL INFILTRATION TRENCH DETAILS
31. SEDIMENT & EROSION CONTROL NOTES
32. SEDIMENT & EROSION CONTROL PLAN
33. TRAFFIC CONTROL PLAN - SUBDIVISION WORKS

GENERAL NOTES

1. ALL WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH PITTWATER COUNCIL'S STANDARDS AND SPECIFICATIONS.

2. THE CONTRACTOR SHALL LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND SHALL MAKE ALL NECESSARY ARRANGEMENTS WITH THE RELEVANT AUTHORITY TO RELOCATE OR ADJUST AS FOUND NECESSARY AT THE DEVELOPER'S COST.
SERVICES SHOWN ON THESE PLANS HAVE BEEN LOCATED FROM INFORMATION SUPPLIED BY THE RELEVANT AUTHORITIES AND FIELD INVESTIGATIONS AND ARE TO BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
THE CONTRACTOR IS TO TAKE ALL REASONABLE CARE TO PROTECT EXISTING SERVICES. DAMAGED SERCIMES ARE TO REPAIRED AT THE CONTRACTORS EXPENSE.

3. THE CONTRACTOR SHALL NOT ENTER UPON OR DO ANY WORK WITHIN ADJACENT LANDS WITHOUT PRIOR WRITTEN PERMISSION OF THE LAND OWNER.

4. THE CONTRACTOR SHALL MAINTAIN SERVICES AND ALL WEATHER ACCESS AT ALL TIMES TO THE PUBLIC FOOTWAYS, ROAD WAYS AND PROPERTIES ADJACENT TO THE SITE IN A SAFE CONDITION TO THE SATISFACTION OF COUNCIL'S ENGINEER.

5. SURVEY MARKS SHOWN THUS ▲ ⊠ △ SHALL BE MAINTAINED AT ALL TIMES. WHERE RETENTION IS NOT POSSIBLE THE ENGINEER SHALL BE NOTIFIED AND CONSENT RECEIVED PRIOR TO THEIR REMOVAL.

6. THE CONTRACTOR SHALL OBTAIN ALL LEVELS FROM ESTABLISHED BENCHMARKS.

7. A SUBDIVIDER OR CONTRACTOR CARRYING OUT CONSTRUCTIONAL WORKS ON THE SUBDIVISION SHALL RESTRICT SUCH ACTIVITY TO WITHIN THE HOURS OF 7.00a.m. TO 6.00p.m. MONDAY TO FRIDAY INCLUSIVE AND SATURDAY 8.00a.m. TO 1.00p.m. NO WORK SHALL BE UNDERTAKEN OUTSIDE THE HOURS SPECIFIED ABOVE OR ON SUNDAYS WITHOUT THE WRITTEN APPROVAL OF COUNCIL.

8. ALL NEW WORKS SHALL MAKE SMOOTH JUNCTION WITH EXISTING CONDITIONS.

9. SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED PRIOR TO SOIL DISTURBANCE IN KEEPING WITH LANDCOM'S MANAGING URBAN STORMWATER – SOILS & CONSTRUCTION MANUAL 4th EDITION.

10. THE CONTRACTOR SHALL CLEAR AND DISPOSE OF ONLY THOSE TREES THAT ARE CONDEMNED BY THE ENGINEER. COUNCIL'S TREE PRESERVATION ORDER SHALL BE OBSERVED AND NO TREE SHALL BE FELLED, LOPPED OR REMOVED WITHOUT PRIOR APPROVAL FROM COUNCIL'S ENGINEER. ONLY THOSE TREES LOCATED WITHIN ROAD AREAS ARE TO BE REMOVED. TREES TO BE RETAINED ON SITE SHALL PROTECTED BY THE ERECTION OF PROTECTIVE FENCING PRIOR TO COMMENCEMENT OF SITE WORKS.

11. ALL TREES TO BE RETAINED SHALL BE PROTECTED BY PARAWEB FENCING FIRMLY STAKED 4m FROM THE TRUNK OF THE TREE & MAINTAINED IN POSITION FOR THE DURATION OF THE CONSTRUCTION WORKS. NO STOCKPILING OF ANY MATERIALS OR THE PARKING OF VEHICLES OR MACHINERY WITHIN THE DRIPLINE AREA OF THESE TREES.

12. NO BUILDING MATERIALS, MACHINERY OR THE LIKE ARE TO BE STORED ON THE ROAD OR FOOTPATH. THE PATHWAY IS TO BE KEPT IN A CLEAN, TIDY & SAFE CONDITION DURING THE CONSTRUCTION PERIOD.

13. THE CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH, BUILDINGS (AS NOMINATED), FENCES, OUT-HOUSES, CAR BODIES, DEBRIS, ETC. THE CONTRACTOR SHALL NOT DISPOSE OF ANY DEBRIS BY BURNING OFF IN AN OPEN FIRE.

14. TOPSOIL IS TO BE STRIPPED AND STOCKPILED ON THE SITE WITH EROSION CONTROL MEASURES PROVIDED AS DETAILED. UPON COMPLETION OF WORKS, MINIMUM 150mm THICK TOPSOIL SHALL BE SPREAD ON ALL FOOTPATHS, BERMS, BATTERS AND SITE REGRADED AREAS. EXCESS TOPSOIL SHALL BE DISPOSED OF AS DIRECTED BY COUNCIL'S ENGINEER/CERTIFYING AUTHORITY.

15. PROVIDE 150mm TOPSOIL WITH TURF OR GRASS SEEDING ON ALL FOOTPATHS AND FILLED AREAS.

16. EARTHWORKS TO BE CARRIED OUT TO THE SATISFACTION OF COUNCIL'S ENGINEER/CERTIFYING AUTHORITY. UNSOUND MATERIALS ARE TO BE REMOVED FROM ROADS AND LOTS PRIOR TO FILLING.

17. SURPLUS EXCAVATED MATERIAL SHALL BE DISPOSED OF IN CONSULTATION WITH COUNCIL'S ENGINEER. DOCUMENTATION OF THE DISPOSAL SITE IS TO BE CERTIFYING AUTHORITY PRIOR TO COMMENCEMENT OF WORKS.

18. WHERE THE SLOPE OF THE NATURAL SURFACE EXCEEDS ONE IN FOUR (1:4) FILL EMBANKMENTS, BENCHES ARE TO BE CUT TO PREVENT SLIPPING OF THE FILL MATERIAL AS REQUIRED BY COUNCIL'S ENGINEER/CERTIFYING AUTHORITY.

19. ALL LAND DISTURBED BY EARTHWORKS SHALL BE SPRAY-GRASSED OR SIMILARLY TREATED TO ESTABLISH GRASS COVER. SEED MIXTURES ARE TO BE APPROVED BY COUNCIL PRIOR TO SPRAYING. ALL GRASSED AREAS SHALL BE REGULARLY WATERED AND MAINTAINED UNTIL EXPIRATION OF THE MAINTENANCE PERIOD.

20. THE CONTRACTOR SHALL MAINTAIN DUST CONTROL THROUGHOUT THE DURATION OF THE PROJECT.

21. THE CONTRACTOR SHALL MAINTAIN IN GOOD WORKING ORDER ALL SOIL AND WATER MANAGEMENT STRUCTURES FOR THE DURATION OF THE WORKS AND FOR A MINIMUM PERIOD OF 6 MONTHS AFTER THE DATE OF PRACTICAL COMPLETION.

22. ALL DRAINAGE LINES THROUGH LOTS SHALL BE CONTAINED WITHIN THEIR EASEMENTS AND CONFORM WITH COUNCIL'S STANDARDS.

23. ALL DRAINAGE LINES ON HIGH SIDE AND UNDER ROADS SHALL BE BACKFILLED WITH 20mm METAL (NOT RECYCLED) AND HAVE 3.0m OF AGRICULTURAL LINE WRAPPED IN AN APPROVED FILTER FABRIC, DISCHARGING INTO THE DOWNSTREAM PIT.

24. ALL PITS TO BE BENCHED AND STREAMLINED AND PITS DEEPER THAN 900mm SHALL HAVE STEP IRONS PROVIDED IN ACCORDANCE WITH COUNCIL'S STANDARDS.

25. PRECAST KERB INLET LINTELS SHALL BE USED ON GULLY PITS. GRATES SHALL BE "WELDLOCK" TYPE GG 78/50 OR EQUIVALENT. GULLY PITS ARE GENERALLY TO BE IN ACCORDANCE WITH COUNCIL'S STANDARDS UNLESS NOTED OTHERWISE & IN PUBLIC ROAD USE "DURHAM" D.G.G.P.

26. INTERALLOTMENT DRAINAGE LINES SHALL HAVE A MINIMUM 300mm COVER AND DESIRABLE MINIMUM GRADE OF 1%.

27. 100x50mm HOT DIPPED GALVANISED RHS OR SIMILAR WITH 90mm ADAPTER FOR ROOF WATER CONNECTION SHALL BE PROVIDED TO ALL LOTS DRAINING TO THE KERB AT THEIR DOWNSTREAM BOUNDARY.

28. LENGTH OF LINTEL SHOWN INDICATES CLEAR LENGTH OF OPENING.

29. CONDUIT TRENCHES AND STORMWATER DRAINAGE LINES TO BE BACKFILLED WITH 20mm METAL, FLOODED AND VIBRATED. CONDUIT TRENCHES TO BE GRADED AT A MINIMUM ONE PERCENT (1 %). GRADE TO EITHER SUB-SOIL OR STORMWATER DRAINAGE LINES.

30. CONDUITS SHALL BE LAID AFTER POSITIONS HAVE BEEN DETERMINED BY THE RELEVANT AUTHORITIES AND BEFORE FINAL A.C. IS LAID.

31. ADEQUATE PROVISION TO BE MADE FOR SCOURING AND SEDIMENTATION TO ALL DRAINAGE WORKS AS DIRECTED.

32. WHERE KERB AND GUTTER IS LAID BY THE USE OF A KERB AND GUTTER MACHINE THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE TAKING AND TESTING OF CORE SAMPLES, FORWARDING THEIR RESULTS TO COUNCIL AND REMOVAL OF KERB AND GUTTER, ALL AT HIS OWN EXPENSE, WHERE THE MINIMUM STRENGTH IS NOT ACHIEVED IN ACCORDANCE WITH COUNCIL'S STANDARD SPECIFICATIONS.

33. ACCESS RAMPS ARE TO BE PROVIDED IN KERB AND GUTTER IN ACCORDANCE WITH COUNCIL'S STANDARDS.

34. CONDUITS ARE TO BE PROVIDED FOR THE FOLLOWING SERVICES:
1) WATER – AS DIRECTED BY THE SUPERINTENDENT
2) ELECTRICAL – AS DIRECTED BY THE SUPERINTENDENT AND IN ACCORDANCE WITH ENERGY AUSTRALIA
3) TELSTRA – ADJACENT TO EACH ENERGY AUST. CROSSING

35. POSITION OF ALL CONDUITS SHALL BE MARKED ON THE KERB.

36. PROVIDE SUBSOIL DRAINAGE LINES WITH FLUSHING POINTS AND STANDARD COVERS AT MAXIMUM 60m INTERVALS. ON HIGH SIDE OF ROAD AND ELSEWHERE AS DIRECTED BY THE SITE SUPERINTENDENT. MARK FACE OF KERB ADJACENT TO COVER "S.S.".

37. CATCH DRAINS TO BE CONSTRUCTED AS REQUIRED BY THE SITE SUPERINTENDENT AND/OR COUNCIL'S ENGINEER.

38. FELLED TREES SHALL BE SALVAGED FOR REUSE AS WOODCHIP MULCH OR LOG FORM FOR SITE REHABILITATION, NON-SALVAGEABLE MATERIAL SUCH AS STUMPS AND ROOTS SHALL BE DISPOSED OFF SITE AS NOMINATED BY THE ENGINEER.

39. PROVISIONS TO BE MADE FOR SUITABLE PROTECTION OF ROAD PAVEMENT, KERB & GUTTER AND FOOTPATH FORMATION.

40. SUB-GRADE IN ROCK IS TO BE RIPPED, SCARIFIED, SPREAD AND COMPACTED TO A MINIMUM DEPTH OF 300mm BELOW THE FINISHED SUB-GRADE LEVEL.

41. THE CONTRACTOR SHALL PROVIDE A MINIMUM 24 HOURS NOTICE TO SUPERINTENDENT OR COUNCIL'S ENGINEER FOR ALL INSPECTIONS. (ph. 0438777556)

42. THE CONTRACTOR SHALL UNDERTAKE TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH COUNCIL'S TRAFFIC MANAGEMENT POLICY AND TRAFFIC CONTROL PLAN AND SHALL DISPLAY ALL APPROPRIATE WARNING SIGNS THROUGHOUT THE DURATION OF CONSTRUCTION.

43. ERECT STREET NAME SIGNS, CONDUIT WARNING SIGNS AND NO THROUGH ROAD SIGNS AS REQUIRED, COMPLYING WITH COUNCIL'S STANDARDS.

44. DETAILS OF ALL SOIL TESTS AND THE PAVEMENT DESIGN ARE TO BE SUBMITTED TO COUNCIL/CERTIFYING AUTHORITY PRIOR TO INSPECTION OF SUBGRADE.

LEGEND

- EXISTING EDGE OF BITUMEN
- EXISTING KERB & GUTTER
- PROPOSED KERB & GUTTER
- FUTURE KERB & GUTTER (BY OTHERS)
- K&G 150mm BARRIER KERB & GUTTER
- RK ROLL KERB
- ES 100mm WIDE CONCRETE EDGE STRIP
- SUBSOIL DRAINAGE LINE (2 x ø90mm IN SOCK)
- EXISTING DRAINAGE LINE
- I/C PROPOSED INTERALLOTMENT DRAINAGE
- PROPOSED DRAINAGE LINE
- S EXISTING SEWER
- PS PROPOSED SEWER
- 12.5 EXISTING CONTOURS (0.5m INTERVAL)
- 12.25 PROPOSED CONTOURS (0.25m INTERVAL)
- W EXISTING WATERMAIN
- PW PROPOSED WATERMAIN
- T EXISTING UNDERGROUND TELSTRA
- E EXISTING UNDERGROUND ELECTRICITY
- G EXISTING GAS MAIN
- UG TANK 1kL UNDERGROUND RAINWATER TANK WITH OVERFLOW PIPE
- TANK 3kL ABOVEGROUND SLIMLINE RAINWATER TANK WITH OVERFLOW PIPE
- FRONT YARD RAINGARDEN (3m²/LOT)
- REAR YARD RAINGARDEN (6m²/LOT)
- RETAINING WALL
- TREE TO BE RETAINED
- TREE TO BE REOVED

CC

DIAL 1100 BEFORE YOU DIG

Project: COVER SHEET - SHEET INDEX, LOCALITY SKETCH, LEGEND & GENERAL NOTES

Principal: WARRIEWOOD PROPERTIES PTY LTD				
Scale: N.T.S.	Date: 19.2.14	Council Ref.		
	Datum: A.H.D.	L.G.A. PITTWATER		
Calc's: A.D.	Drawn: C.G.H.	Proj.Man. A.D.	Client Ref.	

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19-2-14 - 001

A1

LOMANDRA WAY

ROAD No.1

ROAD No.2

ROAD No.3

ROAD No.4

FERN CREEK

GARDEN STREET

MACPHERSON STREET

FERN CREEK RECONSTRUCTION WORKS TO BE COMPLETED UNDER SEPARATE CONTRACT

LOT 11 SECTION C D.P.5464 1.434 ha.(Deed)

D.P. 1092802

D.P. 367229

D.P. 378841

NO ENTRY

TIMBER GUIDE POSTS WITH RETROREFLECTORS @ 1.2m CENTRES

S.S.M.136918 R.L.13.58 (A.H.D.)

S.S.M.136909 R.L.14.00 (A.H.D.)

S.S.M.136908 R.L.13.095 (A.H.D.)

DUAL USE FOOTPATH/ CYCLEWAY 1.5m WIDE

1m WIDE GRAVEL INFILTRATION TRENCH (SEE DETAIL SHEET 030)

GROSS POLLUTANT TRAP (ROCLA CL600 UNIT OR EQUIVALENT)

VISITOR PARKING AREA

BIO BASIN No.1

BIO BASIN No.2

BIO BASIN No.3

BIO BASIN No.4

REMOVABLE BOLLARDS @ 1.5m CENTRES

WHEEL STOPS

COMMUNAL OPEN SPACE

PROPOSED EASEMENT TO DRAIN WATER 2.2 WIDE

FERN CREEK/BOUNDARY VIDE LOT 11 SECTION C D.P.5464

P.M.25546 R.L.11.47 (A.H.D.)

9 PAD 13.550 FFL 13.700

10 PAD 13.550 FFL 13.700

11 PAD 13.550 FFL 13.700

12 PAD 13.300 FFL 13.450

13 PAD 13.300 FFL 13.450

14 PAD 13.000 FFL 13.150

15 PAD 13.000 FFL 13.150

16 PAD 13.000 FFL 13.150

17 PAD 13.485 FFL 13.635

18 PAD 13.485 FFL 13.635

19 PAD 13.665 FFL 13.815

20 PAD 13.665 FFL 13.815

21 PAD 13.770 FFL 13.920

22 PAD 13.770 FFL 13.920

23 PAD 13.770 FFL 13.920

24 PAD 13.920 FFL 14.070

25 PAD 13.920 FFL 14.070

Pt.2 PAD 12.700 FFL 12.850 FOCAL NEIGHBOURHOOD CENTRE

5 UNDERGROUND ON-SITE DETENTION TANK VOLUME = 255m³

900mm WIDE DISH DRAIN

10kL UNDERGROUND RAINWATER TANK

TRAFFIC CALMING DEVICE (SPEED HUMP) SEE DETAIL SHEET 022

RAISED TRAFFIC ISLANDS

TRANSITION FROM ROLL KERB TO BARRIER KERB & GUTTER

TEMPORARY BATTER @ 2(H):1(V)

1.2m HIGH BLACK POWDER COATED GALVANISED POOL-TYPE FENCE ALONG TOP OF WALL

PROPOSED ELECTRICAL SUBSTATION

6 x Ø140mm YELLOW SAFETY BOLLARDS WITH 50mm WIDE REFLECTIVE TAPE @ 1.2m CENTRES

150mm CONCRETE BLOCK RETAINING WALL (SEE SHEET 022 FOR DETAILS)

PRAM RAMP (TO PITTWATER COUNCIL SPECIFICATION)

EXISTING SEWER MAINTENANCE HOLE TO BE ADJUSTED

APPROX. 9m OF EXISTING KERB & GUTTER TO BE DEMOLISHED

TELSTRA PIT TO BE ADJUSTED

POWER POLE TO BE REMOVED

HALF ROAD CONSTRUCTION SAW CUT ALONG CENTRELINE MAKE SMOOTH JOIN WITH EXISTING PAVEMENT

TEMPORARY BATTER @ 2(H):1(V)

EXISTING STORMWATER PIT & PIPE TO BE DEMOLISHED

FUTURE ROUNDABOUT (BY OTHERS)

B.M. P.M.6871 R.L.11.04 (A.H.D.)

BREAK OUT & REMOVE EXISTING PIVE

8 PARKING BAYS

900mm WIDE DISH DRAIN

HALF ROAD CONSTRUCTION

CHARCOAL COLOURED 80mm THICK PAVERS LAID ON 150mm THICK COMPACTED CRUSHED SANDSTONE

FUTURE KERB & GUTTER (BY OTHERS)

ORIGIN OF LEVELS: P.M.6871 R.L.11.04 (A.H.D.) VIDE SCIMS DATED 21/11/07

1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: LAYOUT PLAN (SHEET 1 OF 2)

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:250	Date	19.2.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.
				Client Ref.	

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CC

A1

NO ENTRY

D. P. 3 7 8 8 4 1

VISITOR PARKING AREA

Pt.2

WHEEL STOPS

BIO BASIN No.4

COMMUNAL OPEN SPACE

FERN CREEK/BOUNDARY VIDE LOT 11 SECTION C D.P.5464

10kL UNDERGROUND RAINWATER TANK

Pt.2

PAD 12.700
FFL 12.850

FOCAL NEIGHBOURHOOD CENTRE

8

7

TEMPORARY BATTER @ 2(H):1(V)

TRAFFIC CALMING DEVICE (SPEED HUMP) SEE DETAIL SHEET 022

RAISED TRAFFIC ISLANDS

TRANSITION FROM ROLL KERB TO BARRIER KERB & GUTTER

1.2m HIGH BLACK POWDER COATED GALVANISED POOL-TYPE FENCE ALONG TOP OF WALL

PROPOSED ELECTRICAL SUBSTATION

6 x Ø140mm YELLOW SAFETY BOLLARDS WITH 50mm WIDE REFLECTIVE TAPE @ 1.2m CENTRES

150mm CONCRETE BLOCK RETAINING WALL (SEE SHEET 022 FOR DETAILS)

PRAM RAMP (TO PITTWATER COUNCIL SPECIFICATION)

EXISTING SEWER MAINTENANCE HOLE TO BE ADJUSTED

TEMPORARY BATT

MACPHERSON

STREET

EXISTING STORMWATER PIT & PIPE TO BE DEMOLISHED

POWER POLE TO BE REMOVED

FUTURE ROUNDABOUT (BY OTHERS)

B.M. P.M.6871
R.L.11.04 (A.H.D.)

POWER POLE TO BE REMOVED

POWER POLE TO BE REMOVED

POWER POLE TO BE REMOVED

8 PARKING BAYS

900mm WIDE DISH DRAIN

HALF ROAD CONSTRUCTION

CHARCOAL COLOURED 80mm THICK PAVERS LAID ON 150mm THICK COMPACTED CRUSHED SANDSTONE

GARDEN

K&G

EXISTING EDGE OF BITUMEN

P.M.25546
R.L.11.47 (A.H.D.)

TRANSITION FROM ROLL KERB TO BARRIER KERB & GUTTER

HALF ROAD CONSTRUCTION SAW CUT ALONG CENTRELINE MAKE SMOOTH JOIN WITH EXISTING PAVEMENT

FUTURE KERB & GUTTER (BY OTHERS)

POWER POLE

D. P. 1 6 3 8 7

CONSTRUCT TEMPORARY JUNCTION PITS (TO BE CONVERTED TO GRATED GULLY PIT IN THE FUTURE BY OTHERS)

BREAK OUT & REMOVE EXISTING PIPE

FUTURE KERB & GUTTER (BY OTHERS)

CONSTRUCT JUNCTION PIT OVER EXISTING PIPE

EXISTING 225mm PIPE

EXISTING BUS SHELTER

EXISTING JUNCTION PIT

VEHICLE CROSSING

D.P.749234

D.P.217288

CC

ORIGIN OF LEVELS: P.M.6871 R.L.11.04 (A.H.D.) VIDE SCIMS DATED 21/11/07

1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: LAYOUT PLAN (SHEET 2 OF 2)

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:250	Date 19.2.14		Council Ref.
	Datum A.H.D.		L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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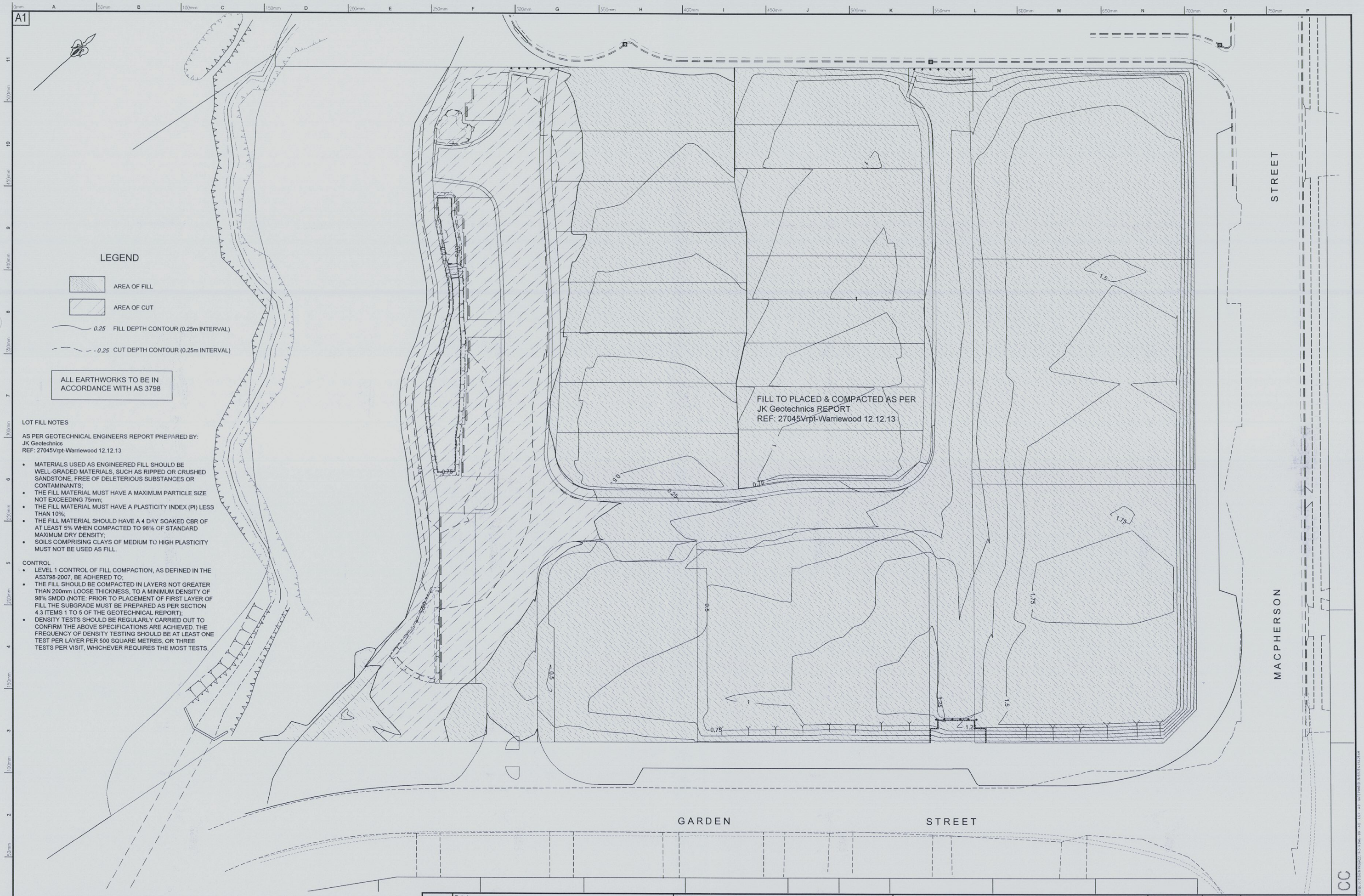
A1



LEGEND

- AREA OF FILL
- AREA OF CUT
- 0.25 FILL DEPTH CONTOUR (0.25m INTERVAL)
- -0.25 CUT DEPTH CONTOUR (0.25m INTERVAL)

ALL EARTHWORKS TO BE IN ACCORDANCE WITH AS 3798

LOT FILL NOTES

AS PER GEOTECHNICAL ENGINEERS REPORT PREPARED BY:
JK Geotechnics
REF: 27045Vrpt-Warriewood 12.12.13

- MATERIALS USED AS ENGINEERED FILL SHOULD BE WELL-GRADED MATERIALS, SUCH AS RIPPED OR CRUSHED SANDSTONE, FREE OF DELETERIOUS SUBSTANCES OR CONTAMINANTS;
- THE FILL MATERIAL MUST HAVE A MAXIMUM PARTICLE SIZE NOT EXCEEDING 75mm;
- THE FILL MATERIAL MUST HAVE A PLASTICITY INDEX (PI) LESS THAN 10%;
- THE FILL MATERIAL SHOULD HAVE A 4 DAY SOAKED CBR OF AT LEAST 5% WHEN COMPACTED TO 98% OF STANDARD MAXIMUM DRY DENSITY;
- SOILS COMPRISING CLAYS OF MEDIUM TO HIGH PLASTICITY MUST NOT BE USED AS FILL.

CONTROL

- LEVEL 1 CONTROL OF FILL COMPACTION, AS DEFINED IN THE AS3798-2007, BE ADHERED TO;
- THE FILL SHOULD BE COMPACTED IN LAYERS NOT GREATER THAN 200mm LOOSE THICKNESS, TO A MINIMUM DENSITY OF 98% SMDD (NOTE: PRIOR TO PLACEMENT OF FIRST LAYER OF FILL THE SUBGRADE MUST BE PREPARED AS PER SECTION 4.3 ITEMS 1 TO 5 OF THE GEOTECHNICAL REPORT);
- DENSITY TESTS SHOULD BE REGULARLY CARRIED OUT TO CONFIRM THE ABOVE SPECIFICATIONS ARE ACHIEVED. THE FREQUENCY OF DENSITY TESTING SHOULD BE AT LEAST ONE TEST PER LAYER PER 500 SQUARE METRES, OR THREE TESTS PER VISIT, WHICHEVER REQUIRES THE MOST TESTS.

ORIGIN OF LEVELS: P.M 6871 R.L.11.04 (A.H.D.) VIDE SCIMS DATED 21/11/07

10 8 6 4 2 0 5 10

1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: CUT-FILL PLAN

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
1:250	19.2.14	
	Datum A.H.D.	L.G.A. PITTWATER

Calc's	Drawn.	Proj.Man.	Client Ref.
A.D.	C.G.H.	A.D.	

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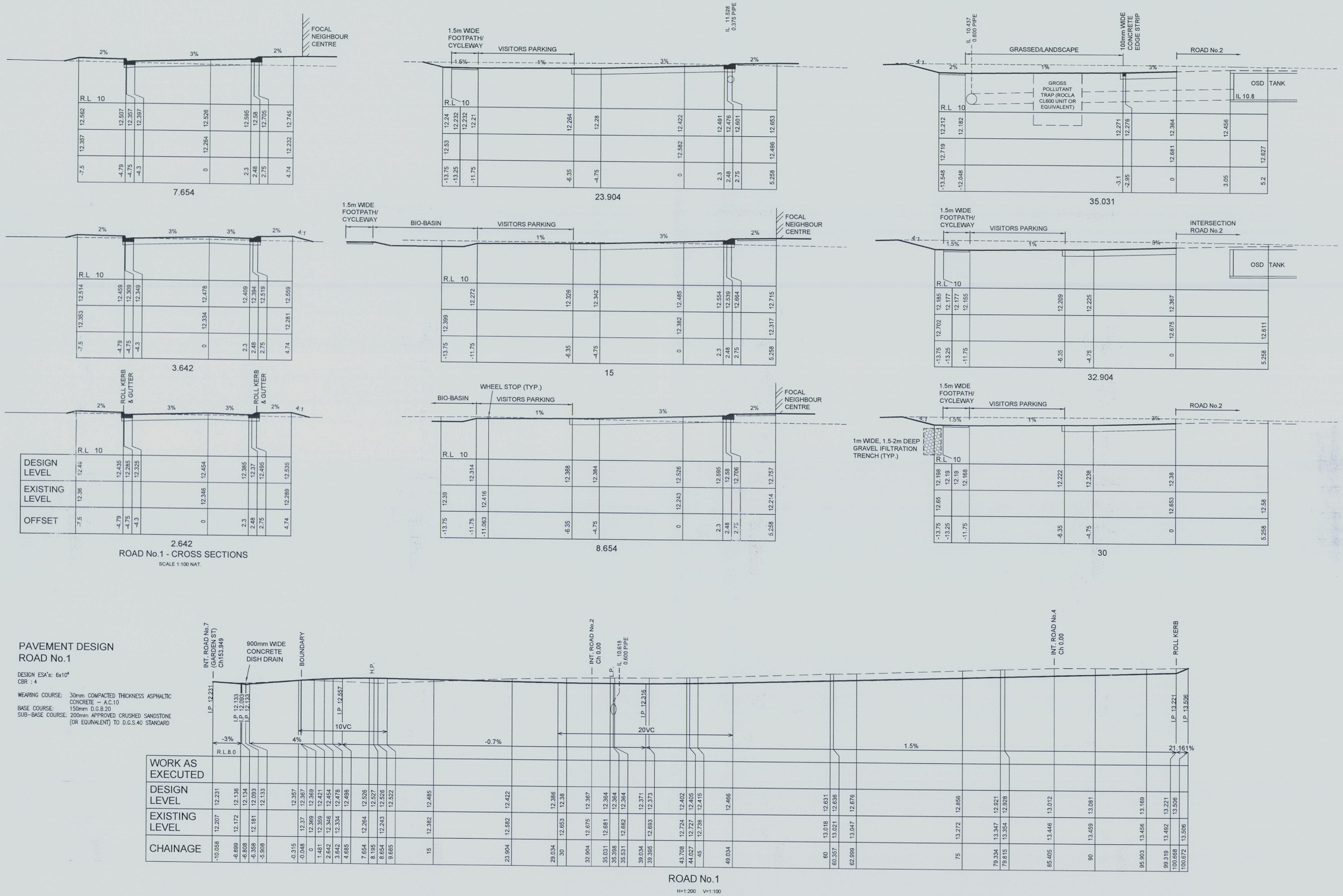
FOCAL NEIGHBOUR CENTRE
7.654
1.5m WIDE FOOTPATH/ CYCLEWAY
VISITORS PARKING
IL 11.528 0.375 PIPE
23.904
IL 10.437 0.600 PIPE
GRASSED/LANDSCAPE
100mm WIDE CONCRETE EDGE STRIP
ROAD No.2
GROSS POLLUTANT TRAP (ROCLA CL600 UNIT OR EQUIVALENT)
OSD TANK
IL 10.8
35.031
3.642
BIO-BASIN
15
INTERSECTION ROAD No.2
32.904
ROLL KERB & GUTTER
DESIGN LEVEL
EXISTING LEVEL
OFFSET
2.642
ROAD No.1 - CROSS SECTIONS
SCALE 1:100 NAT.
WHEEL STOP (TYP.)
8.654
1m WIDE, 1.5-2m DEEP GRAVEL IFILTRATION TRENCH (TYP.)
30
PAVEMENT DESIGN
ROAD No.1
DESIGN ESA's: 6x10^6
CBR : 4
WEARING COURSE: 30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 150mm D.G.B.20
SUB-BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD
INT. ROAD No.7 (GREENHILLS ST) Ch153.948
900mm WIDE CONCRETE DISH DRAIN
BOUNDARY
INT. ROAD No.2 Ch 0.00
IL 10.618 0.600 PIPE
INT. ROAD No.4 Ch 0.00
ROLL KERB
10VC
20VC
-3%
4%
-0.7%
1.5%
21.161%
WORK AS EXECUTED
DESIGN LEVEL
EXISTING LEVEL
CHAINAGE
ROAD No.1
H=1:200 V=1:100
1:100 @ A1
1:200 @ A1
DIAL 1100 BEFORE YOU DIG
Project:
ROAD No.1
LONG SECTION &
CROSS SECTIONS Ch2.64 TO Ch35.03
Principal: WARRIEWOOD PROPERTIES PTY LTD
Scale: LONG SECT. H:1:200 V:1:100 CROSS SECT. 1:100 NAT.
Date: 19.2.14
Council Ref.
Datum: A.H.D.
L.G.A.: PITTWATER
Calc's: A.D.
Drawn: C.G.H.
Proj.Man.: A.D.
Client Ref.
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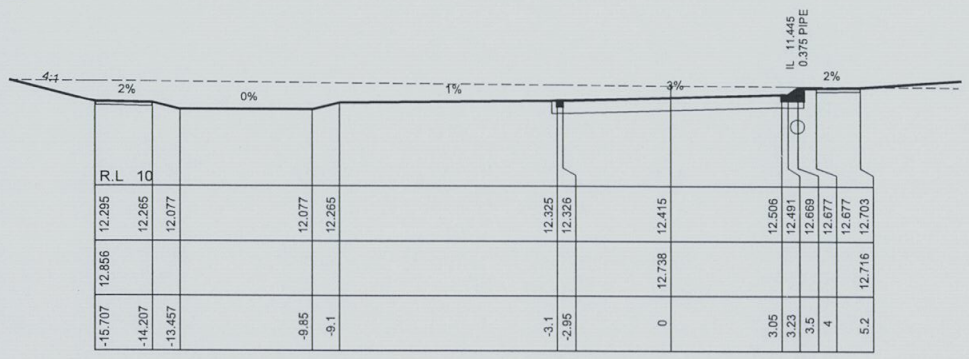
19-2-14 - 005
CC

A1



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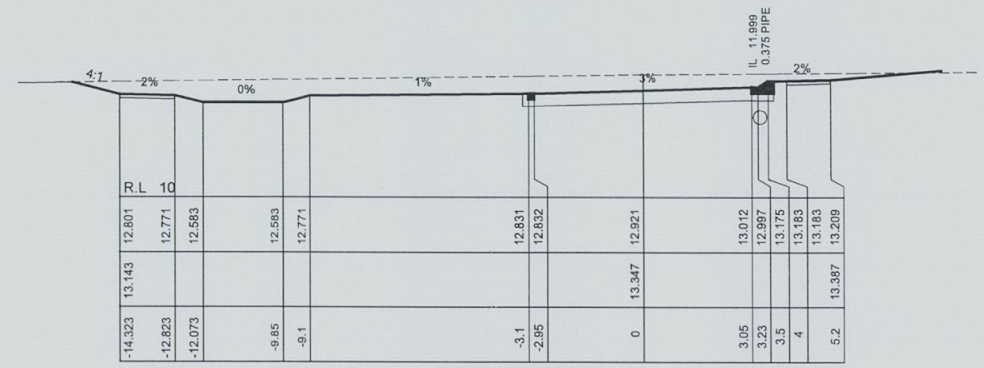

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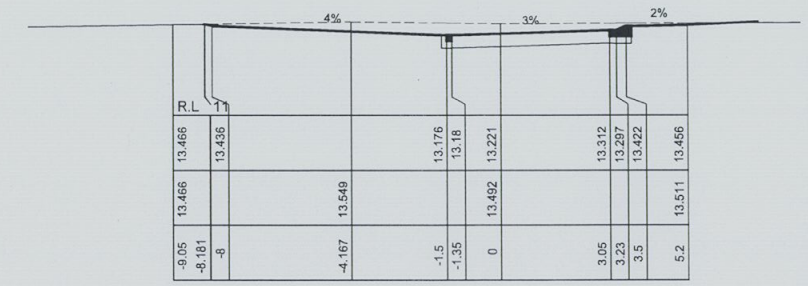

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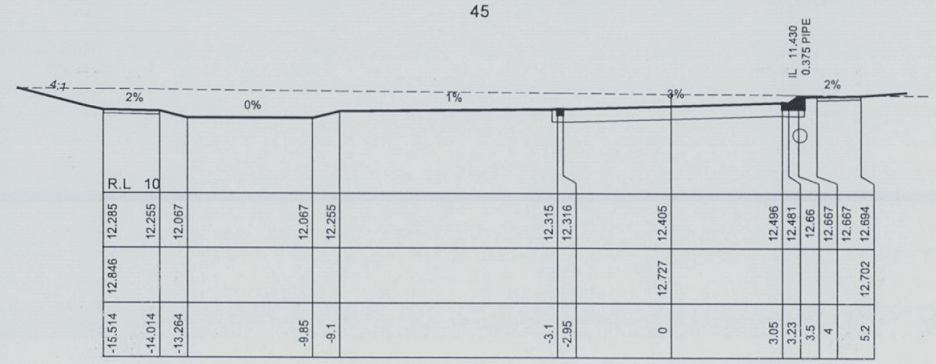

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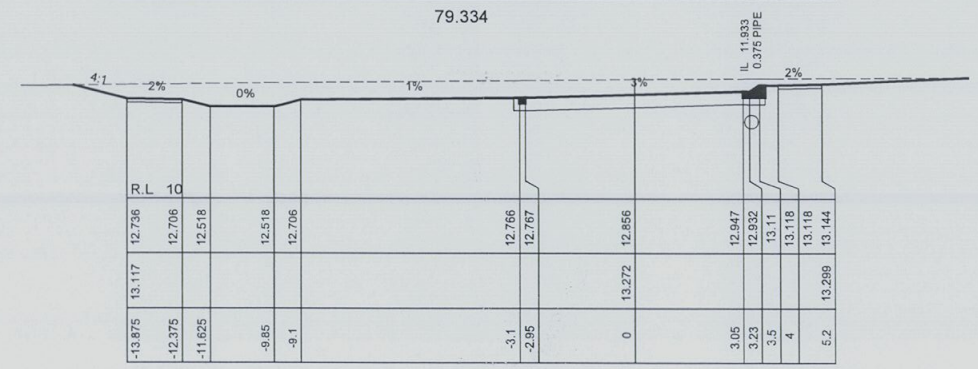

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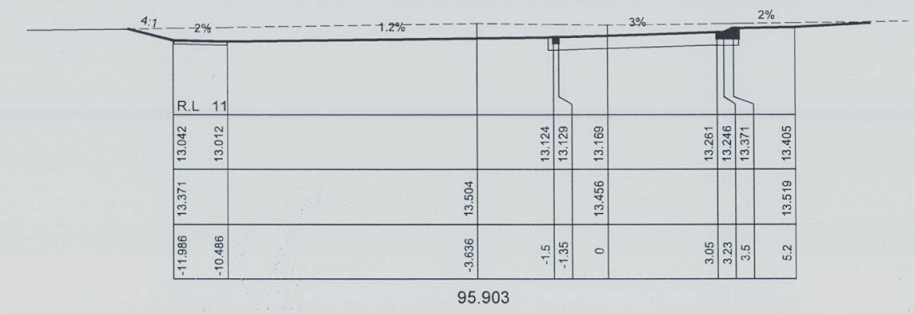

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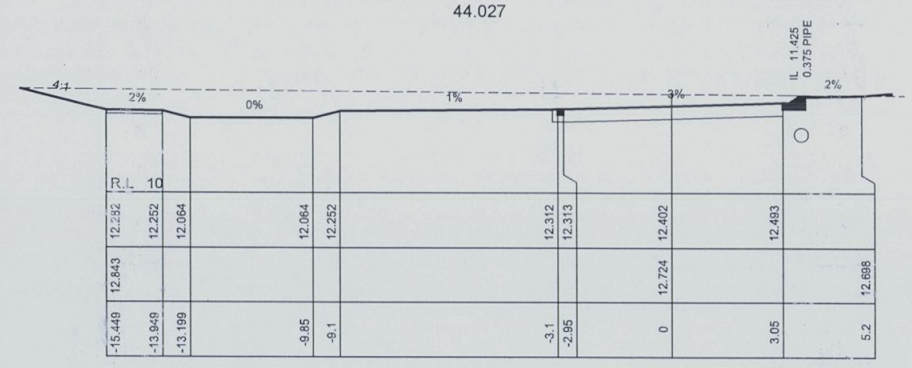

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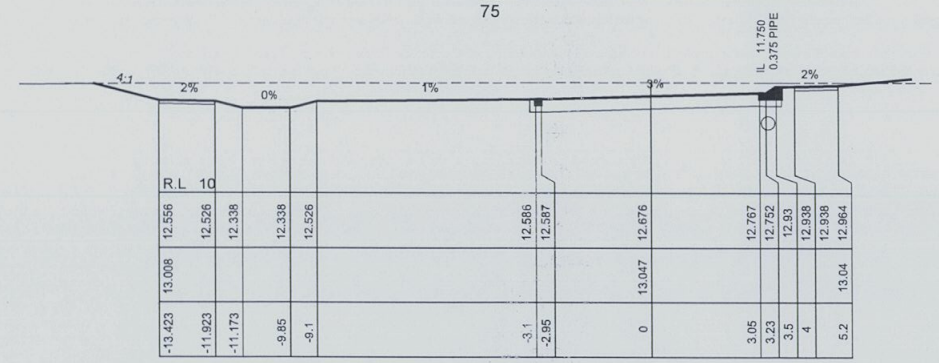
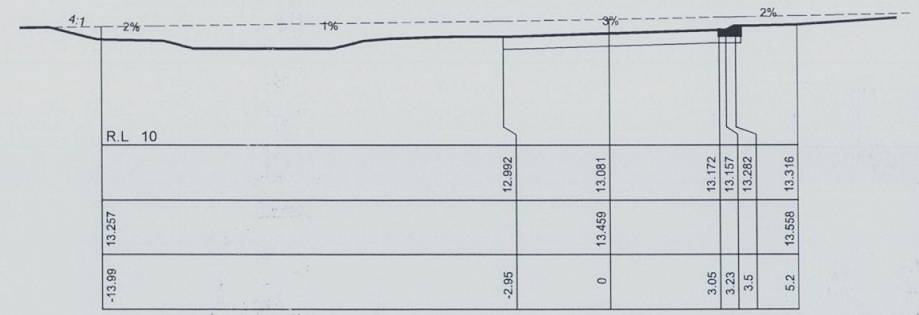


62.999



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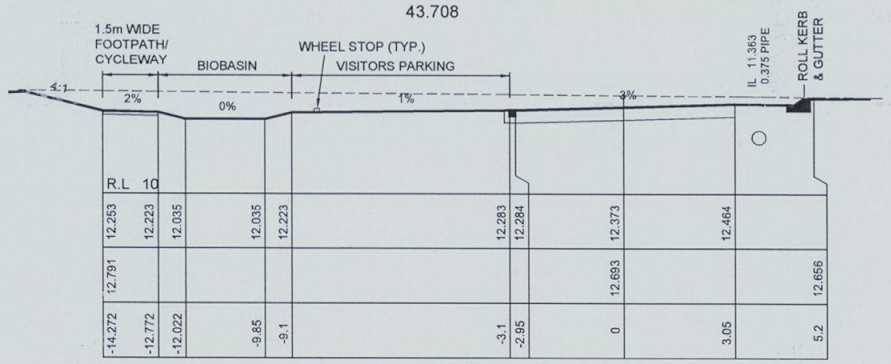
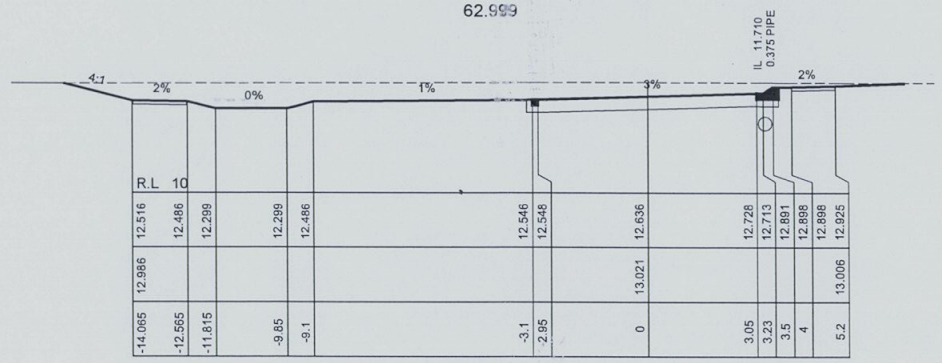


39.395



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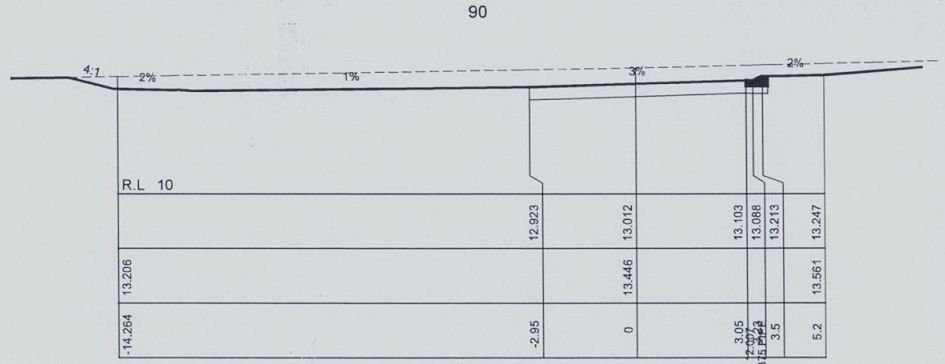

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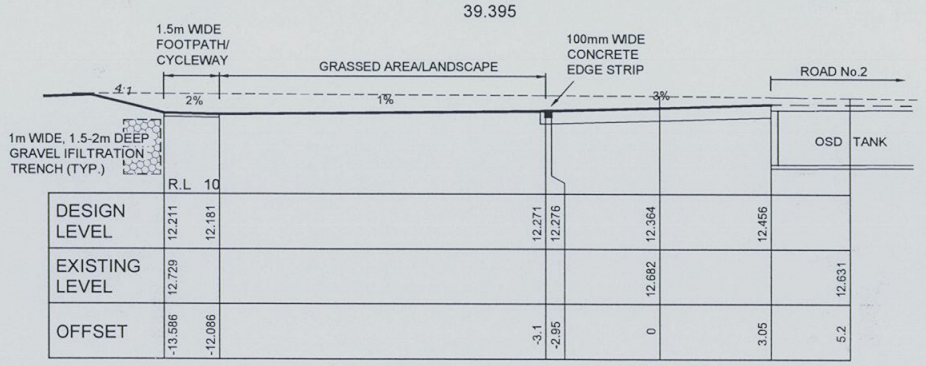
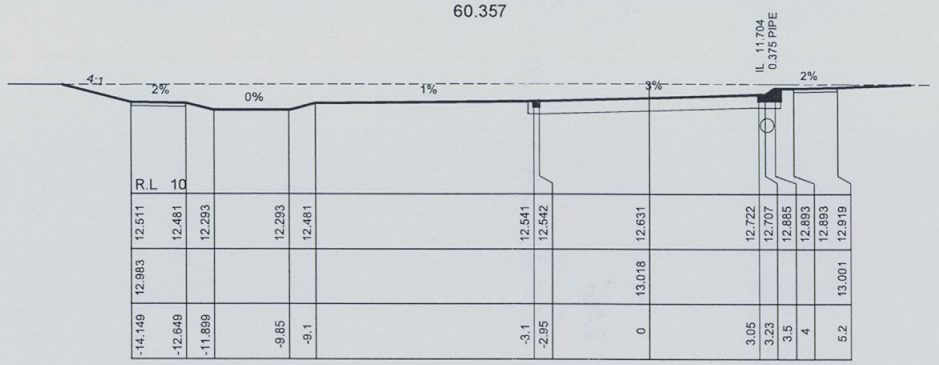


35.531

ROAD No.1 - CROSS SECTIONS

SCALE 1:100 NAT.



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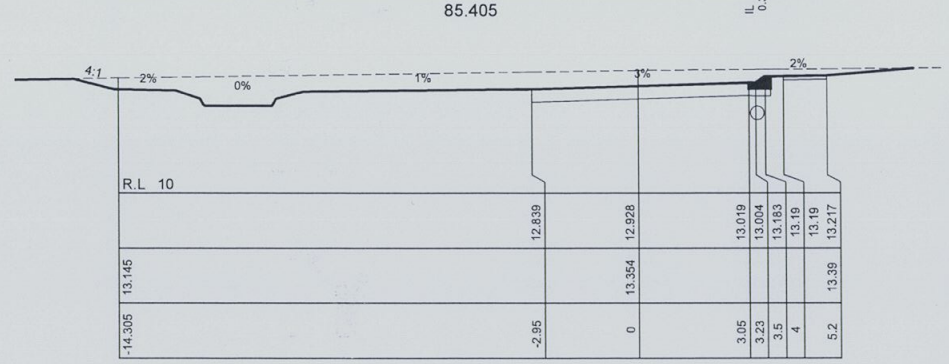

79.815

CC

5 4 3 2 1 0 5

1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.1 CROSS SECTIONS Ch35.53 TO Ch99.31

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:100 NAT.	Date 19.2.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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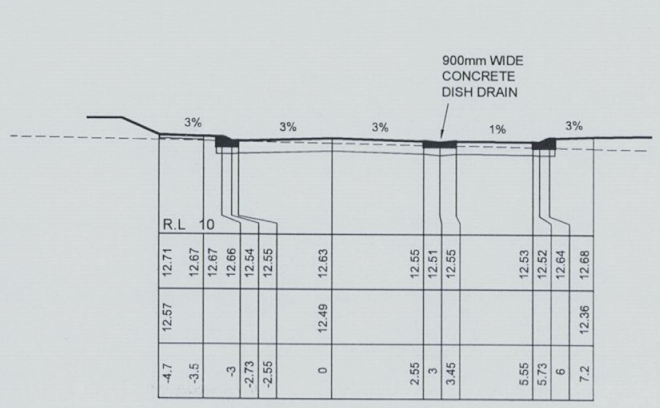
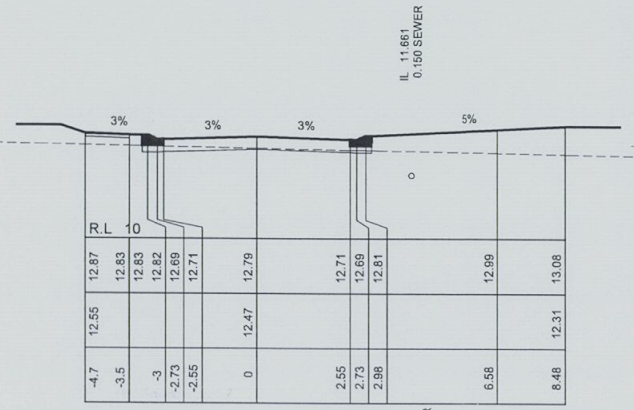
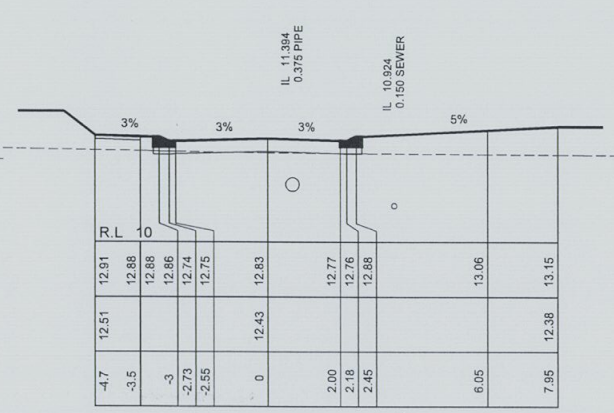
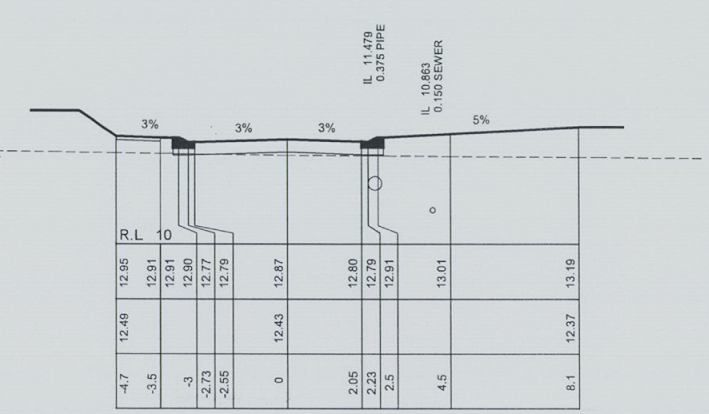
1736C CC 01 [A] in progress
19-2-14 - 006

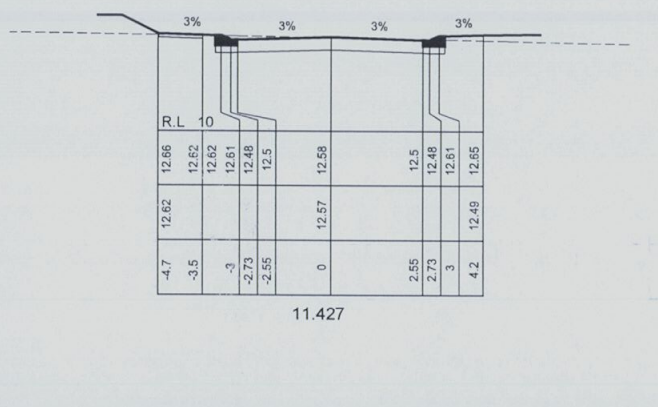
A1

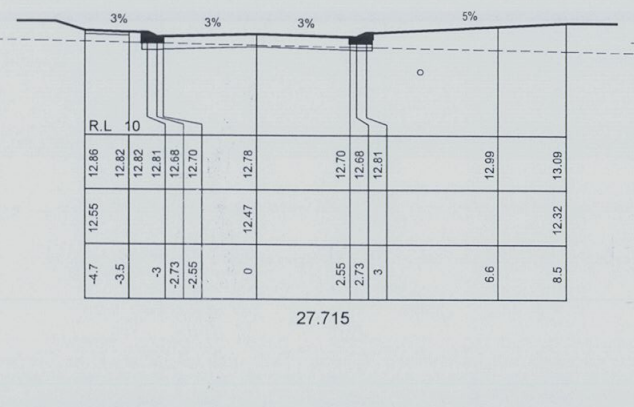


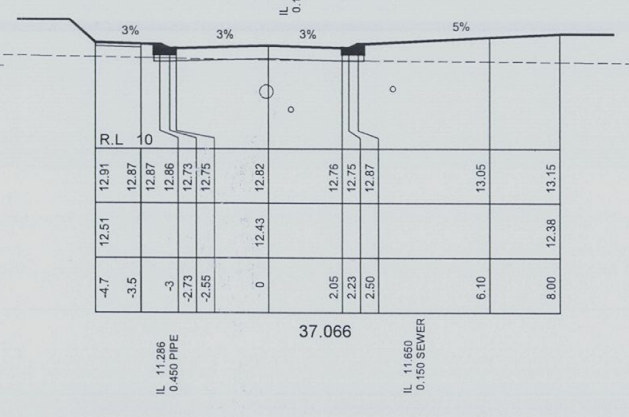


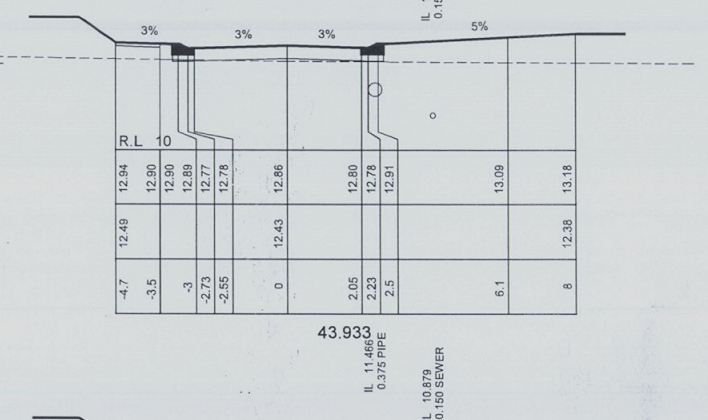


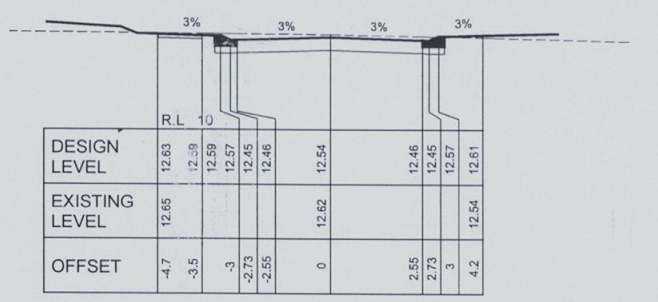


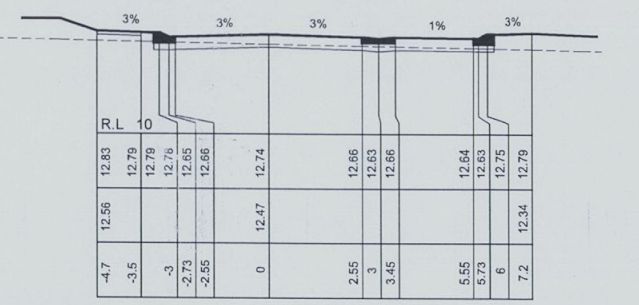


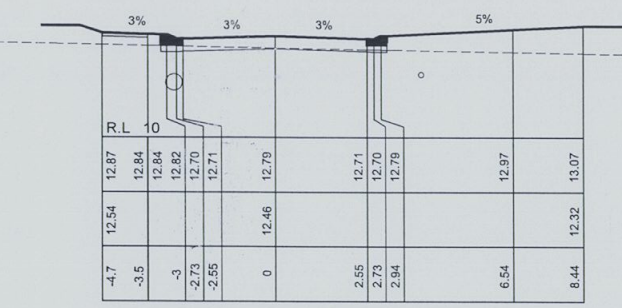


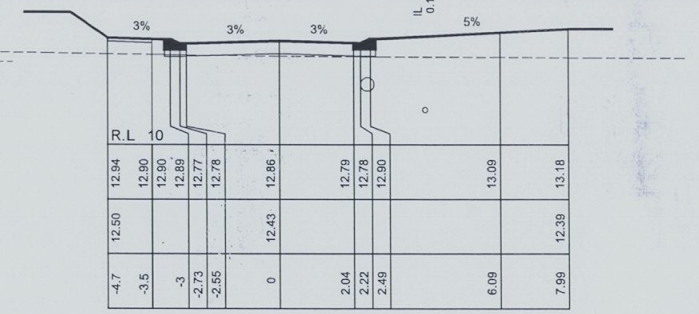












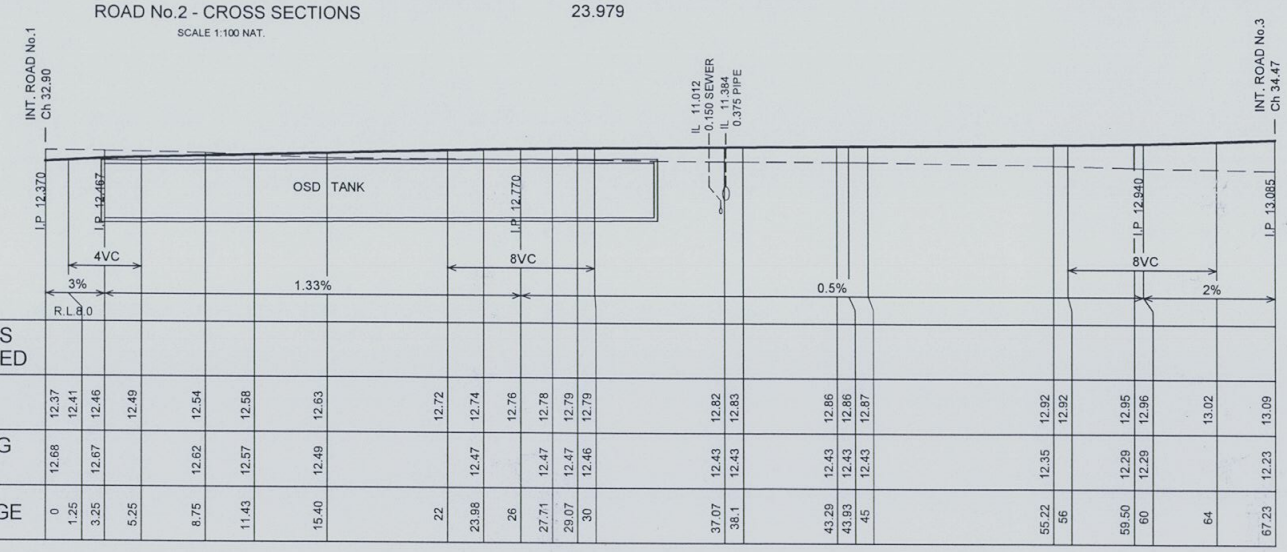
ROAD No.2 - CROSS SECTIONS

SCALE 1:100 NAT.

PAVEMENT DESIGN
ROAD No.2

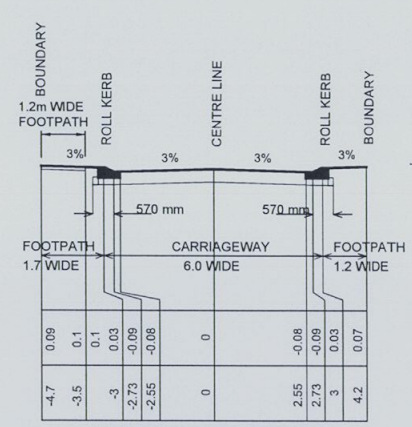
DESIGN ESA's: 6×10^6
CBR : 4

WEARING COURSE: 30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 150mm D.G.B.20
SUB-BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD



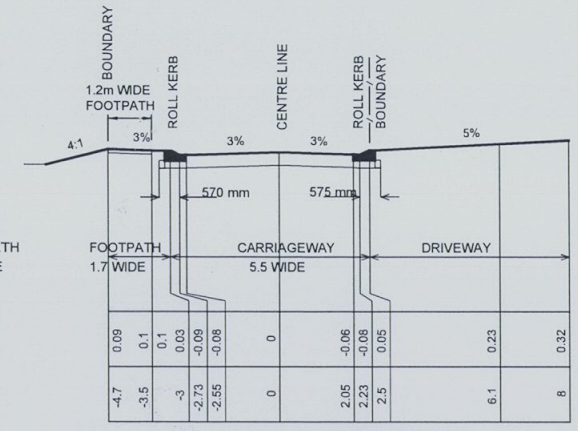
ROAD No.2

H=1:200 V=1:100



TYPICAL CROSS SECTION
Ch 8.75 TO Ch 11.427

SCALE 1:100 NAT.



TYPICAL CROSS SECTION
Ch 27.715 TO Ch 55.219

SCALE 1:100 NAT.

CC

5 4 3 2 1 0 5
1:100 @ A1

5 4 3 2 1 0 5 10
1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.2
LONG SECTION &
CROSS SECTIONS Ch8.75 TO Ch45

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: LONG SECT. H.1:200 V.1:100 CROSS SECT.1:100 NAT.	Date: 19.2.14	Council Ref.	
	Datum: A.H.D.	L.G.A. PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man. A.D.	Client Ref.

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Our Ref. 1736

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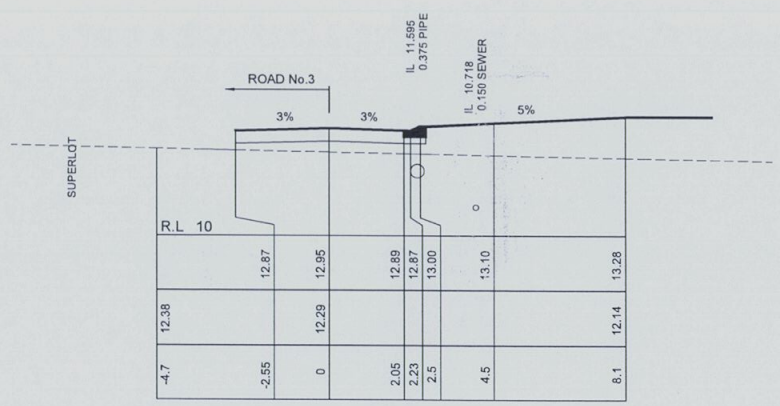
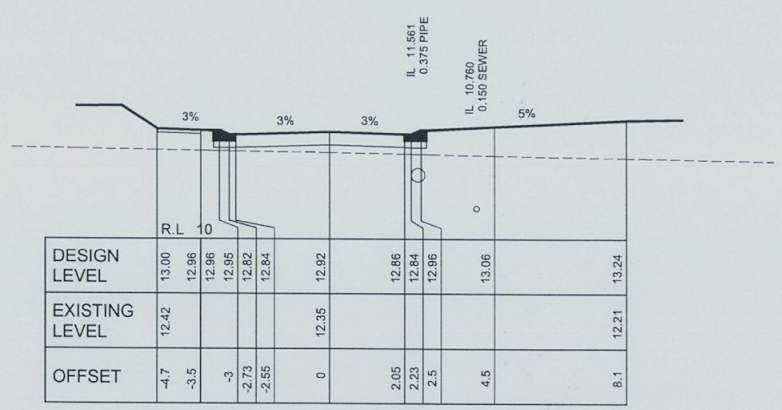
1736C CC 01 [A] in progress
19-2-14 - 007

A1





ROAD No.2 - CROSS SECTIONS

SCALE 1:100 NAT.

5 4 3 2 1 0 5

1:100 @ A1

CC

DIAL 1100 BEFORE YOU DIG	Project: ROAD No.2 CROSS SECTIONS Ch55.21 T0 Ch59.50	Principal: WARRIEWOOD PROPERTIES PTY LTD			
		Scale 1:100 NAT.	Date 19.2.14	Council Ref.	
			Datum A.H.D.	L.G.A. PITTWATER	
		Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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Dwg File Ref. [Rev] - Sheet Ref.

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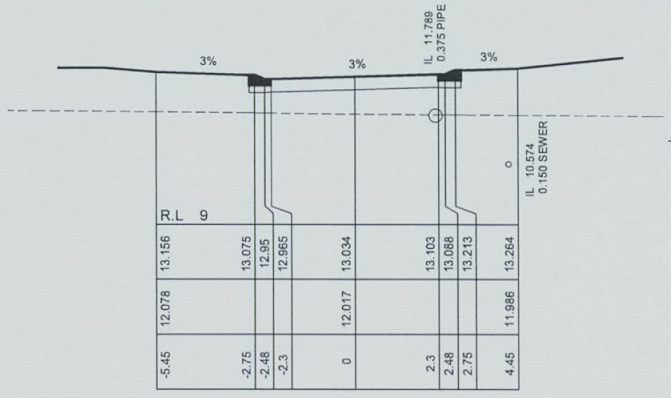
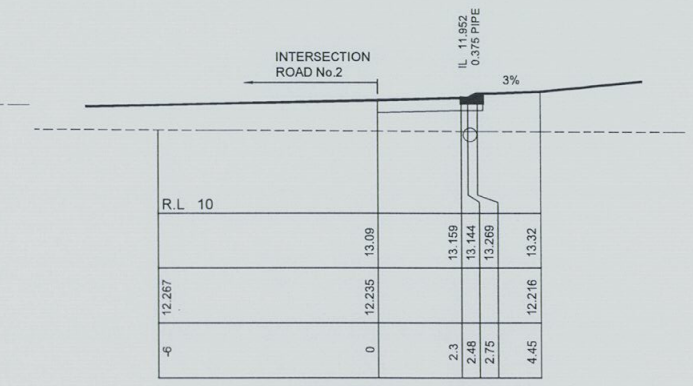
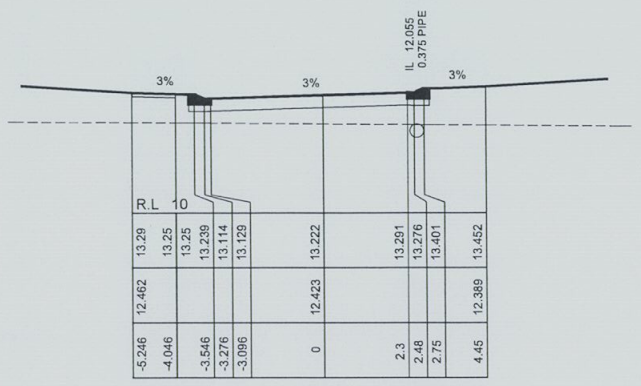
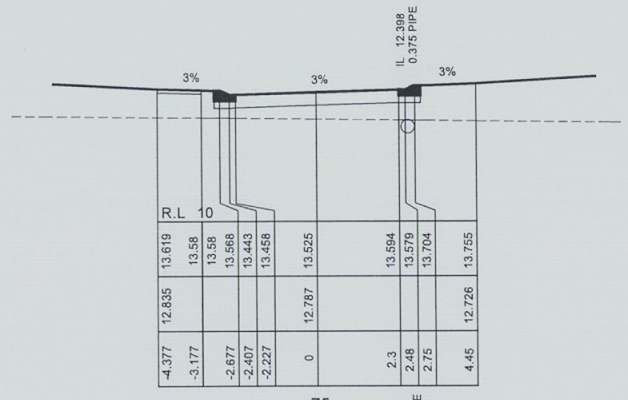
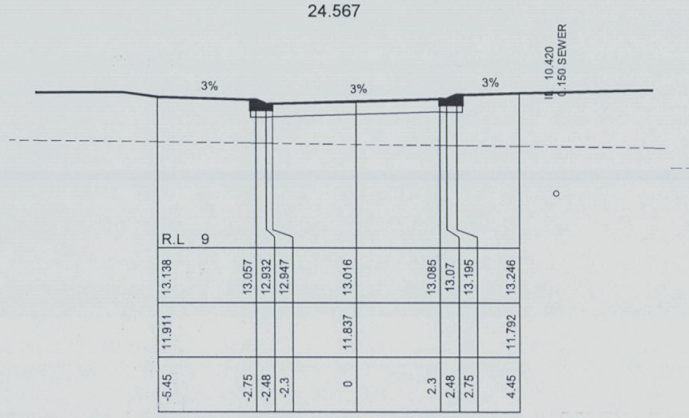
19-2-14 - 008

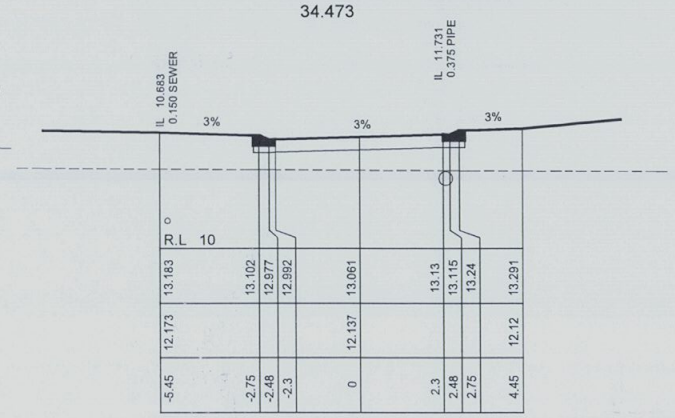


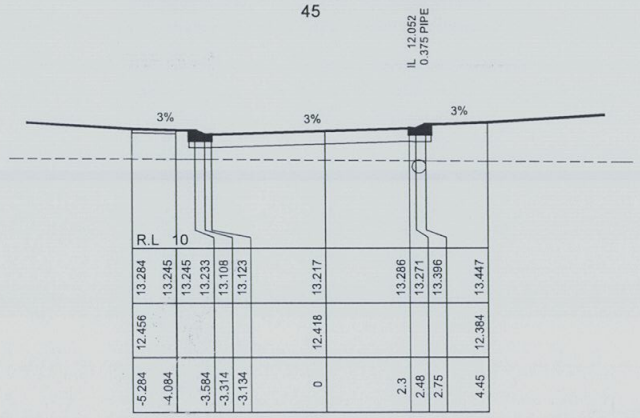


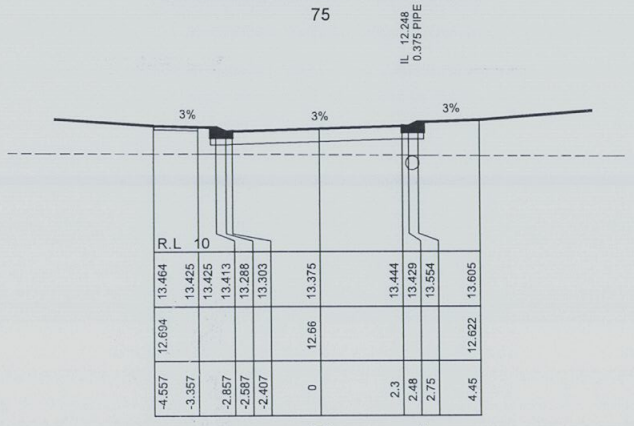


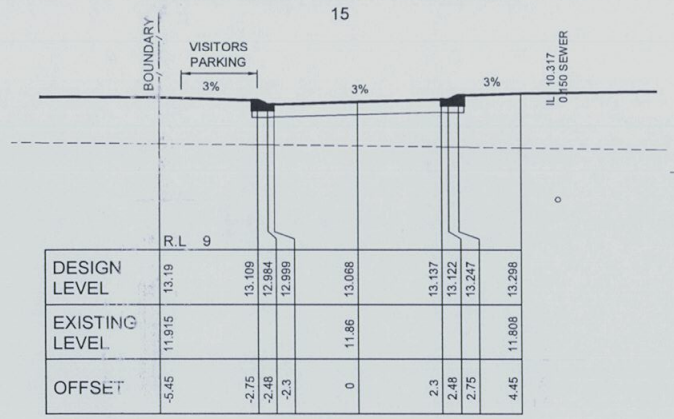


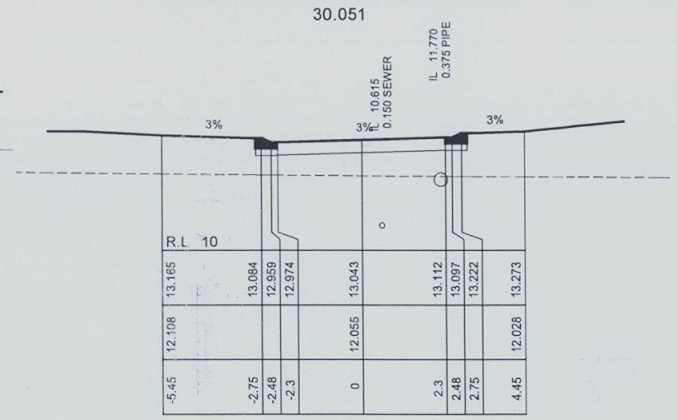


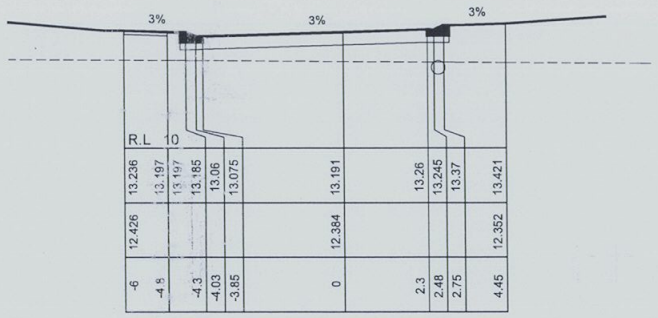


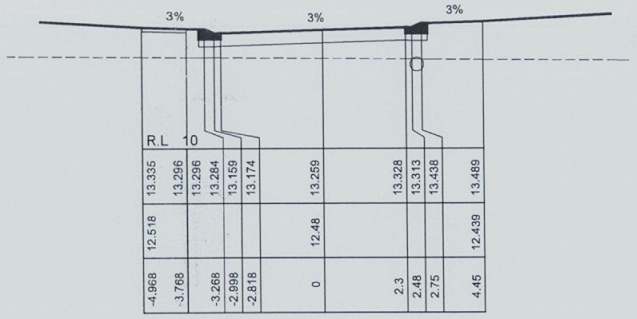


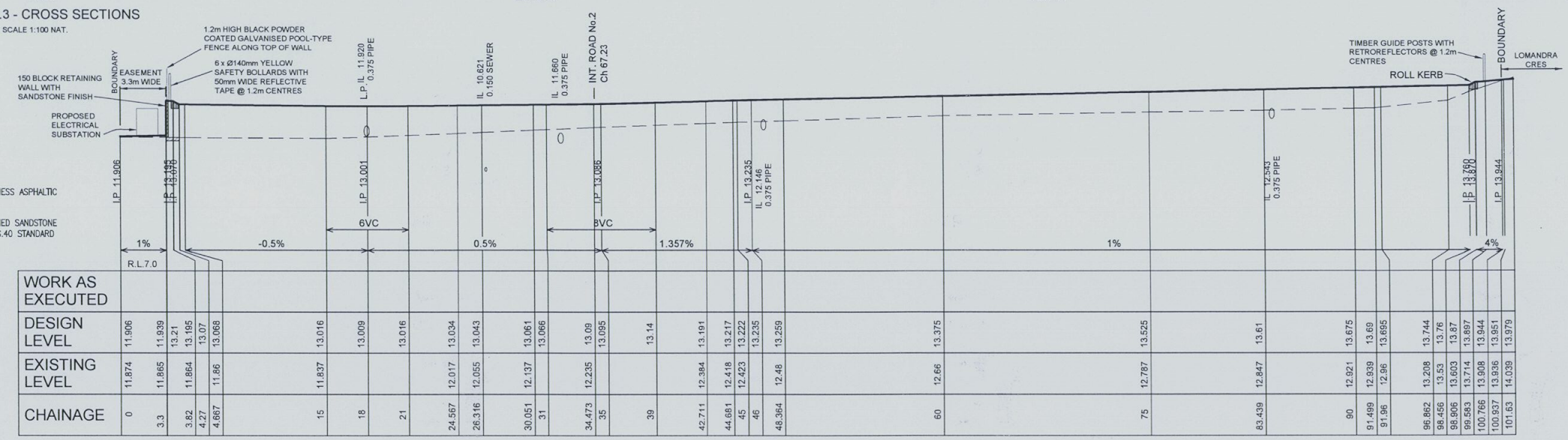












A1

ROAD No.3 - CROSS SECTIONS

SCALE 1:100 NAT.

PAVEMENT DESIGN
ROAD No.3

DESIGN ESA's: $6x10^4$
CBR : 4

WEARING COURSE:	30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE:	150mm D.G.B.20
SUB-BASE COURSE:	200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD

ROAD No.3

H=1:200 V=1:100

TYPICAL CROSS SECTION

1:100 @ A1

1:200 @ A1

CC

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.3
LONG SECTION &
CROSS SECTIONS Ch4.66 TO Ch75

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale LONG SECT H.1:200 V.1:100 CROSS SECT 1:100 NAT.	Date 19.2.14	Council Ref.
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref:

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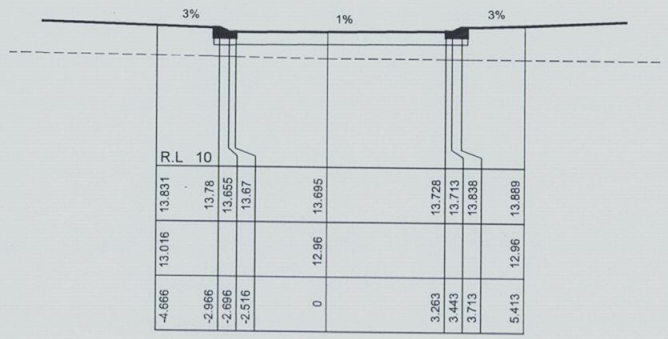
Our Ref. 1736

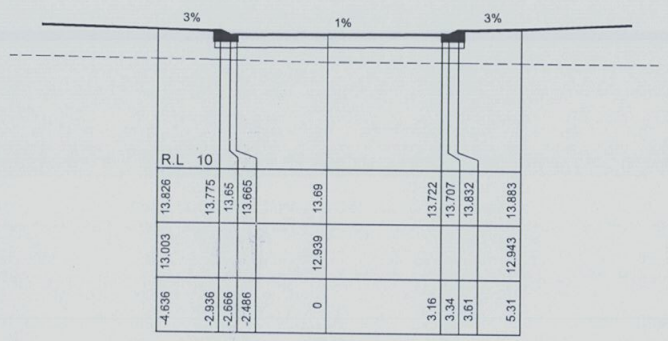
Dwg File Ref. [Rev] - Sheet Ref.

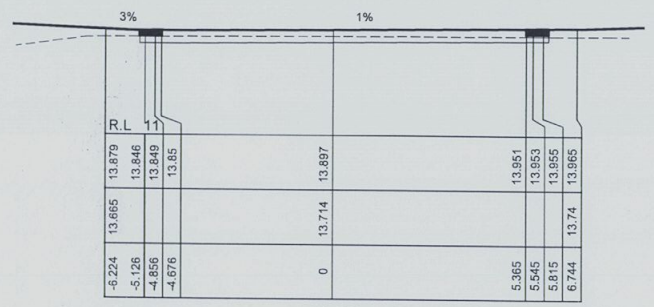
1736C CC 01 [A] in progress

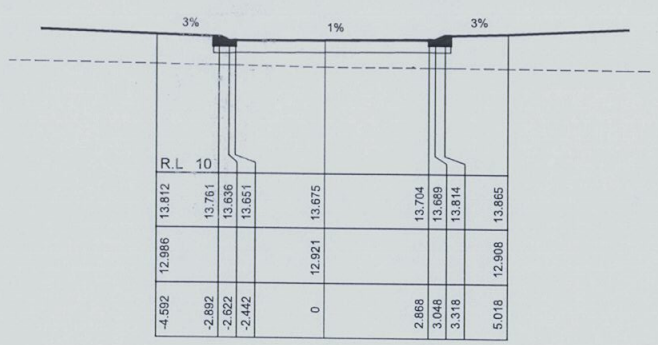
19-2-14 - 009

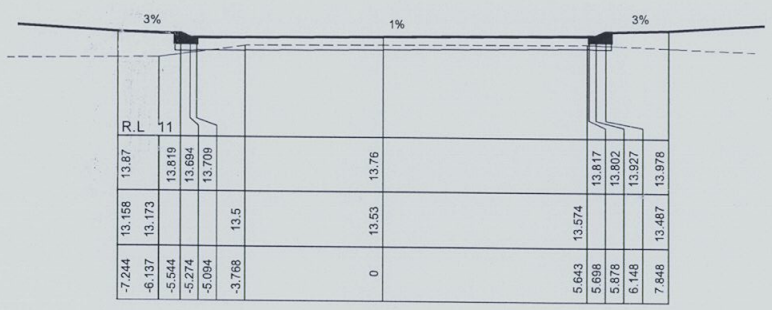
A1

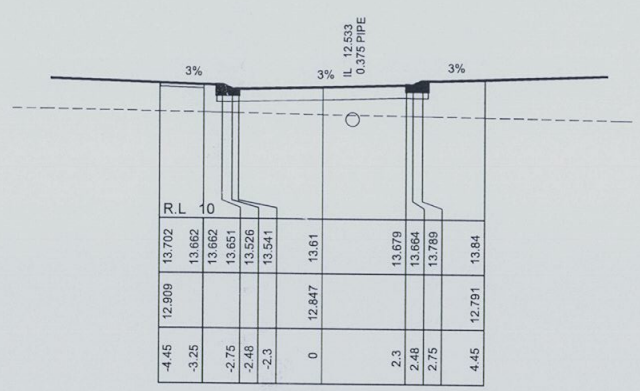






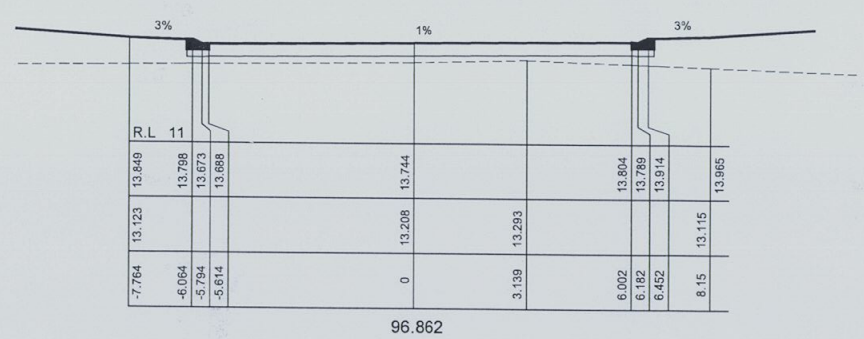






ROAD No.3 - CROSS SECTIONS

SCALE 1:100 NAT.



5 4 3 2 1 0 5

1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project:

ROAD No.3
CROSS SECTIONS Ch83.43 TO Ch99.58

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:100 NAT.	Date 19.2.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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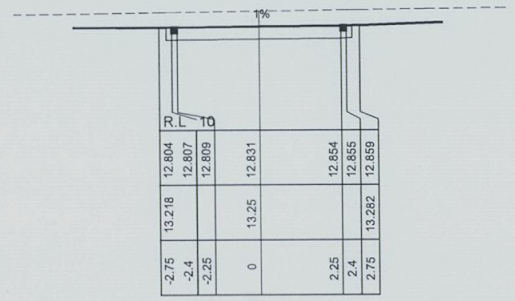
Dwg File Ref. [Rev] - Sheet Ref.

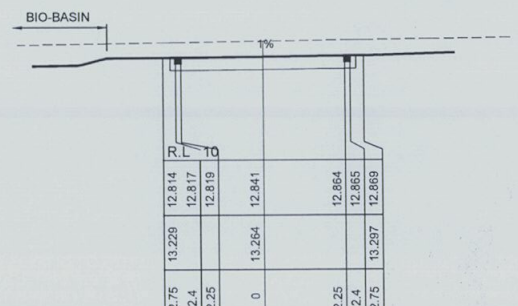
1736C CC 01 [A] in progress
19-2-14 - 010

CC

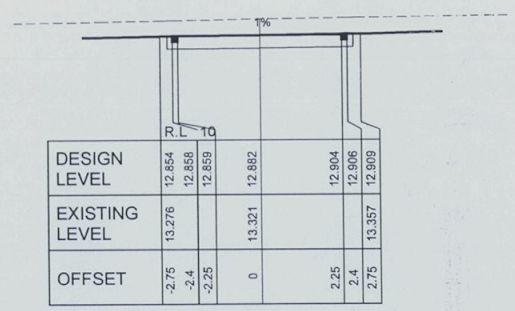
A1



11.896



10.9



6.815

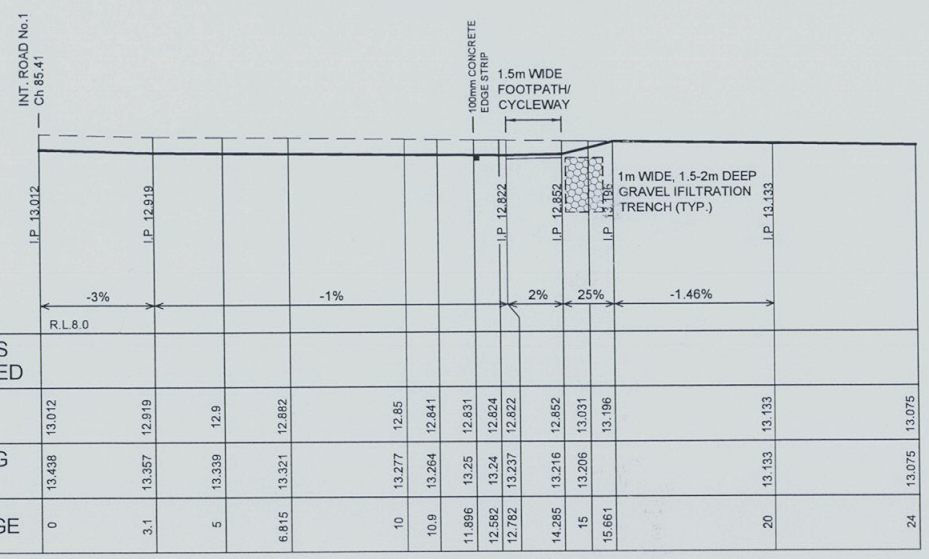
ROAD No.4 - CROSS SECTIONS

SCALE 1:100 NAT.

PAVEMENT DESIGN
ROAD No.4

DESIGN ESA's: $6x10^4$
CBR : 4

WEARING COURSE: 30mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 150mm D.G.B.20
SUB–BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD



WORK AS EXECUTED														
DESIGN LEVEL	13.012	12.919	12.9	12.882	12.85	12.841	12.831	12.824	12.822	12.852	13.031	13.196	13.133	13.075
EXISTING LEVEL	13.438	13.357	13.339	13.321	13.277	13.264	13.25	13.24	13.237	13.216	13.206		13.133	13.075
CHAINAGE	0	3.1	5	6.815	10	10.9	11.896	12.582	12.782	14.285	15	15.661	20	24

ROAD No.4

H=1:100 V=1:100

5 4 3 2 1 0 5
1:100 @ A1

5 4 3 2 1 0 5 10
1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.4 LONG & CROSS SECTIONS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
LONG SECT H.1:200 V.1:100 CROSS SECT 1:100 NAT.	19.2.14	
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.
		Client Ref:

CRAIG & RHODES

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www.craigandrhodes.com.au

90th ANNIVERSARY 1923 - 2013

IQA ISO 9001 Approved Company

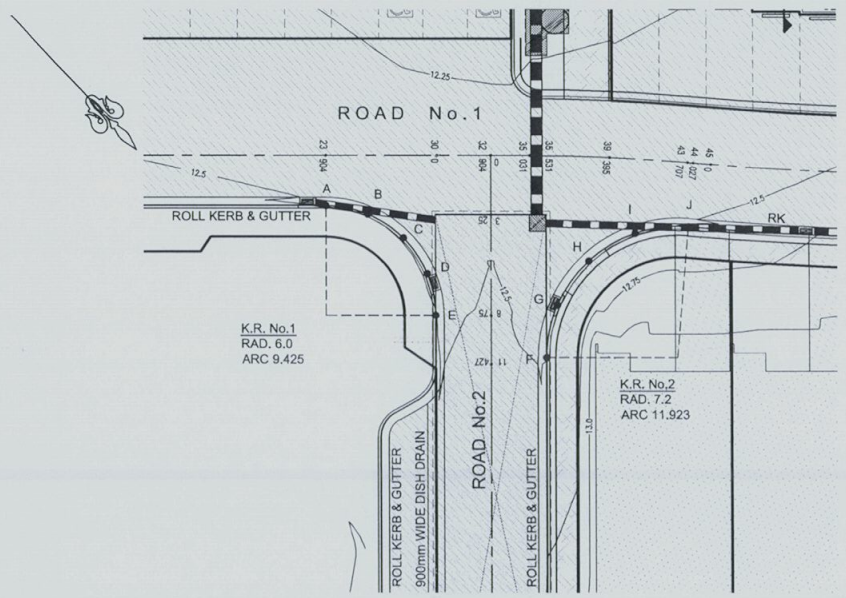
Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

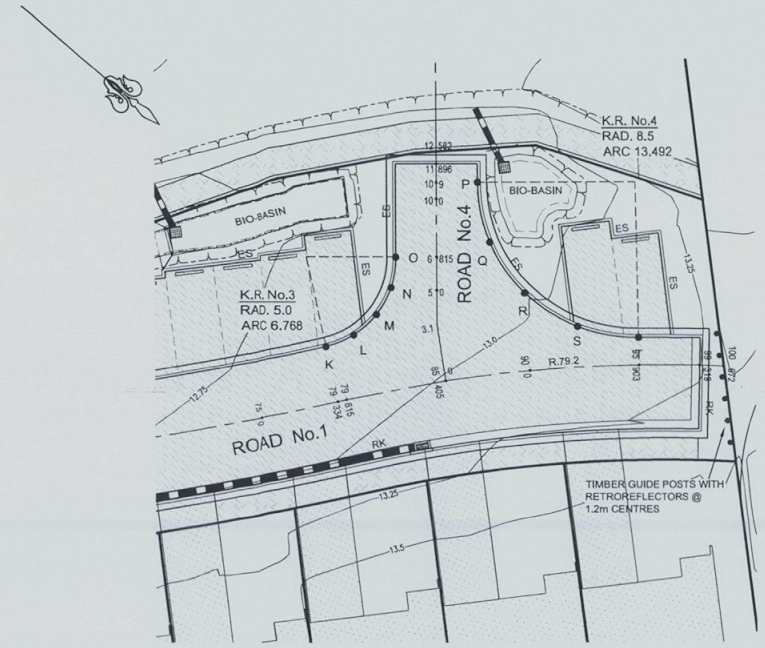
1736C CC 01 [A] in progress
19-2-14 - 011

CC

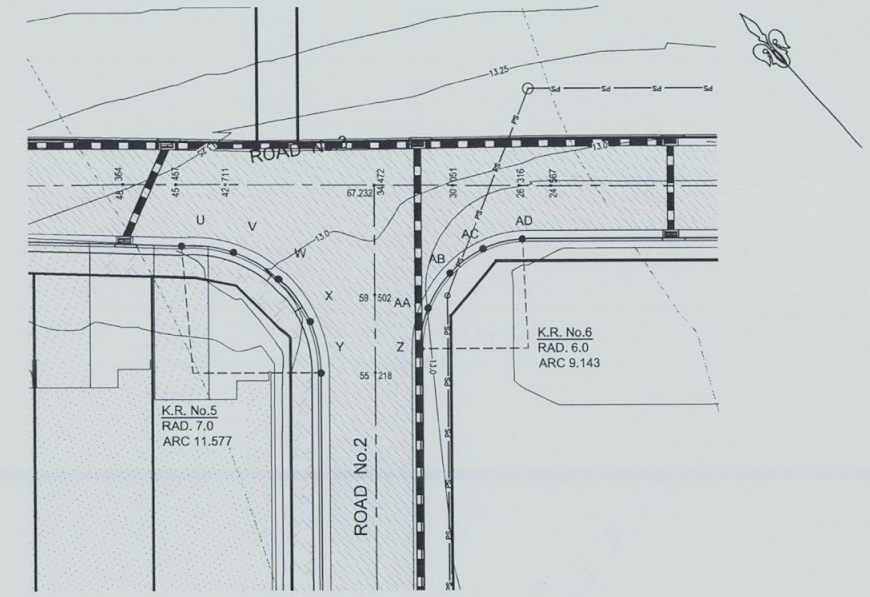
A1



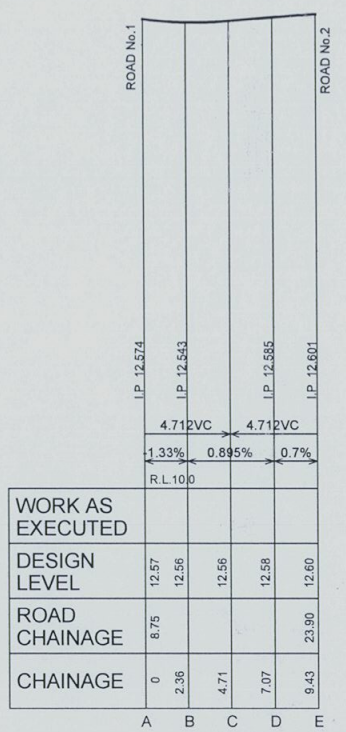
PLAN
1:200



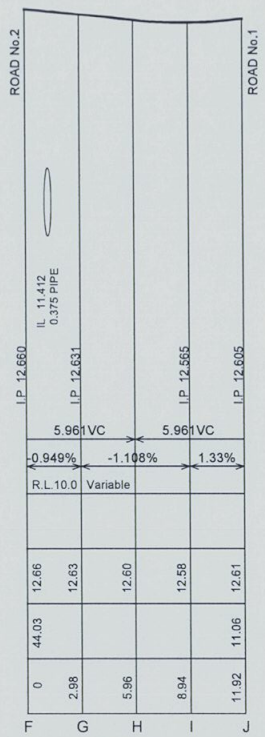
PLAN
1:200



PLAN
1:200



K.R.No1
H=1:200 V=1:20



K.R.No2
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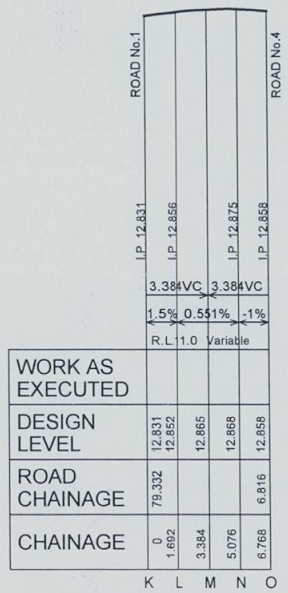
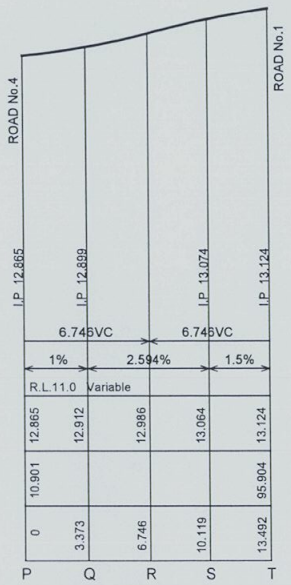


K.R.No3
H=1:200 V=1:20



K.R.No4
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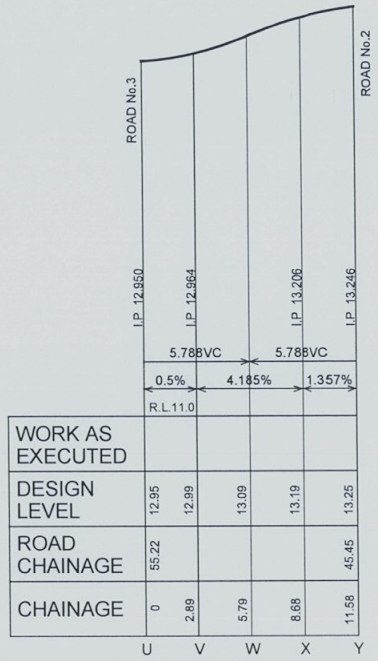

K.R.No5
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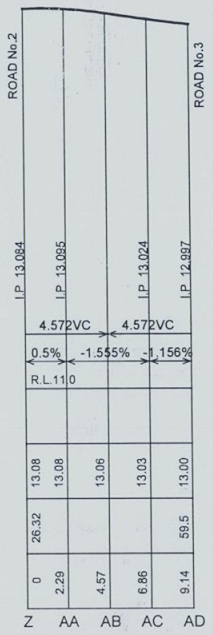

K.R.No6
H=1:200 V=1:20

5 4 3 2 1 0 5 10
1:200 @ A1

0.5 0.4 0.3 0.2 0.1 0 0.5
1:20 @ A1

DIAL 1100 BEFORE YOU DIG

Project: KERB RETURNS No.1 TO No.6

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale H.1:200 V.1:20	Date 19.2.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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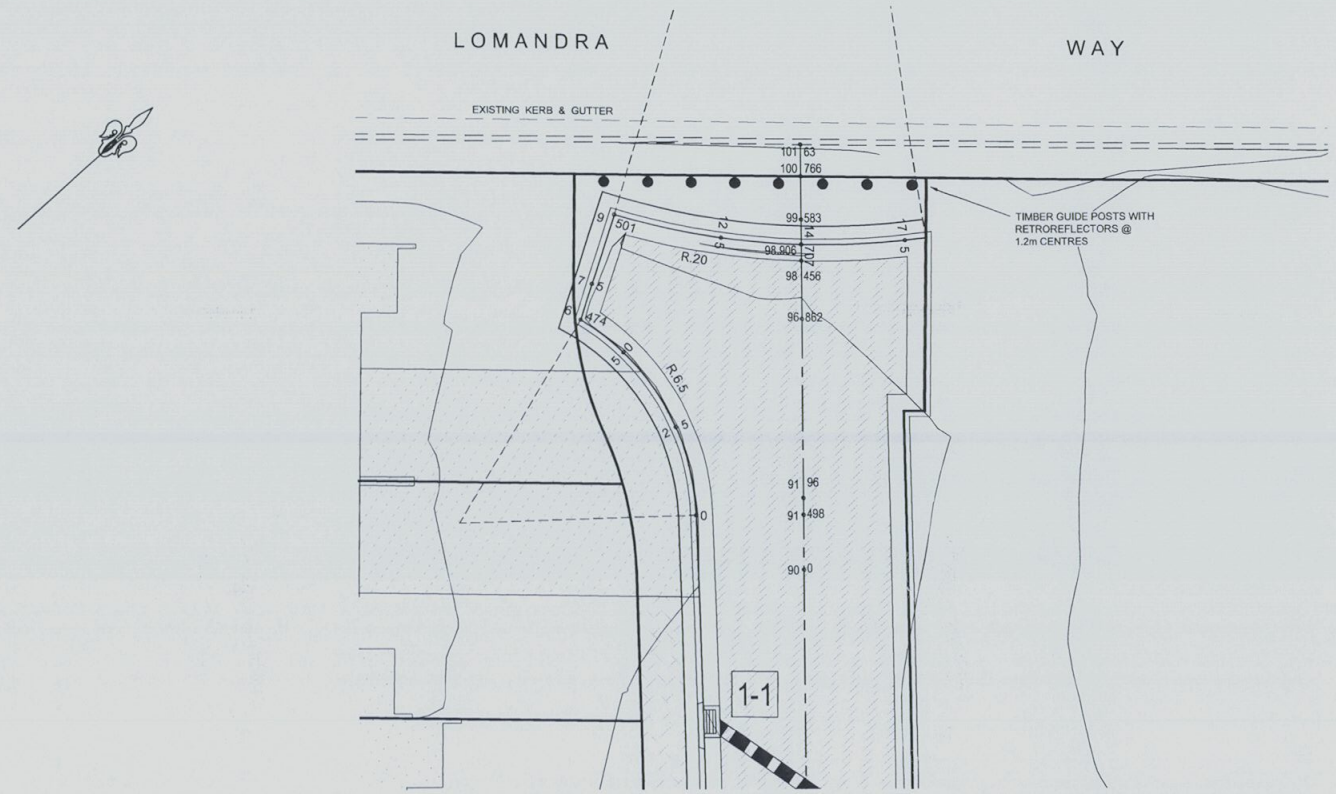
ISO 9001 Approved Company

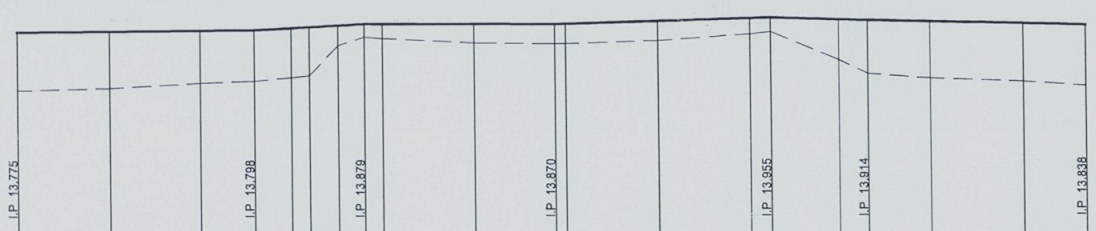
Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [A] in progress
19-2-14 - 012

CC



PLAN
1:100



WORK AS EXECUTED																								
DESIGN LEVEL	13.775	13.784	13.793	13.798	13.825	13.839	13.86	13.879	13.878	13.874	13.87	13.874	13.91	13.947	13.955	13.926	13.914	13.892	13.86	13.838
EXISTING LEVEL	12.978	13.01	13.077	13.102	13.15	13.174	13.585	13.7	13.681	13.617	13.603	13.604	13.643	13.732	13.76	13.375	13.185	13.117	13.067	13.009
CHAINAGE	0	2.5	5	6.474	7.5	7.997	8.778	9.501	10	12.5	14.707	15	17.5	20	20.583	22.5	23.289	25	27.5	29.162

KERB DEVELOPMENT - TURNING HEAD ROAD No.3
H=1:100 V=1:50

5 4 3 2 1 0 5
1:100 @ A1

5 4 3 2 1 0 5
1:150 @ A1

DIAL 1100 BEFORE YOU DIG

Project:
KERB DEVELOPMENT
ROAD No.3 TURNING HEAD

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: PLAN 1:100 SECTION H.1:100 V.1:50	Date: 19.2.14	Council Ref:	
	Datum: A.H.D.	L.G.A.: PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref:

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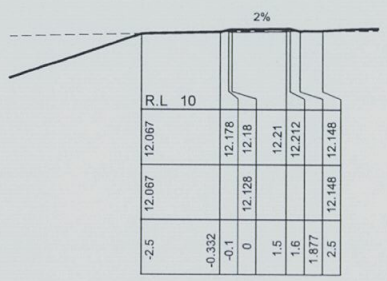
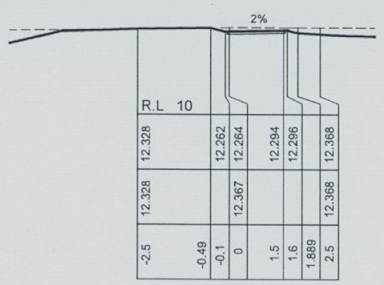
LRQA ISO 9001 Approved Company

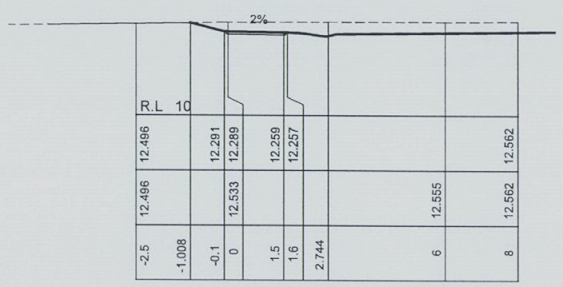
Our Ref: 1736

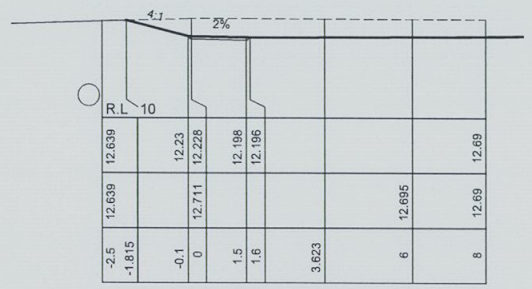
Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [A] in progress
19-2-14 - 013

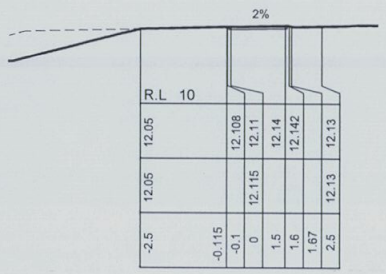
CC

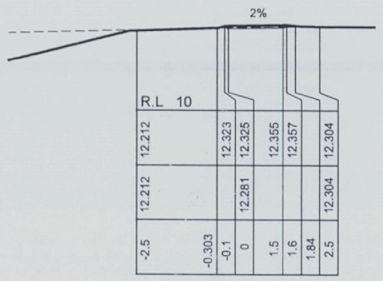


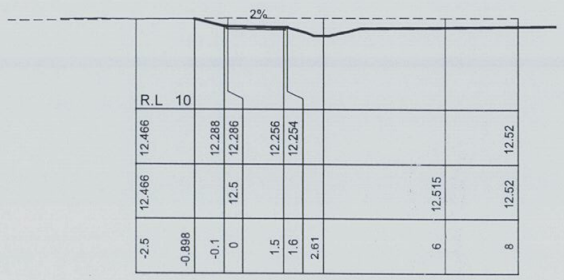


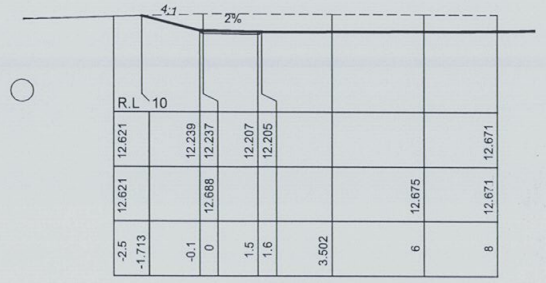


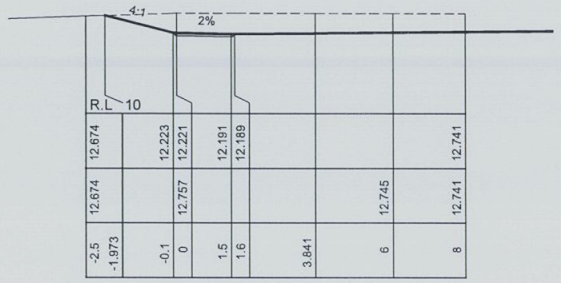


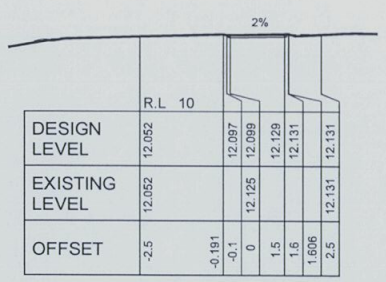


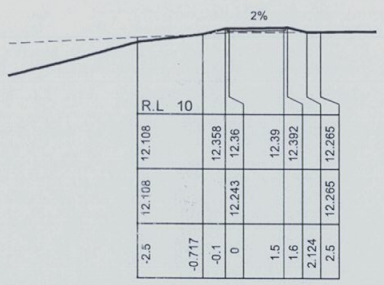


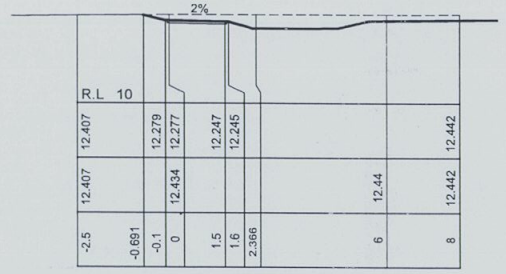


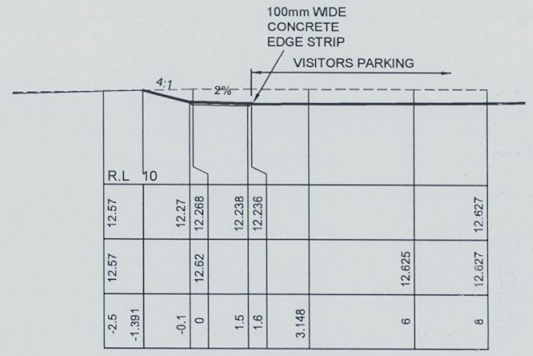


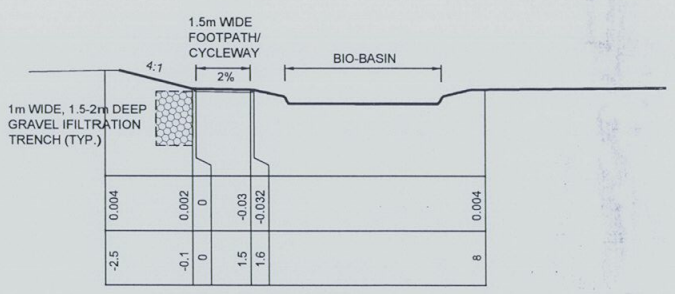


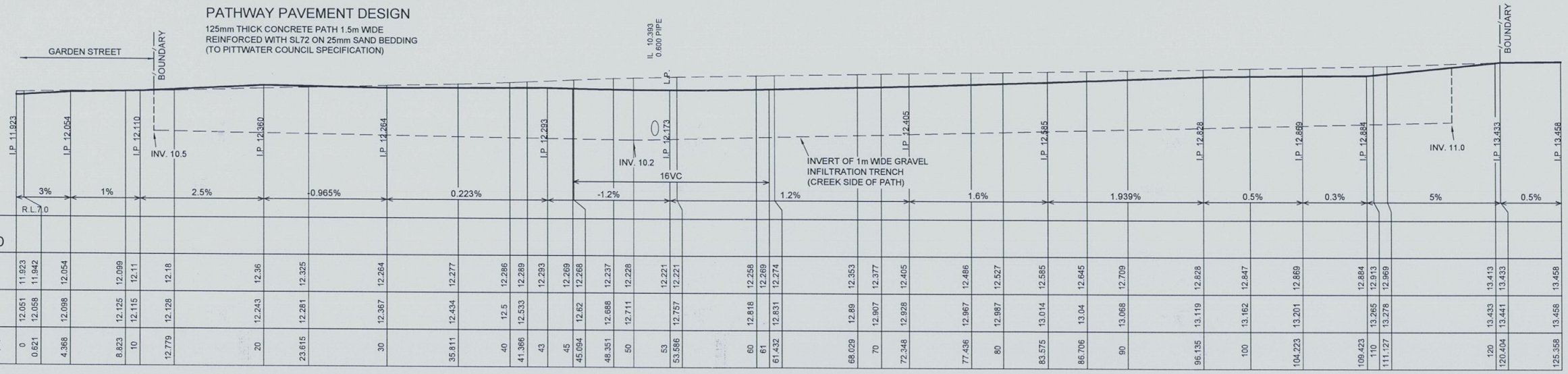












PATHWAY - CROSS SECTIONS
SCALE 1:100 NAT.

TYPICAL CROSS SECTION

PATHWAY PAVEMENT DESIGN

125mm THICK CONCRETE PATH 1.5m WIDE
REINFORCED WITH SL72 ON 25mm SAND BEDDING
(TO PITTWATER COUNCIL SPECIFICATION)

CHAINAGE	EXISTING LEVEL	DESIGN LEVEL	WORK AS EXECUTED
0	12.051	11.923	
0.621	12.058	11.942	
4.368	12.098	12.054	
8.823	12.125	12.099	
10	12.115	12.11	
12.779	12.128	12.18	
20	12.243	12.36	
23.615	12.281	12.325	
30	12.367	12.264	
35.811	12.434	12.277	
40	12.5	12.286	
41.366	12.533	12.289	
43		12.293	
45		12.269	
45.094	12.62	12.268	
48.351	12.688	12.237	
50	12.711	12.228	
53		12.221	
53.586	12.757	12.221	
60	12.818	12.258	
61		12.269	
61.432	12.831	12.274	
68.029	12.89	12.353	
70	12.907	12.377	
72.348	12.928	12.405	
77.436	12.967	12.486	
80	12.987	12.527	
83.575	13.014	12.585	
86.706	13.04	12.645	
90	13.068	12.709	
96.135	13.119	12.828	
100	13.162	12.847	
104.223	13.201	12.869	
109.423		12.884	
110	13.265	12.913	
111.127	13.278	12.969	
120	13.433	13.413	
120.404	13.441	13.433	
125.358	13.458	13.458	

PATHWAY
H=1:200 V=1:100

1:100 @ A1
1:200 @ A1

CC

DIAL 1100 BEFORE YOU DIG

Project:
PATHWAY
LONG SECTION, TYPICAL CROSS SECTIONS &
CROSS SECTIONS Ch8.82 TO Ch60

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
LONG SECT H.1:200 V.1:100 CROSS SECT 1:100 NAT.	19.2.14	
	Datum: A.H.D.	L.G.A. PITTWATER

Calc's	Drawn.	Proj.Man.	Client Ref:
A.D.	C.G.H.	A.D.	

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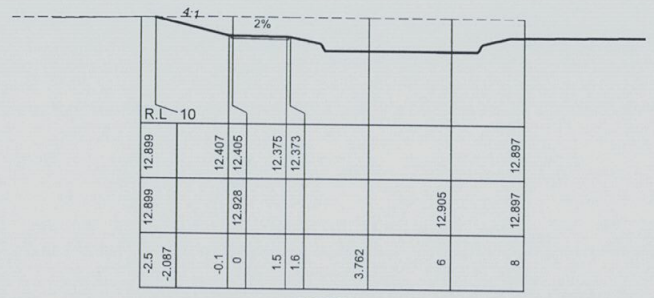
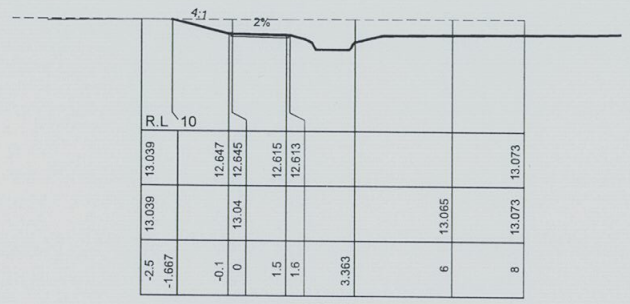
QMS ISO 9001 Approved Company

Our Ref. 1736
Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [A] in progress
19-2-14 - 014

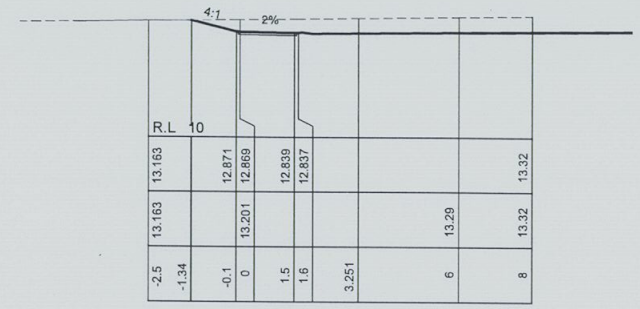
A1



72.348



86.706



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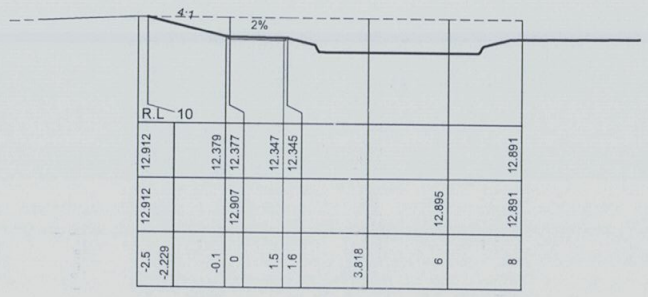

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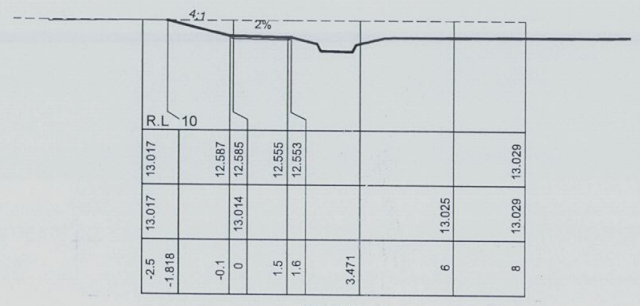
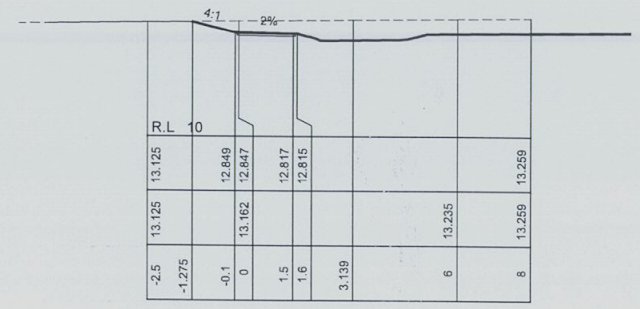


83.575



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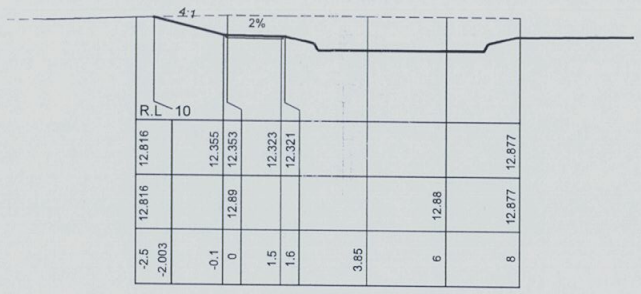

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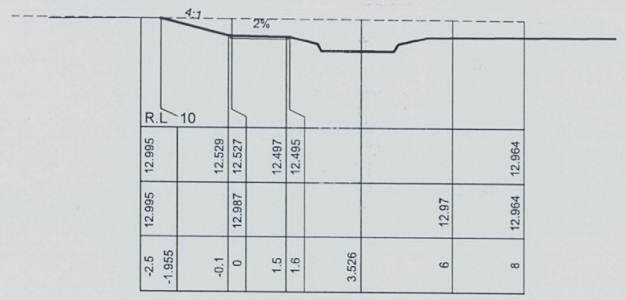

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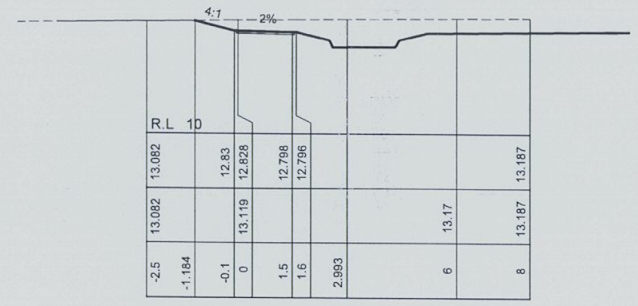
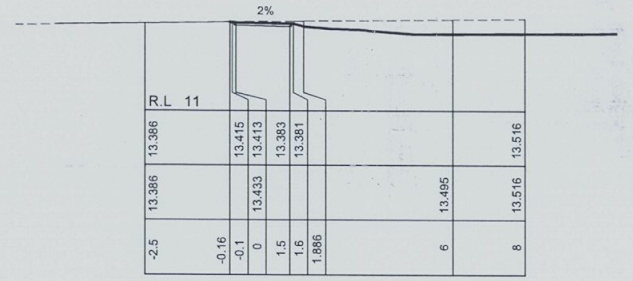


96.135



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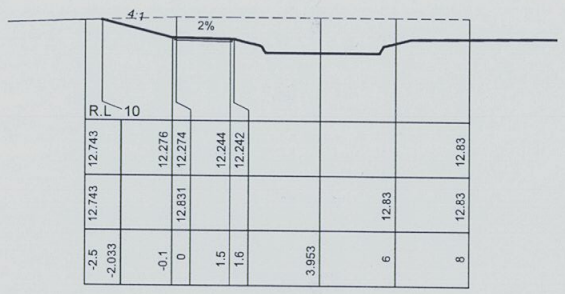
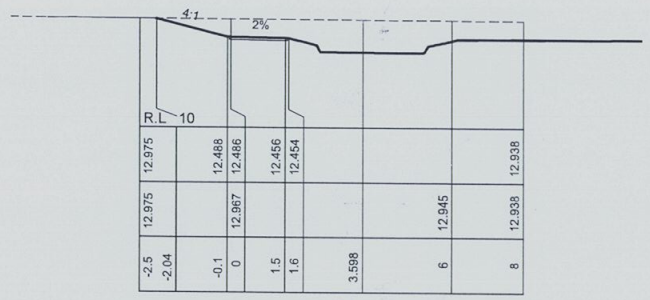


61.432

PATHWAY - CROSS SECTIONS

SCALE 1:100 NAT.



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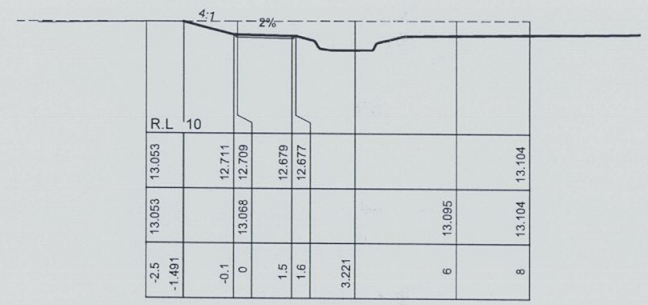

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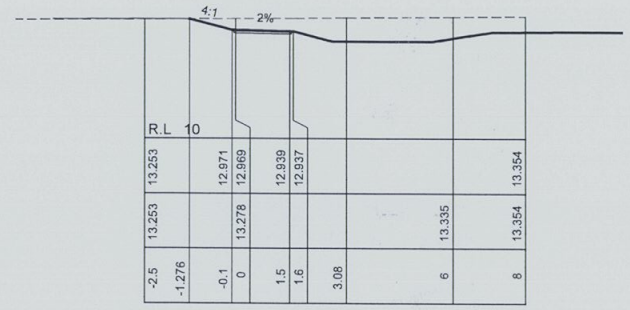

111.127

1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project:

PATHWAY
CROSS SECTIONS Ch61.43 TO Ch120

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
1:100 NAT.	19.2.14	
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D. / Client Ref.

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Our Ref. 1736

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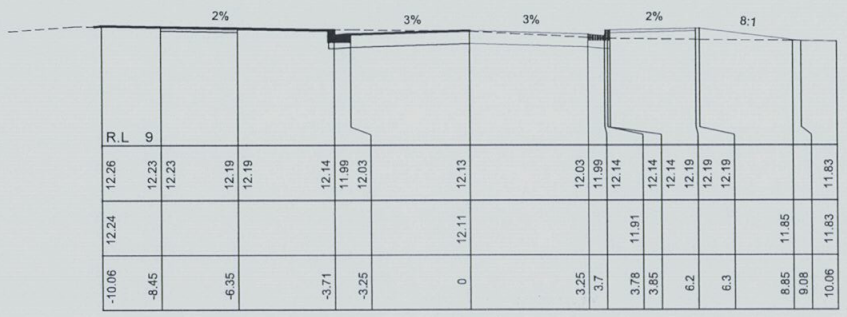
1736C CC 01 [A] in progress
19-2-14 - 015

CC

A1



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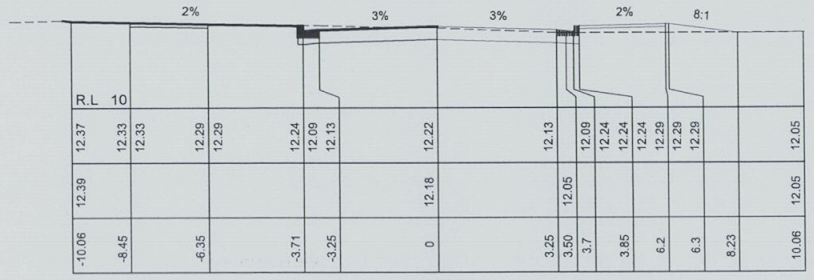
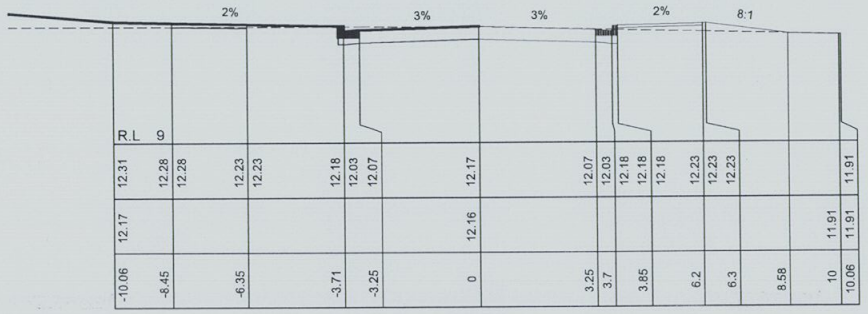


143.5



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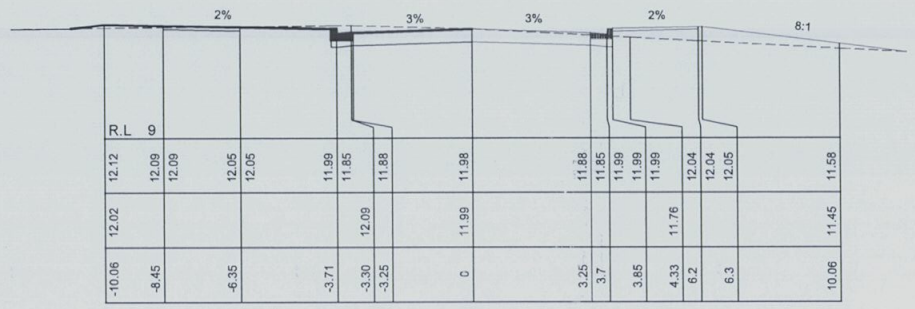

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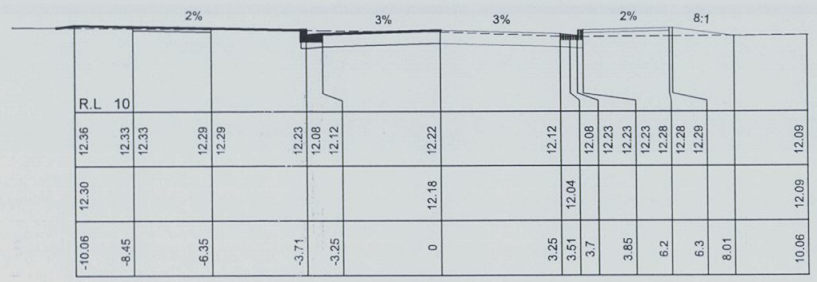
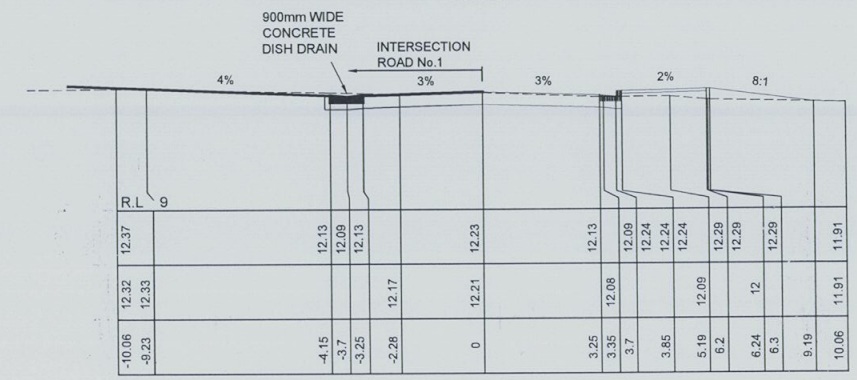
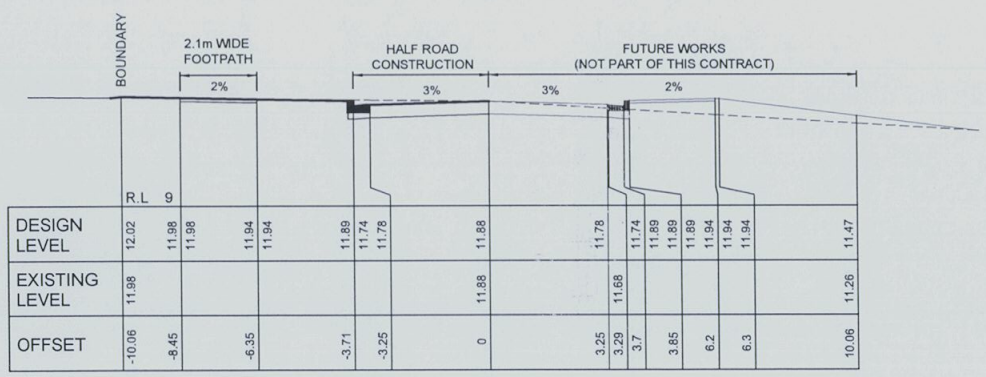


142.528



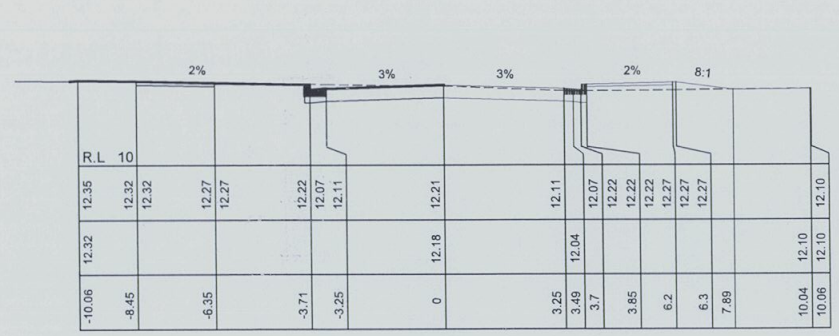
153.949



113.844

ROAD No.7 (GARDEN ST) - CROSS SECTIONS

SCALE 1:100 NAT.



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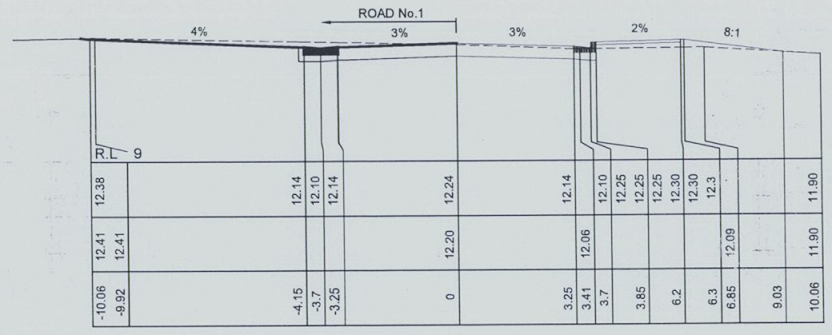
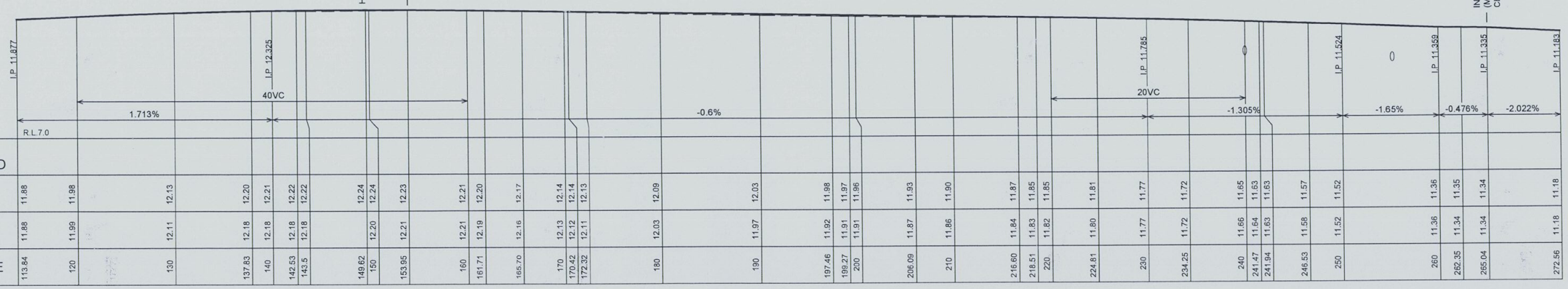


150

PAVEMENT DESIGN
GARDEN STREET (ROAD No.7)

DESIGN ESA's: $3x10^5$
CBR : 4
95% CONFIDENCE LEVEL

WEARING COURSE: 40mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 200mm D.G.B.20
SUB–BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT) TO D.G.S.40 STANDARD



ROAD No.7 (GARDEN STREET)

H=1:250 V=1:100

1:100 @ A1

1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.7 (GARDEN STREET)
LONG SECTION &
CROSS SECTIONS Ch113.84 TO Ch165.69

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: LONG SECT H:1:250 V:1:100, CROSS SECT 1:100 NAT.	Date: 19.2.14	Council Ref.	
	Datum: A.H.D.	L.G.A.: PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref.

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Our Ref. 1736

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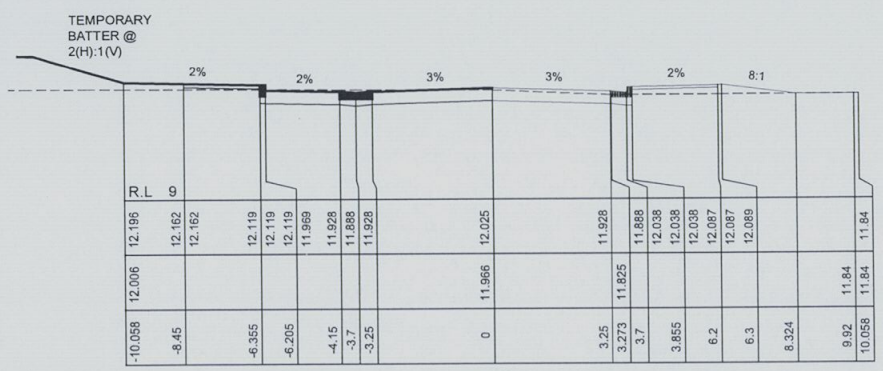
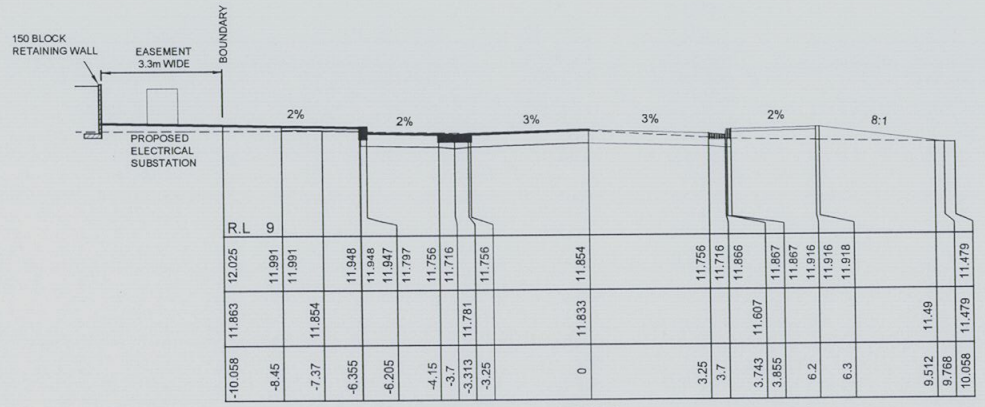
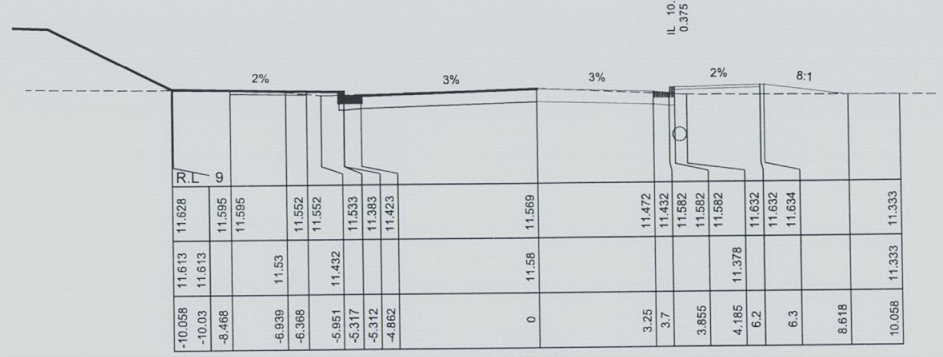
19-2-14 - 016

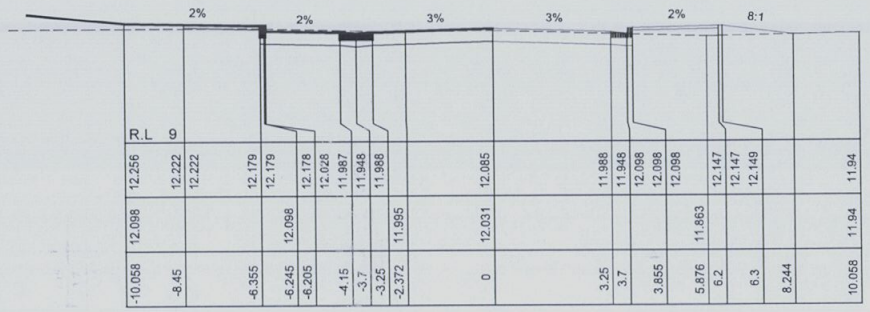
CC

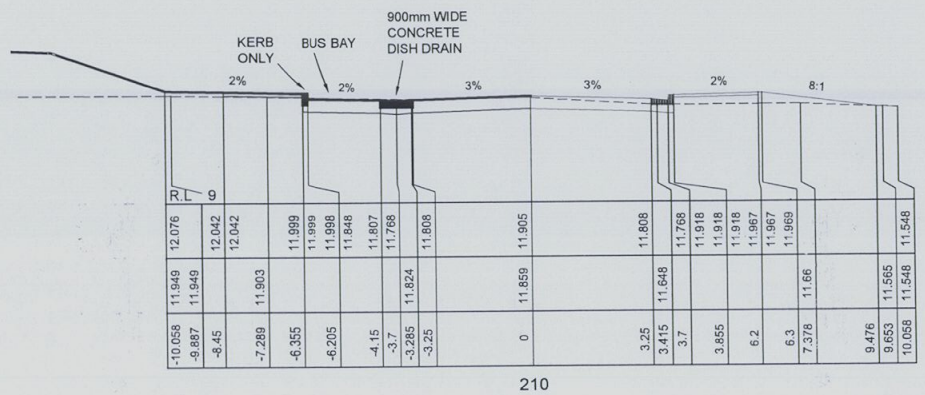
A1

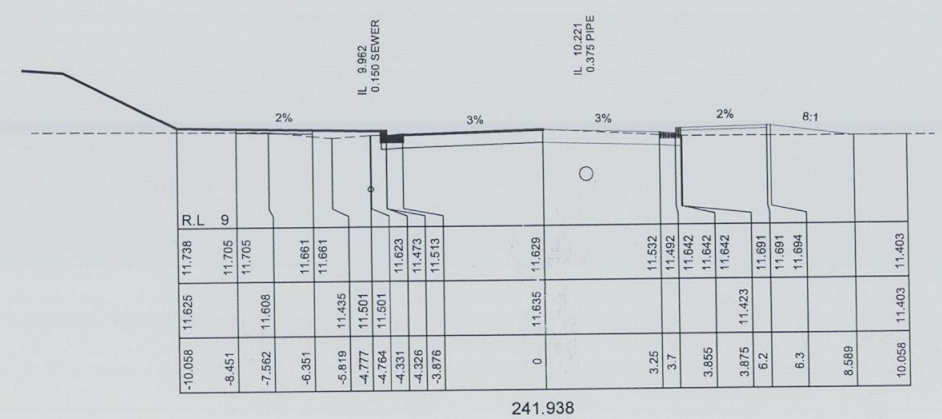


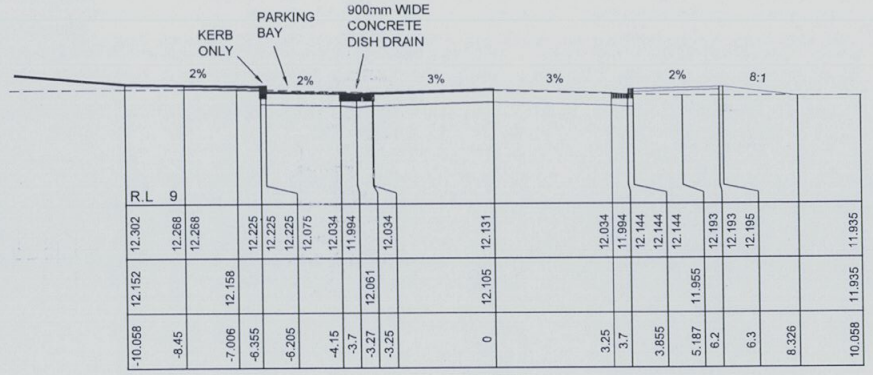


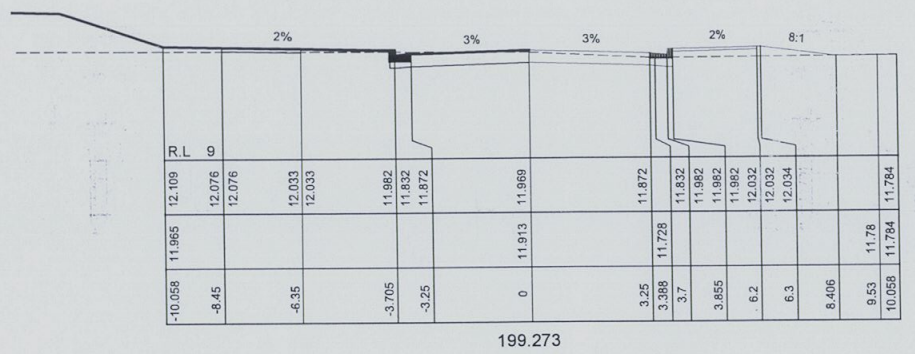


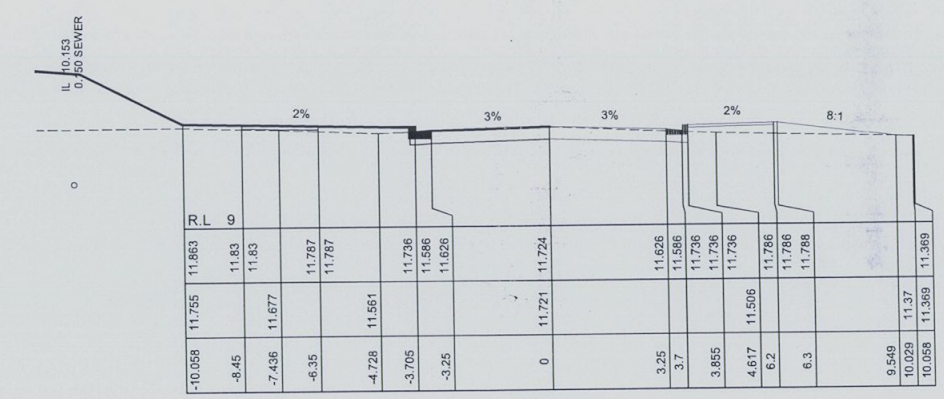


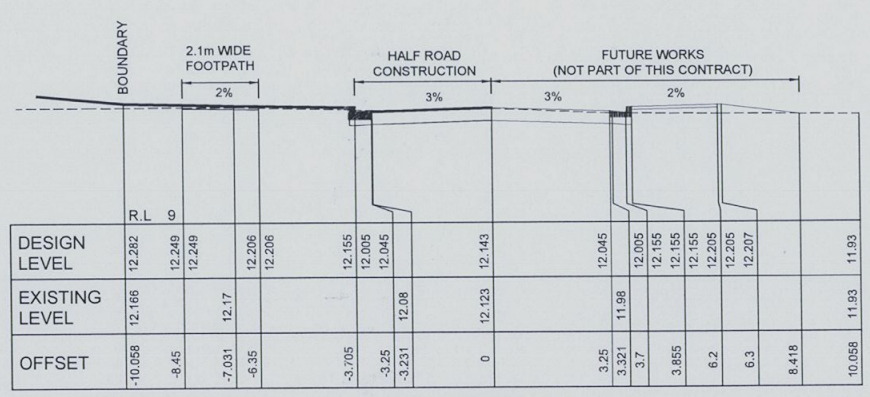






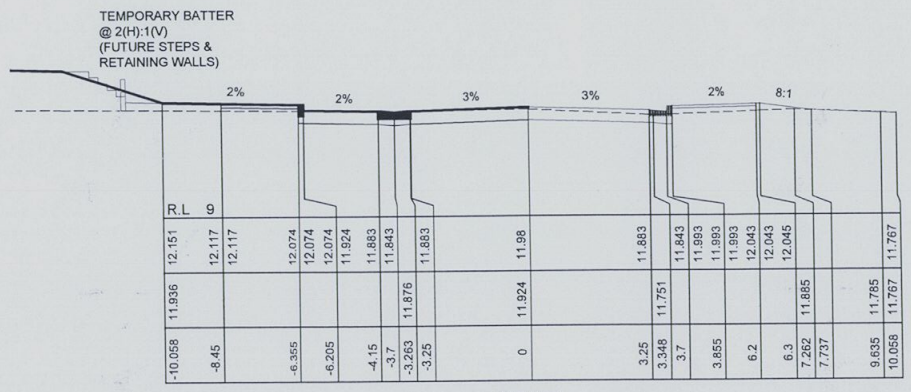


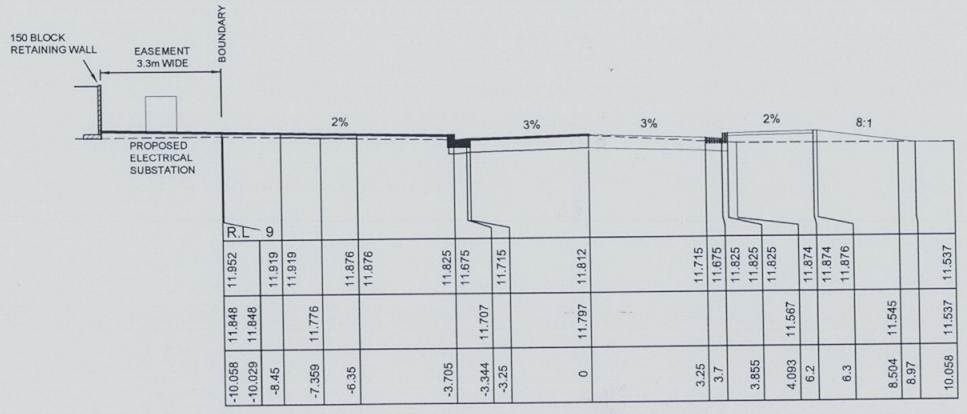




ROAD No.7 (GARDEN ST) - CROSS SECTIONS

SCALE 1:100 NAT.





CC

5 4 3 2 1 0 5

1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.7 (GARDEN STREET) CROSS SECTIONS Ch170.41 TO Ch246.529

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:100 NAT.	Date 19.2.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

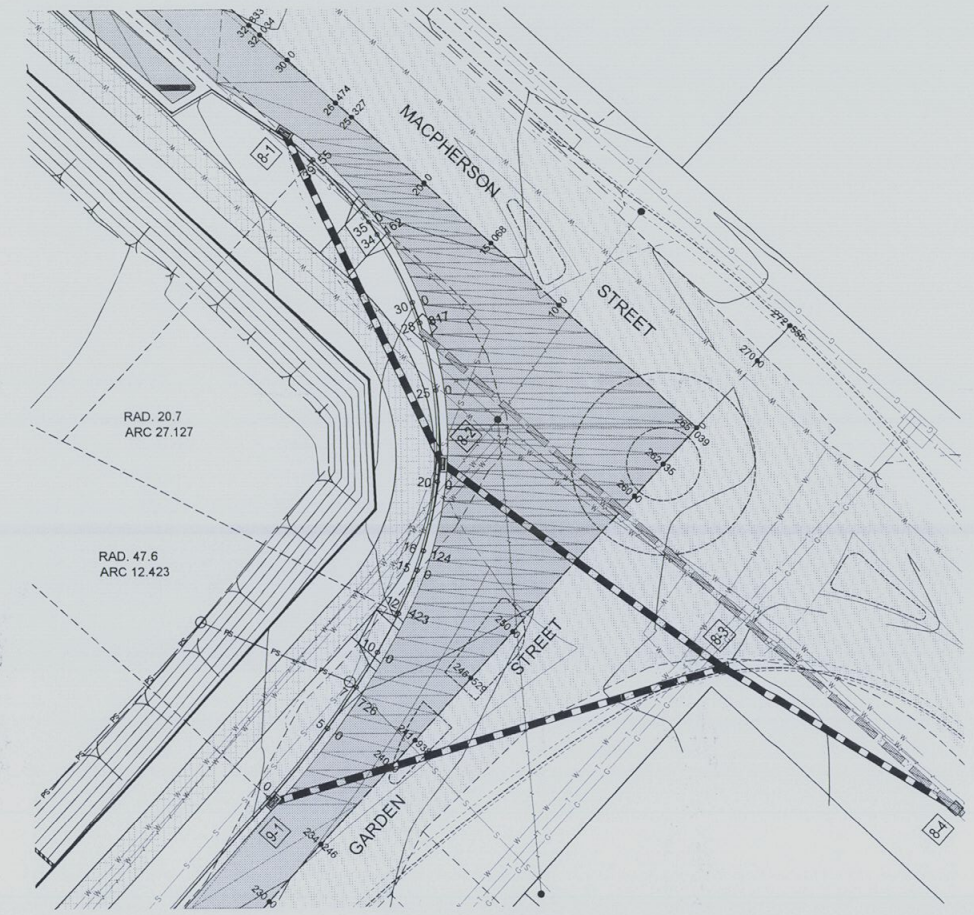
1736C CC 01 [A] in progress

19-2-14 - 017

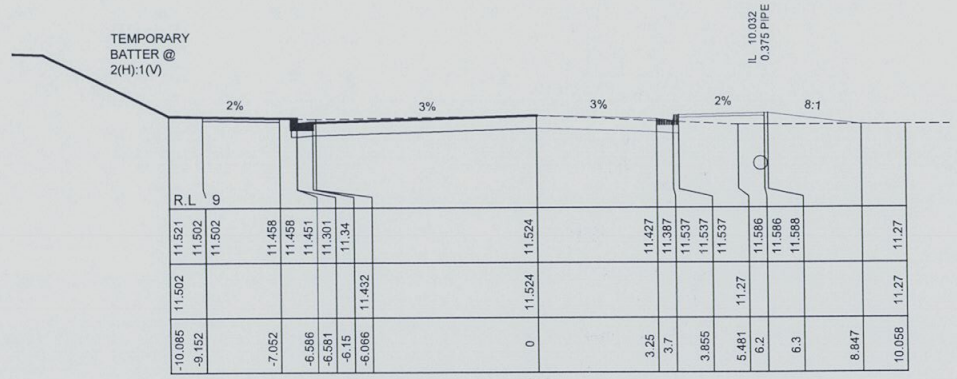
A1

LEGEND

	EXISTING EDGE OF BITUMEN
	EXISTING KERB & GUTTER
	PROPOSED KERB & GUTTER
	FUTURE KERB & GUTTER (BY OTHERS)
K&G	150mm BARRIER KERB & GUTTER
RK	ROLL KERB
ES	100mm WIDE CONCRETE EDGE STRIP
	SUBSOIL DRAINAGE LINE (2 x #90mm IN SOCK)
	EXISTING DRAINAGE LINE
IAD	PROPOSED INTERALLOTMENT DRAINAGE
	PROPOSED DRAINAGE LINE
S	EXISTING SEWER
PS	PROPOSED SEWER
12.5	EXISTING CONTOURS (0.5m INTERVAL)
12.25	PROPOSED CONTOURS (0.25m INTERVAL)
W	EXISTING WATERMAIN
PW	PROPOSED WATERMAIN
T	EXISTING UNDERGROUND TELSTRA
E	EXISTING UNDERGROUND ELECTRICITY
G	EXISTING GAS MAIN



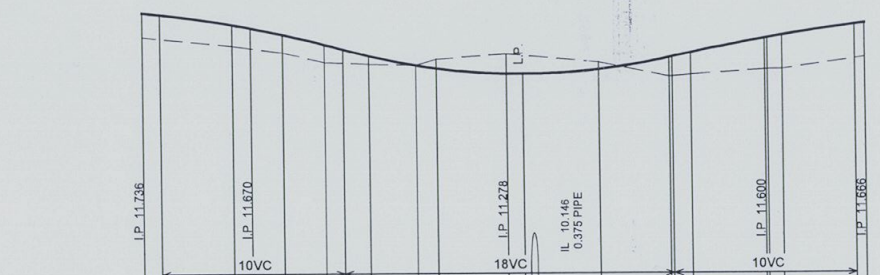
PLAN
1:200



250

ROAD No.7 (GARDEN ST) - CROSS SECTIONS

SCALE 1:100 NAT.



WORK AS EXECUTED																											
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EXISTING LEVEL	11.603		11.552	11.513	11.459	11.448	11.442	11.475	11.503		11.455	11.376	11.376	11.386		11.414	11.415	11.479			
CHAINAGE	0	1	5	6	7.726	10	11	12.423	15	16.124	20	20.883	25	28.817	29	30	34	34.163	35	39	39.55

KERB DEVELOPMENT - INTERSECTION MACPHERSON ST & GARDEN ST

H=1:200 V=1:20

1:200 @ A1

1:20 @ A1

1:100 @ A1

CC

DIAL 1100 BEFORE YOU DIG	Project: ROAD No.7 (GARDEN STREET) CROSS SECTION Ch250, KERB DEVELOPMENT INT. GARDEN ST & MACPHERSON ST	Principal: WARRIEWOOD PROPERTIES PTY LTD			
		Scale CROSS SECT 1:100 NAT. PLAN 1:200 KERB DEV H 1:200 V 1:20	Date 19.2.14	Council Ref.	
			Datum A.H.D.	L.G.A. PITTWATER	
		Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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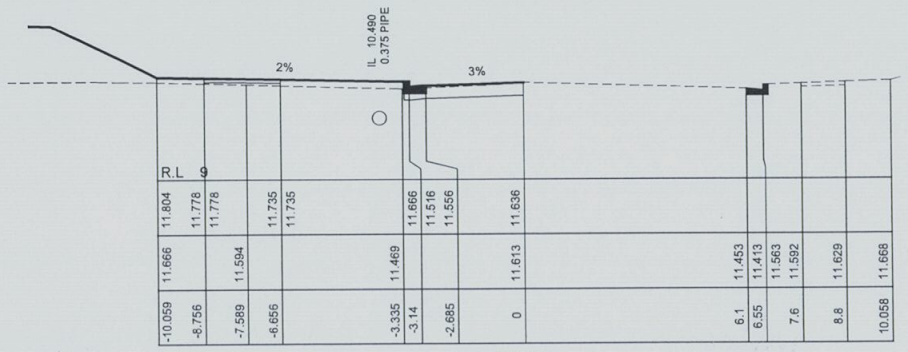
Dwg File Ref. [Rev] - Sheet Ref.	1736C CC 01 [A] in progress 19-2-14 - 018

A1



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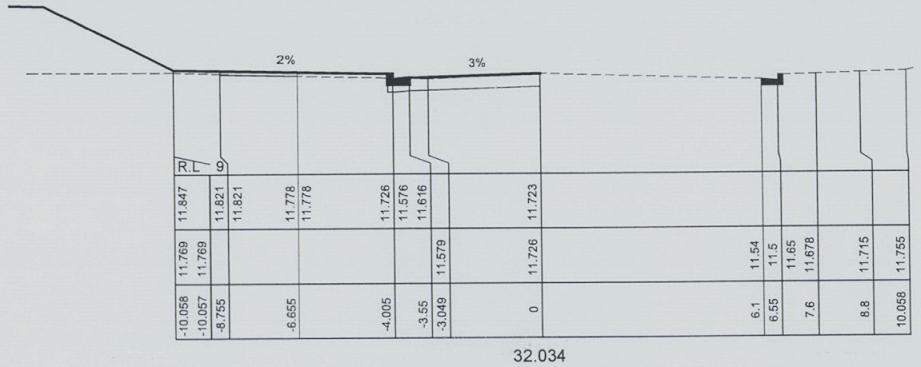
-10.059	-8.756		-7.589	-6.656			-3.335	-3.395	-3.382	0	11.546			6.1	6.55	7.6	8.8	10.058	11.39	11.35	11.5	11.528	11.566	11.605

25.327



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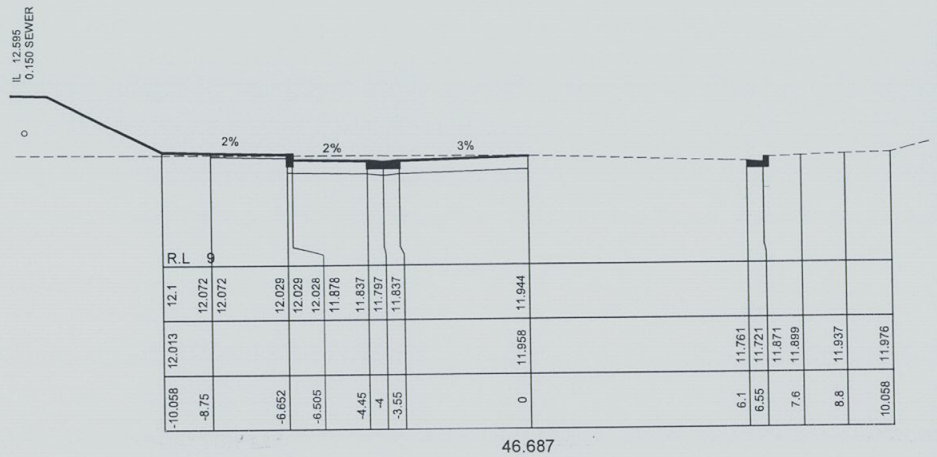
-10.058	11.769									11.579		11.726		6.1	6.55	7.6	8.8	10.058	11.54	11.5	11.65	11.678	11.715	11.755
-10.057	11.769																							
-10.058	-8.755			-6.655			-4.005	-3.55	-3.049		0			6.1	6.55	7.6	8.8	10.058						

32.034



	12.1	12.072		12.029	12.028	11.878	11.837	11.797	11.837		11.944											
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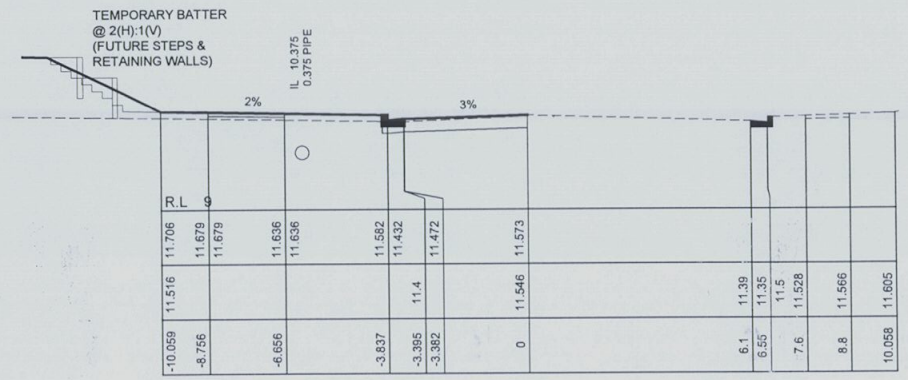
46.687



	11.706	11.679		11.636	11.636		11.582	11.432	11.472		11.573											
-10.059	11.516							11.4		11.546				6.1	6.55	7.6	8.8	10.058	11.39	11.35	11.5	11.528	11.566	11.605
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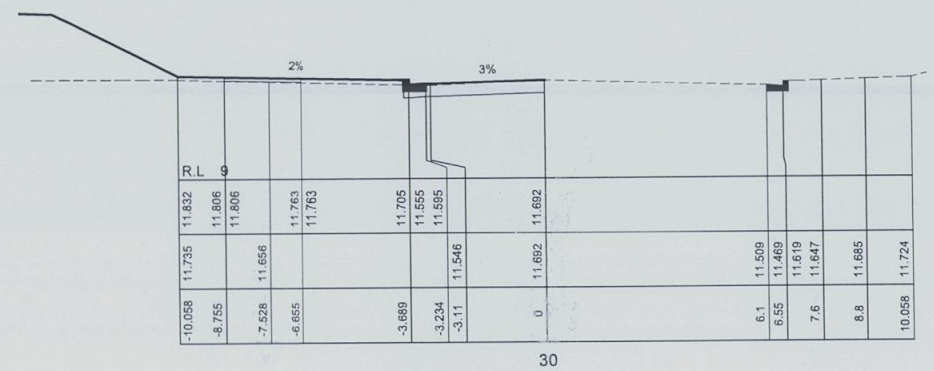
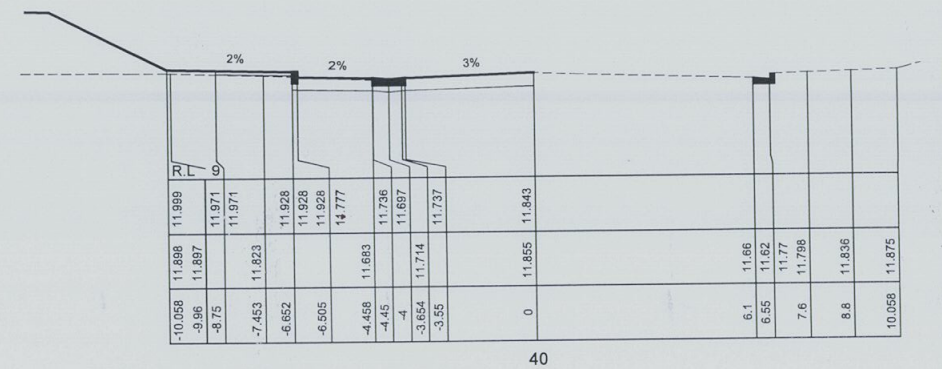


	11.832	11.806		11.763	11.763		11.705	11.555	11.595		11.692											
-10.058	11.735		11.656			-3.689		-3.234	11.546		11.692			6.1	6.55	7.6	8.8	10.058	11.509	11.469	11.619	11.647	11.685	11.724
	-8.755		-7.528	-6.655				-3.11		0														

30



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-9.96																								
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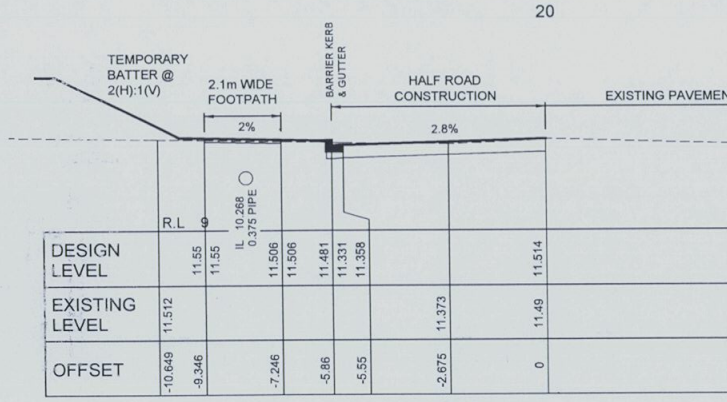
40

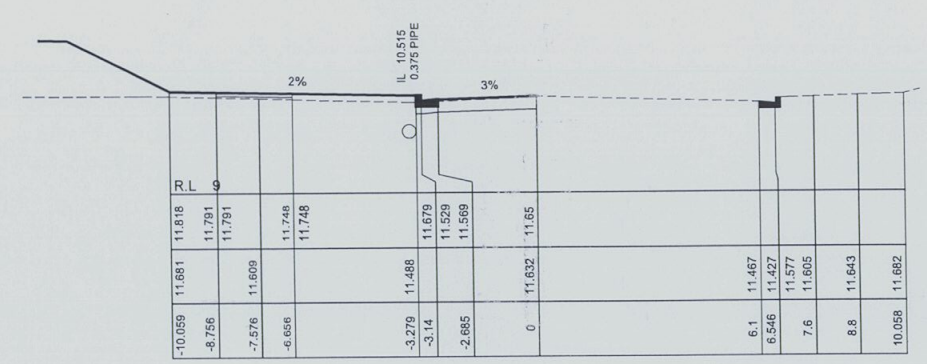


DESIGN LEVEL	11.55	11.55		11.506	11.506	11.481	11.331	11.358			11.514											
EXISTING LEVEL	11.512								11.373		11.49			6.1	6.55	7.6	8.8	10.058	11.331	11.291	11.441	11.469	11.507	11.546
OFFSET	-10.649	-9.346		-7.246		-5.86	-5.55		-2.675		0											

15.069

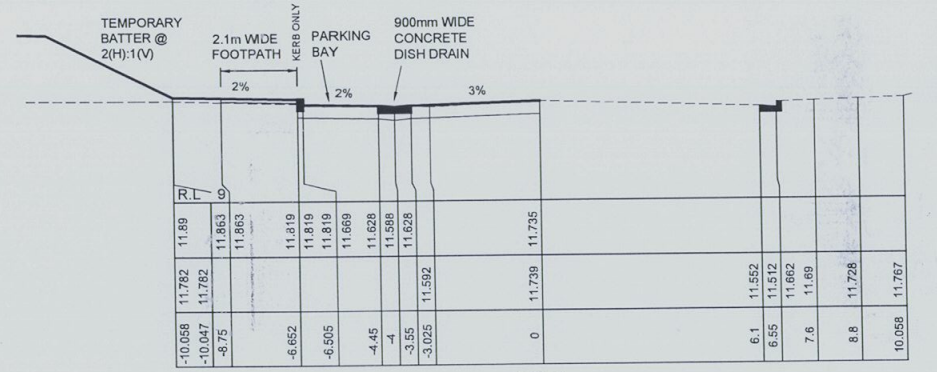
ROAD No.8 (MACPHERSON ST) - CROSS SECTIONS

SCALE 1:100 NAT.



	11.818	11.791		11.748	11.748		11.679	11.529	11.569		11.65											
-10.059	11.681		11.609			11.488				11.632				6.1	6.55	7.6	8.8	10.058	11.467	11.427	11.577	11.605	11.643	11.682
-10.059	-8.756		-7.576	-6.656			-3.279	-3.14	-2.685		0													

26.474



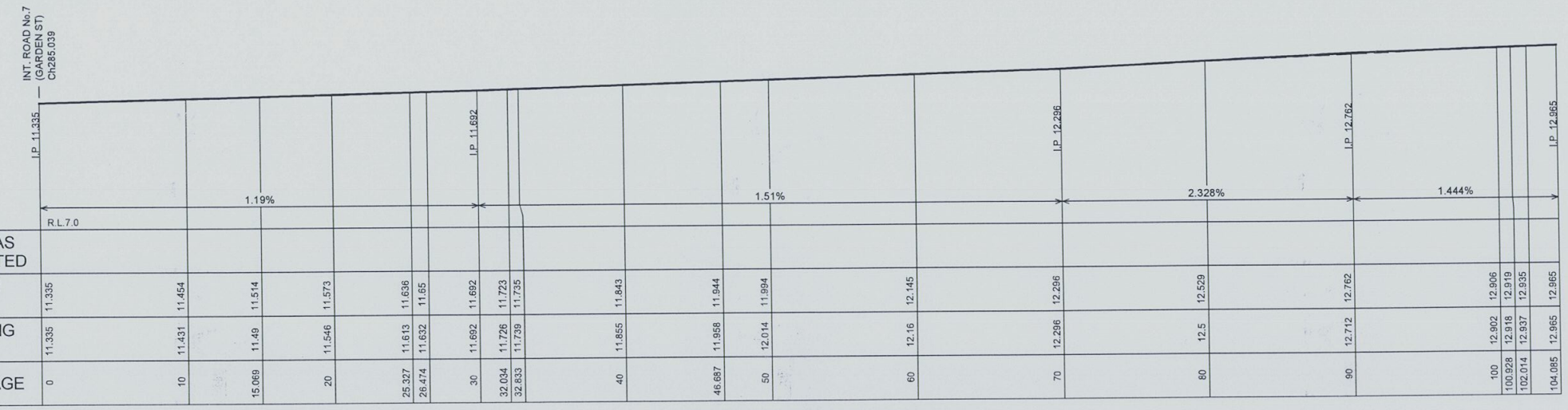
	11.89	11.863		11.819	11.819	11.669	11.628	11.588	11.628		11.735											
-10.058	11.782									11.592		11.739		6.1	6.55	7.6	8.8	10.058	11.562	11.512	11.662	11.689	11.728	11.767
-10.047	11.782	11.863																						
	-8.75		-6.652	-6.505		-4.45	-4	-3.55	-3.025		0													

32.833

PAVEMENT DESIGN
MACHERSON STREET (ROAD No.8)

DESIGN ESA's: $3x10^5$
CBR : 4
90% CONFIDENCE LEVEL

WEARING COURSE: 40mm COMPACTED THICKNESS ASPHALTIC CONCRETE – A.C.10
BASE COURSE: 200mm D.G.B.20
SUB–BASE COURSE: 200mm APPROVED CRUSHED SANDSTONE (OR EQUIVALENT)
TO D.G.S.40 STANDARD



WORK AS EXECUTED																												
DESIGN LEVEL	11.335		11.454		11.514		11.573		11.636	11.65		11.692	11.723	11.735		11.843		11.944	11.994		12.145		12.296		12.529		12.762		12.906	12.919	12.935	12.965
EXISTING LEVEL	11.335		11.431		11.49		11.546		11.613	11.632		11.692	11.726	11.739		11.855		11.958	12.014		12.16		12.296		12.5		12.712		12.902	12.918	12.937	12.965
CHAINAGE	0		10		15.069		20		25.327	26.474		30	32.034	32.833		40		46.687	50		60		70		80		90		100	100.928	102.014	104.085

ROAD No.8 (MACPHERSON STREET)

H=1:200 V=1:100

CC

5 4 3 2 1 0 5
1:100 @ A1

5 4 3 2 1 0 5 10
1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: ROAD No.8 (MACPHERSON STREET)
LONG SECTION &
CROSS SECTIONS Ch15.06 TO Ch46.68

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	LONG SECT H 1:200 V 1:100 CROSS SECT 1:100 NAT.	Date	19.2.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.
Client Ref.					

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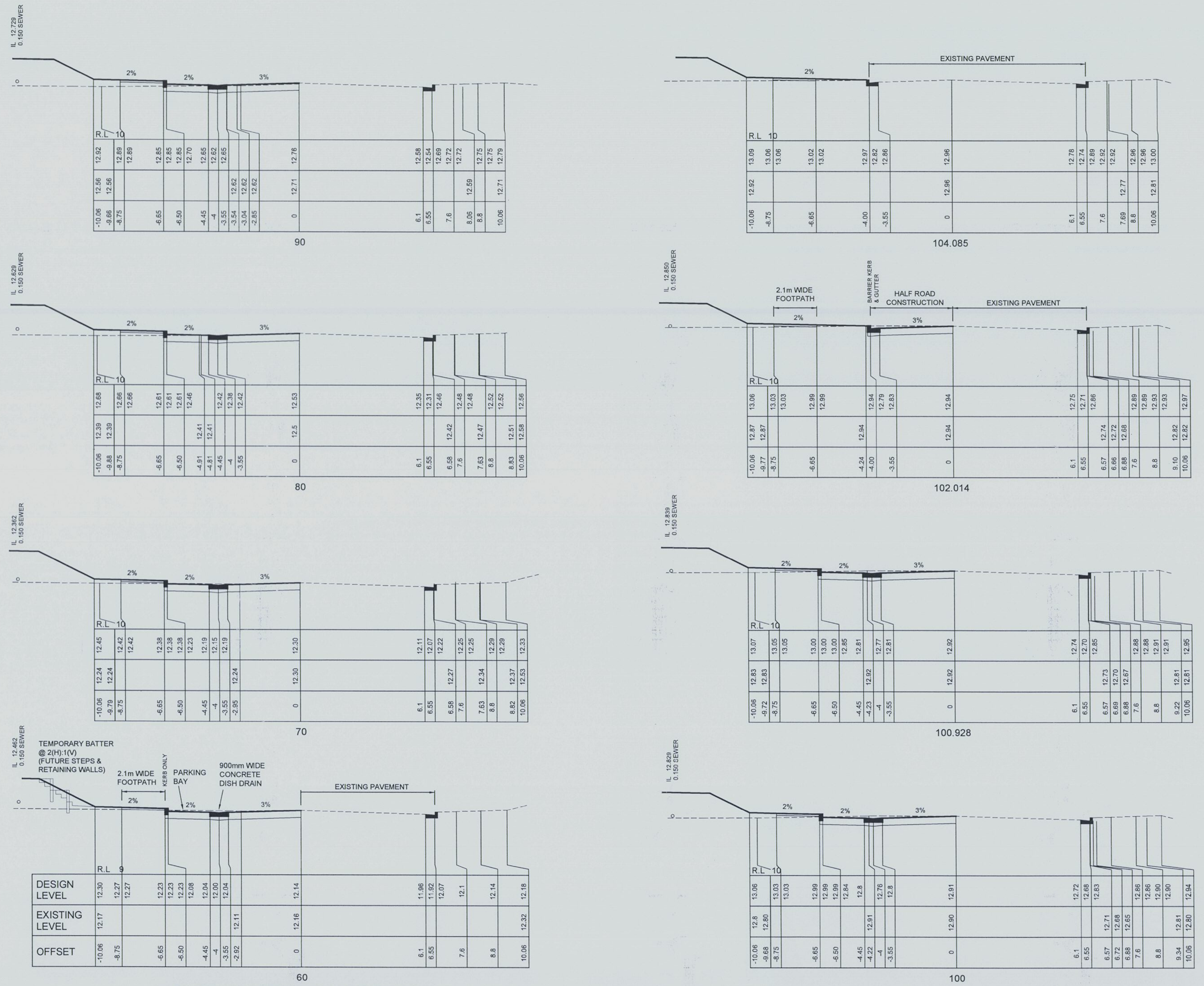
IQNS ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [A] in progress
19-2-14 - 019

A1



ROAD No.8 (MACPHERSON ST) - CROSS SECTIONS

SCALE 1:100 NAT.

5 4 3 2 1 0 5

1:100 @ A1

CC

Project:
ROAD No.8 (MACPHERSON STREET)
CROSS SECTIONS Ch60 TO Ch104.08

DIAL 1100 BEFORE YOU DIG

Principal: WARRIEWOOD PROPERTIES PTY LTD					
Scale 1:100 NAT.		Date 19.2.14		Council Ref.	
		Datum A.H.D.		L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.		Proj.Man. A.D.	Client Ref:	

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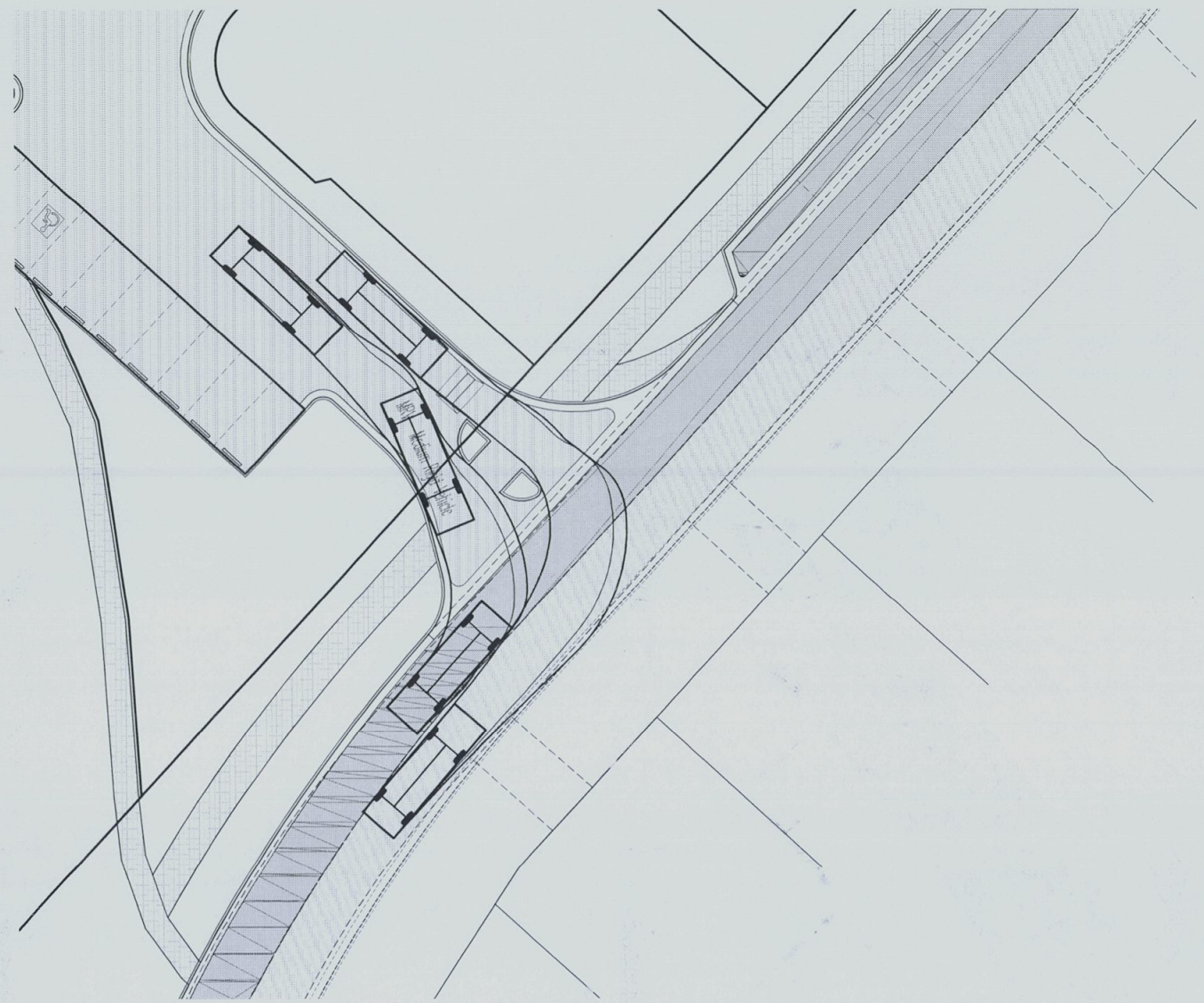
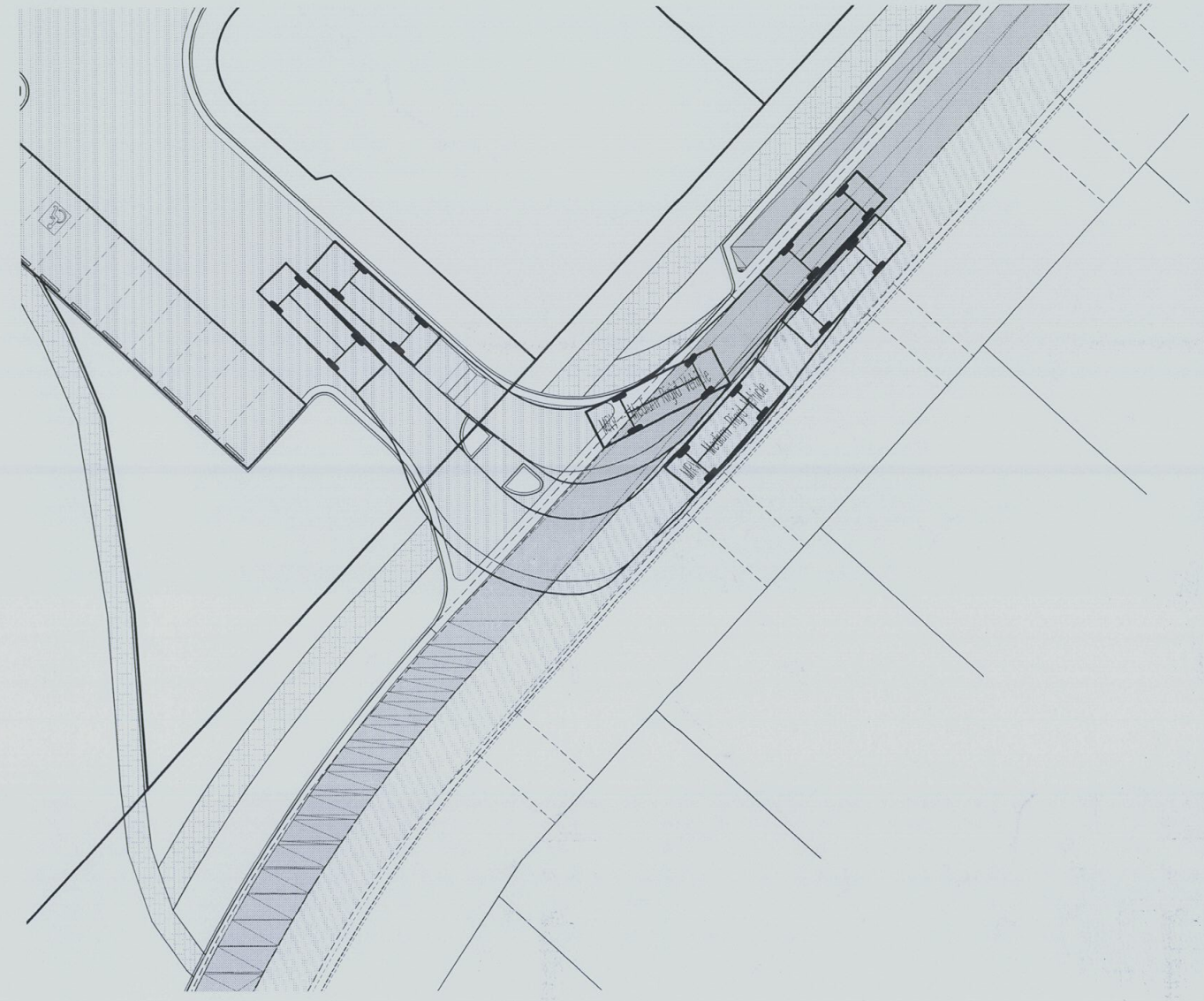
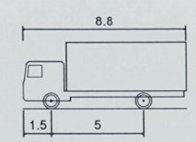
Dwg File Ref. [Rev] - Sheet Ref.
1736C CC 01 [A] in progress
19-2-14 - 020

A1







MRV - Medium Rigid Vehicle

Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock to Lock Time	4.00s
Kerb to Kerb Turning Radius	10.000m

5 4 3 2 1 0 5 10

1:200 @ A1

CC

DIAL 1100 BEFORE YOU DIG

Project: DESIGN VEHICLE TURN PATHS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:200	Date 19.2.14	Council Ref.			
	Datum A.H.D.	L.G.A. PITTWATER			
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.		

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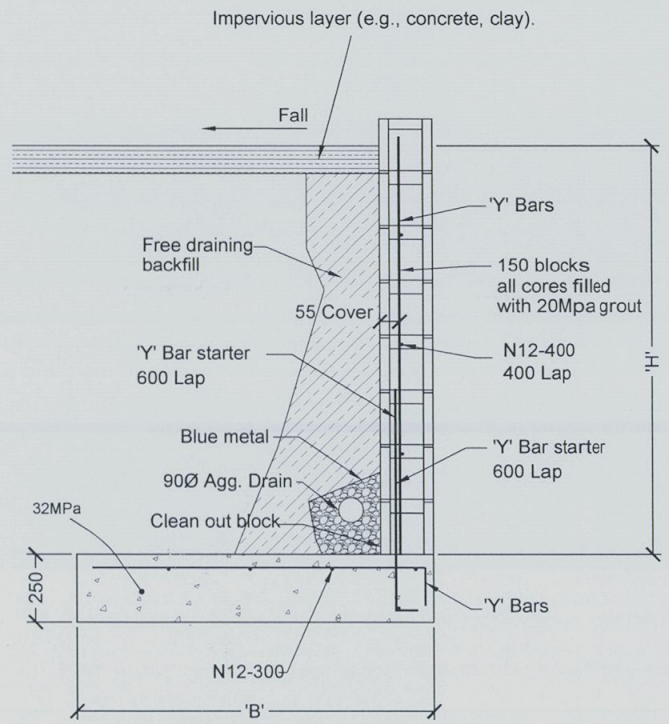
19-2-14 - 021

A1

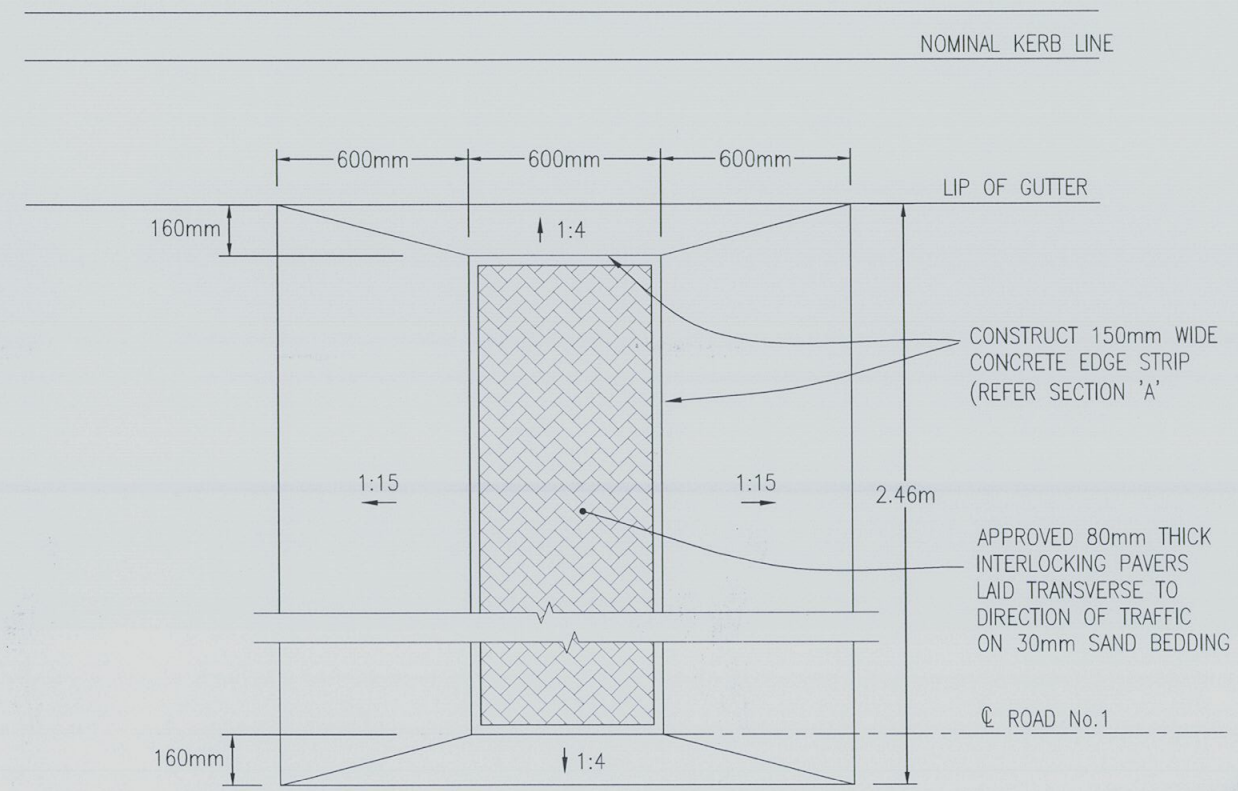
Block Retaining Wall Schedule		
'H'	'B'	'Y' Bars
0 - 800	700	N12 - 400
800-1200	800	N12 - 400
1200-1800	1200	N16 - 400
1800-2200	1500	N16 - 400
2200-2600	1800	N16 - 400
2600-3000	2100	N20 - 400
3000-3400	2400	N20 - 400
3400-4000	2700	N24 - 400

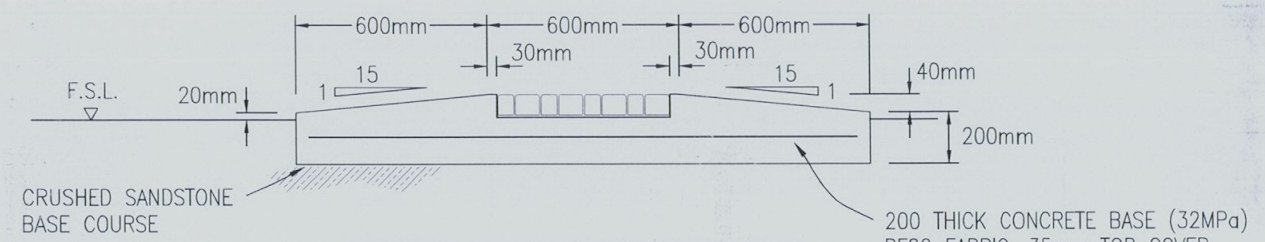
retaining wall design based on 5kPa surcharge internal friction angle 30° refer to page 18 CMAA concrete retaining structures - reinforced masonry



RETAINING WALL RW1

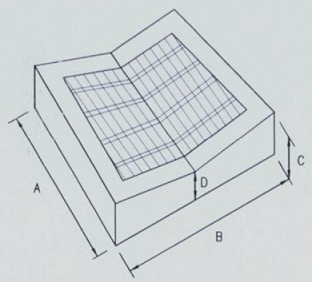
for 'h' up to 1800





TRAFFIC CALMING DEVICE

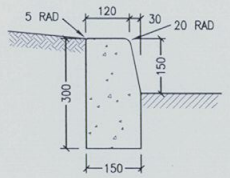
NOT TO SCALE



Dimensions in mm				PIT SIZE
A	B	C	D	
900	900	200	165	600x600
1300	1000	200	165	900x600
1300	1300	200	145	900x900

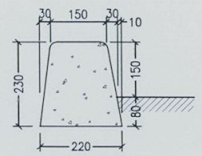
STANDARD V GRATE IN CONCRETE SURROUND

NOT TO SCALE



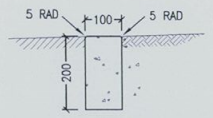
KERB ONLY

SCALE 1:10



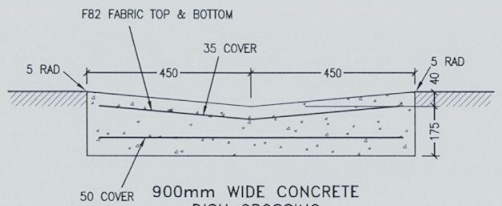
BARRIER KERB AT TRAFFIC ISLANDS

SCALE 1:10



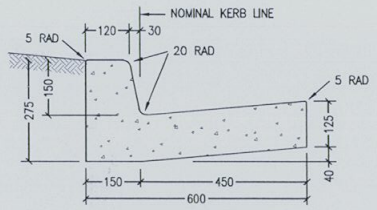
CONCRETE EDGE STRIP

SCALE 1:10



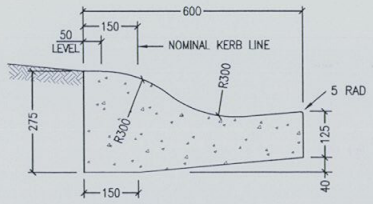
900mm WIDE CONCRETE DISH CROSSING

SCALE 1:10



150mm BARRIER KERB & GUTTER

SCALE 1:10



150mm ROLL KERB & GUTTER

SCALE 1:10

CC

DIAL 1100 BEFORE YOU DIG	Project: TYPICAL KERB DETAILS TRAFFIC CALMING DEVICE DETAILS RETAINING WALL DETAILS	Principal: WARRIEWOOD PROPERTIES PTY LTD			Our Ref. 1736
		Scale N.T.S.	Date 19.2.14	Council Ref.	Dwg File Ref. [Rev] - Sheet Ref. 1736C CC 01 [A] in progress
			Datum A.H.D.	L.G.A. PITTWATER	19-2-14 - 022
		Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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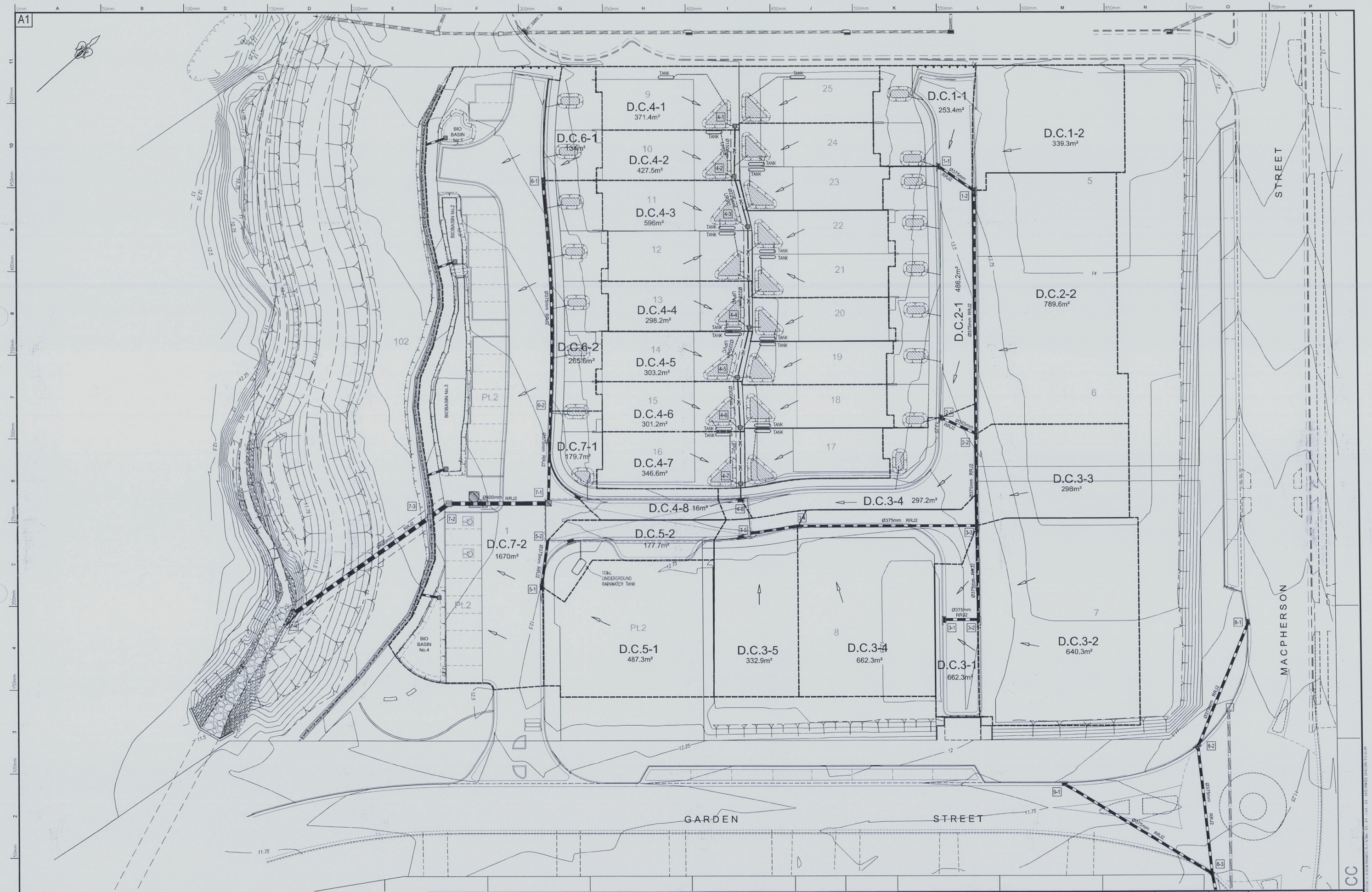

1:250 @ A1

DIAL 1100 BEFORE YOU DIG

Project: CATCHMENT PLAN

Principal: WARRIEWOOD PROPERTIES PTY LTD				
Scale 1:250	Date 19.2.14	Council Ref.		
	Datum A.H.D.	L.G.A. PITTWATER		
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.	

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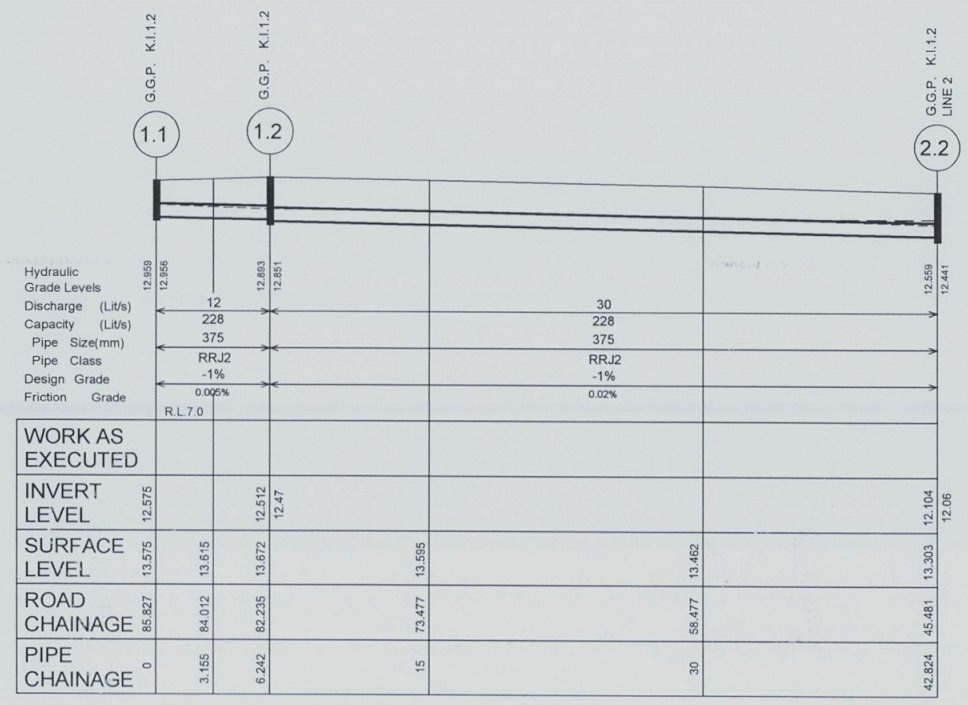
Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

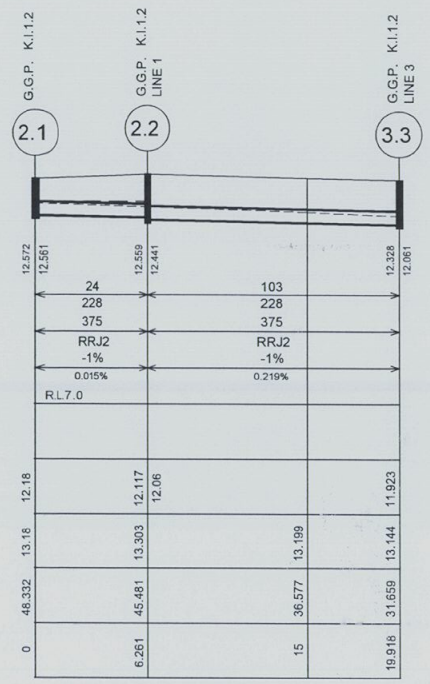
1736C CC 01 [A] in progress
19-2-14 - 023

A1



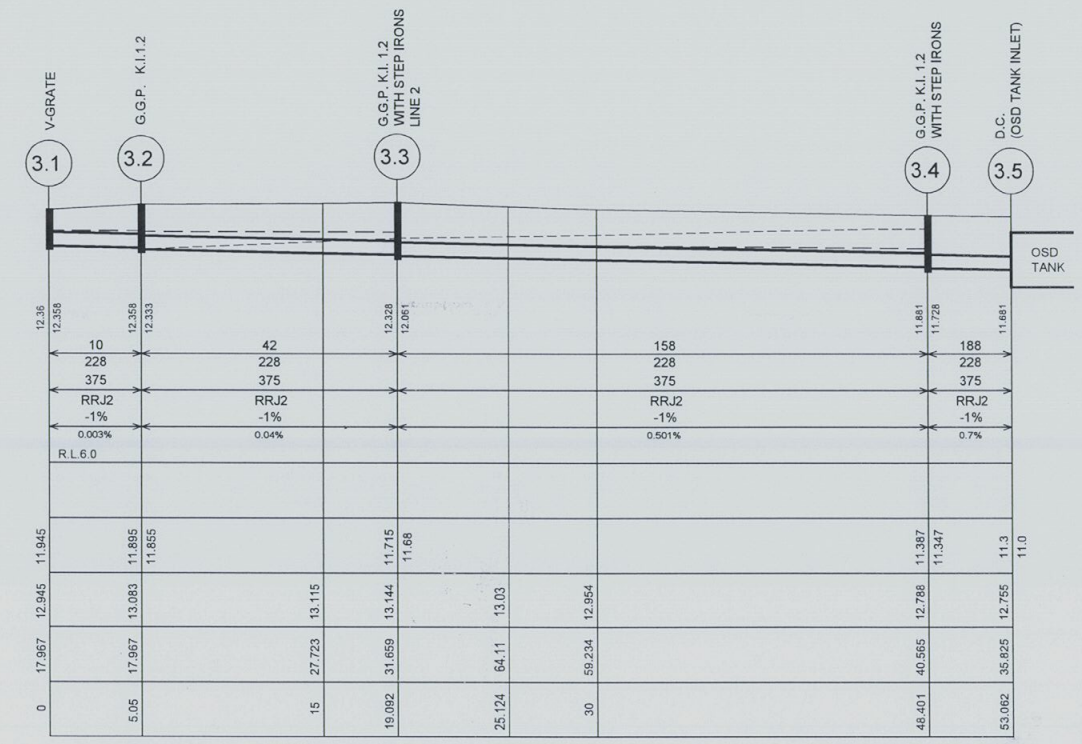
LINE.1

H=1:200 V=1:100



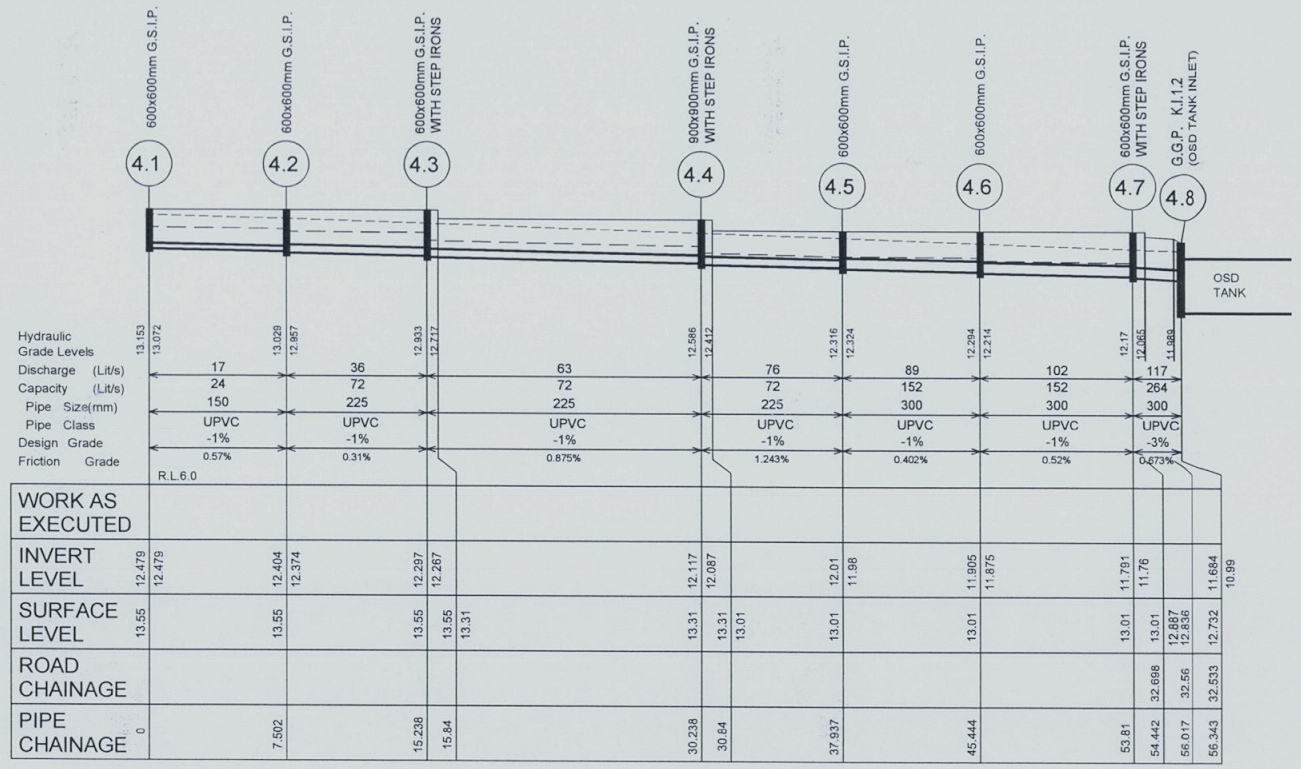
LINE.2

H=1:200 V=1:100



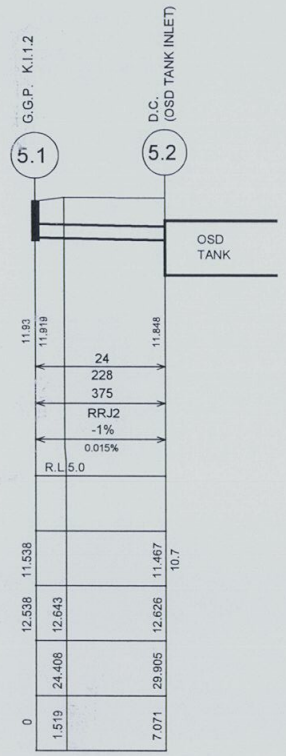
LINE.3

H=1:200 V=1:100



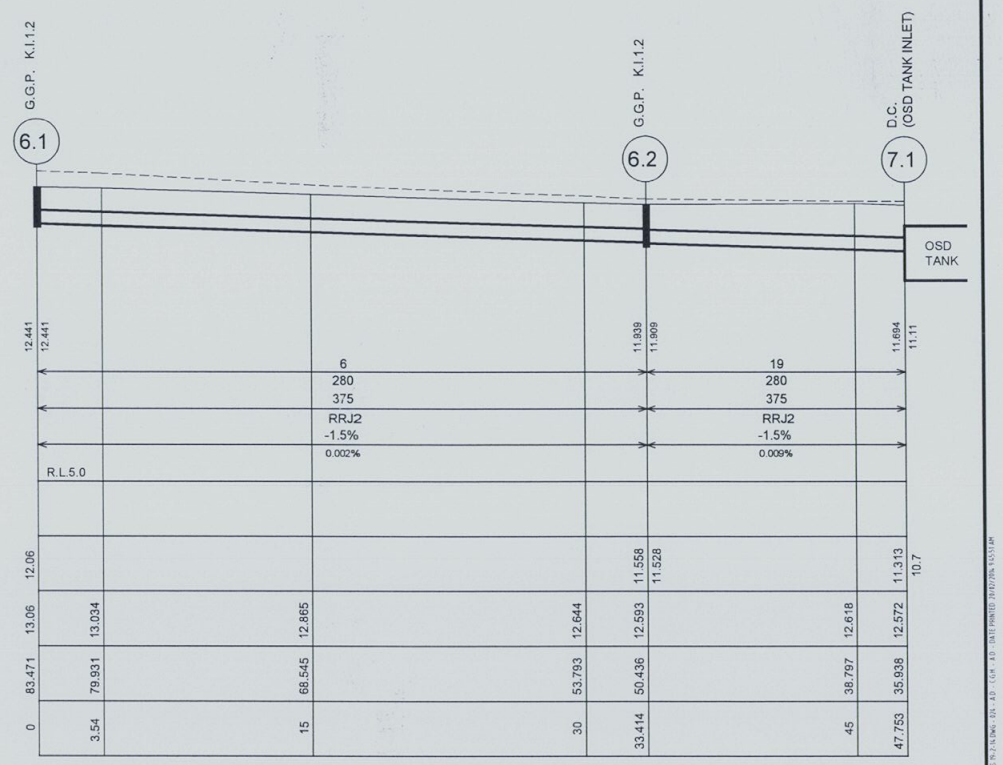
LINE.4

H=1:200 V=1:100



LINE.5

H=1:200 V=1:100



LINE.6

H=1:200 V=1:100

1:100 @ A1

1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: DRAINAGE LINES 1 TO 6

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale H:1:200 V:1:100	Date 19.2.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [A] in progress

19-2-14 - 024

CC

A1

DRAINAGE NOTES

1. CALCULATIONS BASED ON AUSTRALIAN RAINFALL RUNOFF (1987)
2. DESIGN RECURRENCE INTERVAL FOR ROAD AND INTERALLOTMENT DRAINAGE IS 20 YEARS FOR THE PIPED SYSTEM
3. THE ROUGHNESS VALUE FOR THE COLEBROOK–WHITE EQUATION ADOPTED IS AS FOLLOWS: FOR THE UPVC PIPE = 0.3mm
4. PIT LOSS FACTORS BASED ON THE MISSOURI CHARTS
5. KERB INLET DIMENSIONS (e.g. K.I. 1.8m) REFER TO THE OPENING OF LINTELS
6. PRECAST PIT LINTELS ARE TO BE USED
7. ALL PITS ARE TO BE BENCHED WITH MASS CONCRETE TO HALF DIAMETER TO STREAMLINE FLOW
8. GULLY PIT CLOGGING FACTORS ARE: 0.7 FOR GRATES, 0.9 FOR LINTELS
9. CONCRETE BULK HEADS TO BE PROVIDED AT MAX. 3.6m SPACINGS WHERE PIPE GRADES EXCEED 12% OR AS DIRECTED

PIT TYPES

1 – G.G.P. – STANDARD GRATED GULLY PIT

4 – G.I.S.P. – GRATED SURFACE INLET PIT

5 – J.P. – JUNCTION PIT

7 – D.C. – DIRECT CONNECTION

10 – G.P.T. – GROSS POLLUTANT TRAP

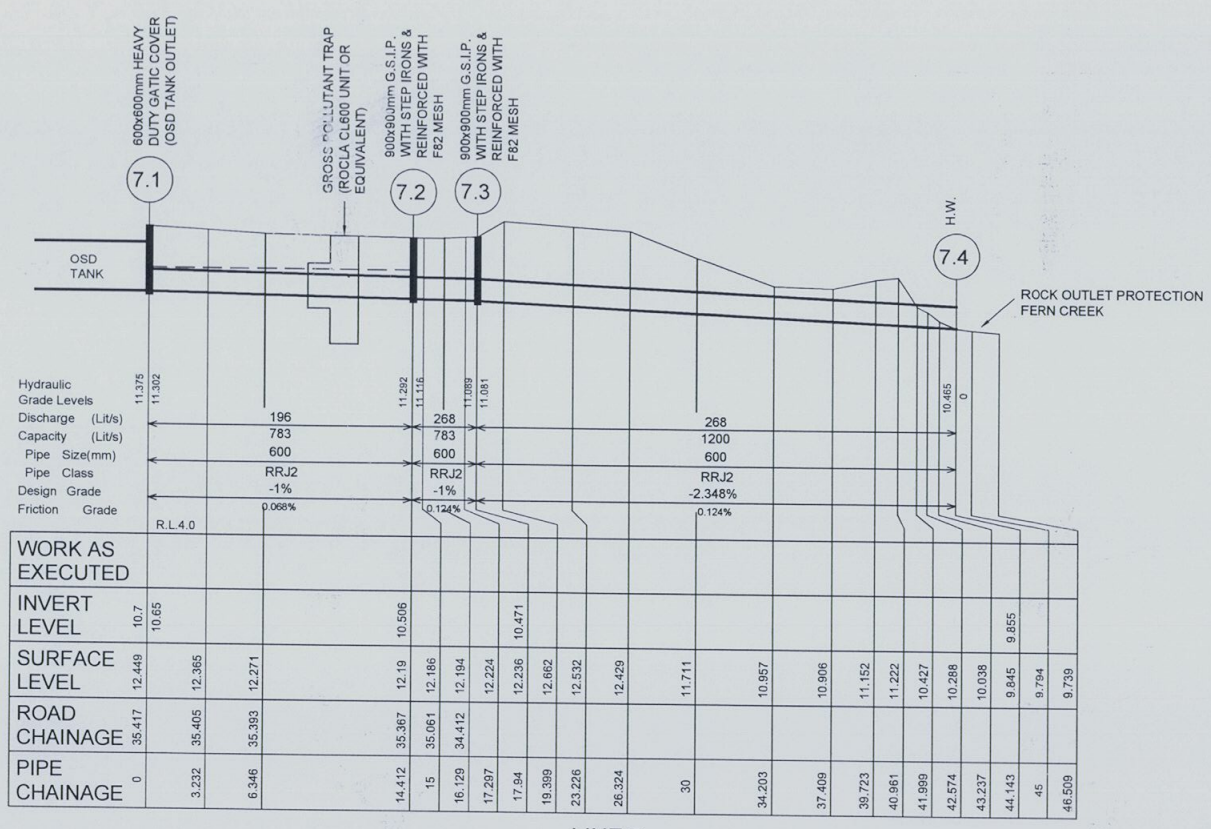
H.W. – HEAD WALL

HYDROLOGICAL DESIGN SHEET

PIT	LAND USE	FLOW LENGTH	SLOPE	"n"	TIME	TIME	INTENSITY	CODE	COEFF	AREA	C.A	SUM AREA	Q	BY PASS	TOTAL FLOW	GUTTER SLOPE	FLOW WIDTH	PIT TYPE	LINTEL	INFLOW	BY FLOW	BY PIT	KINEMATIC MIN TIME 5 MAX TIME 20 WARRIEWOOD REMARKS
		m	%		min	min	mm/h			ha	ha	ha	L/s	L/s	L/s	%	m		m	L/s	L/s		
1.1						5	203 20Yr	-0.9	0.908	0.025	0.023	0.023	13		13	1	1.096	1	1.2	13		2.1	
1.2						5	203 20Yr	-0.9	0.908	0.034	0.031	0.031	17		17	1	1.274	1	1.2	17		2.2	
2.1						5	203 20Yr	-0.9	0.908	0.049	0.044	0.044	25		25	1	1.512	1	1.2	25		4.8	
2.2	1	30.5	1	0.170	9.753	5 ADP	203 20Yr	-0.9 -0.650	0.908 0.815	0.079 0.027	0.072 0.022	0.094	53		53	1	2.1	1	1.2	53		3.3	
3.1						5	203 20Yr	-0.9	0.908	0.021	0.019	0.019	11		11	0.7	1.081 0.03PH	1 SAG		11			
3.2						5	203 20Yr	-0.9	0.908	0.064	0.058	0.058	33		33	0.5	1.985 0.03PH	1 SAG	1.2	33		3.2	
3.3						5	203 20Yr	-0.9	0.908	0.030	0.027	0.027	15		15	1	1.194	1	1.2	15		3.4	
3.4						5	203 20Yr	-0.9	0.908	0.066	0.060	0.06	34		34	0.5	2.014	1	1.2	34		5.2	
4.1						5	203 20Yr	-0.650	0.815	0.037	0.030	0.03	17		17			4		17		4.2	
4.2						5	203 20Yr	-0.650	0.815	0.043	0.035	0.035	20		20			4		20		4.2	
4.3	1	10	2	0.230	4.334	5	203 20Yr	-0.650	0.815	0.060	0.049	0.049	27		27		0.03PH	4 SAG		27		4.3	
4.4						5	203 20Yr	-0.650	0.815	0.030	0.024	0.024	14		14			4		14		4.5	
4.5						5	203 20Yr	-0.650	0.815	0.030	0.025	0.025	14		14			4		14		4.6	
4.6						5	203 20Yr	-0.650	0.815	0.030	0.025	0.025	14		14			4		14		4.7	
4.7						5	203 20Yr	-0.650	0.815	0.035	0.028	0.028	16		16			4		16		4.8	
5.1						5	203 20Yr	-0.9	0.908	0.049	0.044	0.044	25		25	1	1.514	1	1.2	25		5.2	
6.1						5	203 20Yr	-0.9	0.908	0.013	0.012	0.012	7		7	1	0.731	1	1.2	7		6.2	
6.2						5	203 20Yr	-0.9	0.908	0.027	0.024	0.024	14		14	1	1.124	1	1.2	14		7.1	
7.1						5	203 20Yr	-0.9	0.908	0.018	0.016	0.016	9		9	2	0.702 0.03PH	1 SAG	1.2	9			
7.2						5	203 20Yr	-0.650	0.815	0.167	0.136	0.136	77		77	1	4.826 0.03PH	4 SAG		77		7.2	
7.3						5	203 20Yr						268 ADP		268			4		ADP	268		

HYDRAULIC DESIGN SHEET

PIT	TIME	INTENSITY	AREAS	FLOW	LENGTH	DIAMETER	GRADE	H.G.L.GRADE	VEL Q/A	K	HEAD LOSS	VEL CAP	PIPE VEL	PIPE CAP	PIPE TIME	C=C.W., N=MANNINGS MAX TIME 20 WARRIEWOOD BY PASS=AREA AREA=SUM.CA REMARKS
	min	mm/hr	ha	L/s	m	mm	%	%	m/s		m	m/s	m/s	L/s	min	
LINE 1 1.1-1.2	5	202 20Yr	0.023	13	6.242 C0.0003	381	1	0.005	0.113	4.7	0.003	2.007	0.98	229	0.11	
1.2-2.2	5.1	201 20Yr	0.054	30	36.582 C0.0003	381	1	0.02	0.263	3	0.011	2.007	1.2	229	0.51	
LINE 2 2.1-2.2	5	202 20Yr	0.044	25	6.261 C0.0003	381	1	0.015	0.218	4.7	0.011	2.007	1.15	229	0.09	
2.2-3.3	5.6	194 20Yr	0.192	104	13.657 C0.0003	381	1	0.219	0.91	2.8	0.118	2.007	1.73	229	0.13	
LINE 3 3.1-3.2	5	202 20Yr	0.019	11	5.05 C0.0003	381	1	0.003	0.093	4.7	0.002	2.007	0.94	229	0.09	
3.2-3.3	5.1	201 20Yr	0.077	43	14.042 C0.0003	381	1	0.04	0.377	3.4	0.025	2.007	1.31	229	0.18	
3.3-3.4	5.7	193 20Yr	0.296	159	29.309 C0.0003	381	1	0.501	1.391	2.7	0.267	2.007	1.97	229	0.25	
3.4-3.5	6	190 20Yr	0.356	188	4.661 C0.0003	381	1	0.7	1.65	1.1	0.153	2.007	2.07	229	0.04	
LINE 4 4.1-4.2	5	202 20Yr	0.03	17	7.502 C0.00006	152	1	0.57	0.938	1.8	0.081	1.371	1.34	25	0.09	
4.2-4.3	5.1	201 20Yr	0.065	36	7.736 C0.00006	229	1	0.31	0.884	1.8	0.072	1.759	1.57	72	0.08	
4.3-4.4	5.2	200 20Yr	0.114	63	15 C0.00006	229	1	0.875	1.535	1.8	0.216	1.759	1.85	72	0.14	
4.4-4.5	5.3	198 20Yr	0.138	76	7.699 C0.00006	229	1	1.243	1.846	1	0.174	1.759	1.9	72	0.07	
4.5-4.6	5.4	197 20Yr	0.163	89	7.507 C0.00006	305	1	0.402	1.222	-0.1	-0.008	2.09	1.95	153	0.06	
4.6-4.7	5.4	196 20Yr	0.187	102	8.365 C0.00006	305	1	0.52	1.4	0.8	0.08	2.09	2.04	153	0.07	
4.7-4.8	5.5	195 20Yr	0.215	117	2.533 C0.00006	305	3	0.673	1.605	0.8	0.105	3.621	3.11	265	0.01	
LINE 5 5.1-5.2	5	202 20Yr	0.044	25	7.071 C0.0003	381	1	0.015	0.218	4.7	0.011	2.007	1.15	229	0.1	
LINE 6 6.1-6.2	5	202 20Yr	0.012	7	33.414 C0.0003	381	1.5	0.002	0.06	4.7	0.001	2.458	0.97	280	0.57	
6.2-7.1	5.6	195 20Yr	0.036	20	14.339 C0.0003	381	1.5	0.009	0.172	3.8	0.006	2.458	1.28	280	0.19	
LINE 7 7.1-7.2	5.8	192 20Yr	0.053	196 ADP	14.412 C0.0003	610	1	0.068	0.671	3.2	0.073	2.681	1.92	784	0.13	
7.2-7.3	5.9	191 20Yr	0.189	268 ADP	3.528 C0.0003	610	1	0.124	0.917	4.1	0.176	2.681	2.12	784	0.03	
7.3-7.4	5.9	191 20Yr	-0.287 -0.476	268 ADP	26.203 C0.0003	610	2.348	0.124	0.917	0.2	0.009	4.108	2.85	1201	0.15	



LINE.7

H=1:200 V=1:100

1:100 @ A1

1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: DRAINAGE LINE 7
DRAINAGE NOTES & CALCULATION SHEETS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale H:1:200 V:1:100 | Date 19.2.14 | Datum A.H.D. | Council Rev. L.G.A. PITTWATER

Calc's A.D. | Drawn. C.G.H. | Proj.Man. A.D. | Client Ref.

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90th ANNIVERSARY 1923 - 2013

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1736C CC 01 [A] in progress
19-2-14 - 025

CC

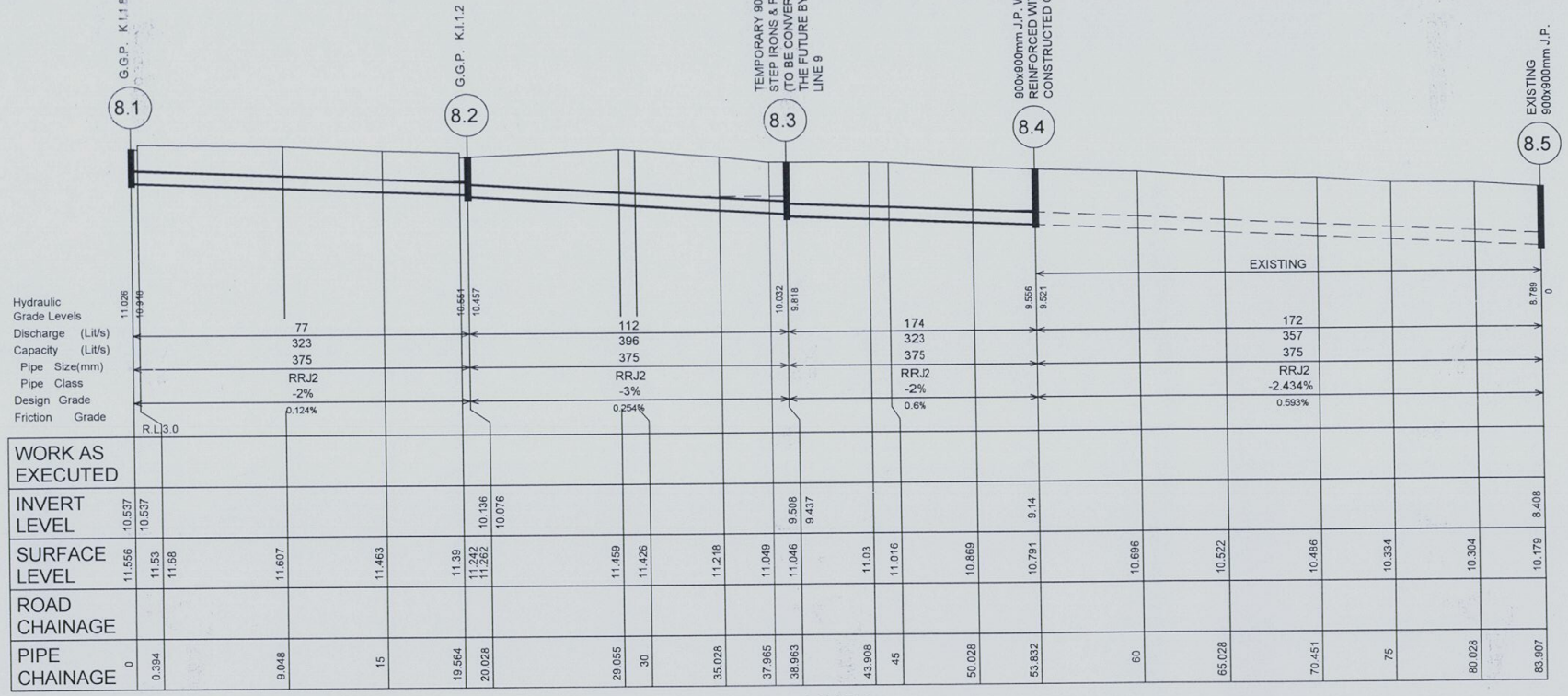
A1

HYDROLOGICAL DESIGN SHEET

PIT	LAND USE	FLOW LENGTH	SLOPE	"n"	TIME	TIME	INTENSITY	CODE	COEFF.	AREA	C.A	SUM AREA	Q	BY PASS	TOTAL FLOW	GUTTER SLOPE	FLOW WIDTH	PIT TYPE	LINTEL	INFLOW	BY FLOW	BY PIT	KINEMATIC MIN TIME 5 MAX TIME 20 WARRIEWOOD REMARKS
		m	%		min	min	mm/h			ha	ha	ha	L/s	L/s	L/s	%	m		m	L/s	L/s		
9.1						5	203 20Yr	-0.650	0.815	0.140	0.114	0.114	64		64	1	2.272	1	1.8	64		8.2	
8.1						5	203 20Yr	-0.650	0.815	0.169	0.138	0.138	78		78	0.7	2.639	1	1.8	78		8.2	
8.2						5	203 20Yr	-0.9	0.908	0.070	0.064	0.064	36		36	0.7	2.459 0.03PH	1 SAG	1.2	36			
8.3						5	203 20Yr									1.4		1	1.2	ADP			
8.4						5	203 20Yr									1.4		5		ADP			

HYDRAULIC DESIGN SHEET

PIT	TIME	INTENSITY	AREAS	FLOW	LENGTH	DIAMETER	GRADE	H.G.L.GRADE	VEL Q/A	K	HEAD LOSS	VEL CAP	PIPE VEL.	PIPE CAP	PIPE TIME	C=C.W., N=MANNINGS MAX TIME 20 WARRIEWOOD BY PASS=AREA AREA=SUM CA REMARKS
	min	mm/hr	ha	L/s	m	mm	%	%	m/s		m	m/s	m/s	L/s	min	
LINE 9 9.1-8.3	5	202 20Yr	0.114	64	25.699 C0.0003	381	2	0.086	0.561	3.2	0.051	2.839	1.89	324	0.23	
LINE 8 8.1-8.2	5	202 20Yr	0.138	78	20.028 C0.0003	381	2	0.124	0.68	4.6	0.109	2.839	2.01	324	0.17	
8.2-8.3	5.2	200 20Yr	0.202	112	18.935 C0.0003	381	3	0.254	0.984	1.9	0.094	3.477	2.6	396	0.12	
8.3-8.4	5.3	198 20Yr	0.315	174	14.869 C0.0003	381	2	0.6	1.526	1.8	0.214	2.839	2.59	324	0.1	
8.4-8.5	5.4	197 20Yr	0.315	173	30.075 C0.0003	381	2.434	0.593	1.517	0.3	0.035	3.131	2.76	357	0.18	



LINE.8

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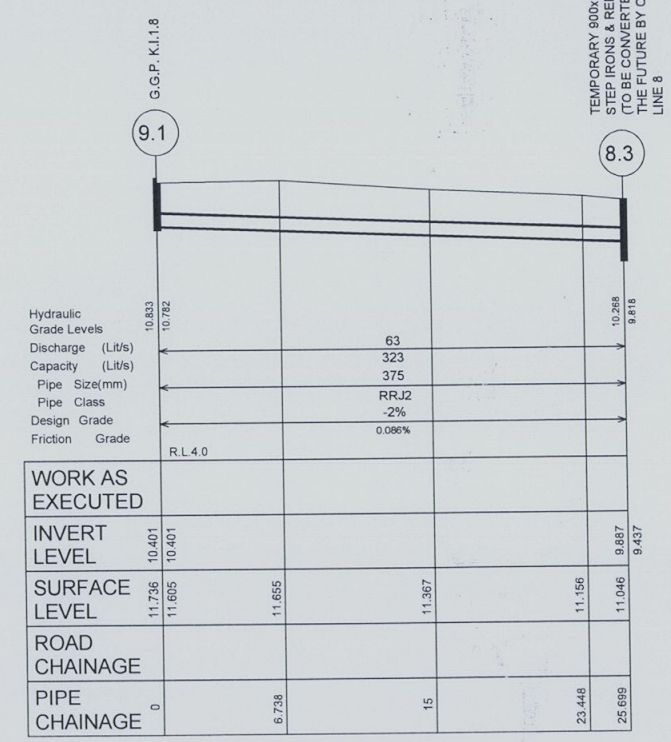

LINE.9

H=1:200 V=1:100

1:100 @ A1

1:200 @ A1

DIAL 1100 BEFORE YOU DIG

Project: DRAINAGE LINES 8 & 9
DRAINAGE CALCULATION SHEETS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	H.1:200 V.1:100	Date	19.2.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref.

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1736C CC 01 [A] in progress

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CC

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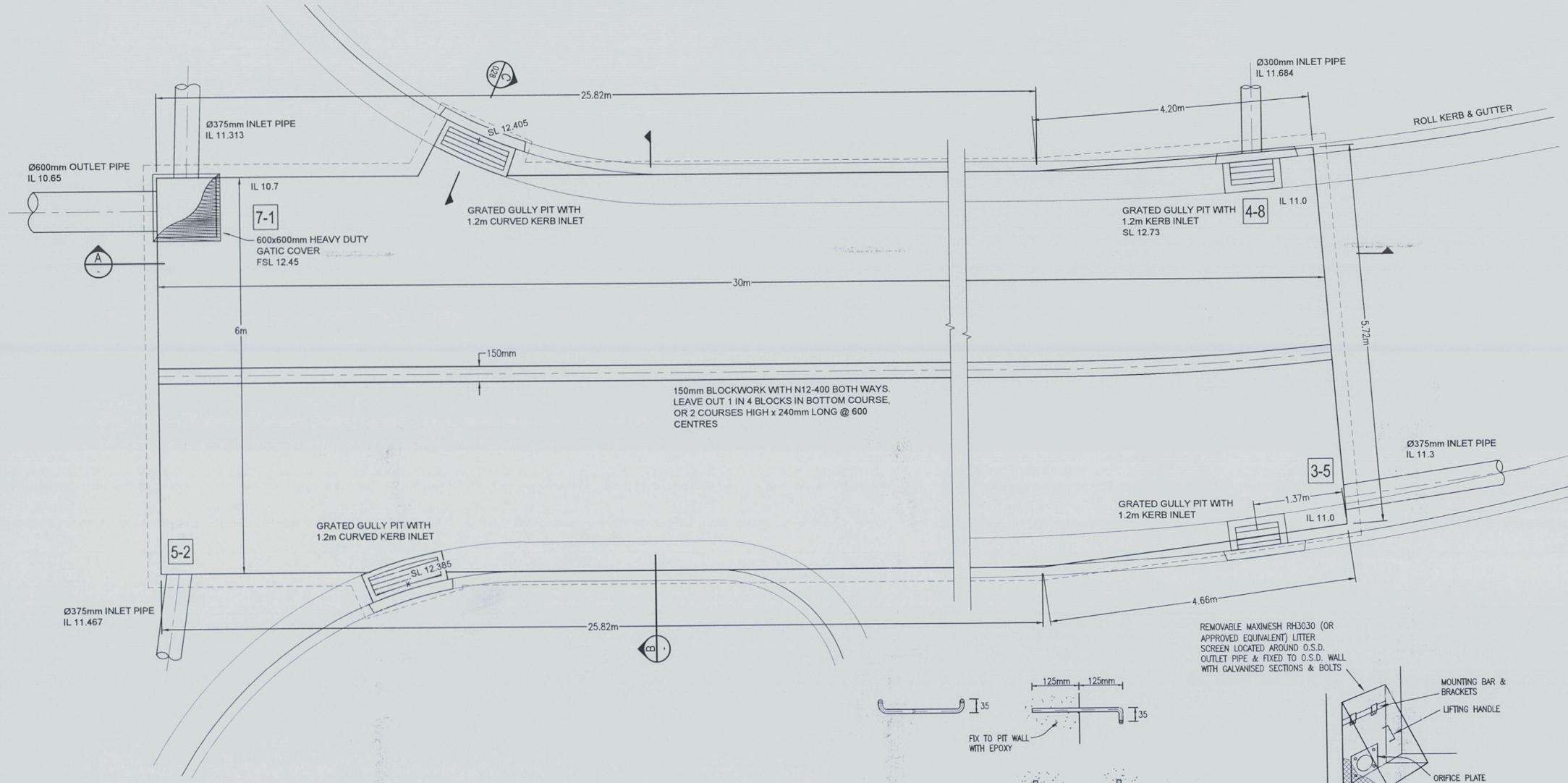
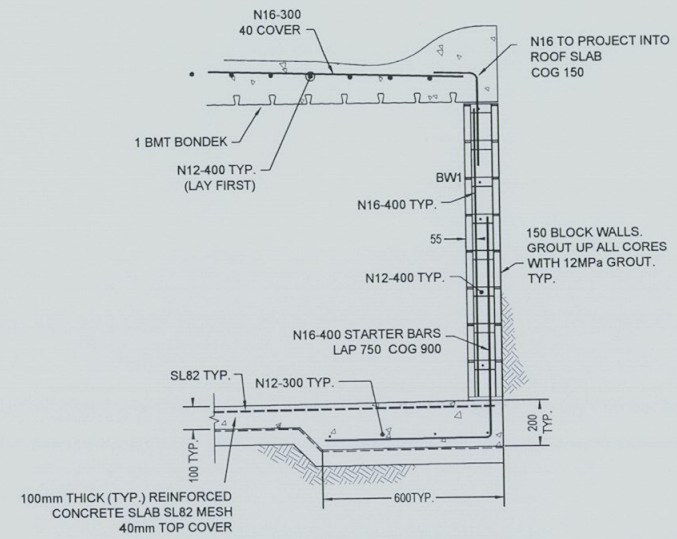
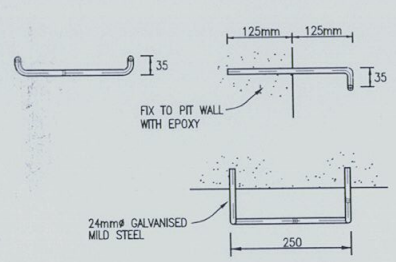
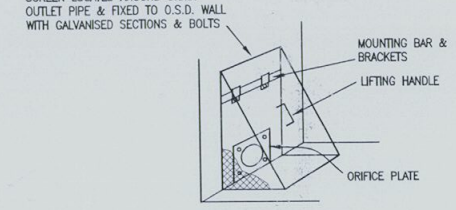




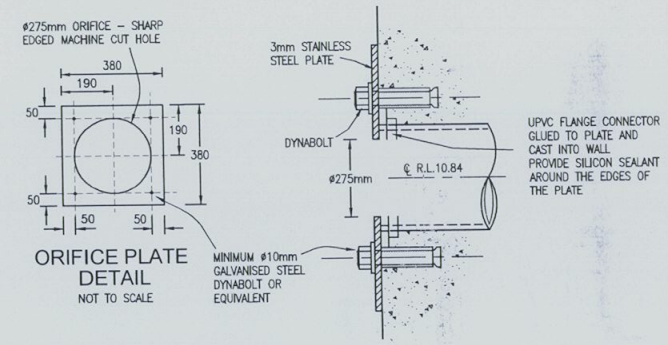
D - OSD TANK - DETAIL
TYPICAL WALL SECTION
NOT TO SCALE



STEP IRON DETAILS
NOT TO SCALE

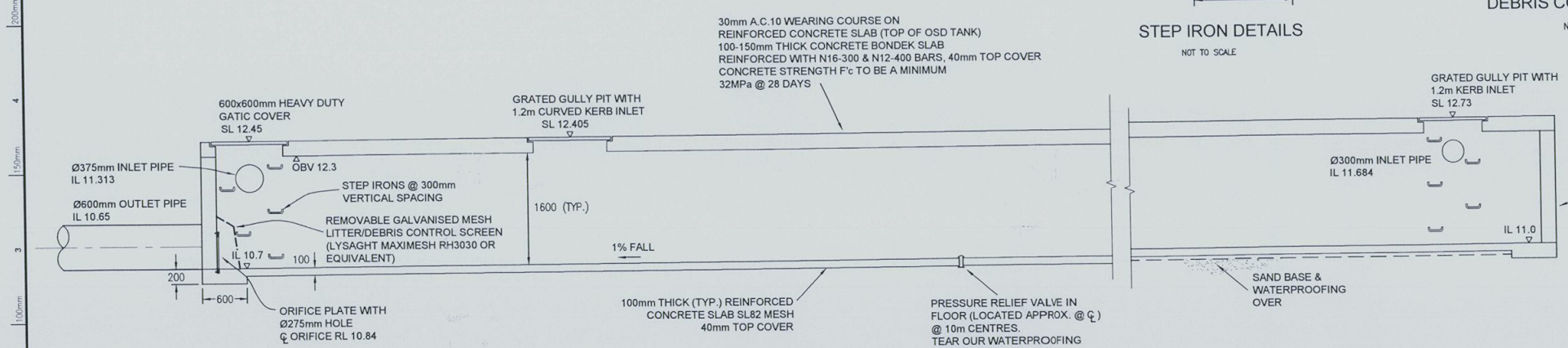


TYPICAL INSTALLATION OF
DEBRIS CONTROL SCREEN
NOT TO SCALE

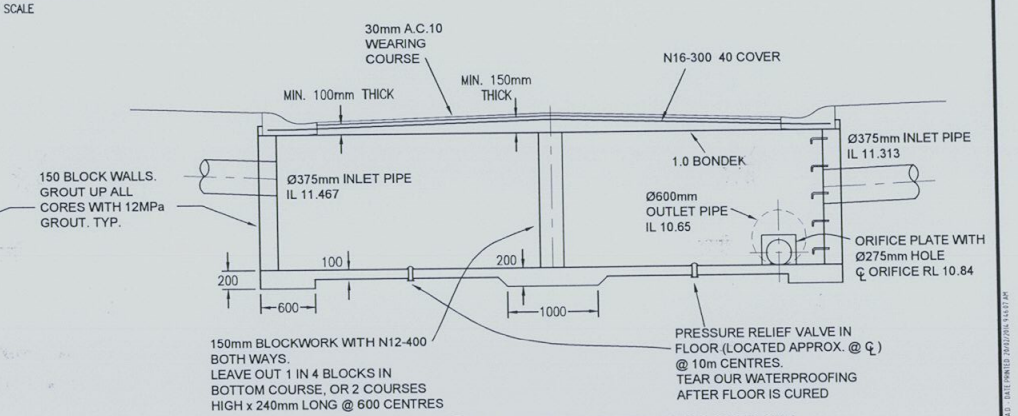


ORIFICE PLATE
DETAIL
NOT TO SCALE

ORIFICE PLATE ARRANGEMENTS
NOT TO SCALE



A - ON-SITE DETENTION TANK
SECTION
NOT TO SCALE



B - ON-SITE DETENTION TANK
SECTION
NOT TO SCALE

DANGER
CONFINED SPACE
NO ENTRY WITHOUT
CONFINED SPACE
TRAINING

A) A CONFINED SPACE DANGER SIGN SHALL BE POSITIONED IN A LOCATION AT ALL ACCESS POINTS SUCH THAT IT IS CLEARLY VISIBLE TO PERSONS PROPOSING TO ENTER THE BELOW GROUND TANK/S CONFINED SPACE

B) MINIMUM DIMENSIONS OF THE SIGN
– 300mm x 450mm (LARGE ENTRIES SUCH AS DOORS)
– 250mm x 180mm (SMALL ENTRIES SUCH AS GRATES & MAN–HOLES)

C) THE SIGN SHALL BE MANUFACTURED FROM COLOUR BONDED ALUMINIUM OR POLYPROPYLENE

D) SIGN SHALL BE AFFIXED USING SCEWS AT EACH CORNER OF THE SIGN AND/OR SUITABLE EPOXY GLUE/CEMENT

CONFINED SPACE DANGER SIGN
COLOURS – 'DANGER' & BACKGROUND – WHITE
ELIPTICAL AREA – RED
RECTANGLE CONTAINING ELIPSE – BLACK
OTHER LETTERING & BORDER – BLACK

DIAL 1100 BEFORE YOU DIG

Project: O.S.D. TANK DETAILS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date 19.2.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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CC

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GENERAL

1) THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS, SPECIFICATIONS AND OTHER INSTRUCTIONS ISSUED FOR THE WORKS. ANY DISCREPANCIES SHALL BE REFERRED TO THE ARCHITECT IMMEDIATELY FOR RESOLUTION.
2) DIMENSIONS SHALL NOT BE OBTAINED BY SCALING.
3) DIMENSIONS FOR SETTING OUT AND OF EXISTING WORKS SHALL BE VERIFIED BY THE BUILDER.
4) THE BUILDER SHALL AT ALL TIMES OBSERVE RECOGNISED GOOD BUILDING PRACTICE, CONFORMING TO ALL RELEVANT CODES. HE SHALL MAINTAIN THE WORKS IN A SAFE AND STABLE CONDITION AT ALL TIMES.
5) TRUSS LAYOUT AND/OR PITCHING POINTS FOR ROOF LOADS TO BE APPROVED BY ENGINEER BEFORE CONSTRUCTION.

FOOTINGS

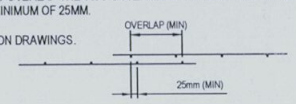
1) THE FOOTINGS HAVE BEEN DESIGNED FOR MATERIAL WITH A MINIMUM BEARING CAPACITY OF 1000 KPA UNLESS OTHERWISE NOTED. THIS IS TO BE CONFIRMED BY A QUALIFIED GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF CONCRETE.

EXCAVATION & FILLING

1) TOP SOIL CONTAINING GRASS, ROOTS OR OTHER ORGANIC MATERIAL SHALL BE REMOVED FROM THE AREA ON WHICH THE SLAB IS TO BE CONSTRUCTED.
2) IF THE SITE CONDITIONS ENCOUNTERED VARY FROM THE CONDITIONS INDICATED ON THE DRAWINGS OR REPORTED IN THE GEOTECHNICAL REPORT, THE STRUCTURAL ENGINEER AND/OR THE GEOTECHNICAL ENGINEER SHOULD BE NOTIFIED IMMEDIATELY.
3) FILL USED IN THE CONSTRUCTION OF A SLAB EXCEPT WHERE THE SLAB IS SUSPENDED SHALL CONSIST OF CONTROLLED FILL OR ROLLED FILL IN ACCORDANCE WITH AS 2870 CLAUSE 6.4.2.
4) CONTROLLED FILL
4.A) SAND FILL UP TO 800MM DEEP COMPACTED IN LAYERS NOT MORE THAN 300MM THICK USING A VIBRATING PLATE OR VIBRATING ROLLER.
4.B) NON-SAND FILL UP TO 400MM THICK COMPACTED IN LAYERS NOT MORE THAN 150MM THICK USING A MECHANICAL ROLLER. CLAY FILL SHALL BE MOIST DURING COMPACTION.
5) ROLLED FILL CONSISTS OF MATERIAL COMPACTED IN LAYERS BY REPEATED ROLLING WITH AN EXCAVATOR. SAND FILL UP TO 600MM DEEP COMPACTED IN LAYERS NOT MORE THAN 300MM THICK. NON-SAND FILL UP TO 300MM DEEP COMPACTED IN LAYERS NOT MORE THAN 150MM THICK.
6) BACK FILL MATERIAL SHALL BE COMPACTED TO A DENSITY EQUIVALENT TO AT LEAST 95% OF ITS MAXIMUM DRY DENSITY.

REINFORCEMENT

1) ALL REINFORCING BAR AND FABRIC IS DESIGNATED AS INDICATED BELOW:
R - DENOTES GRADE 250 HOT ROLLED PLAIN BARS TO AS/NZS 4671-2001.
S - DENOTES GRADE 250 HOT ROLLED DEFORMED BARS TO AS/NZS 4671-2001.
N - DENOTES GRADE D500N DEFORMED BARS TO AS/NZS 4671-2001.
SL/RL - DENOTES GRADE D500L SQUARE/RECTANGULAR MESH TO AS/NZS 4671-2001.
TM - DENOTES TRENCH MESH TO AS/NZS 4671-2001.
2) THE FIGURES FOLLOWING THE MESH DESIGNATION IS THE REFERENCE NUMBER FOR FABRIC TO AS/NZS 4671-2001.
3) REINFORCEMENT IS SHOWN DIAGRAMMATICALLY AND NOT NECESSARILY IN TRUE PROJECTION.
4) SLAB REINFORCEMENT SHALL EXTEND AT LEAST 75MM ONTO MASONRY SUPPORT WALLS AND 50 PERCENT OF THE BOTTOM REINFORCEMENT SHALL BE COGGED TO ACHIEVE ANCHORAGE AT SIMPLY SUPPORTED ENDS.
5) FABRIC SHALL BE LAPPED SUCH THAT THE TWO OUTER MOST WIRES OF ONE SHEET OVERLAP THE TWO OUTER MOST WIRES OF THE OTHER SHEET BY A MINIMUM OF 25MM.
6) NOTATION ON DRAWINGS.



7) SPLICES IN REINFORCEMENT SHALL NOT BE MADE EXCEPT AS INDICATED ON THE DRAWINGS OR APPROVED BY THE ENGINEER.
8) ALL REINFORCEMENT SHALL BE ADEQUATELY SUPPORTED TO ENSURE POSITION IS MAINTAINED DURING PLACEMENT OF CONCRETE. THIS MAY BE ACHIEVED BY USING PURPOSE MADE STEEL OR PLASTIC SUPPORTS DEPENDING ON THE EXPOSURE CONDITION TO ACHIEVE THE REQUIRED CONCRETE COVER TO REINFORCEMENT. SUPPORTS SHALL BE LOCATED AT NOT MORE THAN 60 BAR DIAMETERS EACH WAY FOR BARS AND NOT MORE THAN 800MM EACH WAY FOR MESH.
9) A MINIMUM OF 24 HOURS NOTICE SHALL BE GIVEN FOR INSPECTION OF THE REINFORCEMENT BY THE ENGINEER AS REQUIRED BY THE SPECIFICATION.

CONCRETE

1) ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3600.
2) CONCRETE QUALITY

ELEMENT	STRENGTH (MPa)	MAX. AGG. SIZE (mm)	SLUMP (mm)
FOOTINGS	20	20	80
SLAB ON GROUND	25	20	80
PIERS	20	20	60
SUSPENDED SLABS	40	20	80
COLUMNS	40	20	80

3) NO ADMIXTURES SHALL BE USED IN CONCRETE UNLESS APPROVED BY THE ENGINEER. ADMIXTURES CONTAINING CHLORIDES WILL NOT BE APPROVED.
4) SIZES OF CONCRETE ELEMENTS DO NOT INCLUDE APPLIED FINISHES.
5) DEPTH OF BEAMS AND BANDS ARE GIVEN FIRST AND INCLUDE SLAB THICKNESS.
6) NO HOLES, CHASES OR EMBEDMENT OF PIPES OR OTHER REDUCTION IN MEMBER DIMENSIONS OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS WITHOUT THE PRIOR WRITTEN APPROVAL OF THE ENGINEER.

CONCRETE (CONT')

7) CLEAR CONCRETE COVER TO REINFORCEMENT FOR DURABILITY AND FIRE RESISTANCE SHALL BE AS FOLLOWS UNLESS SHOWN OTHERWISE.

ELEMENT	INTERNAL ENVIRONMENT	EXTERNAL ENVIRONMENT	CAST AGAINST GROUND
FOOTINGS	-	-	40
SLAB ON GROUND	20	45	30*+
PIERS	-	-	60
SLABS	20 TOP 30 BTM	45	30*+
COLUMNS	45	45	-

*+ IF PROTECTED BY A VAPOUR PROOF MEMBRANE OTHERWISE 40MM.

8) CONDUITS, PIPES ETC. WILL ONLY BE ALLOWED TO BE LOCATED IN THE MIDDLE ONE THIRD OF THE SLAB DEPTH AND SPACED AT NOT LESS THAN THREE DIAMETERS. PIPES OR CONDUITS SHALL NOT BE PLACED IN THE COVER ZONE TO THE REINFORCEMENT.
9) CONSTRUCTION JOINTS SHALL BE AS SHOWN OR TO THE APPROVAL OF THE ENGINEER.
10) SLABS AND BEAMS SHALL BE CONSTRUCTED TO ONLY BE SUPPORTED ON THE BEAMS, WALLS, COLUMNS ETC. AS SHOWN ON THE STRUCTURAL DRAWINGS. ALL OTHER BUILDING ELEMENTS SHALL BE KEPT A MINIMUM OF 15MM CLEAR FROM THE SOFFITS OF THE STRUCTURE UNLESS NOTED OTHERWISE.
11) THE FINISHED CONCRETE SHALL BE A HOMOGENEOUS MASS FREE OF POCKETS, COMPLETELY FILLING THE FORMWORK AND THOROUGHLY EMBEDDING THE REINFORCEMENT. ALL CONCRETE SHALL BE COMPACTED USING MECHANICAL VIBRATORS.
12) WHERE THE VERTICAL FACE CONCRETE IS PLACED AGAINST BRICKWORK, A 10MM JOINT OF COMPRESSIBLE MATERIAL SHALL BE PLACED AGAINST THE BRICKWORK FOR THE FULL DEPTH OF THE CONCRETE.
13) CURING OF ALL CONCRETE IS TO BE ACHIEVED BY KEEPING SURFACES CONTINUOUSLY WET FOR A PERIOD OF 7 DAYS, UNLESS SPECIFIED OTHERWISE. APPROVED SPRAY ON CURING COMPOUNDS THAT COMPLY WITH AS3799 MAY BE USED WHERE FLOOR FINISHES WILL NOT BE AFFECTED. POLYTHENE SHEETING OR WET HESSIAN MAY BE USED TO RETAIN CONCRETE MOISTURE WHERE PROTECTED FROM WIND AND TRAFFIC. CURING IS TO COMMENCE IMMEDIATELY AFTER CONCRETE PLACEMENT.
14) CONSTRUCTION SUPPORT PROPPING IS TO BE LEFT IN PLACE WHERE NEEDED TO AVOID OVERSTRESSING THE STRUCTURE DUE TO CONSTRUCTION LOADING. NO BRICKWORK OR PARTITION WALLS ARE TO BE CONSTRUCTED ON SUSPENDED LEVELS UNTIL ALL PROPPING IS REMOVED AND THE SLAB HAS DEFLECTED UNDER ITS SELF WEIGHT.

REINFORCED BLOCKWORK

1) MASONRY BLOCKS SHALL BE GRADE 12 (AS/NZS 4455), LAID WITH MORTAR MIXED 1 CEMENT, 0.1 LIME AND 3 SAND. CORE GROUT SHALL HAVE MAX. 10MM AGGREGATE IN A 20MPA MIX, 230 SLUMP.
2) ALL BLOCKS SHALL BE DOUBLE 'U' BLOCKS U.N.O.
3) PROVIDE CLEAN-OUT SPACE AT THE BASE OF EACH CORE. GROUTING SHOULD NOT EXCEED LIFTS OF 800MM. LIFT STAGES SHOULD BE AT LEAST 30MINUTES APART.
4) FILL SHALL NOT BE PLACED BEHIND BLOCKWORK WALLS UNTIL THE CORE GROUT IS AT LEAST 7 DAYS OLD, AND SHALL NOT PROCEED PAST HALF DEPTH UNTIL CORE GROUT IS 21 DAYS OLD.

STRUCTURAL STEELWORK

1) ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS4100 AND AS1554 EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
2) UNLESS OTHERWISE NOTED, ALL STEEL SHALL BE:
- GRADE 250 HOT ROLLED PLATES, ANGLES 100X100 EA OR 125X75 UA AND SMALLER.
- GRADE 300 FOR UB'S, UC'S, PFC'S AND LARGER ANGLES.
- GRADE 300 FOR WB'S AND WC'S.
- GRADE 350 FOR RHS, SHS AND CHS.

3) UNLESS OTHERWISE NOTED, ALL WELDS SHALL BE 6MM CONTINUOUS FILLET FROM E48XX ELECTRODES. ALL WELDS SHALL BE CATEGORY GP, ALL BOLTS M16 COMMERCIAL GRADE AND ALL CLEATS AND GUSSETS 8MM PLATE.
4) FOR BOLTS OTHER THAN AS NOTED ABOVE, THE FOLLOWING NOTATION IS USED: BOLTS - DESIGNATED BY THE NUMBER, DIAMETER, GRADE AND TIGHTENING PROCEDURE:
EG. 4M16 4.6/S DENOTES 4 NO. M16Ø COMMERCIAL GRADE BOLTS, SNUG TIGHT.
6M20 8.8/TF DENOTES 6 NO. M20Ø HIGH STRENGTH STRUCTURAL BOLTS FULLY TENSIONED IN A NO SLIP JOINT.
6M24 8.8/TB DENOTES 6 NO. M24Ø HIGH STRENGTH STRUCTURAL BOLTS FULLY TENSIONED IN A BEARING JOINT (SOME SLIP ALLOWED)
5) COMMERCIAL GRADE BOLTS SHALL CONFORM TO AS1111 AND AS4100. HIGH STRENGTH STRUCTURAL BOLTS SHALL CONFORM TO AS1252 AND AS4100. WELDS SHALL CONFORM TO AS1554 AND WELDING ELECTRODES TO AS1553.
6) STRUCTURAL STEELWORK SHALL HAVE THE FOLLOWING SURFACE TREATMENT IN ACCORDANCE WITH AS2312 AND THE SPECIFICATION: ALL EMBEDDED STRUCTURAL STEELWORK SHALL BE HOT-DIP GALVANISED. ALL EXPOSED STRUCTURAL STEELWORK SHALL BE GALVANISED OR EQUIVALENT. SHELTERED STEELWORK SHALL BE GALVANISED OR PAINTED WITH A PRIMER AND A ZINC-RICH PAINT. ALL SITE WELDS SHALL BE CLEANED AND MADE GOOD WITH TWO COATS OF A ZINC-RICH PAINT.

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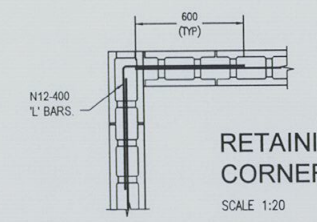
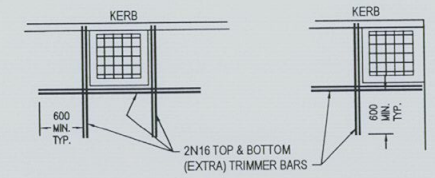


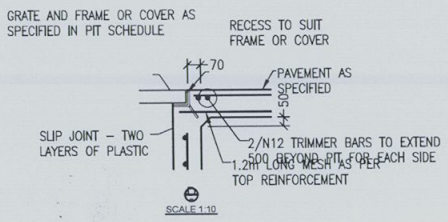
RETAINING WALL CORNER DETAIL

SCALE 1:20



TYPICAL TRIMMER BARS AROUND PIT

SCALE 1:50



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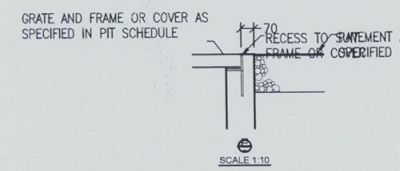

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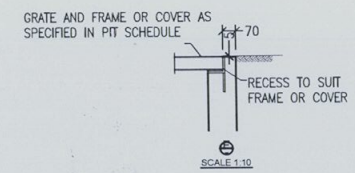

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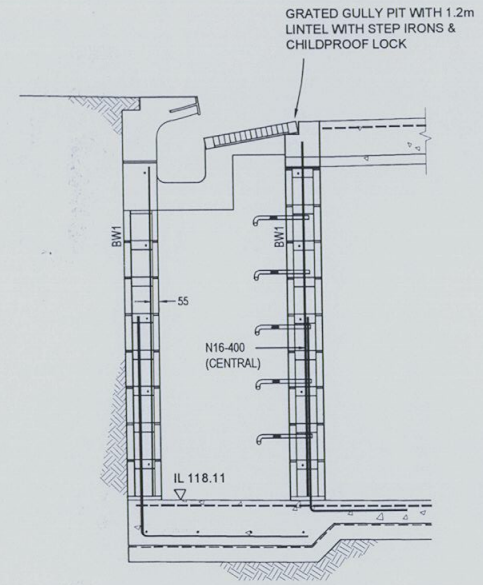
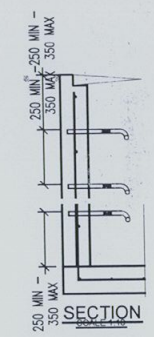
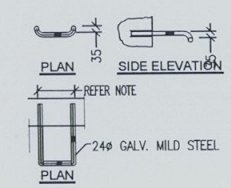


C / 027 BELOW GROUND OSD SECTION

SCALE 1:20



SECTION



SCALE 1:10

PIT ACCESS STEP DETAILS

NOTES
1. WHEN POSITIONED IN STRAIGHT ALIGNMENT, STEP TO BE 400 WIDE.
2. STAGGERED STEPS TO BE 200 WIDE, STEPS TO BE STAGGERED 200, CENTRE TO CENTRE FOR ALTERNATE STEPS.
3. SPACING OF STEPS TO BE UNIFORM TO WITHIN ±8mm IN EACH PIT.

CC

DIAL 1100 BEFORE YOU DIG

Project: O.S.D. TANK DETAILS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale		Date	19.2.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref.

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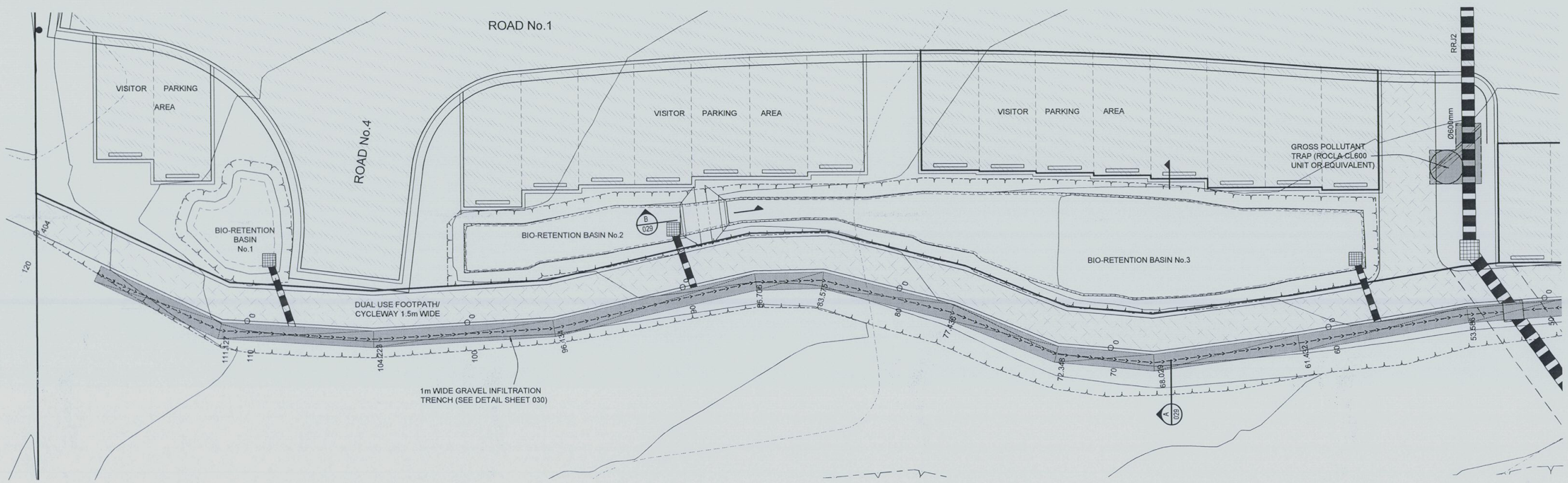
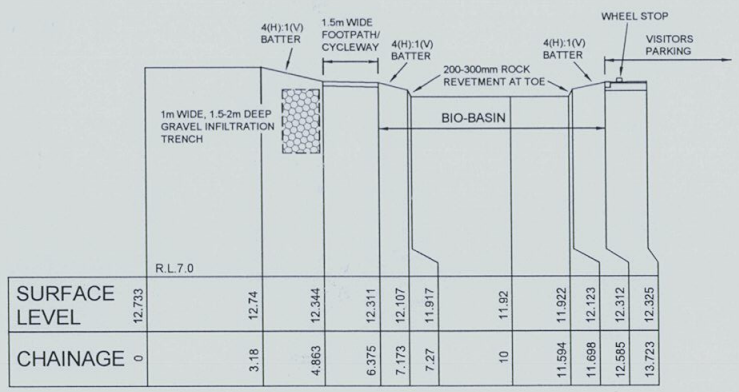
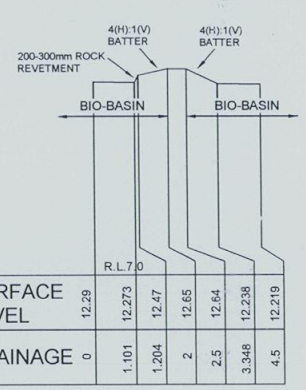




SURFACE LEVEL	12.733	12.74	12.344	12.311	12.107	11.917	11.92	11.922	12.123	12.312	12.325
CHAINAGE	0	3.18	4.863	6.375	7.173	7.27	10	11.594	11.698	12.585	13.723

A 029 BIO-BASIN TYPICAL SECTION

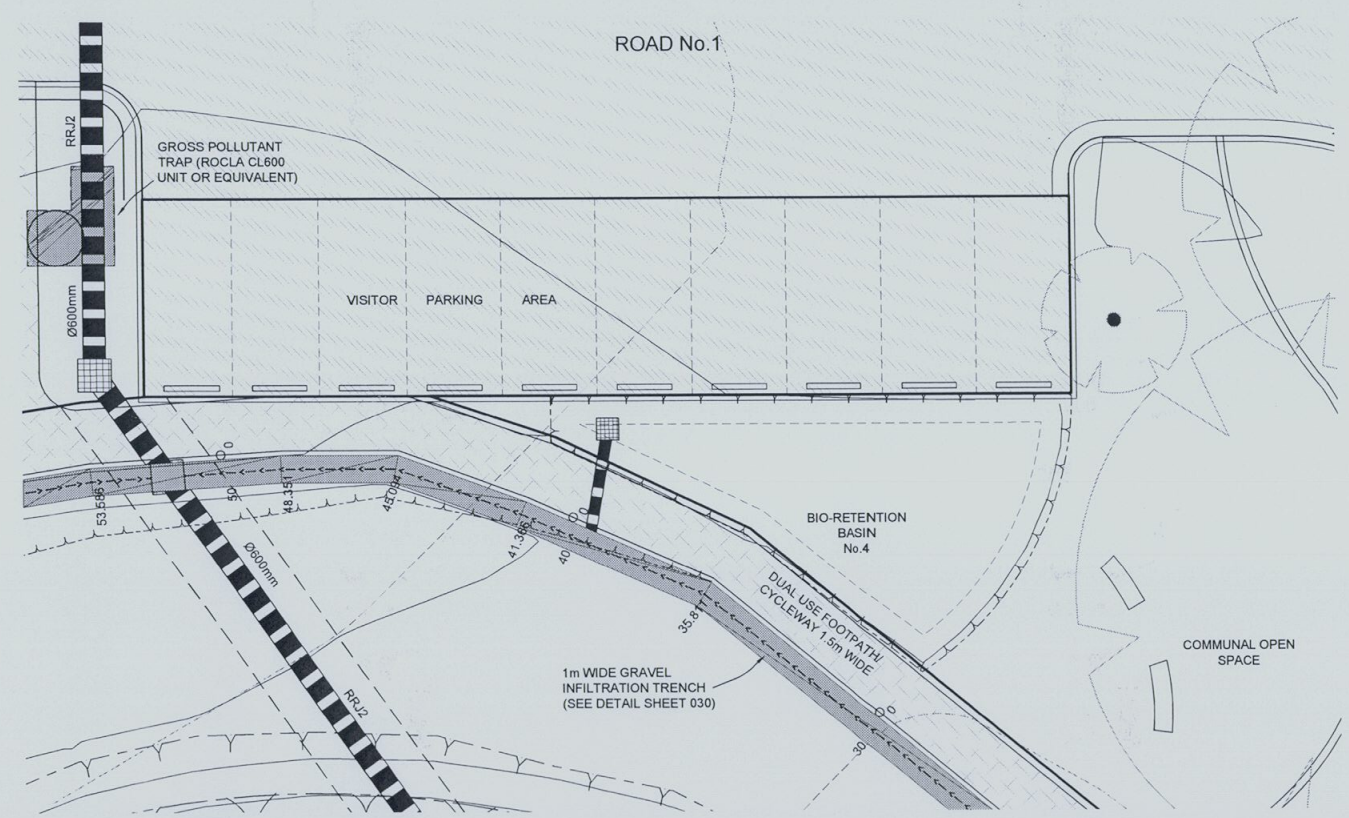
H=1:100 V=1:100



SURFACE LEVEL	12.29	12.273	12.47	12.65	12.64	12.238	12.219
CHAINAGE	0	1.101	1.204	2	2.5	3.348	4.5

B 029 BIO-BASIN SEPARATION MOUND SECTION

H=1:100 V=1:100



CC

ORIGIN OF LEVELS: P.M.6871 R.L.11.04 (A.H.D.) VIDE SCIMS DATED 21/11/07

5 4 3 2 1 0 5

1:100 @ A1

DIAL 1100 BEFORE YOU DIG

Project: BIO RETENTION BASIN PLAN & SECTIONS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:100	Date	19.2.14	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.
				Client Ref.	

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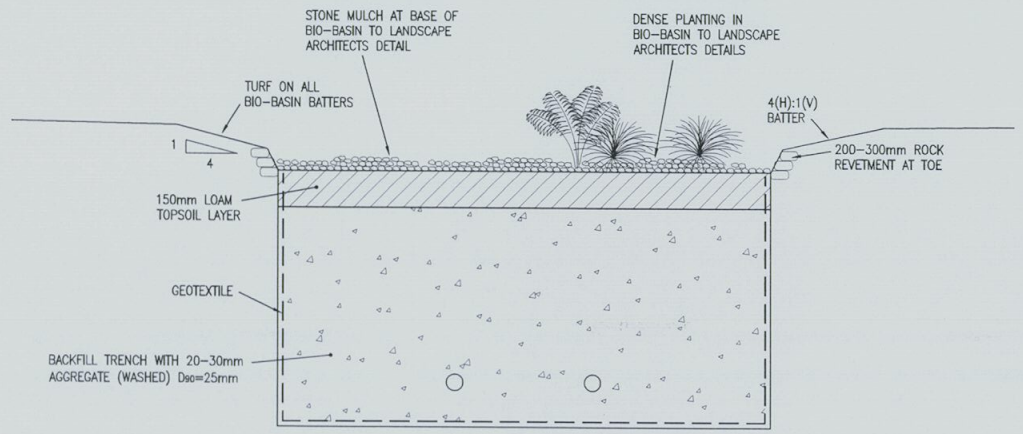
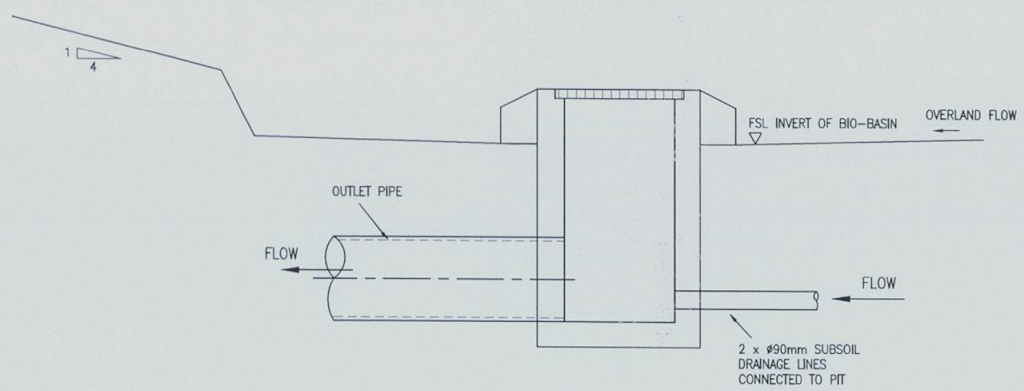


2 x ø90 SUBSOIL LINES (IN SOCK) CONNECTED TO NEXT DOWNSTREAM PIT. BOTH LINES RETURNED AT UPSTREAM END AND CONNECTED TO FLUSHING POINT (FP)

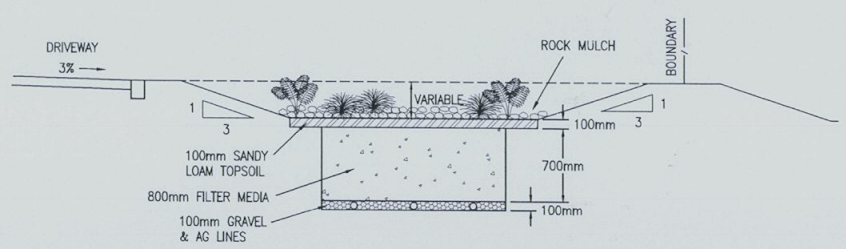
TYPICAL BIO-RETENTION BASIN DETAIL

NOT TO SCALE



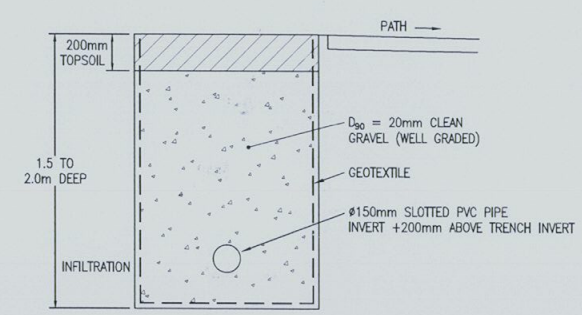
TYPICAL RAISED PIT DETAIL

NOT TO SCALE



TYPICAL LOT RAIN GARDEN DETAIL

NOT TO SCALE



TYPICAL GRAVEL INFILTRATION TRENCH DETAIL

NOT TO SCALE

BIO-RETENTION BASIN TABLE

MEASURE TYPE	SURFACE AREA (m²)	INVERT LEVEL (m AHD)	PONDING DEPTH (mm)	FILTER AREA (m²)	TOTAL FILTER DEPTH (m)	PONDING VOLUME (m³)
BIO-BASIN No.1	10	12.500	400	5	1	3.2
BIO-BASIN No.2	25		400	13	1	6.6
BIO-BASIN No.3	120		400	60	1	19.2
BI-BASIN No.4	45		400	23	1	6.6
LOT 9-25 FRONTYARD BIO-BASINS (17 No.)	3m²/LOT	VARIES	200	1.5m²/LOT	0.9	0.6m³/LOT
LOT 9 - 25 BACKYARD BIO-BASINS (17 No.)	6m²/LOT	VARIES	400	3m²/LOT	0.9	2.4m³/LOT
LOT 26 - 38 FRONTYARD BIO-BASINS (13 No.)	5m²/LOT	VARIES	400	2.5m²/LOT	0.9	2m³/LOT

O.S.D. TABLE

MEASURE TYPE	STORAGE VOLUME (m³)	EFFECTIVE DETENTION (%)	O.S.D. VOLUME (m³)
LOT 9 - 25 RAINWATER TANKS (3kL)	51	25	12.75
FOCAL NEIGHBOURHOOD CENTRE RAINWATER TANK (10kL)	10	25	2.500
LOT 39-46 RIANWATER TANKS (1kL)	8	25	2
LOT 26-38 RAINWATER TANKS (3kL)	39	25	9.75
BIO-BASIONS 1-4	35.6	100	35.6
ABOVE GROUND PONDING ROAD No.1 SAG	71.7	100	71.7
ROAD No.2 U/G O.S.D. TANK	255	100	255
LOT 9 - 25 FRONTYARD BIO-BASINS (3m² x 0.2m DEEP)	10.2	100	10.2
LOT 9 - 25 BACKYARD BIO-BASINS (6m² x 0.4m DEEP)	40.8	100	40.8
LOT 26 - 38 FRONTYARD BIO-BASINS (5m² x 0.4m DEEP)	26	100	26
TOTAL			466.3m³
TOTAL REQUIRED			464m³

CC

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Project: BIO-BASIN & RAIN GARDEN DETAILS

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	Date	Council Ref.
N.T.S.	19.2.14	
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D. Client Ref.

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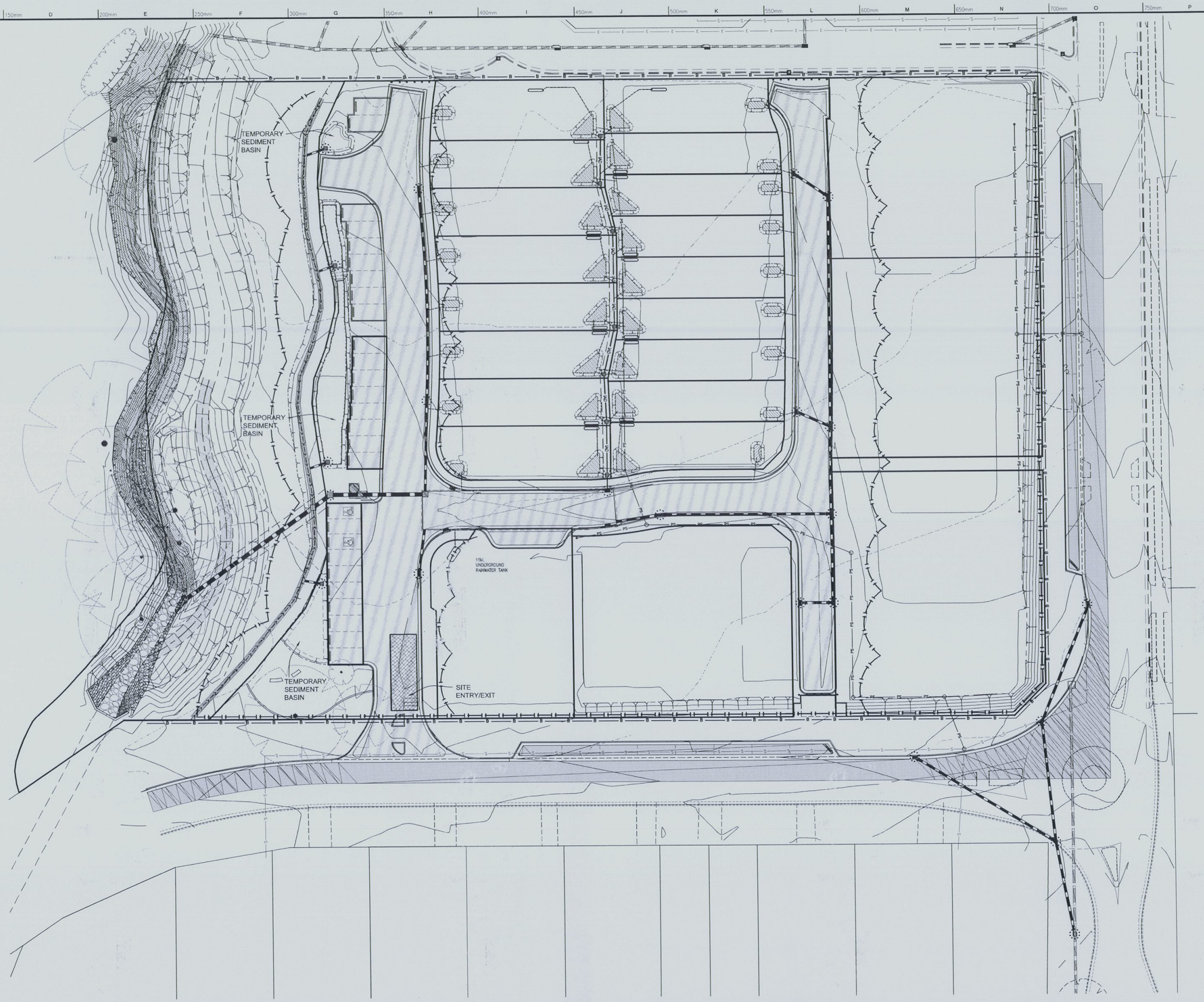
A1

LEGEND

- SEDIMENT FENCE
- BARRIER FENCE
- i) GEOTEXTILE INLET FILTER DURING CONSTRUCTION
- ii) MESH & GRAVEL INLET FILTER AFTER CONSTRUCTION
- STRAW BALE FILTER
- STABILISED SITE ACCESS

10 8 6 4 2 0 15

1:300 @ A1



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DIAL 1100 BEFORE YOU DIG

Project: SEDIMENT & EROSION CONTROL PLAN

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:300	Date 19.2.14	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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A1

NOTES

1. THIS PLAN IS TO BE READ IN CONJUNCTION WITH OTHER ENGINEERING PLANS AND ANY WRITTEN INSTRUCTIONS THAT MAY BE ISSUED.

2. PITTWATER COUNCIL IS TO RE-INSPECT TREES PRIOR TO THE CONSTRUCTION WORKS COMMENCING.

3. THE CONTRACTOR SHALL IMPLEMENT ALL SOIL EROSION AND SEDIMENT CONTROL MEASURES PRIOR TO DISTURBANCE OF THE RELATED CATCHMENT AREA AND TO THE STANDARDS OF 'MANAGING URBAN STORMWATER, SOILS & CONSTRUCTION' & BLACKTOWN CITY COUNCIL SPECIFICATIONS

4. ALL SUBCONTRACTORS SHALL BE INFORMED OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWN SLOPE AREAS.

5. LAND DISTURBANCE SHALL BE LIMITED TO THAT NECESSARY FOR IMPLEMENTATION OF THE PLANS OF WORKS. BUFFER ZONES AND LANDS NOT TO BE DISTURBED SHALL BE CLEARLY MARKED WITH BARRIER FENCES. "SILT" FENCES OR STRAW BALE SEDIMENT TRAPS SHALL BE PLACED AT REGULAR INTERVALS IMMEDIATELY DOWNSLOPE OF ALL UNPROTECTED DISTURBED LANDS.

6. THE LOCATION OF "SILT" FENCES, BARRIER FENCES, SEDIMENT TRAPS AND OTHER DEVICES ARE INDICATIVE ONLY AND FINAL LOCATIONS ARE TO BE DECIDED ON SITE. VARIATIONS WILL BE PERMITTED TO BEST SUIT THE CIRCUMSTANCES.

7. ALL SOIL EROSION AND SEDIMENT CONTROL STRUCTURES SHALL BE INSPECTED FOLLOWING EACH STORM EVENT AND ANY NECESSARY MAINTENANCE WORK SHALL BE UNDERTAKEN TO ENSURE THEIR CONTINUED PROPER OPERATION. SEDIMENT SHALL BE REMOVED FROM THE THE SOIL EROSION & SEDIMENT CONTROL STRUCTURES WHEN NO MORE THAN 40% CAPACITY HAS BEEN REACHED. THESE STRUCTURES SHALL CONTINUE IN PROPER OPERATION UNTIL ALL DEVELOPMENT ACTIVITIES HAVE BEEN COMPLETED AND THE SITE FULLY STABILISED.

8. TEMPORARY REHABILITATION SHALL BE UNDERTAKEN WITHIN 14 WORKING DAYS ON DISTURBED AREAS WHERE WORKS HAVE STOPPED AND SOILS ARE EXPECTED TO REMAIN EXPOSED FOR MORE THAN 14 DAYS BEFORE EITHER WORKS CONTINUE OR PERMANENT REHABILITATION IS UNDERTAKEN.

9. A 300mm WIDE STRIP OF TURF IS TO BE LAID BEHIND ALL KERBS.

10. 1.0m WIDE TURFING IS TO BE PLACED AROUND ALL SURFACE INLET PITS.

11. AT LEAST WEEKLY, THE CONTRACTOR WILL INSPECT THE SITE, PROVIDING PARTICULAR ATTENTION TO THE FOLLOWING MATTERS :
(A) ENSURE DRAINS OPERATE EFFECTIVELY AND INITIATE REPAIR AS REQUIRED.
(B) REMOVE SPILLED SAND (OR OTHER MATERIALS) FROM HAZARD AREAS, INCLUDING LANDS CLOSER THAN 5 METRES FROM LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS AND PAVED AREAS.
(C) REMOVE TRAPPED SEDIMENT WHENEVER LESS THAN DESIGN CAPACITY REMAINS.
(D) ENSURE REHABILITATED LANDS HAVE EFFECTIVELY REDUCED THE EROSION HAZARD AND INITIATE UPGRADING OR REPAIR AS APPROPRIATE.
(E) CONSTRUCT ADDITIONAL EROSION AND/OR SEDIMENT CONTROL WORKS AS MIGHT BECOME NECESSARY TO ENSURE THE DESIRED PROTECTION IS GIVEN TO DOWNSLOPE LANDS AND WATERWAYS, i.e. MAKE ONGOING CHANGES TO THE PLAN.
(F) MAINTAIN EROSION AND SEDIMENT CONTROL MEASURES IN A FUNCTIONING CONDITION UNTIL ALL EARTHWORK ACTIVITIES ARE COMPLETED AND THE SITE IS REHABILITATED.
(G) REMOVE TEMPORARY SOIL CONSERVATION STRUCTURES AS A LAST ACTIVITY IN THE REHABILITATION PROGRAM.

12. THE CONTRACTOR WILL KEEP A LOG BOOK, MAKING ENTRIES AT LEAST WEEKLY AND IMMEDIATELY PRIOR TO FORECAST RAINFALL AND/OR SITE CLOSURE. RECORD:
(I) THE VOLUME OF ANY RAINFALL EVENTS;
(II) THE CONDITION OF ANY SOIL AND WATER MANAGEMENT WORKS;
(III) APPLICATIONS OF FLOCCULATING AGENTS TO SEDIMENT RETENTION SYSTEMS;
(IV) VOLUMES OF WATER DISCHARGED FROM SEDIMENT RETENTION SYSTEMS; AND
(V) REMEDIAL WORKS. THE BOOK WILL BE KEPT ON-SITE AND MADE AVAILABLE TO ANY AUTHORISED PERSON ON REQUEST. IT WILL BE GIVEN TO THE PROJECT MANAGER AT THE CONCLUSION OF WORKS. COPIES OF MONTHLY ENTRIES ARE TO BE PROVIDED WITH PROGRESS CLAIMS.

13. DO NOT TAINT CLEAN CATCHMENT WATER WITH SILT FROM THE WORKS.

14. FACILITIES AND/OR EQUIPMENT MUST BE PROVIDED FOR THE APPLICATION OF WATER TO DISTURBED AREAS TO MINIMISE THE GENERATION OF AIRBORNE DUST FROM ANY AREA DISTURBED BY CONSTRUCTION ACTIVITIES. DUST CONTROL MEASURES SHALL BE IMPLEMENTED CONTINUOUSLY DURING CONSTRUCTION WORKS TO THE SATISFACTION OF THE SUPERINTENDENT AND COUNCIL.

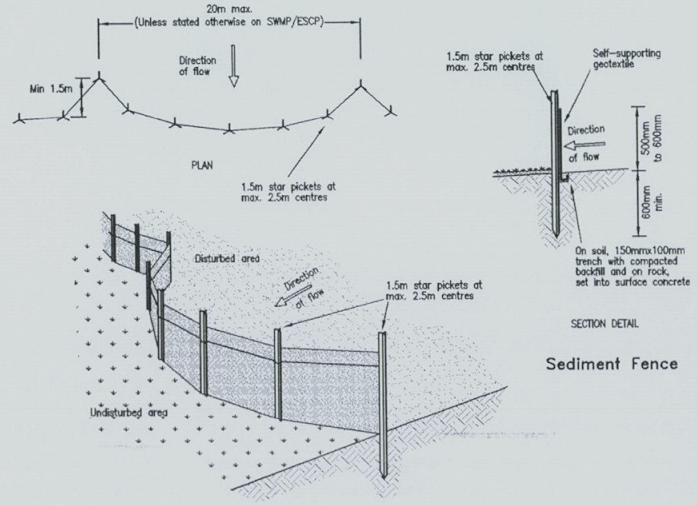
15. MATERIAL REMOVED FROM SEDIMENT CONTROL STRUCTURES MUST BE DISPOSED OF IN A WAY THAT DOES NOT POLLUTE WATERS OR BUSHLAND AND DISPOSED OF TO AN APPROVED DUMP SITE.

16. RUNOFF FROM VEHICLE OR CONSTRUCTION PLANT MAINTENANCE AND CLEANING AREAS SHALL BE COLLECTED AND DISPOSED OF IN A MANNER THAT DOES NOT POLLUTE.

17. CONFORMITY WITH THIS PLAN SHALL IN NO WAY REDUCE THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT AGAINST WATER DAMAGE DURING THE COURSE OF THE CONTRACT.

18. ALL POSITIONS SHOWN ARE APPROXIMATE AND ARE BEST DETERMINED ON SITE IN CONJUNCTION WITH THE SUPERINTENDENT.

19. DUST SCREENS ARE TO BE ERECTED AROUND THE PERIMETER OF THE WORK SITE DURING LAND CLEARING, EXCAVATIONS & CONSTRUCTIONS AS DIRECTED BY THE SITE SUPERVISOR.

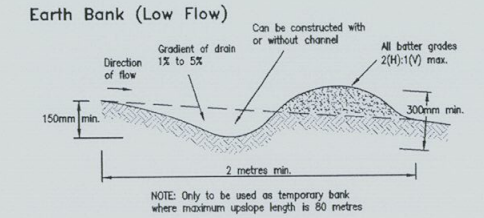


Sediment Fence

CONSTRUCTION NOTES

SEDIMENT FENCE

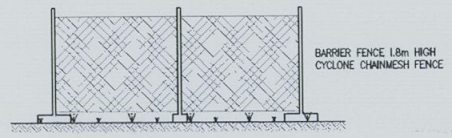
1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BE PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING, TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 litres/sec IN THE DESIGN STORM EVENT, USUALLY THE 10 YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX.) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS, ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES, OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.



CONSTRUCTION NOTES

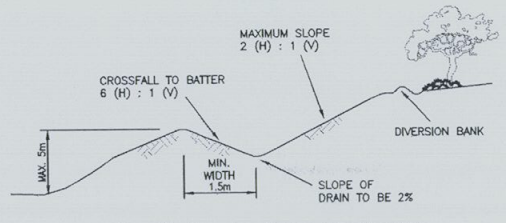
EARTH BANK (LOW FLOW)

1. BUILD WITH GRADIENTS BETWEEN 1% AND 5%.
2. AVOID REMOVING TREES AND SHRUBS IF POSSIBLE – WORK AROUND THEM.
3. ENSURE THE STRUCTURES ARE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT COULD IMPEDE WATER FLOW.
4. BUILD THE DRAINS WITH CIRCULAR, PARABOLIC OR TRAPEZOIDAL CROSS SECTIONS, NOT V SHAPED.
5. ENSURE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE.
6. COMPLETE PERMANENT OR TEMPORARY STABILISATION WITHIN 10 DAYS OF CONSTRUCTION.



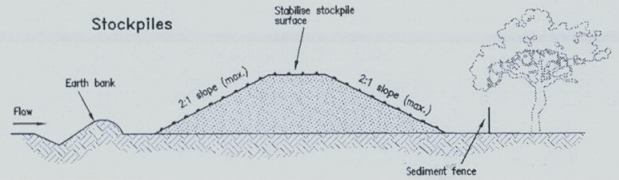
BARRIER FENCE

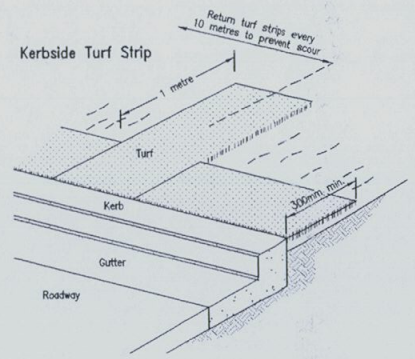
NOT TO SCALE



Specification for Batter Construction

NOT TO SCALE





CONSTRUCTION NOTES

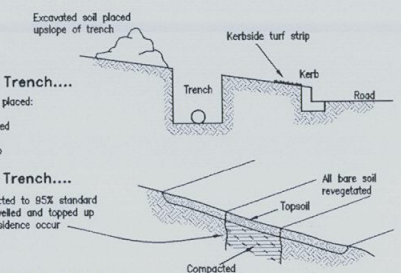
STOCKPILES

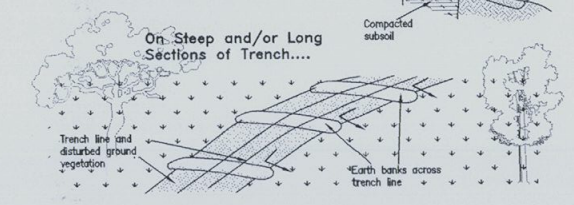
1. PLACE STOCKPILES MORE THAN 2 (PREFERABLY 5) METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.
2. CONSTRUCT THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT.
4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LESS THAN 0.10
5. CONSTRUCT EARTH BANKS ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES 1 TO 2 METRES DOWNSLOPE.

CONSTRUCTION NOTES

KERBSIDE TURF STRIPS

1. INSTALL A 300mm MINIMUM WIDE ROLL OF TURF ON THE FOOTPATH NEXT TO THE KERB AND AT THE SAME LEVEL AS THE TOP OF THE KERB.
2. LAY 1.4m LONG TURF STRIPS NORMAL TO THE KERB EVERY 10m.
3. REHABILITATE DISTURBED SOIL BEHIND THE TURF STRIP FOLLOWING THE ESCP/SWMP.



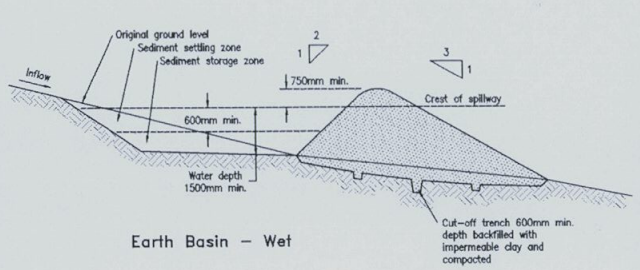


Utility Construction

CONSTRUCTION NOTES

UTILITY CONSTRUCTION

1. DO NOT OPEN ANY TRENCH UNLESS IT IS LIKELY TO BE CLOSED IN THREE DAYS.
2. PLACE EXCAVATED MATERIAL UPSLOPE OF TRENCH.
3. STOCKPILE TOPSOIL SEPARATELY FROM SUBSOIL.
4. DIVERT RUNOFF FROM THE LINE OF CUT WITH DIVERSIONS AS DIRECTED BY STANDARD DRAWING 5-2 (RECP SHEET FLOW).
5. REHABILITATE IN ACCORDANCE WITH SPECIFICATION.

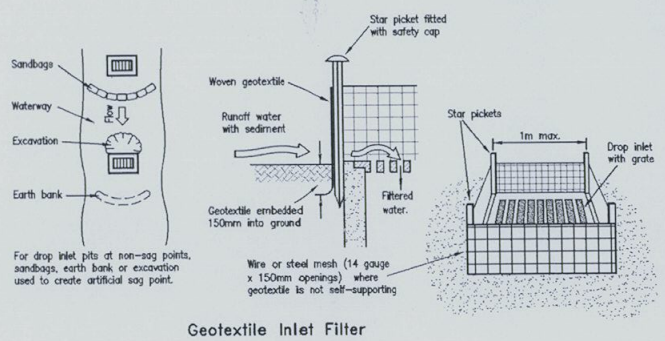


Earth Basin – Wet

CONSTRUCTION NOTES

EARTH BASINS – WET
(applies to Type D and Type F soils only)

1. REMOVE ALL VEGETATION AND TOPSOIL FROM UNDER THE DAM WALL AND FROM WITHIN THE STORAGE AREA.
2. CONSTRUCT A CUT-OFF TRENCH 500mm DEEP AND 1200mm WIDE ALONG THE CENTRELINE OF THE EMBANKMENT EXTENDING TO A POINT ON THE GULLY WALL LEVEL WITH THE RISER CREST.
3. MAINTAIN THE TRENCH FREE OF WATER AND RECOMPACT THE MATERIALS WITH EQUIPMENT AS SPECIFIED IN THE SWMP TO 95% STANDARD PROCTOR DENSITY.
4. SELECT FILL FOLLOWING THE SWMP THAT IS FREE OF ROOTS, WOOD, ROCK LARGE STONE OR FOREIGN MATERIAL.
5. PREPARE THE SITE UNDER THE EMBANKMENT BY RIPPING TO AT LEAST 100mm TO HELP BOND COMPACTED FILL TO THE EXISTING SUBSTRATE.
6. SPREAD THE FILL IN 100mm TO 150mm LAYERS AND COMPACT IT AT OPTIMUM MOISTURE CONTENT FOLLOWING THE SWMP.
7. CONSTRUCT THE EMERGENCY SPILLWAY.
8. REHABILITATE THE STRUCTURE FOLLOWING THE SWMP.

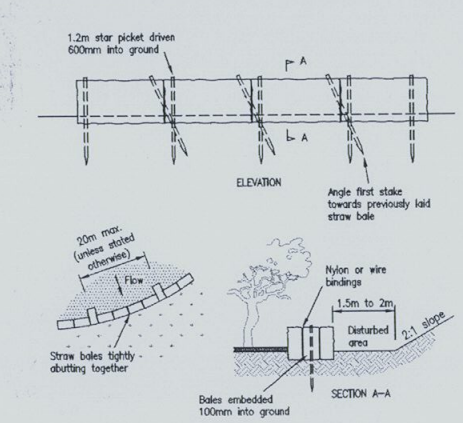


Geotextile Inlet Filter

CONSTRUCTION NOTES

DROP INLET FILTERS

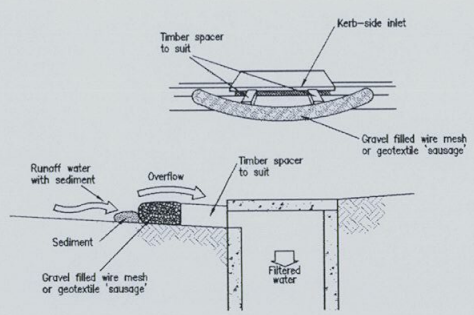
1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OF STRAW BALES.
2. FOLLOW STANDARD DRAWINGS OF STRAW BALE FILTERS AND SEDIMENT FENCES FOR INSTALLATION PROCEDURES FOR THE STRAW BALES OR GEOFABRIC. REDUCE THE PICKET SPACING TO 1m CENTRES.
3. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
4. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.



CONSTRUCTION NOTES

STRAW BALE FILTERS

1. CONSTRUCT THE STRAW BALE FILTER AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DIAGRAM TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN THE BALES. THE STRAWS IN EACH BALE ATE TO BE ALIGNED PARALLEL TO THE GROUND.
3. ENSURE THAT THE MAXIMUM HEIGHT OF THE FILTER IS ONE BALE.
4. EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH 1.2m STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm INTO THE GROUND AND, IF POSSIBLE, FLUSH WITH THE TOP OF THE BALES. WHERE STAR PICKETS ARE USED AND THEY PROTRUDE ABOVE THE BALES, ENSURE THEY ARE FITTED WITH SAFETY CAPS.
5. WHERE A STRAW BALE FILTER IS CONSTRUCTED DOWNSLOPE FROM A DISTURBED BATTER, ENSURE BALES ARE PLACED 1m TO 2m DOWNSLOPE FROM THE TOE.
6. ESTABLISH A MAINTENANCE PROGRAM THE ENSURES THE INTEGRITY OF THE BALES IS RETAINED – THEY COULD REQUIRE REPLACEMENT EACH TWO TO FOUR MONTHS.



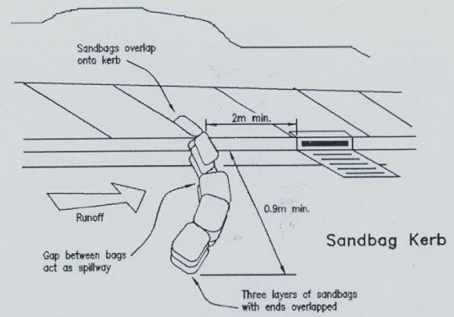
Note: This practice only to be used where specified in an approved SWMP/ESCP

Mesh and Gravel Inlet Filter

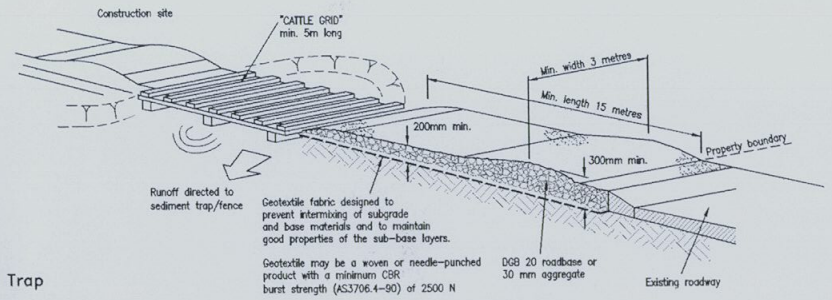
CONSTRUCTION NOTES

KERB INLET FILTERS

1. INSTALL FILTERS TO KERB INLETS ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH BY 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET. MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING THE FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OF GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN THEM.



Sandbag Kerb Inlet Sediment Trap



Stabilised Site Access

CONSTRUCTION NOTES

STABILISED SITE ACCESS

1. STRIP THE TOPSOIL, LEVEL THE SITE & COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15 METRES LONG OR TO BUILDING ALIGNMENT AND AT LEAST 3 METRES WIDE.
5. WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.

CC

DIAL 1100 BEFORE YOU DIG

Project: SEDIMENT & EROSION CONTROL NOTES

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale: N.T.S.	Date: 19.2.14	Council Ref.	
	Datum: A.H.D.	L.G.A. PITTWATER	
Calc's: A.D.	Drawn: C.G.H.	Proj.Man.: A.D.	Client Ref.

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90th ANNIVERSARY 1923 - 2013

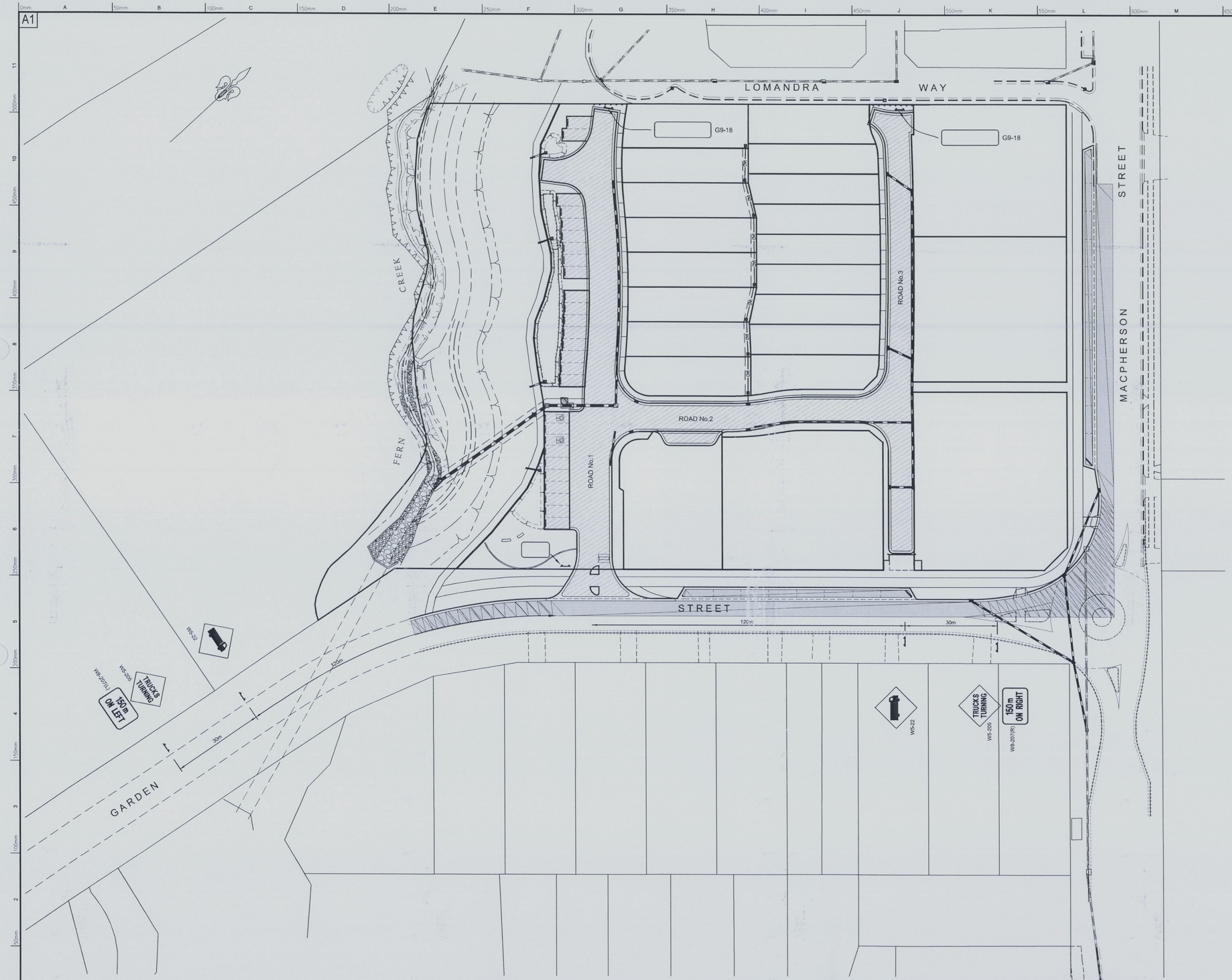
LRQA ISO 9001 Approved Company

Our Ref. 1736

Dwg File Ref. [Rev] - Sheet Ref.

1736C CC 01 [A] in progress
19-2-14 - 032

A1



TRAFFIC CONTROL PLAN NOTES

1. ALL WORK IS TO BE UNDERTAKEN DURING HOURS AS STATED IN THE CONDITIONS OF CONSENT BY PITTWATER COUNCIL.
2. ALL TRAFFIC CONTROL DEVICES MUST BE REMOVED & SIGNS TO BE COVERED AND/OR REMOVED OUTSIDE OF THESE TIMES & ALL LANES MUST REMAIN OPEN.
3. SIGNAGE TO BE PLACED SO AS TO ALLOW NORMAL VEHICULAR & PEDESTRIAN ACCESS AT ALL TIMES.
4. PLANT AND/OR MATERIAL TO BE STORED ON SITE & NOT ON THE GRASSED VERGE.
5. ALL SIGN SIZES TO BE CLASS A
6. PROVIDE A CONTAINMENT FENCE TO PREVENT WORKERS ENTERING THE FLOW OF TRAFFIC.
7. PROVIDE A TEMPORARY RAMP FOR PRAMS & A SAFE PATH FOR PEDESTRIANS AT ALL CROSSING POINTS & ENSURE A SAFE CROSSING POINT FOR ALL PEDESTRIAN TRAFFIC.
8. ARRANGE VEHICULAR ACCESS ACROSS THE WORK AREA USING PORTABLE BARRIERS OR PLASTIC MESH FENCING.
9. METAL PLATES AND/OR ALL-WEATHER MATERIAL (e.g. GRAVEL) TO BE PLACED OVER ANY EXCAVATIONS WHEN WORKS ARE NOT IN PROGRESS. ROAD SURFACE TO BE REINSTATED TO COUNCIL'S SATISFACTION AS SOON AS PRACTICABLY POSSIBLE.
10. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH A.S.1742.3 MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, PART 3: TRAFFIC CONTROL DEVICES FOR WORKS ON ROADS & THE R.T.A TRAFFIC CONTROL AT WORK SITES MANUAL, VERSION 4.0
11. ALL RELEVANT AUTHORITIES MUST BE NOTIFIED BEFORE COMMENCEMENT OF WORK.
12. THIS TRAFFIC CONTROL PLAN HAS BEEN SELECTED & MODIFIED IN ACCORDANCE WITH SECTION 4.2 OF THE R.T.A. TRAFFIC CONTROL AT WORK SITES MANUAL, VERSION 4.0

Fiona Gilbert

FIONA GILBERT DATED: 20.12.2013
(R.T.A. CERTIFICATE No. - 4162047451)
TRAFFIC CONTROL AT WORK SITES
SELECT/MODIFY TRAFFIC CONTROL PLANS

CC

DIAL 1100 BEFORE YOU DIG

Project: TRAFFIC CONTROL PLAN

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale 1:400	Date 19.2.14	Council Ref.			
	Datum A.H.D.	L.G.A. PITTWATER			
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.		

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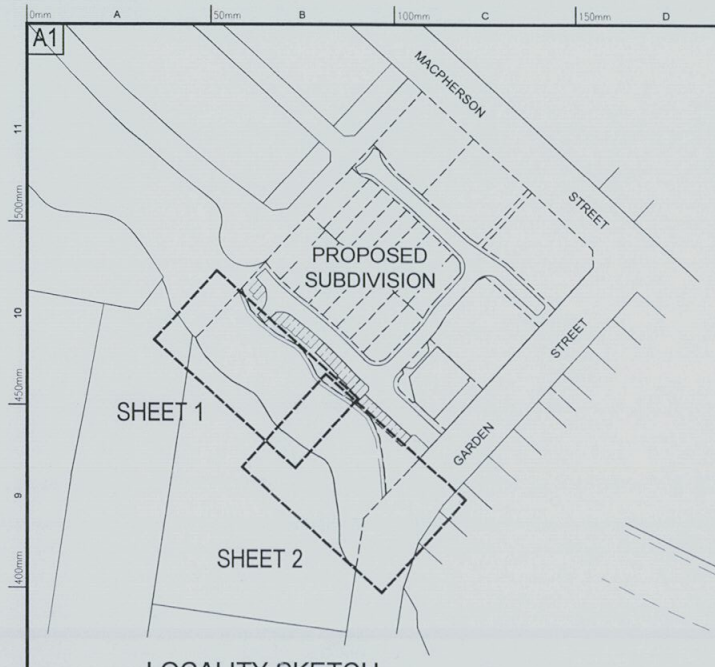
1736C CC 01 [A] in progress
19-2-14 - 033

CC CREEK DESIGN DRAWINGS

A1



LOCALITY SKETCH
SCALE 1:1500

NOTES:

1. ALL BATTERS TO BE STABILISED WITH JUTE MESH PEGGED IN PLACE.

2. RIPARIAN CORRIDOR TO BE VEGETATED AS PER LANDSCAPE ARCHITECTS DRAWINGS

LEGEND

- EXISTING CREEK ALIGNMENT
- EXISTING CREEK BANKS
- PROPOSED CREEK ALIGNMENT (ROCK STABILISED, REFER TO DETAIL ON SHEET 8)
- PROPOSED REGRADED BANKS
- PROPOSED HIGH FLOW CHANNEL (STABILISED WITH VEGETATION AS PER LANDSCAPE ARCHITECTS PLAN)
- R1 RIFFLE LOCATION
- ROCK REVETMENT (REFER TO DETAIL ON SHEET 08)
- TREE TO BE RETAINED
- TREE TO BE REMOVED

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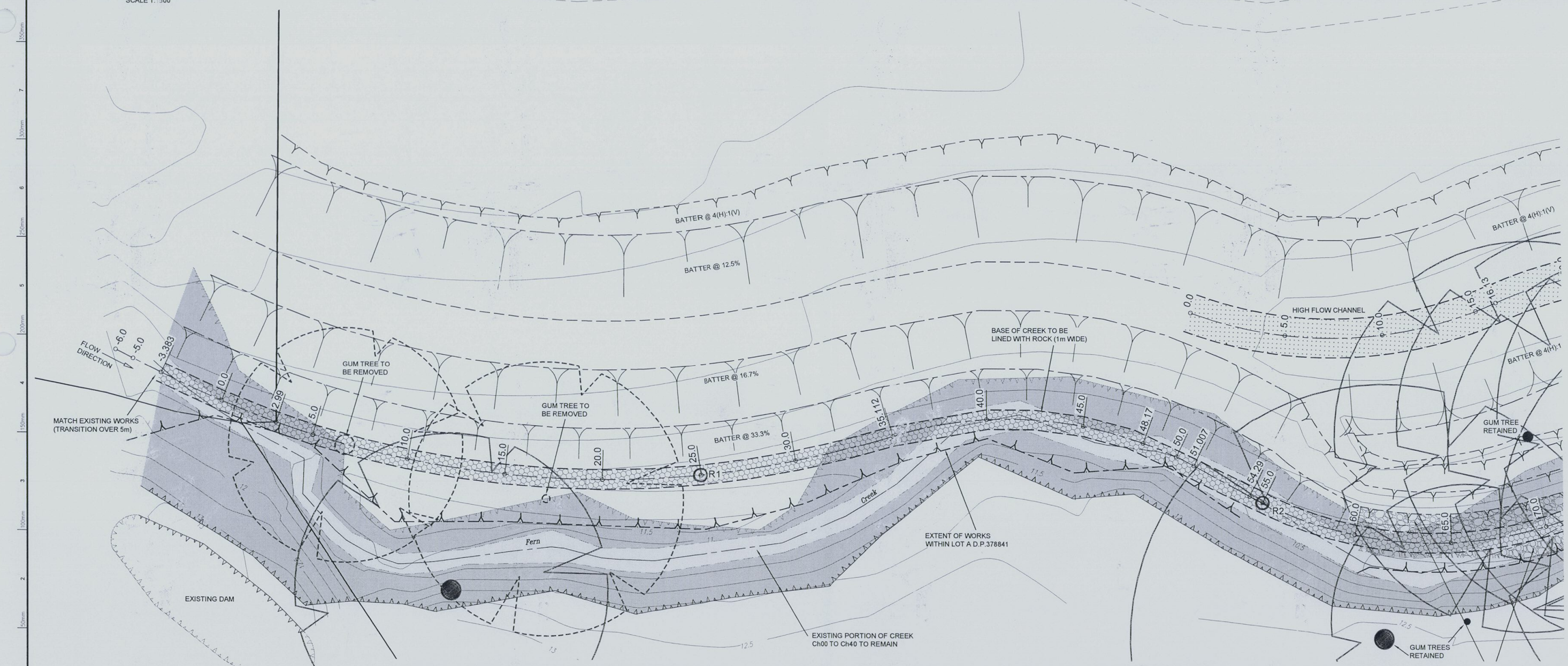
1:100 @ A1



Civil Certification Accredited Certifiers Civil Engineering Michael Shaw BE(Civil) MIEAust CPEng NPER(Civil) Accredited Certifier (BPB 0818) Principal 02 9982 2257 mshaw2000@hotmail.com	CMI Certification 53 Wenona Avenue Gordon NSW 2072	DIAL 1100 BEFORE YOU DIG	Project: FERN CREEK RECONSTRUCTION LOT 11 SECTION C D.P.5464 Cnr. GARDEN & MACPHERSON STREETS WARRIEWOOD	Principal: WARRIEWOOD PROPERTIES PTY LTD Scale 1:100 · Date 8.11.13 · Council Ref. Datum A.H.D. · L.G.A. PITTWATER Calc's A.D. · Drawn. C.G.H. · Proj.Man. A.D. · Client Ref:

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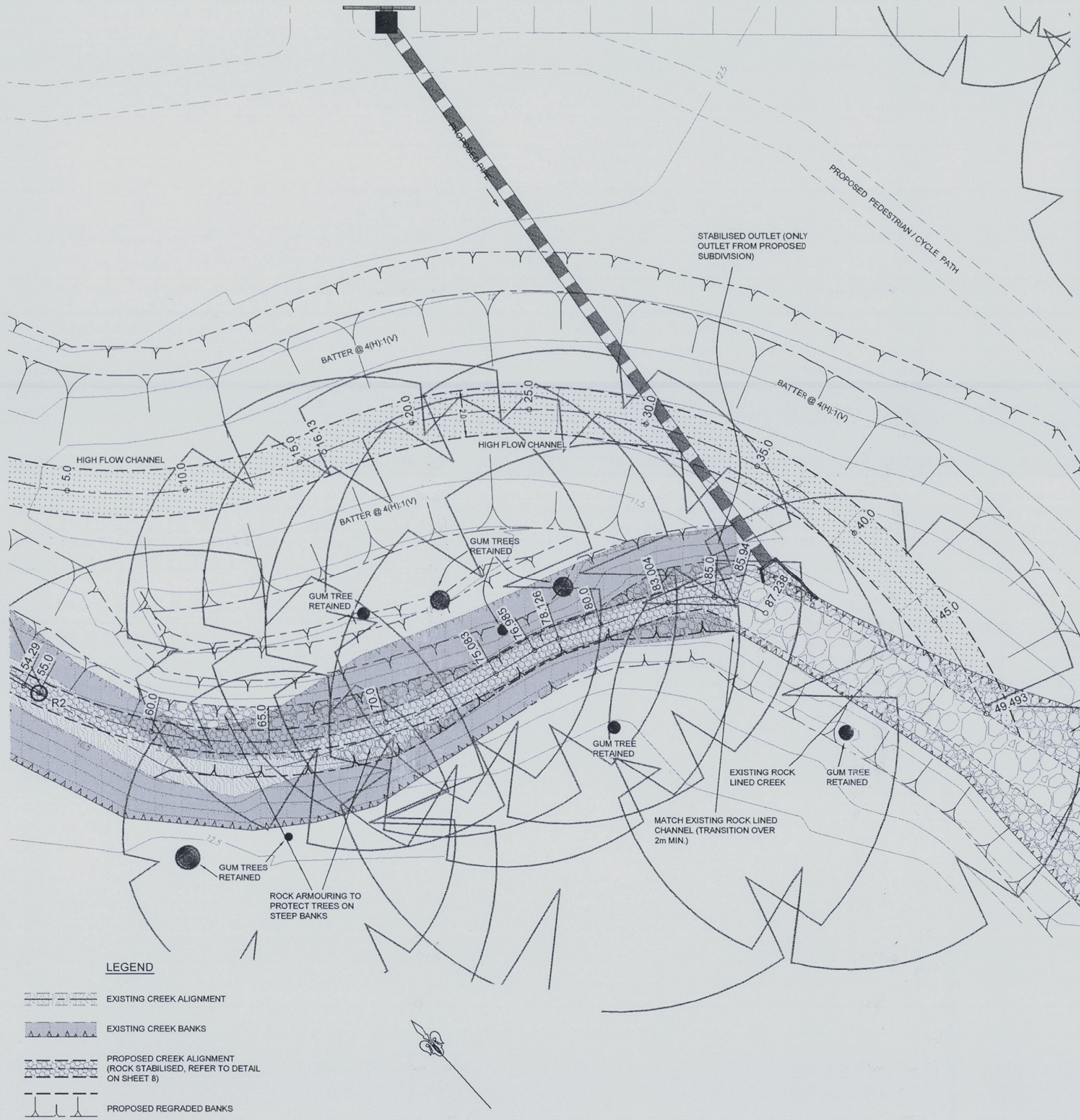
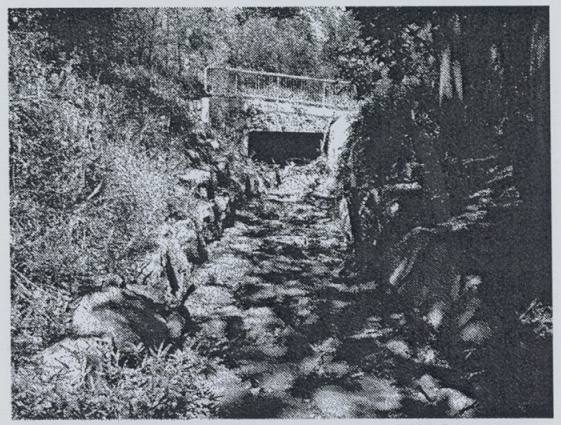
1736E05 [04] - 01

A1



EXISTING ROCK LINED CREEK BED & BATTERS (LOOKING NORTH)



EXISTING ROCK LINED CREEK BED & BATTERS (LOOKING SOUTH)

LEGEND

- EXISTING CREEK ALIGNMENT
- EXISTING CREEK BANKS
- PROPOSED CREEK ALIGNMENT (ROCK STABILISED, REFER TO DETAIL ON SHEET 8)
- PROPOSED REGRADED BANKS
- PROPOSED HIGH FLOW CHANNEL (STABILISED WITH VEGETATION AS PER LANDSCAPE ARCHITECTS PLAN)
- R1 RIFFLE LOCATION
- ROCK REVETMENT (REFER TO DETAIL ON SHEET 08)
- TREE TO BE RETAINED
- TREE TO BE REMOVED

NOTES:

1. ALL BATTERS TO BE STABILISED WITH JUTE MESH PEGGED IN PLACE.

2. RIPARIAN CORRIDOR TO BE VEGETATED AS PER LANDSCAPE ARCHITECTS DRAWINGS

5 4 3 2 1 0 5

1:100 @ A1

Civil Certification
Accredited Certifiers
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Gordon NSW 2072

CMI Civil

DIAL 1100 BEFORE YOU DIG

Project:

FERN CREEK RECONSTRUCTION
LOT 11 SECTION C D.P.5464
Cnr. GARDEN & MACPHERSON STREETS
WARRIEWOOD

Principal:	WARRIEWOOD PROPERTIES PTY LTD				
Scale	1:100	Date	8.11.13	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref.

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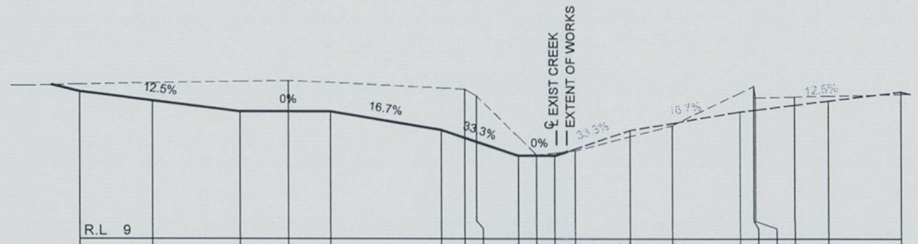
A1



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-12.5	-10.5	-8.1	-6.762	-5.6	-2.6	-1.959	-1.639	-0.5	0	0.5	1.074	2.6	3.754	5.6	5.98	6.029	7.089	8	10

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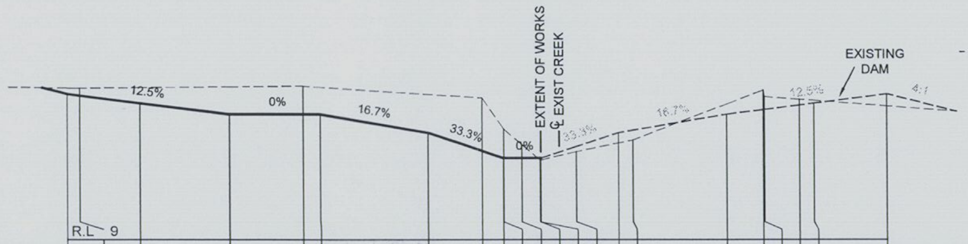

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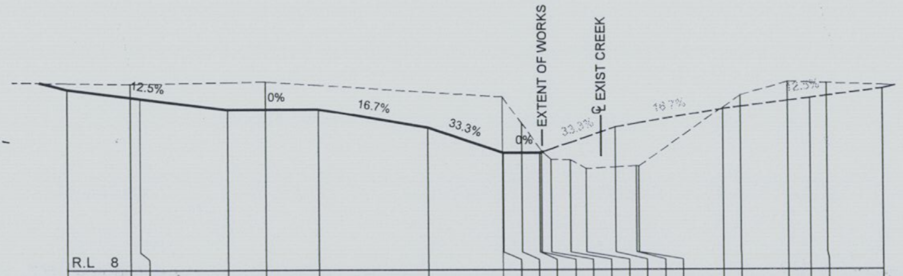
-12.5	-12.158	-10.5	-8.1	-6.083	-5.6	-2.6	-1.102	-0.5	-0.494	0	0.483	0.5	1.467	2.6	2.998	5.6	6.609	6.638	7.611	8	10

2.99



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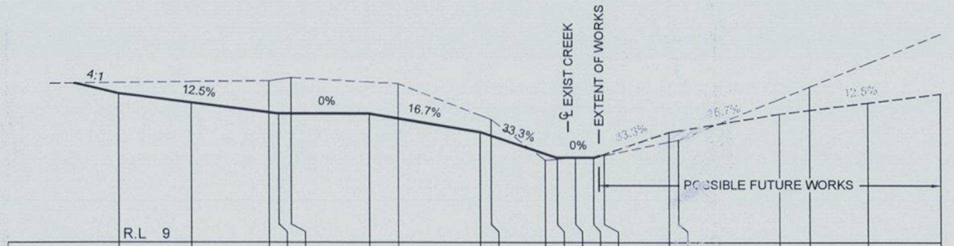
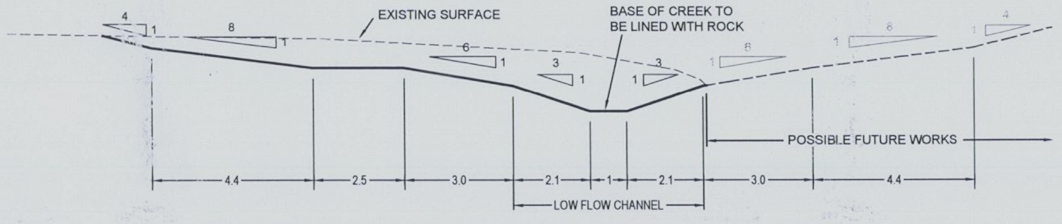
13.136	13.114			13.173			12.751		12.022		11.255	11.03	11.022	10.78		10.85	10.841		12.787	13.152		13.115	13.061
-12.5	-10.761	-10.5	-8.1	-7.064	-5.6	-2.6	-0.526	-0.5	0	0.5	0.552	0.815	1.348	1.79	2.6	3.182	3.254	5.6	6.088	7.401	8	8.459	10

5

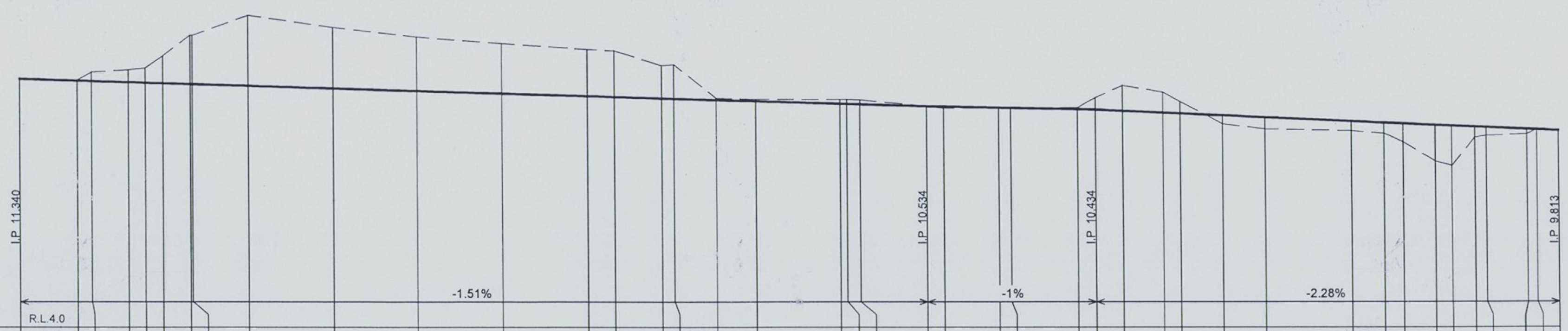


DESIGN LEVEL	13.09	12.84		12.54		12.54		12.04			11.34	11.34	11.34		12.04		12.54		12.84	13.09
EXISTING LEVEL	13.389		13.435		13.528		13.363		12.385	11.27		11.34		11.401		11.825		13.285		14.743
OFFSET	-12.5	-10.5	-8.371	-8.1	-7.76	-5.6	-4.818	-2.6	-2.303	-0.818	-0.5	0	0.5	0.798	2.6	2.85	5.6	6.427	8	10

-3.384



FERN CREEK - TYPICAL CROSS SECTION
Ch -3.4 TO Ch 50
SCALE 1:100 NAT.



WORK AS EXECUTED																					
DESIGN LEVEL	11.34	11.289	11.276	11.244	11.229	11.213	11.189	11.187	11.138	11.062	10.987	10.911	10.836	10.812	10.77	10.759	10.721	10.685	10.61	10.604	10.592
EXISTING LEVEL	11.34	11.313	11.548	11.611	11.665	12.022	12.635	12.628	13.218	12.862	12.581	12.387	12.214	12.176	11.742	11.772	10.774	10.745	10.734	10.741	10.721
CHAINAGE	-3.384	0	0.837	2.99	3.969	5	6.598	6.725	10	15	20	25	30	31.565	34.378	35.112	37.625	40	45	45.375	46.135

WORK AS EXECUTED																					
DESIGN LEVEL	10.534	10.524	10.491	10.484	10.445	10.434	10.397	10.343	10.32	10.263	10.206	10.09	10.047	10.021	9.978	9.956	9.925	9.91	9.855	9.843	9.813
EXISTING LEVEL	10.539	10.475	10.48	10.481	10.489	10.791	11.145	10.949	10.669	10.013	9.862	9.811	9.728	9.461	8.898	8.768	9.603	9.65	9.706	9.848	9.813
CHAINAGE	50	51.007	54.29	55	58.95	60	61.614	63.989	65	67.489	70	75.083	76.985	78.126	80	80.971	82.343	83.004	85.38	85.94	87.238

FERN CREEK - LONG. SECTION
H=1:200 V=1:100

5 4 3 2 1 0 5 10
1:200 @ A1

5 4 3 2 1 0 5
1:100 @ A1

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Project:
FERN CREEK RECONSTRUCTION
LOT 11 SECTION C D.P.5464
Cnr. GARDEN & MACPHERSON STREETS
WARRIEWOOD

Principal: WARRIEWOOD PROPERTIES PTY LTD		
Scale LONG. H.1:200 V. 1:100 CROSS. 1:100 NAT.	Date 8.11.13	Council Ref.
	Datum A.H.D.	L.G.A. PITTWATER
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D. / Client Ref:

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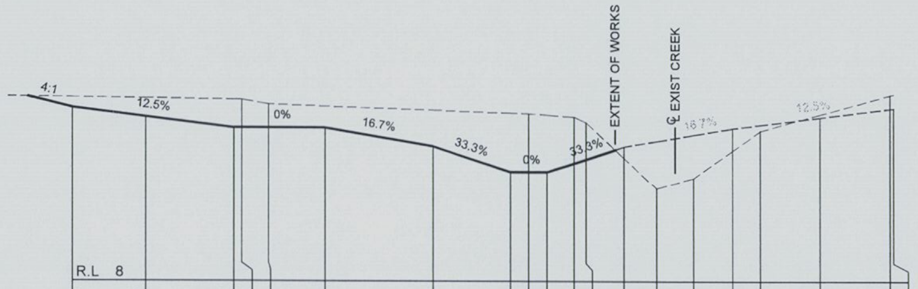
A1



12.737	12.487	12.187			12.187	11.687	10.987	10.987	10.987			11.687			12.187		12.487		12.737
13.016			12.954	12.831				12.581		12.49	12.34		10.548	10.83		12.12		13.095	13.121
-12.5	-10.5	-8.1	-7.886	-7.154	-5.6	-2.6	-0.5	0	0.5	1.23	1.55	2.6	3.498	4.525	5.6	6.369	8	9.904	10

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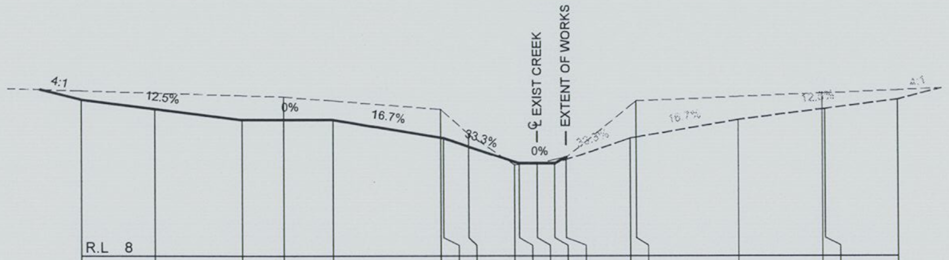
12.509	12.259	11.959		11.959			11.459		10.759		10.759	10.759		11.459				11.959	12.259			12.509
12.915			12.78		12.6	12.654		12.326		11.92	11.772		10.755		10.575	11.57	11.865			12.6	12.64	12.641
-12.5	-10.5	-8.1	-5.93	-5.6	-5.263	-3.045	-2.6	-1.086	-0.5	-0.154	0	0.5	1.367	2.6	2.782	3.837	5.443	5.6	8	8.046	9.961	10

35.112



12.284	12.034	11.734		11.734		11.234			10.534	10.534	10.534		11.234		11.734		12.034	12.284
12.527			12.361		12.021		11.344	10.491		10.539		10.715		12.245		12.455		12.539
-12.5	-10.5	-8.1	-6.946	-5.6	-2.68	-2.6	-1.903	-0.629	-0.5	0	0.5	0.826	2.6	2.761	5.6	7.93	8	10

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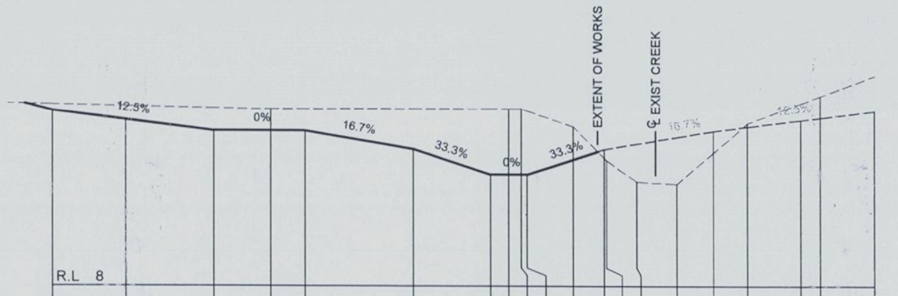

12.812	12.562	12.262		12.262	11.762	11.062	11.062		11.062		11.762				12.262		12.562		12.812
12.981			12.847				12.862	12.865		12.38		11.455	10.875	10.813		12.475		13.225	13.78
-12.5	-10.5	-8.1	-6.539	-5.6	-2.6	-0.5	0	0.345	0.5	1.747	2.6	2.663	3.489	4.602	5.6	6.54	8	8.528	10

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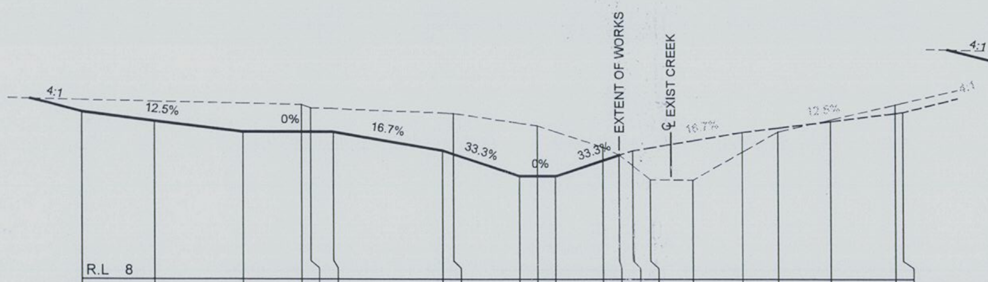

12.586	12.336	12.036			12.036	11.536		10.836	10.836	10.836			11.536			12.036		12.336		12.586
12.911			12.785	12.699			12.552		12.214		11.63	11.42		10.74	10.725		12.055		12.795	12.844
-12.5	-10.5	-8.1	-6.475	-6.215	-5.6	-2.6	-2.301	-0.5	0	0.5	1.796	2.231	2.6	3.072	4.244	5.6	6.573	8	9.789	10

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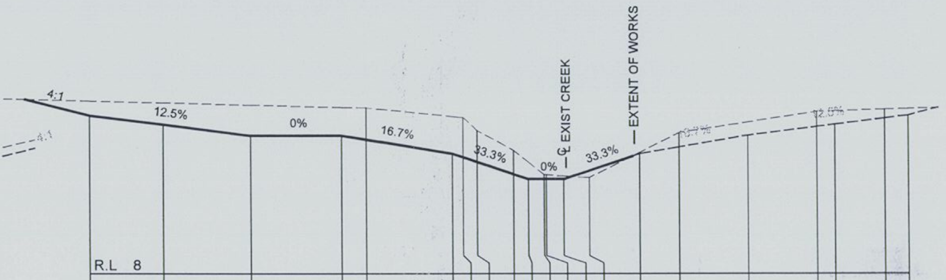

12.359	12.109	11.809	11.809		11.309				10.609		10.61	10.609		11.309		11.809		12.109		12.359
12.756				12.569		12.3	11.945	11.398		10.731	10.734		10.651		11.885		12.46		12.52	12.541
-12.5	-10.5	-8.1	-5.6	-4.919	-2.6	-2.304	-1.908	-0.908	-0.5	-0.059	0	0.5	1.2	2.6	3.696	5.6	7.504	8	9.353	10

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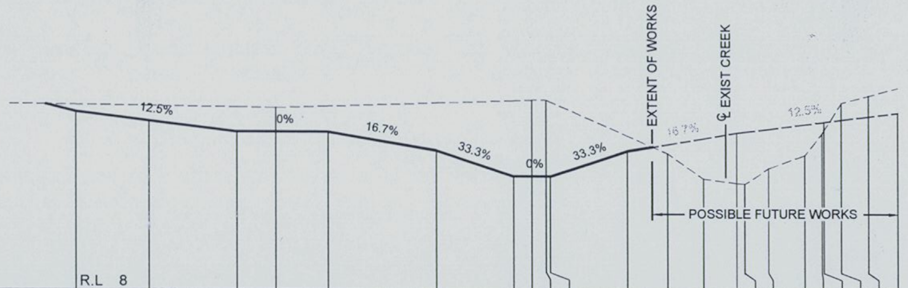

DESIGN LEVEL	12.888	12.638	12.338		12.338	11.838	11.138	11.138		11.138	11.838			12.338					12.638			12.888
EXISTING LEVEL	13.078			12.999				13.218	13.22			11.77	11.085		10.94	11.375	11.73	12.325		13.16	13.355	13.566
OFFSET	-12.5	-10.5	-8.1	-7.034	-5.6	-2.6	-0.5	0	0.381	0.5	2.6	3.695	4.696	5.6	5.821	6.483	7.48	7.947	8	8.466	9.202	10

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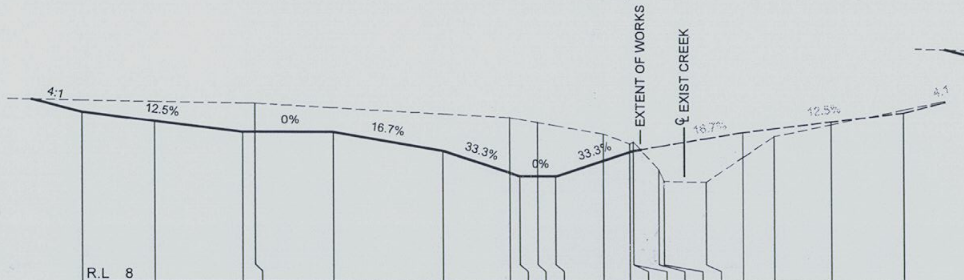

12.661	12.411	12.111		12.111	11.611		10.911	10.911	10.911			11.611					12.111		12.411	12.661
12.981			12.908			12.528		12.387		12.07	11.799		11.854	11.09	10.77	10.753		12.005		12.749
-12.5	-10.5	-8.1	-7.767	-5.6	-2.6	-0.783	-0.5	0	0.5	1.794	2.502	2.6	2.602	3.295	3.439	4.592	5.6	6.447	8	10

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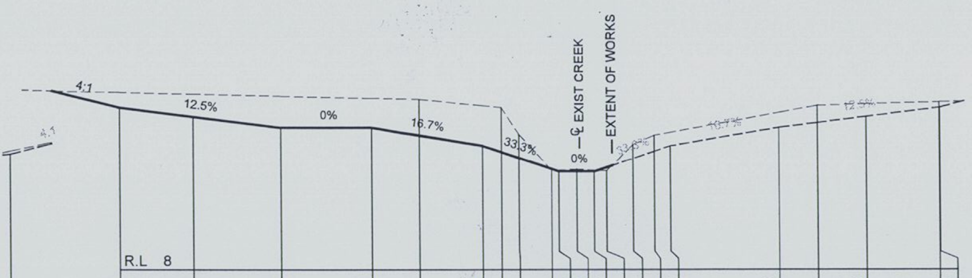

12.435	12.185	11.885	11.885		11.385				10.685	10.685	10.685				11.385	11.885		12.185		12.435
12.85				12.661		12.436	11.693	10.715		10.745		10.7	11.421	11.672			12.49		12.585	12.585
-12.5	-10.5	-8.1	-5.6	-4.325	-2.6	-2.077	-1.595	-0.692	-0.5	0	0.5	0.834	1.571	2.154	2.6	5.6	6.663	8	9.983	10

40

5 4 3 2 1 0 5
1:100 @ A1

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Project:
FERN CREEK RECONSTRUCTION
LOT 11 SECTION C D.P.5464
Cnr. GARDEN & MACPHERSON STREETS
WARRIEWOOD

Principal:	WARRIEWOOD PROPERTIES PTY LTD						
Scale	1:100 NAT.	Date	8.11.13	Council Ref.			
		Datum	A.H.D.	L.G.A.	PITTWATER		
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref:	

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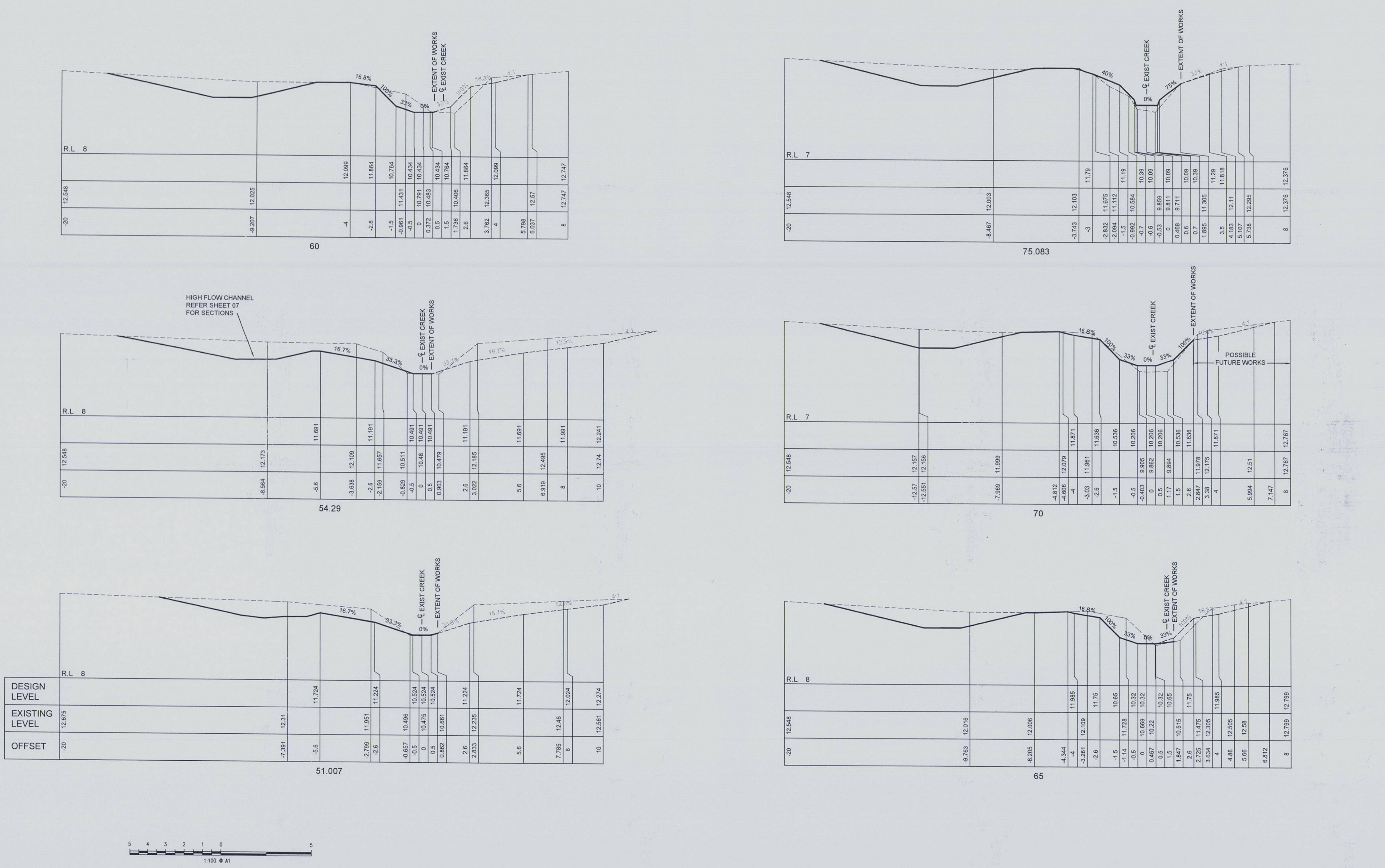

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		Datum	A.H.D.	L.G.A.	PITTWATER		
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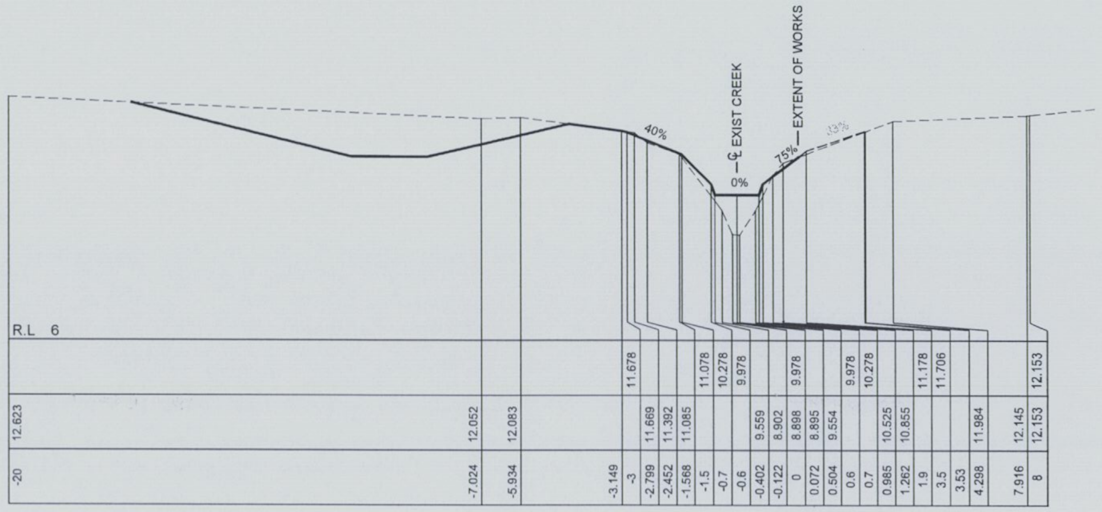

				11.678				11.078	10.278	9.978			9.978			9.978	10.278			11.178	11.706				12.153
12.623	12.052	12.083			11.669	11.392	11.085				9.559	8.902	8.898	8.895	9.554			10.525	10.855				11.984	12.145	12.153
-20	-7.024	-5.934	-3.149	-3	-2.799	-2.452	-1.568	-1.5	-0.7	-0.6	-0.402	-0.122	0	0.072	0.504	0.6	0.7	0.985	1.262	1.9	3.5	3.53	4.298	7.916	8

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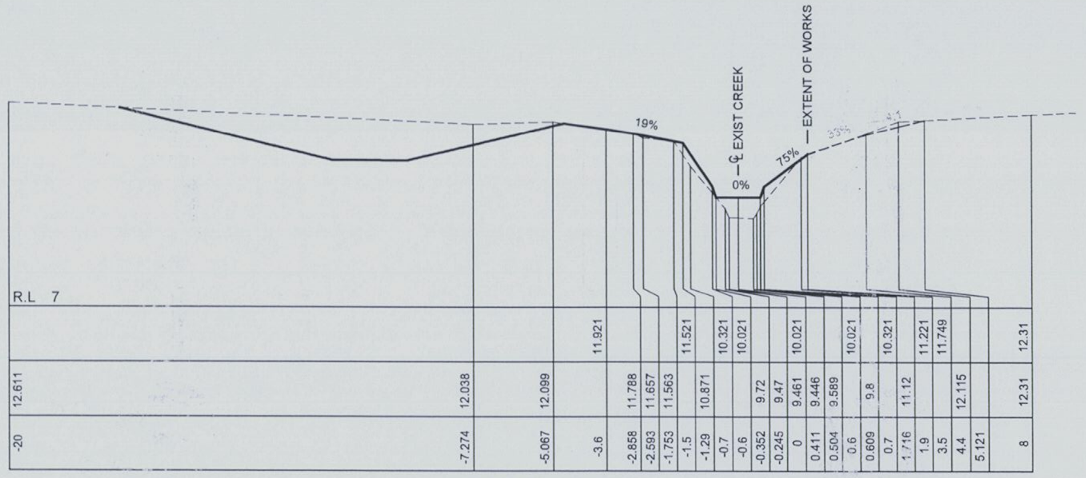
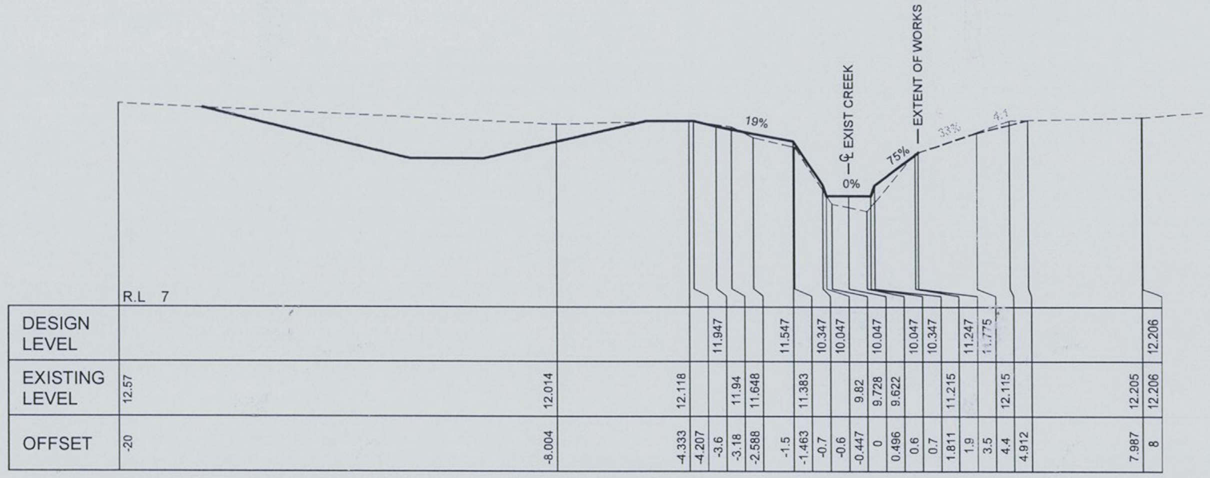


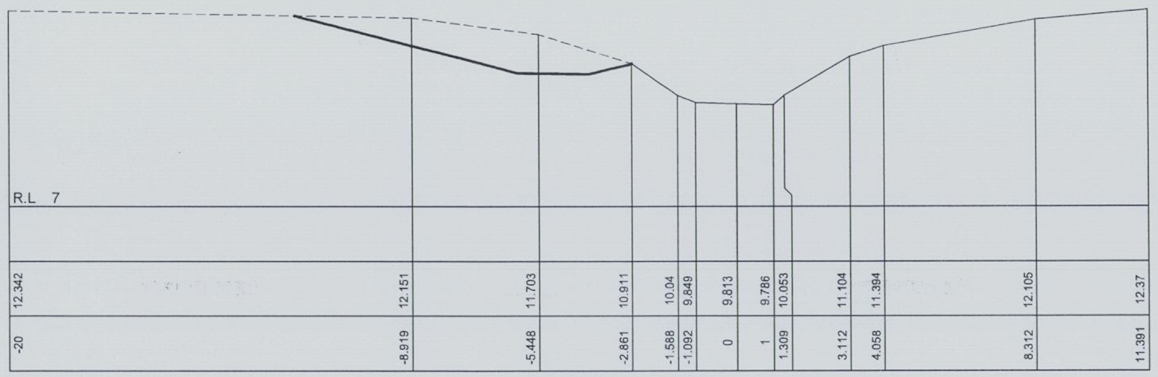
			11.921				11.521		10.321	10.021			10.021			10.021		10.321		11.221	11.749			12.31
12.611	12.038	12.099		11.788	11.657	11.563		10.871			9.72	9.47	9.461	9.446	9.589		9.8		11.12			12.115		12.31
-20	-7.274	-5.067	-3.6	-2.858	-2.593	-1.753	-1.5	-1.29	-0.7	-0.6	-0.352	-0.245	0	0.411	0.504	0.6	0.609	0.7	1.716	1.9	3.5	4.4	5.121	8

78.126



DESIGN LEVEL					11.947			11.547		10.347	10.047		10.047		10.047	10.347		11.247	11.775				12.206
EXISTING LEVEL	12.57	12.014	12.118			11.94	11.648		11.383			9.82	9.728	9.622			11.215			12.115		12.205	12.206
OFFSET	-20	-8.004	-4.333	-4.207	-3.6	-3.18	-2.588	-1.5	-1.463	-0.7	-0.6	-0.447	0	0.496	0.6	0.7	1.811	1.9	3.5	4.4	4.912	7.987	8

76.985



12.342	12.151	11.703	10.911	10.04	9.849	9.813	9.786	10.053	11.104	11.394	12.105	12.37
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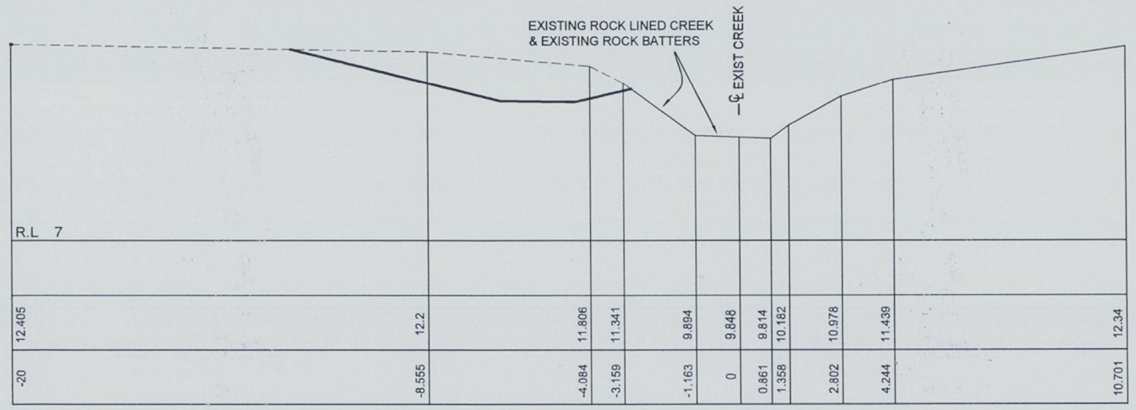
87.238



12.405	12.2	11.806	11.341	9.894	9.848	9.814	10.182	10.978	11.439	12.34
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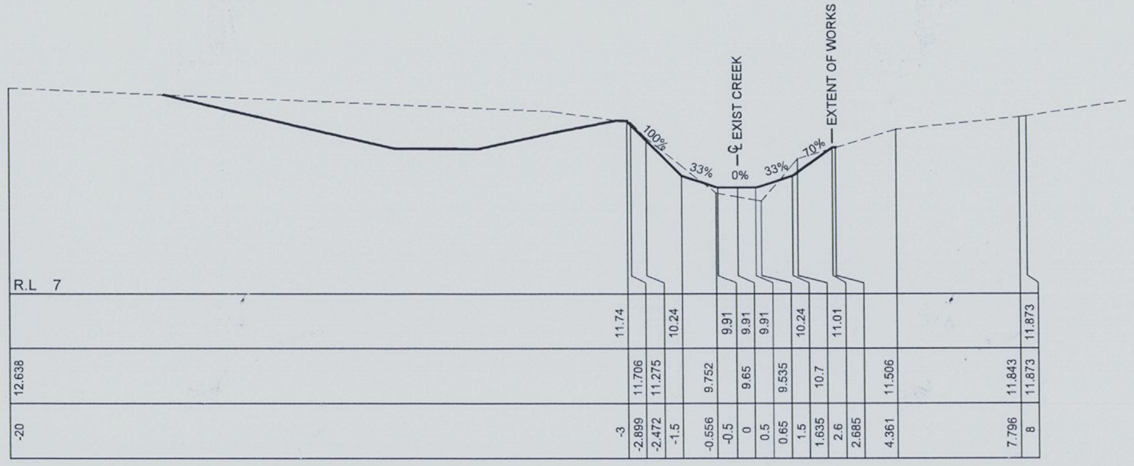
85.94



	11.74			10.24		9.91	9.91	9.91		10.24		11.01				11.873
12.638		11.706	11.275		9.752		9.65		9.535		10.7			11.506	11.843	11.873
-20	-3	-2.899	-2.472	-1.5	-0.556	-0.5	0	0.5	0.65	1.5	1.635	2.6	2.685	4.361	7.796	8

83.004

5 4 3 2 1 0 5
1:100 @ A1

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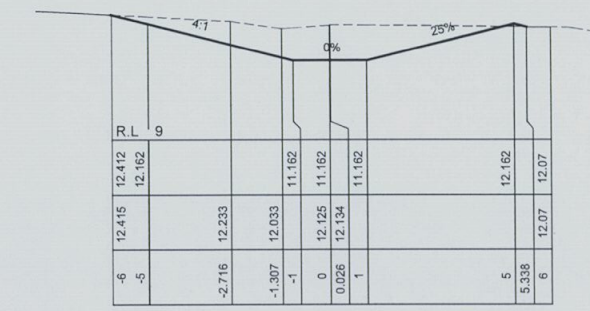

	12.412			11.162		11.162			12.162		12.07
	12.415		12.233	12.033	12.125	12.134					12.07
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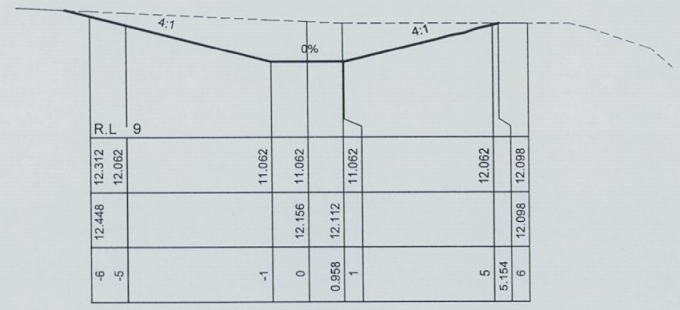

	12.312			11.062		11.062			12.062		12.098
	12.448				12.156	12.112					12.098
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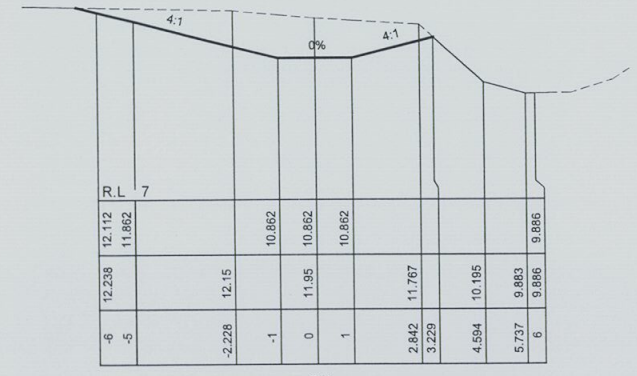

	12.112			10.862		10.862					9.886
	12.238		12.15			11.95		11.767		10.195	9.883
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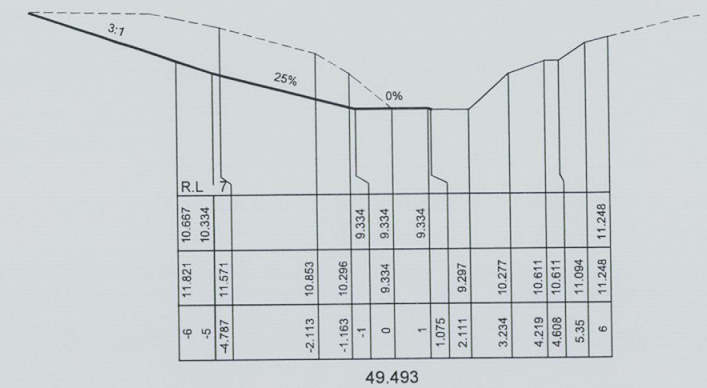

	10.667				9.334	9.334					
	10.334										
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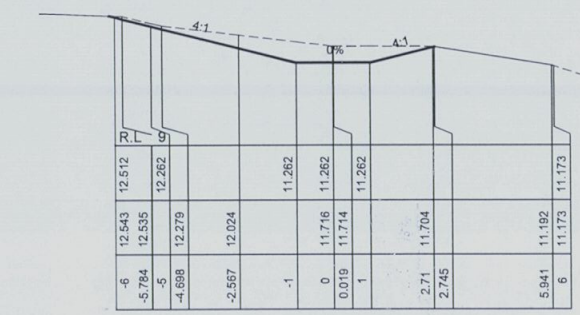
49.493



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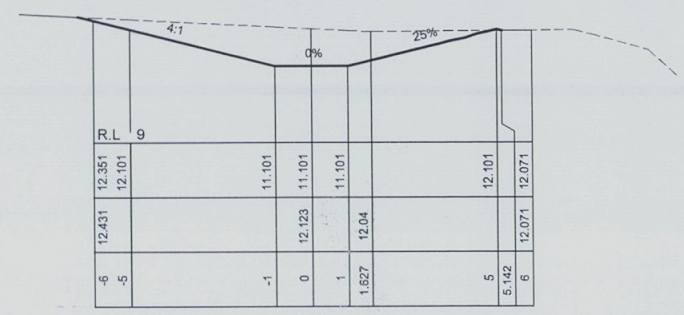

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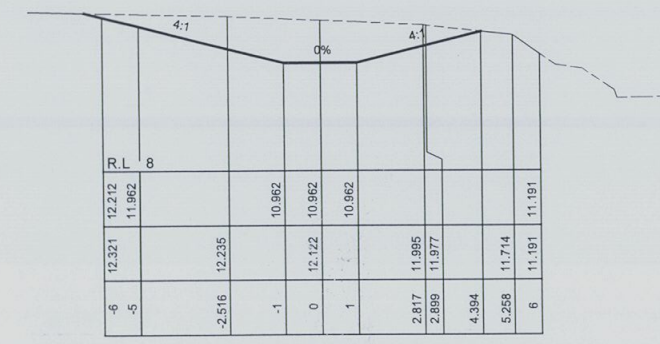

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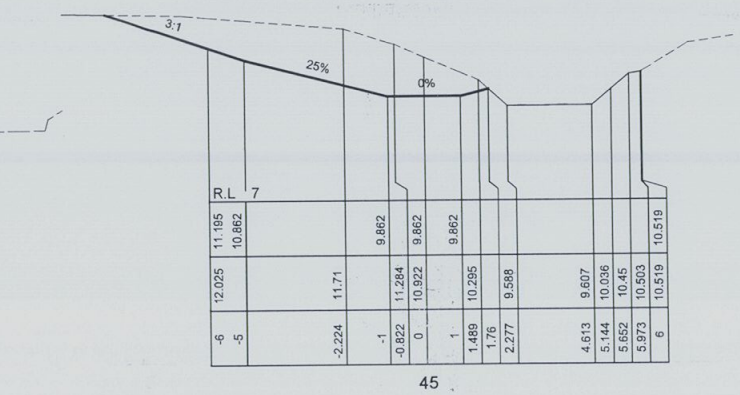

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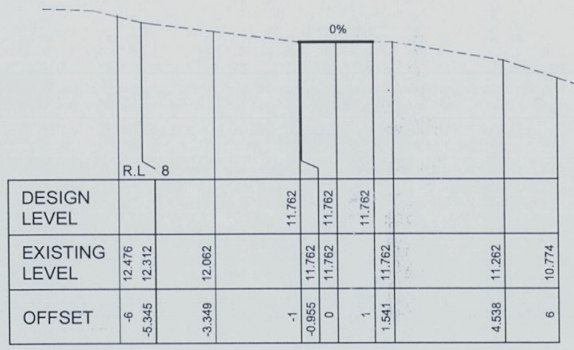

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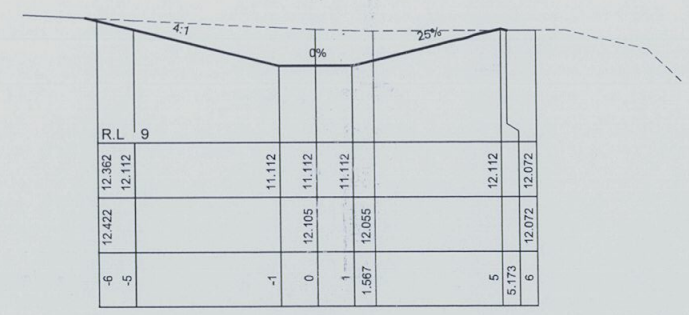

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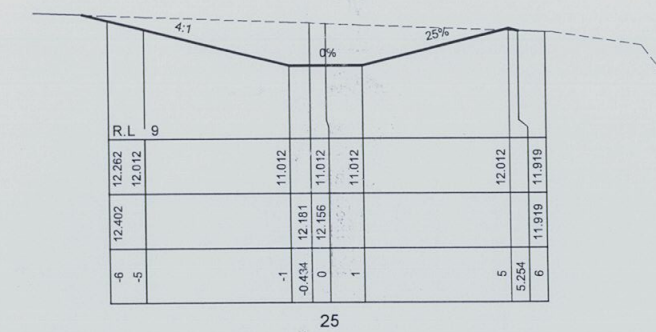

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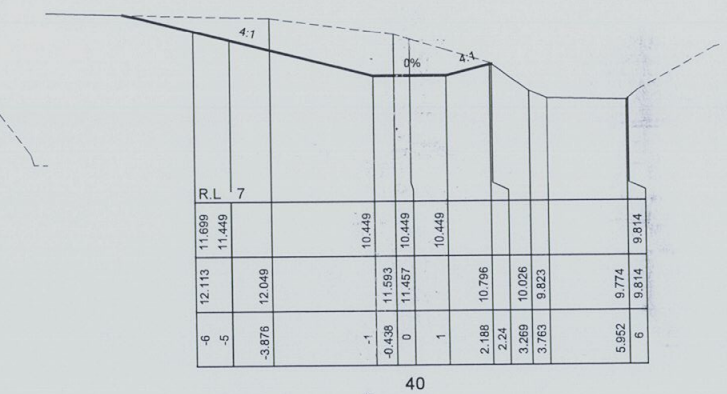

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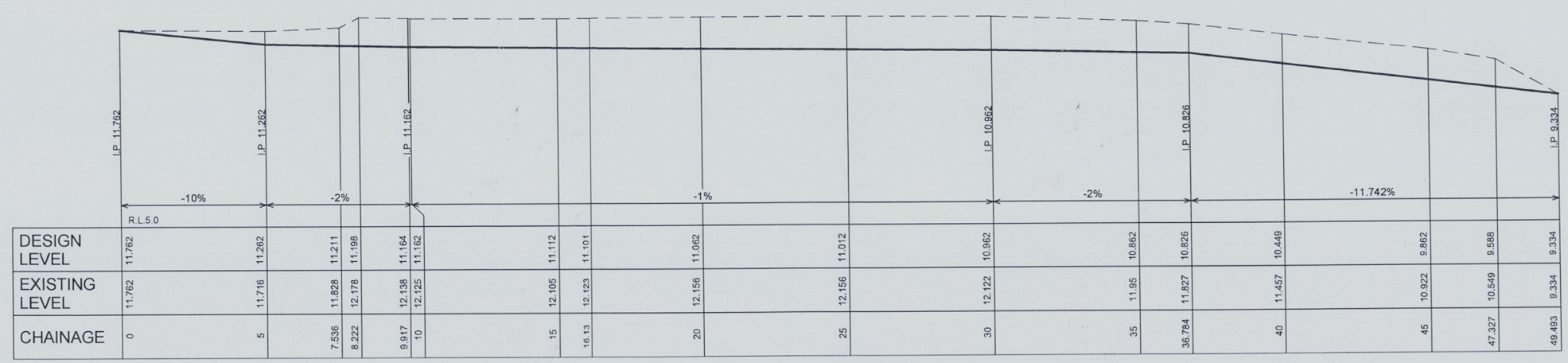

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CHAINAGE	0		5		7.536	8.222	9.917	10		15	16.13	20		25		30		35	36.784	40		45	47.327	49.493

HIGH FLOW CHANNEL

H=1:100 V=1:100

5 4 3 2 1 0 5

1:100 @ A1

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LOT 11 SECTION C D.P.5464
Cnr. GARDEN & MACPHERSON STREETS
WARRIEWOOD

Principal: WARRIEWOOD PROPERTIES PTY LTD

Scale	1:100 NAT.	Date	8.11.13	Council Ref.	
		Datum	A.H.D.	L.G.A.	PITTWATER
Calc's	A.D.	Drawn.	C.G.H.	Proj.Man.	A.D.	Client Ref.

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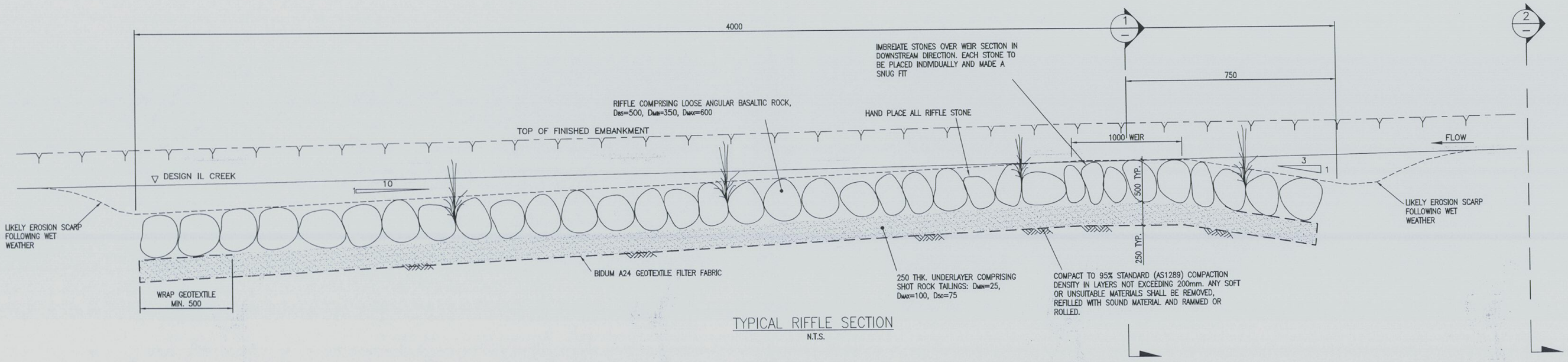
A1



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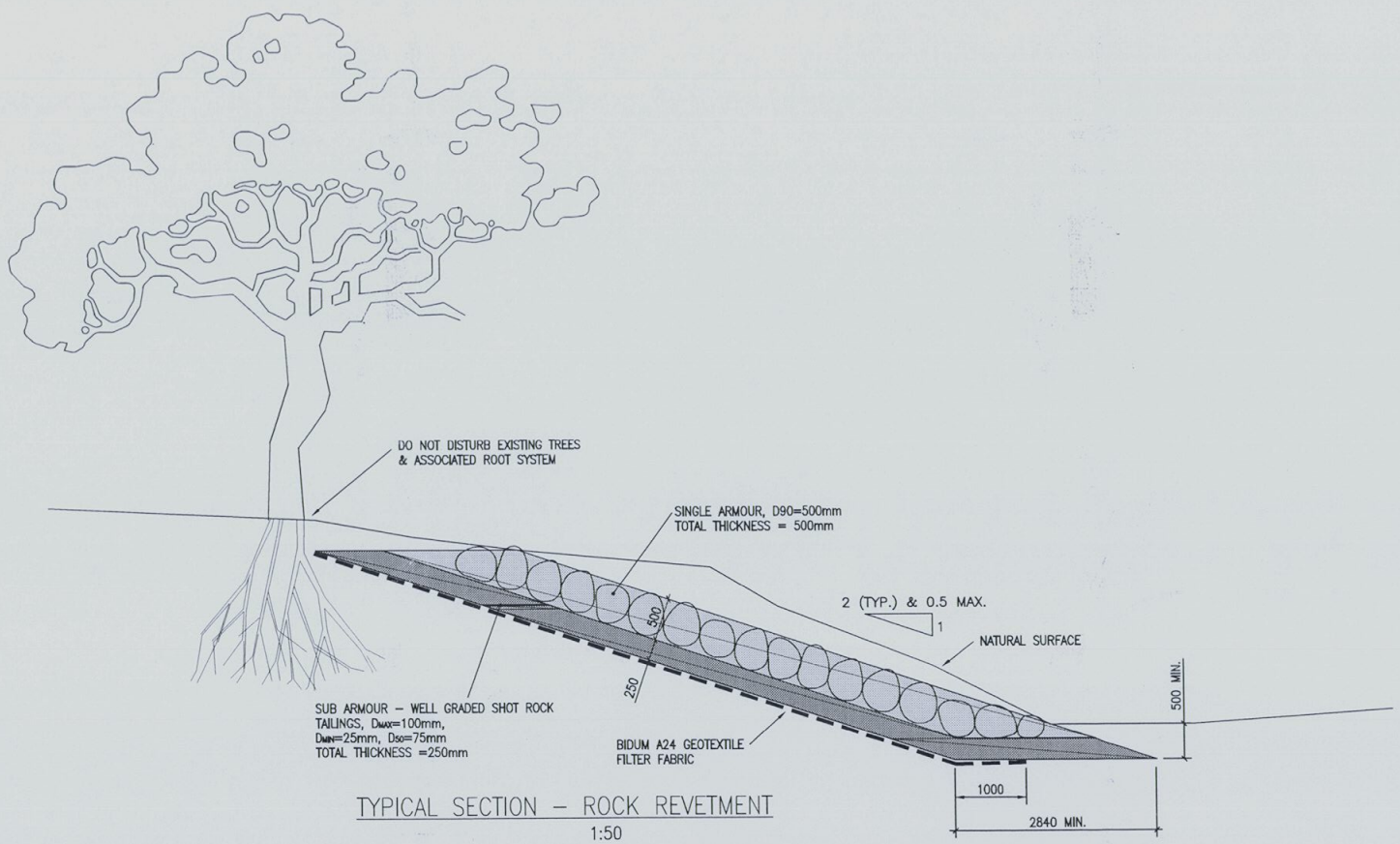

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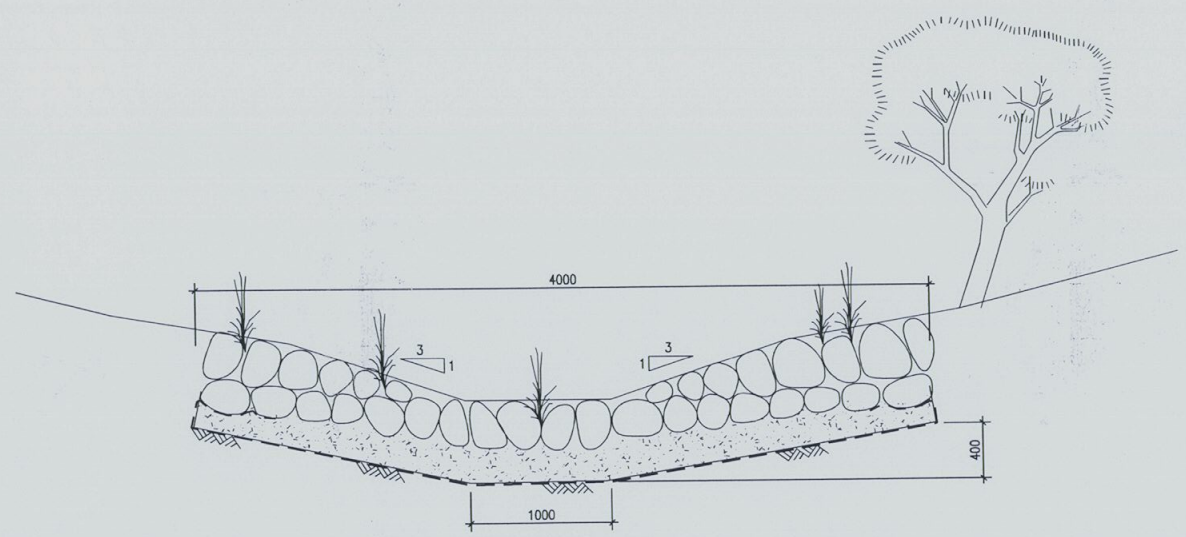

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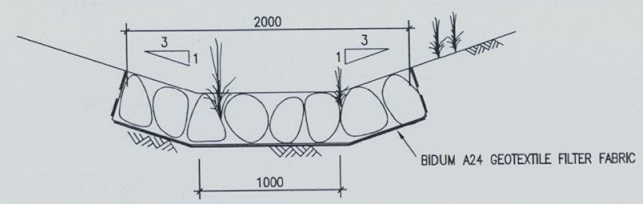

MAIN CHANNEL – SECTION 2
N.T.S.

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LOT 11 SECTION C D.P.5464
Cnr. GARDEN & MACPHERSON STREETS
WARRIEWOOD

Principal: WARRIEWOOD PROPERTIES PTY LTD			
Scale 1:100 NAT.	Date 8.11.13	Council Ref.	
	Datum A.H.D.	L.G.A. PITTWATER	
Calc's A.D.	Drawn. C.G.H.	Proj.Man. A.D.	Client Ref.

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Our Ref.	1736
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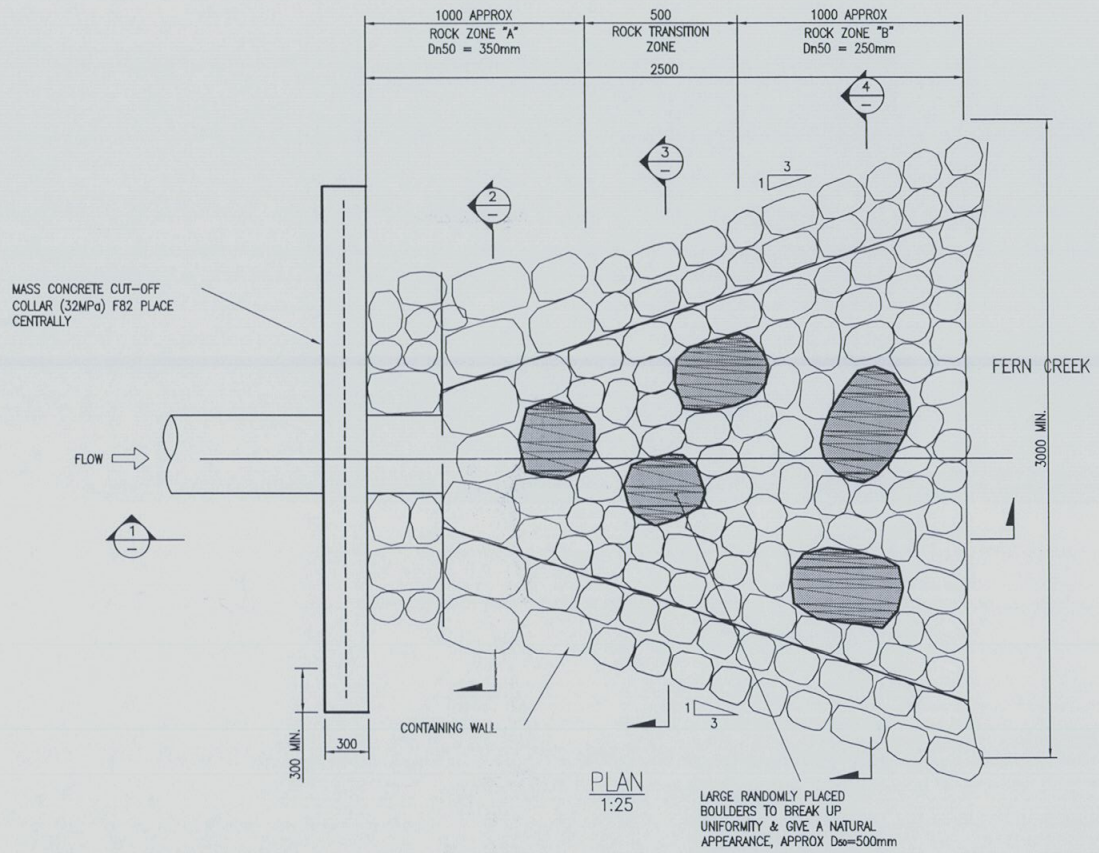
A1



PLAN
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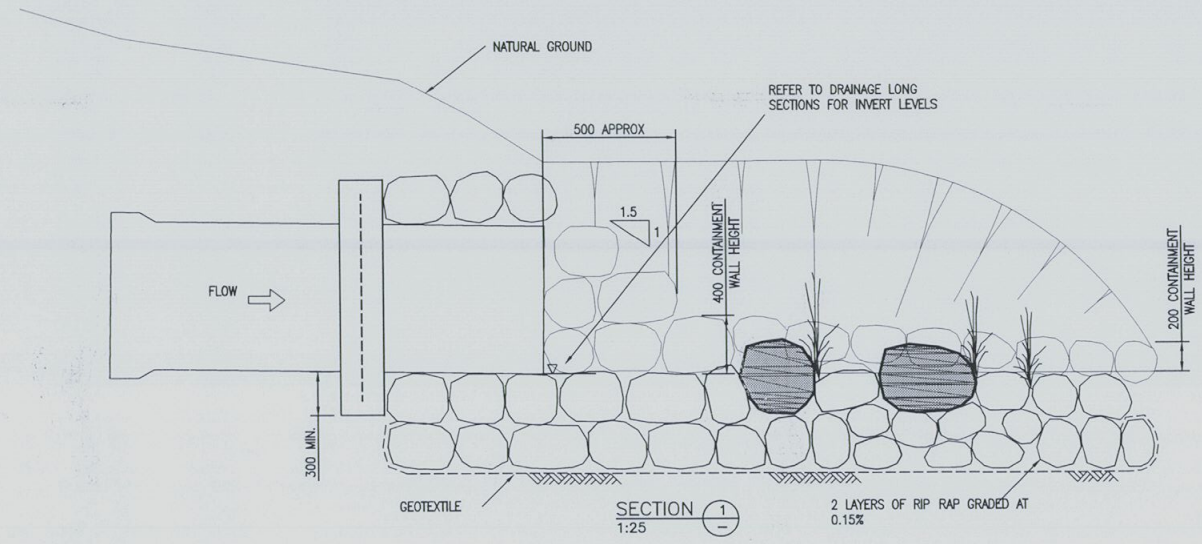

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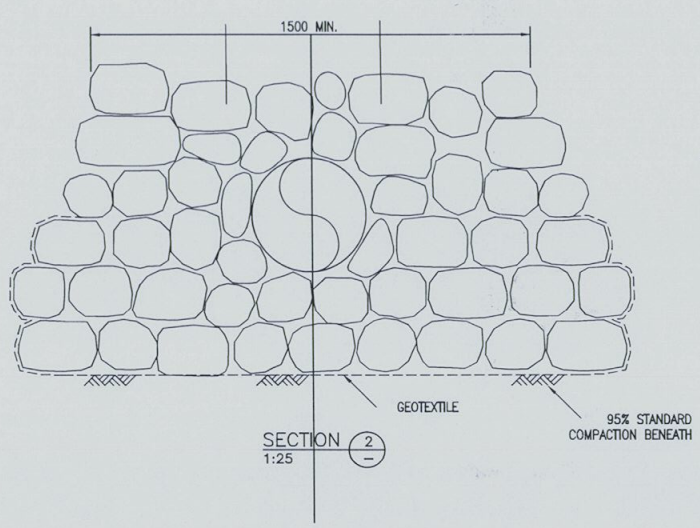

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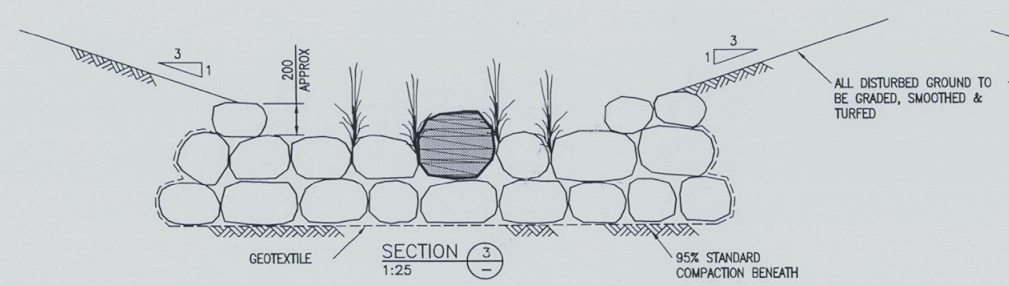

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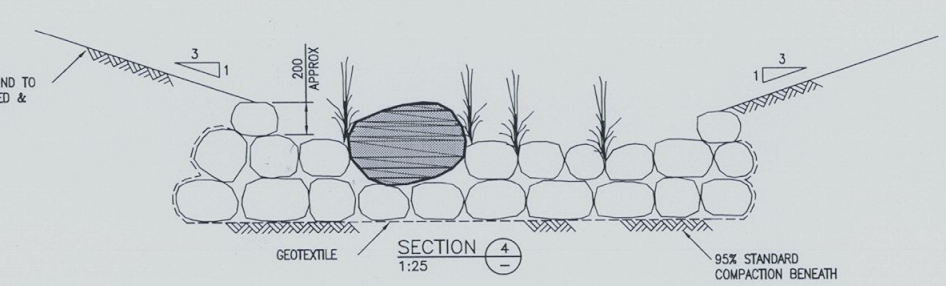

SECTION 4
1:25

PIPE OUTLET STABILISATION DETAIL
1:25

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LOT 11 SECTION C D.P.5464
Cnr. GARDEN & MACPHERSON STREETS
WARRIEWOOD

Principal:	WARRIEWOOD PROPERTIES PTY LTD				
Scale	1:100 NAT.	Date	8.11.13	Council Ref.	
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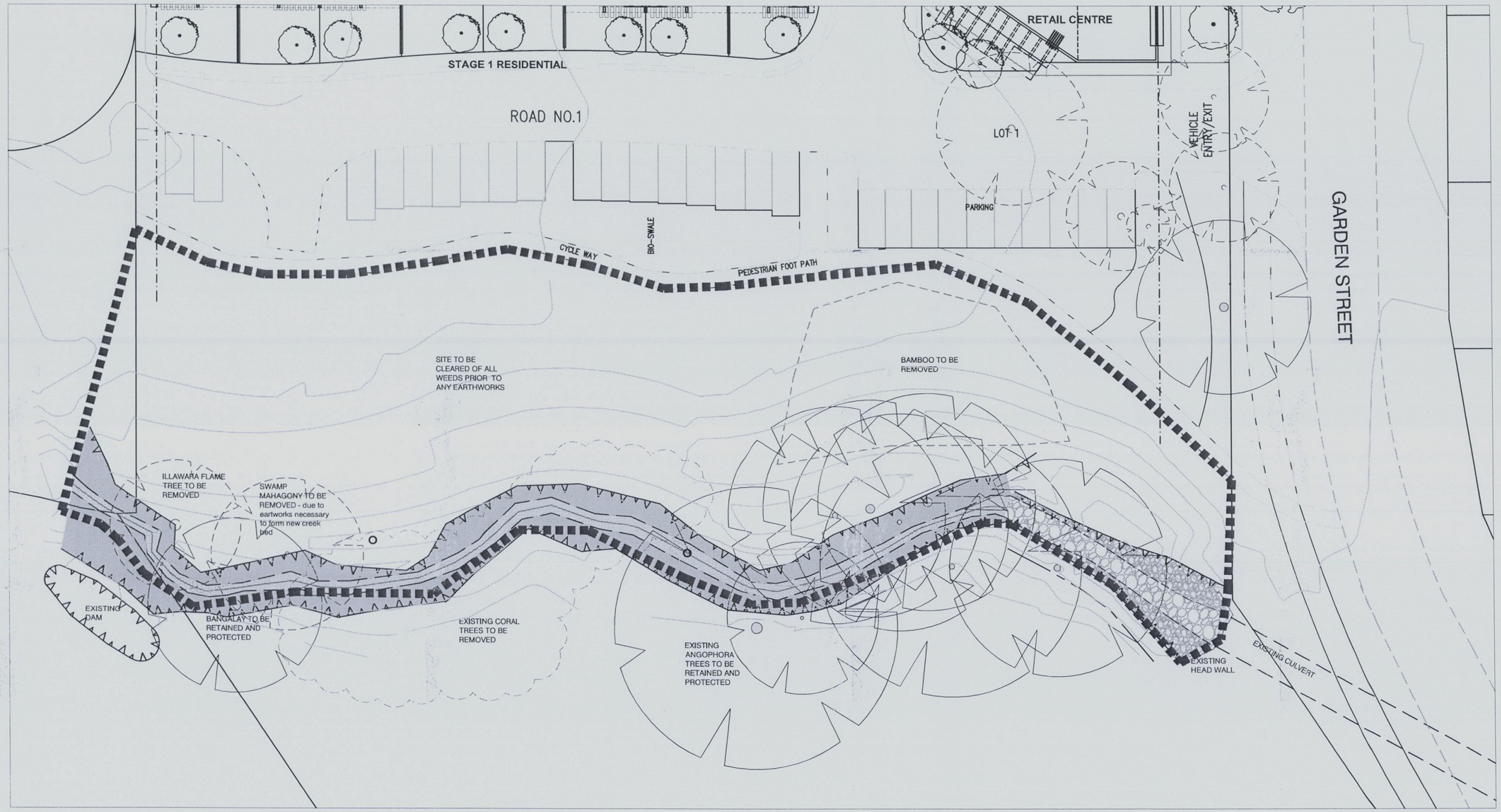

LEGEND

- EXTENT OF WEED REMOVAL UNDER VMP
- EXISTING TREES TO BE REMOVED
- EXISTING TREES TO BE RETAINED AND PROTECTED
- EXISTING CREEK ALIGNMENT

SCALE 1:200 @ A1

0 1 5m 10m 15m 20m

ISSUE	REASON	DATE
A	Submission to Office of Water	15.11.13
B		

WARRIEWOOD RESIDENTIAL VILLAGE

CORNER OF GARDEN & MACPHERSON STREET
WARRIEWOOD NSW 2102

FERN CREEK Vegetation Management Plan
EXTENT OF WORKS

SCALE 1:200 @ A1
JOB No. 0822 DWG L02

Issue B
DATE: November 2013

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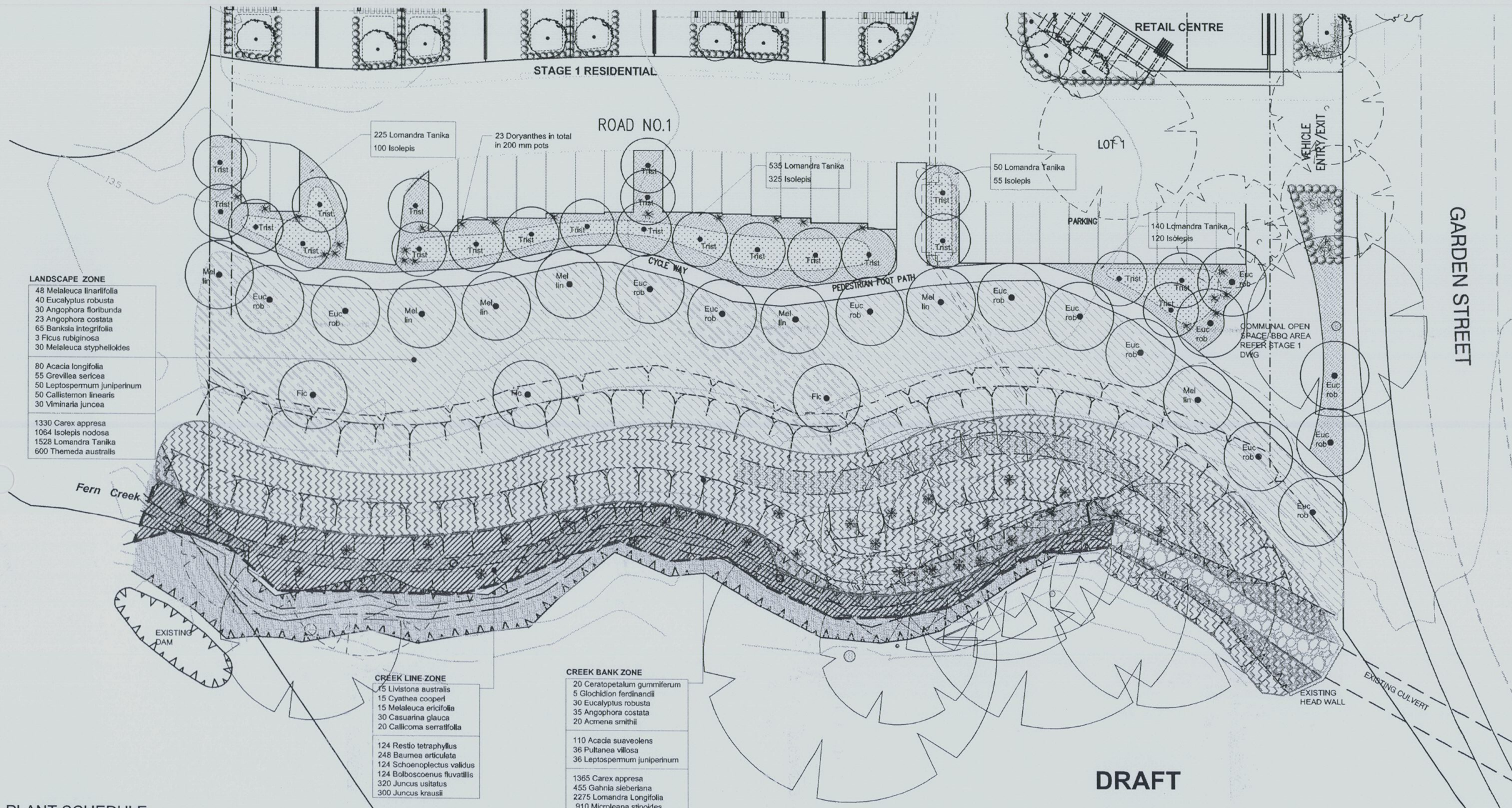


LANDSCAPE ZONE

48 Melaleuca linariifolia
40 Eucalyptus robusta
30 Angophora floribunda
23 Angophora costata
65 Banksia integrifolia
3 Ficus rubiginosa
30 Melaleuca styphelioides

80 Acacia longifolia
55 Grevillea sericea
50 Leptospermum juniperinum
50 Callistemon linearis
30 Viminaria juncea

1330 Carex appresa
1064 Isolepis nodosa
1528 Lomandra Tanika
600 Themeda australis

CREEK LINE ZONE

15 Livistona australis
15 Cyathea cooperi
15 Melaleuca ericifolia
30 Casuarina glauca
20 Callicoma serratifolia

124 Restio tetraphyllus
248 Baumea articulata
124 Schoenoplectus validus
124 Bolboscoenus fluviatilis
320 Juncus usitatus
300 Juncus krausii

CREEK BANK ZONE

20 Ceratopetalum gummiferum
5 Glochidion ferdinandii
30 Eucalyptus robusta
35 Angophora costata
20 Acmena smithii

110 Acacia suaveolens
36 Pultanea villosa
36 Leptospermum juniperinum

1365 Carex appresa
455 Gahnia sieberiana
2275 Lomandra Longifolia
910 Microleana stipoides

DRAFT

VEGETATION MANAGEMENT ZONES MANAGEMENT OBJECTIVES

(Approximate extent)

CREEK LINE LOW RESILIENT ZONE 310 m²

- Large scale eradication of woody weeds by mechanical means - prior to earthworks
- Removal of seed heads, tubes and other productive parts from site
- Removal of foreign fill/sediments and rubbish from within the creek
- Removal of all exotic trees
- Bank stabilisation with jutematting on slopes steeper than 1:3
- Installation of layer of crushed sandstone or other suitable planting mix.
- Installation of 'habitat' timber logs
- Full replanting using tubestock as per schedule
- Secondary follow up weeding/ sparying
- Full long term maintenance program

CREEK BANK LOW RESILIENT ZONE 910m²

- Large scale eradication of woody weeds by mechanical means - prior to earthworks
- Removal of seed heads, tubes and other productive parts from site
- Removal of foreign fill/sediments and rubbish from within the creek
- Removal of all exotic trees
- Bank stabilisation with jutematting on slopes steeper than 1:3
- Installation of layer of crushed sandstone or other suitable planting mix.
- Installation of 'habitat' timber logs
- Full replanting using tubestock as per schedule
- Secondary follow up weeding/ sparying
- Full long term maintenance program

LANDSCAPE ZONE 1330m²

- Large scale eradication of woody weeds by mechanical means - prior to earthworks
- Removal of seed heads tubes and other productive parts from site
- Installation of min 100mm thick layer of woodchip sourced from onsite native trees deemed for removal
- Secondary follow up weeding/ sparying
- Full replanting using tubestock as per schedule
- Full long term maintenance program

BIOSWALE ZONE

- Establishment of bioswales with appropriate filter media and gravel mulch on top
- Planting as per schedule / 2 year maintenance

FOR MORE DETAILS REFER TO VEGETATION MAMAGEMENT PLAN REPORT prepared by UMBACO, DATED Nov. 2013

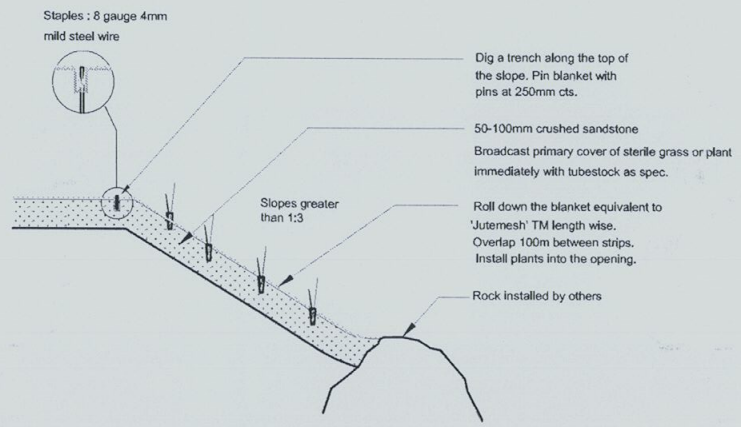
LEGEND

- Mel lin — PROPOSED NEW TREES
- EXISTING TREES TO BE REMOVED
- EXISTING TREES TO BE RETAINED AND PROTECTED
- EXISTING CREEK ALIGNMENT

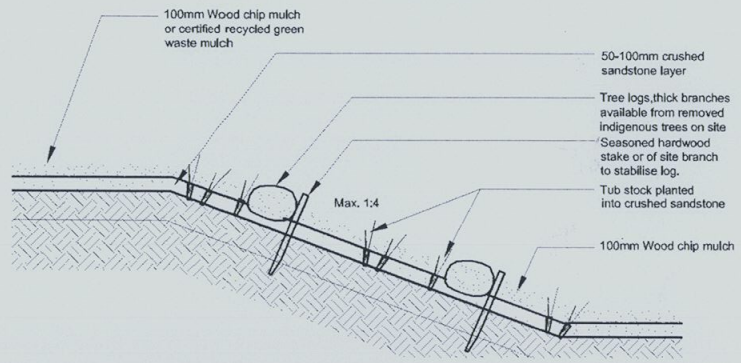
PLANT SCHEDULE

	Botanical name	Location	No	Size	Spacing
	TREES				
	Angophora costata	Terrestrial	58	tube	1/5m²
	Angophora floribunda	Terrestrial	30	tube	1/5m²
	Acmena smithii	Near channel	20	tube	1/5m²
	Banksia integrifolia	Terrestrial	65	tube	1/20m²
	Callicoma serratifolia	Near channel	20	tube	1/5m²
	Casuarina glauca	Near channel	30	tube	1/5m²
	Glochidion ferdinandii	Near channel	5	tube	1/5m²
	Melaleuca linariifolia	Terrestrial	39	tube	1/5m²
Mel lin	Melaleuca linariifolia	Along cycle path	7	75L	at 7m cts
	Ceratopetalum gummiferum	Terrestrial	20	tube	1/5m²
	Eucalyptus robusta	Terrestrial	40	tube	1/5m²
Euc rob	Eucalyptus robusta	Along cycle path	14	75L	at 7m cts
	Melaleuca ericifolia	Terrestrial	15	tube	1/5m²
	Melaleuca styphelioides	Terrestrial	30	tube	1/5m²
Fic	Ficus rubiginosa	Terrestrial	3	tube	1/50m²
Trist	Tristaniopsis laurina Luscious	Carpark Bioswale	22	45L	at 5m cts
	TREE FERNS/ PALMS/ CYCADS				
❋	Cyathea australis	As shown	15	200mm	
❋	Livistona australis	As shown	15	200mm	

Botanical name	Location	No	Size	Spacing
SHRUBS 1/5m²				
Acacia longifolia	Terrestrial	80	tube	1/5m²
Acacia suaveolens	Terrestrial	110		
Leptospermum juniperinum	Terrestrial	86		
Pultanea villosa	Terrestrial	36		
Grevillea sericea	Terrestrial	55		
Viminaria juncea	Terrestrial	30		
Callistemon linearis	Terrestrial	50		
GRASSES MARGINAL DEPRESSION IN CHANNEL				
Restio tetraphyllus	Near channel	124	tube	4/m²
Baumea articulata, junce , rubiginosa	Near channel	248		4/m²
Schoenoplectus validus	Near channel	124		4/m²
Bolboscoenus fluviatilis	In rock channel	124		4/m²
Carex appresa	In depressions	2695		5/m²
Gahnia sieberana	In depressions	455		3/m²
Juncus usitatus	Near channel	320		4/m²
Juncus krausii	Near channel	300		4/m²
GRASSES TERRESTRIAL 4/m²				
Lomandra longifolia	banks, dry areas	2275	tube	4/m²
Lomandra Tanika	banks, dry areas	1528		
Isolepis nodosa	banks, dry areas	1064		
Microleana stipoides	banks, dry areas	910		
Themeda australis	banks, dry areas	600		
Lomandra Tanika	Carpark	950	100mm	4/m²
Isolepis nodosa	Carpark Bioswale	600	100mm	4/m²
Doryanthes excelsa / palmeri	feature shrub	23	200 mm	as shown



1 - INSTALLATION OF JUTEMAT AND PLANTING
Cross section Scale 1 : 25



2 - HABITAT TIMBER LOGS
Cross section Scale 1 : 25

SCALE 1:200
0 1 5m 10m 15m 20m

ISSUE	REASON	DATE
A	Submission to Office of Water	15.11.13
B		

WARRIEWOOD RESIDENTIAL VILLAGE

CORNER OF GARDEN & MACPHERSON STREET
WARRIEWOOD NSW 2102

FERN CREEK Vegetation Management Plan PLANTING PLAN

SCALE 1:200 @ A1
JOB No. 0822 DWG L01

Issue B
DATE: November 2013

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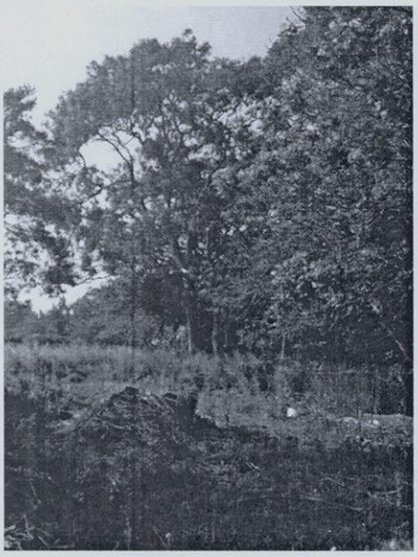
VEGETATION MANAGEMENT PLAN

For the rehabilitation of Fern Creek at Warriewood

Prepared for

Warriewood Properties

November 2013
ISSUE B



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COMMERCIAL IN CONFIDENCE

1. INTRODUCTION

1.1 AIMS

The study area containing a portion of Fern Creek corridor is located in between Garden Street and Lomandra Way in Warriewood. The main purpose of this project is to repair and rehabilitate the riparian corridor consistent with rehabilitation works carried out immediately upstream.

The corridor is contained within the zone up to 40 m wide and over 115 m long.

Figure from the Warriewood Valley Flood Study

The Vegetation Management Plan (VMP) works will become essential part of creek reconstruction works, which will result in a significant increase in available waterway area and hence greatly improve flood conveyance. This plan shall be read in conjunction Fern Creek civil design drawings prepared by Craig and Rhodes. The proposed design alignment will result in a gentle meander of the creekline. This will allow development of a geomorphologically stable form of natural creek beds and adjoining creek banks. A pool and rifle system will be incorporated within the low flow channel to further assist in improvement of water quality and increase of habitat values. The proposed rock riffles will be consistent with those upstream sections of Fern Creek and will be implemented in approximately 25 m intervals. The proposed vegetation layering will reflect creek morphology and appropriate terrestrial species will be planted to creek banks, while semiaquatic species will be used for riffle and pool elements.

All vegetation management works must be carried out in accordance with the latest guidelines of NSW Office of Water, NSW Fisheries and NSW Rural Fire Service.

The aims of this VMP are to:

- To rehabilitate the creek channel with appropriate locally indigenous species
- To make substantial improvement in the visual amenity of area
- To continue on riparian rehabilitation upstream and downstream
- To protect and improve the health of the ecosystem
- To protect and enhance the populations of existing indigenous plant communities and fauna habitats
- Reconstruct and broaden the floristic diversity of bushland within the corridor
- Manage stormwater flow throughout the site
- Facilitate and improve the reserve's function as a wildlife corridor

- To increase public awareness and involvement of residents in the protection of bushland and bush regeneration programs

1.2 STATEMENT OF SIGNIFICANCE

The creek corridor is locally significant given that:

- This portion of creek is a missing link in riparian rehabilitation works on Fern Creek
- Completion of this project will allow for a continuous ecological corridor along the Fern Creek

2 METHODOLOGY

The field assessment has been carried out by Jana Osvald of UmbaCo Landscape Architects on 25 October 2013 and based on the work by Les Robinson, 'field guide to the native plants of Sydney. Our work is carried out in coordination with Craig and Rhodes Engineers responding to the proposed morphology of the creek. The selection of appropriate indigenous pant species was based on species nominated by Pittwater Council in Warriewood Valley and in coordination with Council's Bushcare Officer.

3 SITE DESCRIPTION

Location

The project area is located Warriewood, Pittwater Council municipality. The area is bounded by Garden Street to the south, and Lomandra Way to the North.

Refer to the **Location Map** for the general location of the site.

Geomorphology

The substrate geology of the site belongs to Narrabeen group shales.

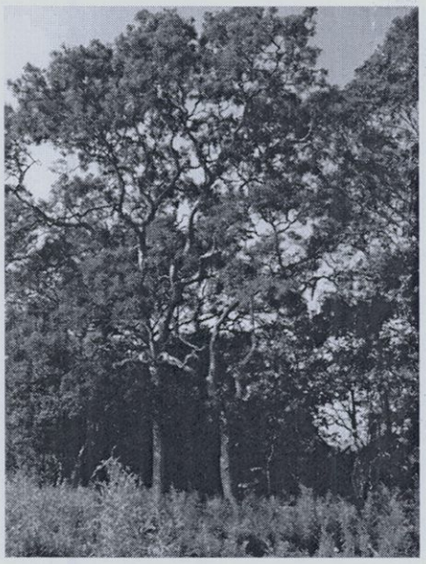
Climate

Proximity to the Pacific Ocean and Pittwater, the high rainfall, between 1200 and 1400 mm per year and absence of frost influence much if the local vegetation. (Benson & Howell, 1990)

Plant community

Original vegetation

Original vegetation belongs to *'Swamp Mahogany Open Forest wet sclerophyll understorey'*. The dominant species of this vegetation group is represented by Swamp Mahogany (Eucalyptus robusta), Smooth Bark Apple (Angophora costata) and Broad leafed Paperbark (Melaleuca quinquenervia). The understorey is usually represented by wattles such as *Acacia longifolia*, bottlebrushes such as Callistemon linearis, small paperbarks including *Melaleuca ericifolia* and *Melaleuca linearifolia*. Swamp She oak (Casuarina glauca) will be established in swampy areas and on the creek banks.



A number of large healthy *Angophora costata* specimen are remnant within the creek corridor

A thicket of Bamboo growth is present on eastern sides of the creek corridor

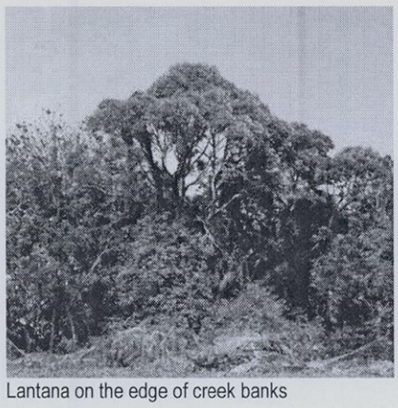
Further native grasses such as *Lomandra longifolia, Carex appressa, Commelina sp.,* reeds and rushes such as *Isolepis, Juncus usitatus, Gahnia sieberana* and *Baumea sp* would be present.

Existing site vegetation

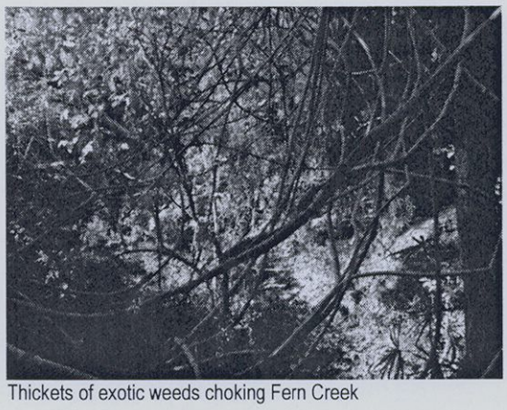
A number of large indigenous remnant trees are prevailing along the creek these include : Angophora costata and Eucalyptus robusta. There is no native understorey along the creek and under the remnant trees, understorey is entire formed by exotic species.

Exotic plants

The entire creek corridor is severely infested with exotic understorey and some tree species. The most dominant species include : Coral trees, *Lantana camara, Bamboo species, Camphor Laurel, Castor Oil plant and Privet . For a full list refer to Appendix .*



Lantana on the edge of creek banks



Thickets of exotic weeds choking Fern Creek

Native fauna

According to Pittwater Council there are over 80 species of native birds, 8 species of native mammals, 9 species of reptiles and frogs recorded in general area of Warriewood Wetlands.
Dogs, cats and foxes have almost certainly contributed to the disappearance of some wildlife from the area.
No specific fauna assessment has been carried out for the purpose of this project. However, we can assume that the existing creekline does present an important link to fauna habitat in the immediate local area and upstream in particular.

Characteristically, the birds were the most diverse group of vertebrates noted in the project area. These could include some common birds living in residential areas such as Sulfur Crested Cockatoo, Eastern Rosellas, Rainbow Lorikeet, Maned Wood Duck, Laughing Kookaburra, a number of Honeyeater species, Australian Raven, Magpie-lark and many others.

Reptiles and amphibians along the creek channel would also be expected.

Mammals would most likely include Common Brush Tail Possum, Brushtail Tail Possum, Grey Headed Flying Fox, Long-nosed Bandicoot and Sugar Glider.

5 SITE WORKS

5.1 PROTECTION OF THE CREEK CORRIDOR during construction

The following list of measures will apply for works in riparian corridor :

- The creek corridor is to be sign posted during construction works and nominated as a *'Bushland Protection Zone'*
- All construction activity should access the site as directed by the superintendent.
- All weed species including exotic trees, woody weeds, annual and climbers must be removed **prior to any earthworks** including the seed propagules. Seeds must be bagged and disposed off the site without further contamination of the site.
- Within *'Bushland Protection Zone'* there is to be no storage of materials or site office/ sheds, nor is cement to be mixed or chemicals spilt / disposed of in the area, no stockpiling of soil or rubble, or any other construction works.
  No topsoil shall be removed from, or added to, the area within the drip line of the trees deemed for retention.
  Excavation: If excavation is required near trees to be retained, give notice and obtain instructions. Open up excavations under tree canopies for as short a period as possible.
- The contractor will be directed to only remove the marked trees .

5.2 REMOVAL OF EXOTIC TREES

- The contractor will be directed to only remove the marked trees .
- All exotic trees including Coral trees, Bamboo and Camphor laurel shall be removed and disposed off the site
- Refer to **Umbaco Landscape Architects Fern Creek Rehabilitation Plan** for removal of select trees as detailed in SCHEDULE OF EXISTING TREES

5.3 EROSION AND SEDIMENT CONTROL PLAN

- An Erosion and Sediment Control Plan (ESCP) must be completed and adhered to during every stage of the development in accordance with The Department of and Natural Resources (DIPNR) guidelines and relevant Pittwater Council procedures
- The ESCP must be implemented prior to any site works commencing.
- For details of ESCP refer to *Craig and Rhodes Engineers* documentation.

5.4 RESTRICTION OF ACCESS

- Public Access through the reserve shall be restricted during the construction works

5.5 SEEDBANK CONSERVATION

Soil

No introduced soil or landfill material shall be deposited within the 'Bushland Protection Zone'. Contaminated site topsoil unsuitable for bushland shall be discarded off the site or capped by clean layer of crushed sandstone.

Brush matting material

Branches from Swamp mahogany deemed for removal shall be used for creek stabilisation. Any other suitable material such as Eucalyptus, Angophora branches, Casuarina and Acacia twigs from outside of 'Bushland Protection Zone' must be stockpiled for later use. Brush material shall be stockpiled over the jutemating fabric to capture any fallen seeds.
This material shall be available for re-use in creek rehabilitation work. Timber such as hollow logs and trunks shall be utilised to stabilise the creek bank and enhance the habitat opportunities along the creek. Branches must be securely pegged in.

6 PREPARATORY WORKS

6.1 SEED COLLECTION

- Arrangements shall be made with a local supplier prior to construction to allow time for seed collection and propagation of tube stock (6 months to 1 year) depending on the season.
- Seeds shall be collected from local area of up to 10 km from the site. Seed \ propagule collection should reflect a planting mix used for this site.
- Alternatively, the plants shall be propagated from the seedstock collected in the local area previously by a licensed seed collector or nursery located within Pittwater LGA.

The following items shall be requested on a Seed Collection Record Sheet to assure quality of seeds collected :

a) species
b) address
c) location / habitat
d) geology / soil type
e) plant association
f) position on slope
g) frequency on site
h) degree of difficulty to collect
i) date collected
j) collector's name

6.2 PLANT PROPAGATION

- Plants shall be propagated from locally provenanced collected seeds \ propagules as noted above.
- Plants shall be planted as forestry tube stock size as a minimum.

7 MANAGEMENT ZONES

The site can be broken down into the two main Riparian **Management Zones** based on treatments required:

- **LOW RESILIENT ZONE** stretching along creek corridor and its newly created batters
- **LANDSCAPE ZONE** is located on flat areas adjacent to 'landscaped corridor' on northern side of the creek
- **BIOSWALE ZONE** is located between new cycleway and carpark

7.1 LOW RESILIENT ZONE

Features
The entire creek channel is severely invaded by woody, climbing and groundcover weed species with little remnant native vegetation. There is little prospect of natural revegetation due to lack of visible seeds in soil store seed bank and due to a complete re-grading of the creek.

Management objectives

- Large scale eradication of woody weeds by mechanical means – prior to earthworks
- Removal of seed heads, tubes and other reproductive parts from the site
- Removal of foreign fill/sediments and rubbish from within the creek
- Removal of all exotic trees
- Bank stabilisation with Jutematting and on slopes steeper than 1:3;
- Installation of layer of crushed sandstone or other suitable planting mix
- Installation of 'habitat' timber logs
- Full re -planting using tubestock as per schedule
- Secondary follow up weeding / spraying
- Full 2 year maintenance program

7.2 LANDSCAPE ZONE

Features
This zone acts as a buffer strip to immediate creek zone. It is currently infested with annual weeds, turf and thicket of bamboo growth.
The area will be regraded as part of creek works.

Management objectives
This zone requires structured bushregeneration techniques combined suppressing of any future weed growth. This method will include :

- Large scale eradication of woody weeds by mechanical means – prior to earthworks
- Removal of seed heads, tubes and other reproductive parts from the site
- Installation of a min 100 mm thick layer of woodchip sourced from on site native trees deemed for removal
- Secondary follow up weeding / spraying
- Full re -planting using tubestock as per schedule
- Full 2 year maintenance program

7.3 BIOSWALE ZONE

Features
Bioswales are established to participate in the stormwater treatment train. The drainage, filter media and soil will be installed in accordance with Craig and Rhodes specifications.

Management objectives
- planting of appropriate macrophytic species suitable for bioswales, Refer plant schedule

8 BUSH REGENERATION AND REVEGETATION WORKS

8.1 BUSHREGENERATION CONTRACTOR

The work program must be completed by a qualified Bushregeneration Company. All the works must be supervised by a TAFE (or equivalent) trained Bush Regeneration Supervisor who is familiar with the standard techniques and who must have had at least 1 year of experience as a supervisor.

Prior to any work on site the bushregeneration contractor must establish a working plan including the following steps :

- Clarify the extent of above identified riparian management zones within the project area
- Detail the management needs of every zone
- Carry out photographic evidence of each zone prior to any site works
- Provide a timeframe and a flexible program for the completion of each phase of the works

8.2 WEED ERADICATION

The process of weeding should occur in three stages:

Primary weeding : the treatment of all mature woody weeds.
Removal of weeds by mechanical means and broad spraying must occur prior to any earthworks on site; The use of excavator with a mulching head should be considered, such excavator is able to mulch woody weeds to the ground which can reduce a need for removal of portion of waste.
Collection and disposal of seed heads, tubes and other reproductive parts from the site
Secondary weeding : this would be predominantly hand weeding to assist in native regeneration.

Maintenance weeding : The ongoing treatment of the weeds in soil stored weed propagules.
Grass weeds shall be eventually suppressed by gradual overshading of areas.

Methods

- Eradicate weeds using environmentally acceptable methods, such as a non-residual glyphosate herbicide in any of its registered formulae, at the recommended maximum rate.
- Weed suppression using jutemating and thick mulch layer
- All seed and propagules should be removed from the plant prior to it being treated. All weeds should be continually suppressed and not allowed to seed. Annual weeds should be controlled at least until plantings are established and when naturally regenerating areas are stable.
- Assess all weeds acting as animal habitat prior to removal

8.3 WILDLIFE HABITAT

- Provide rocks, timber from fallen native trees and protected nest sites for shelter, foraging sites and breeding within the creek area.

8.4 REVEGETATION WORKS

Refer plan schedule on Dwg. L01 for specified plant species and densities.

Stabilise the surface

- Jute-meshing / terracing to areas steeper than 1 : 3
- Jute-meshing as a weed control
- Use of thick layer of mulch such as recycled green waste mulch product (gromulch)
- Clean crushed sandstone

Note : jutemeshing must be rapidly biodegradable.

Planting media
Import **clean crushed sandstone**. (Virgin Excavated Natural Media)
Plant into existing site topsoil toped up with **50 -100 mm layer** of crushed sandstone.
Where required regrade existing levels to remove depressions.
Lightly compacted to improve soil stability

Woodchip Mulch sourced from shredded native trees on site at a **100 to 150 mm layer**
Location : on all areas to be planted / over crushed sandstone
A 3 months fallow to settle in shall be allowed to avoid nitrogen deficit at planting.;

Recycled green waste mulch – GroMulch at 150 mm layer

Fertiliser
Provide a low phosphorus slow release fertiliser

Planting
Only plant material propagated from locally provenanced seeds shall be used.

General: Trees shall be planted as tubestock with the following characteristics:
Large healthy root systems, with no evidence of root curl, restriction or damage.
Vigorous, well established, free from disease and pests, of good form consistent with the species or variety.
Hardened off, not soft or forced, and suitable for planting in the natural climatic conditions prevailing at the site.
Replacement: Replace damaged or failed plants with plants of the same type and size.

Storage
Deliver plant material to the site on the day they are to be installed, and plant immediately after delivery.

Planting conditions
Do not plant in unsuitable weather conditions such as extreme heat, cold, wind or rain. In other than sandy soils, suspend cultivation activities when the soil is wet, or during frost periods.

Soil preparation
Soil moisture levels shall be at or above field capacity ie approximately 50 mm of rain in the week preceding planting. Do not rip the soil on the slope.

Watering
Thoroughly water the plants before planting, immediately after planting, and as required to maintain growth rates free of stress. Less frequent heavy watering is preferable to light watering. The soil moisture content needs to be assessed daily and watering regime adjusted accordingly.

Water retaining polymer: use water crystals such as 'Alcosorb 400' or equivalent. Apply as per recommended rates per each plant.

Placing
When planting into either rip lines or holes the size of the hole shall be at least twice the size of the plant root ball. The hole shall be heavily watered immediately prior to planting and should have ample loose soil to ensure that root soil contact is complete and that no air gaps exist. Clean crushed sandstone shall be used if excessive heavy clay or stones are found. A slight depression or raised lip shall be made around the plant to assist in the trapping and infiltration of water.

Fertilising
Provide native 'Osmocote' to individual plants when planting

Bagging
Use protective bags if there is a chance of animal grazing and / or weed competition is strong.

8.5 COMPLETION

Watering regime
High but not excessive soil moisture levels are essential to plant survival and longterm health. The first month after planting is the critical time for watering. The young plants will require a heavy watering every 3 days. If very hot or windy days are encountered soon after planting then additional watering will be required. A 50 mm of water per week as a minimum must be adopted as general guide.

Planting establishment
Throughout the planting establishment period, carry out maintenance work including, weeding, rubbish removal, pest and disease control, replanting, cultivating, reinstatement of brush matting. The site shall be kept neat and tidy in appearance at all times.

8.6 MONITORING AND MAINTENANCE

A **2 year** Maintenance and Monitoring Period is required following the final plantings.

A photographic monitoring point shall be set up before the start of work for the record. In addition take photos of surrounding weed infested areas. Data collection shall be repeated six monthly or as appropriate during progress of the works. Plant survival counts shall be carried out within the monitoring points. As a guide at least 95% plant establishment for one year shall be accomplished. The maintenance program and species list should be reviewed according to monitoring results. The weed densities shall also be assessed regularly and appropriate control actions undertaken if necessary.

The details shall be recorded photographically and in a form of spreadsheets and submitted to the Site Superintendent on six monthly basis. This information shall be presented in a brief report, including a summary addressing performance criteria as specified in this VMP. The problems encountered during the contract period should be identified and the maintenance program re-assessed accordingly. The six monthly reports shall be forwarded to Office of Water for the period of 2 years.

9 SUBMISSIONS

The following submissions are to be made during the works :

1. SEED COLLECTION DATA SHEET
2. REPORTS ADDRESSING PERFORMANCE CRITERIA ON 6 monthly basis

PERFORMANCE CRITERIA

TASKS	TARGETS / PERFORMANCE CRITERIA	ACTION / FREQUENCY
VEGETATION MANAGEMENT ZONES general	• Plants appear healthy and vigorous • Min. 90 % survival rate in the first year • final densities –in accordance with the densities listed on the Plant Schedules	• Disease and pest control assessment every 3 months, treatment as required • Spot spraying in areas where weeds are coming back • Water new plants (twice weekly if dry for two months • Six monthly data collection
In-channel rehabilitation	• On edges : erosion control works functional and effective • Rocks secured • Localised soil erosion addressed ASAP	• Repair / adjust as required • Assess after major rainfall event / major storm and restore / repair / adjust as required
WEED CONTROL	• Tree stumps after removal non active • Major weeds suppressed in the first year • Selective hand weeding / spraying around new plantings • Grassy weeds suppressed or localised	• Maintenance weeding 5 x year over two years • twice in winter, 3 times in following summer
SITE MANAGEMENT	• All key tasks set out in VMP performed to the specifications and timetable	• Delay in program justified • Any non-performance justified
	• Plant stock obtained from local seed and local nursery	• Verify source of purchase
	• Weed piles neatly assembled outside range of floodwaters	• Maintain neat site
	• General rubbish cleared off site	• Remove rubbish regularly
	• Sedimentation & erosion Control Plan implemented	• Review maintenance activities according to monitoring results • Maintain / ensure effective function continually

PROPOSED PLANT SCHEDULE

Botanical name	Location	No	Size	Spacing
TREES				
Angophora costata	Terrestrial	58	tube	1/5m²
Angophora floribunda	Terrestrial	30	tube	1/5m²
Acmena smithii	Near channel	20	tube	1/5m²
Banksia integrifolia	Terrestrial	65	tube	1/20m²
Callicoma serratifolia	Near channel	20	tube	1/5m²
Casuarina glauca	Near channel	30	tube	1/5m²
Glochidion ferdinandii	Near channel	5	tube	1/5m²
Melaleuca linariifolia	Terrestrial	39	tube	1/5m²
Melaleuca linariifolia	Along cycle path	7	75L	at 7m cts
Ceratopetalum gummiferum	Terrestrial	20	tube	1/5m²
Eucalyptus robusta	Terrestrial	40	tube	1/5m²
Eucalyptus robusta	Along cycle path	14	75L	at 7m cts
Melaleuca ericifolia	Terrestrial	15	tube	1/5m²
Melaleuca styphelioides	Terrestrial	30	tube	1/5m²
Ficus rubiginosa	Terrestrial	3	tube	1/50m²
Tristaniopsis laurina Luscious	Carpark Bioswale	22	45L	at 5m cts
TREE FERNS/ PALMS/ CYCADS				
Cyathea australis	As shown	15	200mm	
Livistona australis	As shown	15	200mm	
SHRUBS 1/5m²				
Acacia longifolia	Terrestrial	80	tube	1/5m²
Acacia suaveolens	Terrestrial	110		
Leptospermum juniperinum	Terrestrial	86		
Pultanea villosa	Terrestrial	36		
Grevillea sericea	Terrestrial	55		
Viminaria juncea	Terrestrial	30		
Callistemon linearis	Terrestrial	50		
GRASSES MARGINAL	DEPRESSION IN CHANNEL			
Restio tetraphyllus	Near channel	124	tube	4/m²
Baumea articulata, junce , rubiginosa	Near channel	248		4/m²
Schoenoplectus validus	Near channel	124		4/m²
Bolboscoenus fluviatilis	In rock channel	124		4/m²
Carex appresa	In depressions	2695		5/m²
Gahnia sieberana	In depressions	455		3/m²
Juncus usitatus	Near channel	320		4/m²
Juncus krausii	Near channel	300		4/m²
GRASSES TERRESTRIAL 4/m²				
Lomandra longifolia	banks, dry areas	2275	tube	4/m²
Lomandra Tanika	banks, dry areas	1528		
Isolepis nodosa	banks, dry areas	1064		
Microleana stipoides	banks, dry areas	910		
Themeda australis	banks, dry areas	600		
Lomandra Tanika	Carpark	950	100mm	4/m²
Isolepis nodosa	Carpark Bioswale	600	100mm	4/m²
Doryanthes excelsa / palmeri	feature shrub	23	200 mm	as shown

APPENDIX B – SITE WEED SPECIES LIST

Anredera cordifolia (Madeira Vine)
Balloon Vine (CArdiospermum grandiflorum)
Bamboo
Camphor laurel (Cinamonum camphora)
Castor Oil Plant
Cirsium vulgare (Black thistle)
Cestrum parqui (Green Cestrum)
Conyza sp. (Fleabane)
Cynodon dactylon (Couch)
Erythrina crista-gali (Coral Tree)
Ipomoea indica (Morning Glory)
Lantana camara
Ligustrum lucidum (Large leaved Privet)
Ligustrum sinense (Small leaved Privet)
Mysiphylum scandens (Asparagus)
Ochna serrulata
Paspalum dilatatum
Pennisetum clandestinum (Kikuyu)
Plantago lanceolata (Robwort)
Protasparus aethiopicum (Fern Asparagus))
Sida Rhombifolia
Sonchus oleraceus (Common sowthistle)
Tradescantia albiflora (Wandering Jew)
Trifolium spp. (Clover)

BIBLIOGRAPHY

Benson, D. & Howell, J. (1990a). *Taken for granted: the bushland of Sydney and its suburbs.* Kangaroo Press

APPENDIX A -
COUNCIL CHECKLIST

DOCUMENTATION CHECKLIST - CONSTRUCTION CERTIFICATE

(Detach and include with submissions)

Section	Item	Requirement	Check (√)
4.1	Water Cycle Assessment - Water Balance Modelling Pre & Post Development		
4.1.1	Stream Gauging, infiltration testing and use of local rainfall data for modelling		
4.2.1	Water Quality Monitoring Plan	♦♦♦♦♦♦♦♦	√
4.2.1	Water Quality Monitoring Sites Shown on Plan (at least three)	♦♦♦♦♦♦♦♦	√
4.2.1, 2, C	Water Quality Monitoring Data	♦♦♦♦♦♦♦♦	√
4.2.1, 2, C	Assessment and interpretation of water quality monitoring data	♦♦♦♦♦♦♦♦	√
4.2.1, 2, C	Assessment and interpretation of water quality monitoring data from SQID's		
4.3	Water Quality Management Assessment - Load Modelling Pre and Post Development		
4.3.1, 3	Justification of assumptions for Event Mean Concentrations		
4.3.2	Identification of and details for Stormwater quality facilities	++++++++++	√
4.3.2, 4.4.5	Mosquito Risk Assessment for both Watercourse and Water Quality/Quantity features	++++++++++	√
4.3.6, 4.6.5	Inspection and Cleaning Reports for SQID's and OSD		
4.3.6	Management Plan for Stormwater Quality Improvement Devices	++++++++++	√
4.3.5	Environmental Management Plan (Soil and Water Aspects)	++++++++++	√
4.3.4	Erosion and Sediment Control Plan	++++++++++	√
4.4.3, 4, 5	Existing and Proposed Creek Corridor in plan with cross/long sections with flood levels	+++Note 1+++	√
4.4.4	Proposed Creek Corridor Planting Schedule	+++Note 1+++	√
4.4.5	Creek Corridor Vegetation Monitoring and Management Plan	♦♦Note 1♦♦	√
4.4.5	Vegetation and Creek Maintenance and Monitoring Reports		
4.5	Flood Analysis – existing design conditions	♦♦♦♦♦♦♦♦	√
4.5.2	Compliance of structures and creek corridor with flood planning levels	++++++++++	√
4.5.4	Details of Interim Flood Protection Works	++++++++++	√
4.6.3	Design Storm Hydrological Modelling of Site - Pre and Post Development	♦♦♦♦♦♦♦♦	√
4.6.3	On-Site Detention Facilities	++++++++++	√
4.6.4	Stormwater Retention Facilities	++++++++++	√
4.7	Stormwater Concept Drainage Plan		

KEY:

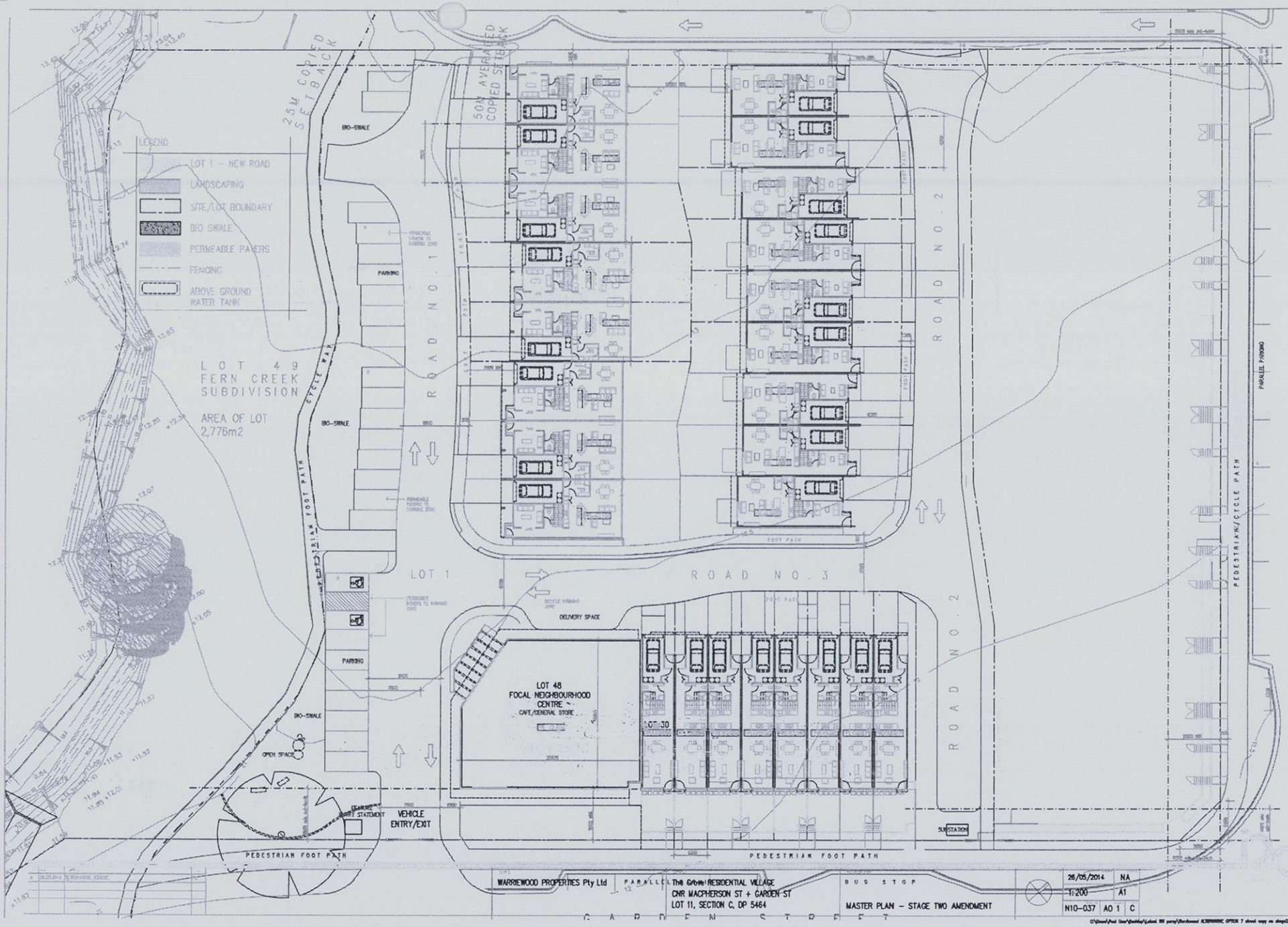
	Preliminary Calculations/Assessment Required		*Work as Executed Plans*
	Concept Design Required	♦♦♦♦♦♦	*Required/Reviewed/Updated*
+++++++	*Detailed Assessment/Calculations/Design*		*Not required*

Note 1 Even if the works are not to be constructed by the Applicant on the land to be transferred to Council under the Material Public Benefit Option in the Section 94 Plan, preliminary investigation for Rezoning and concept design at DA stage is required

Completed by Principal Certifier:

Name: Michael Shaw
Title: Principal, CPEng, NPER(civil), BPB0816
Organisation: Civil Certification
Signature:
Date: 5/11/14

APPENDIX B -
PROPOSED DEVELOPMENT LAYOUT


LEGEND
LOT 1 – NEW ROAD
LANDSCAPING
SITE/LOT BOUNDARY
BIO SWALE
PERMEABLE PAVERS
FENCING
ABOVE GROUND WATER TANK
25M COPIED SETBACK
50M AVERAGED COPIED SETBACK
BIO-SWALE
PARKING
LOT 49
FERN CREEK SUBDIVISION
AREA OF LOT 2,776m2
CYCLE WAY
PEDESTRIAN FOOT PATH
ROAD NO. 1
ROAD NO. 2
ROAD NO. 3
LOT 1
DELIVERY SPACE
LOT 48
FOCAL NEIGHBOURHOOD CENTRE
CAFE/GENERAL STORE
LOT 30
OPEN SPACE
VEHICLE ENTRY/EXIT
SUBSTATION
PARALLEL PARKING
PEDESTRIAN/CYCLE PATH
BUS STOP
GARDEN STREET
WARRIEWOOD PROPERTIES Pty Ltd
PARALLEL The Grove RESIDENTIAL VILLAGE
CNR MACPHERSON ST + GARDEN ST
LOT 11, SECTION C, DP 5464
MASTER PLAN – STAGE TWO AMENDMENT
26/05/2014
NA
1:200
A1
N10-037
AO 1
C

APPENDIX C -
NOT USED

APPENDIX D -
MUSIC RESULTS

MUSIC Results CC Stage.
23 B Macpherson Street, Warriewood

Civil Cert

Existing

Source nodes

```
Location,Ex Riparian ,Ex Cleared Site
ID,2,4
Node Type,ForestSourceNode,ForestSourceNode
Total Area (ha),0.137,1.297
Area Impervious (ha),0,0
Area Pervious (ha),0.137,1.297
Field Capacity (mm),150,150
Pervious Area Infiltration Capacity coefficient - a,100,100
Pervious Area Infiltration Capacity exponent - b,0.65,0.65
Impervious Area Rainfall Threshold (mm/day),1.5,1.5
Pervious Area Soil Storage Capacity (mm),400,400
Pervious Area Soil Initial Storage (% of Capacity),25,25
Groundwater Initial Depth (mm),20,20
Groundwater Daily Recharge Rate (%),0.55,0.55
Groundwater Daily Baseflow Rate (%),0.65,0.65
Groundwater Daily Deep Seepage Rate (%),0,0
Stormflow Total Suspended Solids Mean (log mg/L),1,1.653
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.2,0.2
Stormflow Total Suspended Solids Estimation Method,Mean,Mean
Stormflow Total Suspended Solids Serial Correlation,0,0
Stormflow Total Phosphorus Mean (log mg/L),-1.523,-0.699
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.22,0.22
Stormflow Total Phosphorus Estimation Method,Mean,Mean
Stormflow Total Phosphorus Serial Correlation,0,0
Stormflow Total Nitrogen Mean (log mg/L),-0.495,0.398
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.24,0.24
Stormflow Total Nitrogen Estimation Method,Mean,Mean
Stormflow Total Nitrogen Serial Correlation,0,0
Baseflow Total Suspended Solids Mean (log mg/L),-9,-9
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.13,0.447
Baseflow Total Suspended Solids Estimation Method,Mean,Mean
Baseflow Total Suspended Solids Serial Correlation,0,0
Baseflow Total Phosphorus Mean (log mg/L),-9,-9
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.13,0.5
Baseflow Total Phosphorus Estimation Method,Mean,Mean
Baseflow Total Phosphorus Serial Correlation,0,0
Baseflow Total Nitrogen Mean (log mg/L),-9,-9
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.13,0.13
Baseflow Total Nitrogen Estimation Method,Mean,Mean
Baseflow Total Nitrogen Serial Correlation,0,0
Flow based constituent generation - enabled,Off,Off
Flow based constituent generation - flow file, ,
Flow based constituent generation - base flow column, ,
Flow based constituent generation - pervious flow column, ,
Flow based constituent generation - impervious flow column, ,
Flow based constituent generation - unit, ,
OUT - Mean Annual Flow (ML/yr),0.498,4.71
OUT - TSS Mean Annual Load (kg/yr),2.89,123
OUT - TP Mean Annual Load (kg/yr),8.67E-3,0.548
OUT - TN Mean Annual Load (kg/yr),92.5E-3,6.85
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
Rain In (ML/yr),1.92057,18.1823
ET Loss (ML/yr),1.37637,13.0303
Deep Seepage Loss (ML/yr),0,0
Baseflow Out (ML/yr),0.208426,1.9732
Imp. Stormflow Out (ML/yr),0,0
Perv. Stormflow Out (ML/yr),0.289222,2.73811
Total Stormflow Out (ML/yr),0.289222,2.73811
Total Outflow (ML/yr),0.497648,4.71131
Change in Soil Storage (ML/yr),0.04655,0.440696
TSS Baseflow Out (kg/yr),0,0
TSS Total Stormflow Out (kg/yr),2.89222,123.155
TSS Total Outflow (kg/yr),2.89222,123.155
TP Baseflow Out (kg/yr),0,0
TP Total Stormflow Out (kg/yr),0.00867425,0.547584
TP Total Outflow (kg/yr),0.00867425,0.547584
TN Baseflow Out (kg/yr),0,0
TN Total Stormflow Out (kg/yr),0.092519,6.84621
TN Total Outflow (kg/yr),0.092519,6.84621
GP Total Outflow (kg/yr),0,0
```

No Imported Data Source nodes

No USTM treatment nodes

No Generic treatment nodes

Other nodes

Location,Dummy Out,Junction
ID,1,3
Node Type,ReceivingNode,JunctionNode
IN - Mean Annual Flow (ML/yr),5.21,5.21
IN - TSS Mean Annual Load (kg/yr),126,126
IN - TP Mean Annual Load (kg/yr),0.556,0.556
IN - TN Mean Annual Load (kg/yr),6.94,6.94
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.00,5.21
OUT - TSS Mean Annual Load (kg/yr),0.00,126
OUT - TP Mean Annual Load (kg/yr),0.00,0.556
OUT - TN Mean Annual Load (kg/yr),0.00,6.94
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
% Load Reduction,2.03E-12,2.03E-12
TSS % Load Reduction,12.7E-12,12.7E-12
TN % Load Reduction,4.24E-12,4.24E-12
TP % Load Reduction,9.96E-12,9.96E-12
GP % Load Reduction,0.00,0.00

Links

Location,Drainage Link,Drainage Link,Drainage Link
Source node ID,2,3,4
Target node ID,3,1,3
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed
Muskingum K, , ,
Muskingum theta, , ,
IN - Mean Annual Flow (ML/yr),0.498,5.21,4.71
IN - TSS Mean Annual Load (kg/yr),2.89,126,123
IN - TP Mean Annual Load (kg/yr),8.67E-3,0.556,0.548
IN - TN Mean Annual Load (kg/yr),92.5E-3,6.94,6.85
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.498,5.21,4.71
OUT - TSS Mean Annual Load (kg/yr),2.89,126,123
OUT - TP Mean Annual Load (kg/yr),8.67E-3,0.556,0.548
OUT - TN Mean Annual Load (kg/yr),92.5E-3,6.94,6.85
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00

Catchment Details

Catchment Name,cc 003 sect8 res high d- existingv2 (26-11-13)
Timestep,30 Minutes
Start Date,1/01/1996
End Date,31/12/1999 11:30:00 PM
Rainfall Station, mid-creek-1995to1999(30min)
ET Station,User-defined monthly PET
Mean Annual Rainfall (mm), 1402
Mean Annual ET (mm), 1268

Proposed (No Treatment)

Source nodes

```
Location,Pr Riparian ,Roofs,Roads_ Carparking_ Shared path,Lot Area
ID,2,4,5,6
Node Type,ForestSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Total Area (ha),0.275,0.48,0.251,0.428
Area Impervious (ha),0,0.48,0.22653850877193,0.0947982456140351
Area Pervious (ha),0.275,0,0.0244614912280702,0.333201754385965
Field Capacity (mm),150,50,50,150
Pervious Area Infiltration Capacity coefficient - a,100,50,50,100
Pervious Area Infiltration Capacity exponent - b,0.65,2,2,0.65
Impervious Area Rainfall Threshold (mm/day),1.5,1.5,1.5,1.5
Pervious Area Soil Storage Capacity (mm),400,150,150,400
Pervious Area Soil Initial Storage (% of Capacity),25,25,25,25
Groundwater Initial Depth (mm),20,50,50,20
Groundwater Daily Recharge Rate (%),0.55,0.65,0.65,0.55
Groundwater Daily Baseflow Rate (%),0.65,0.85,0.85,0.65
Groundwater Daily Deep Seepage Rate (%),0,0,0,0
Stormflow Total Suspended Solids Mean (log mg/L),1,1.3,2,2
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.2,0.32,0.32,0.32
Stormflow Total Suspended Solids Estimation Method,Mean,Mean,Mean,Mean
Stormflow Total Suspended Solids Serial Correlation,0,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-1.523,-0.89,-0.523,-0.523
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.22,0.25,0.25,0.25
Stormflow Total Phosphorus Estimation Method,Mean,Mean,Mean,Mean
Stormflow Total Phosphorus Serial Correlation,0,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),-0.495,0.3,0.176,0.176
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.24,0.19,0.19,0.19
Stormflow Total Nitrogen Estimation Method,Mean,Mean,Mean,Mean
Stormflow Total Nitrogen Serial Correlation,0,0,0,0
Baseflow Total Suspended Solids Mean (log mg/L),-9,-5,-5,-9
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.13,0.001,0.17,0.17
Baseflow Total Suspended Solids Estimation Method,Mean,Mean,Mean,Mean
Baseflow Total Suspended Solids Serial Correlation,0,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),-9,-5,-5,-9
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.13,0.19,0.19,0.19
Baseflow Total Phosphorus Estimation Method,Mean,Mean,Mean,Mean
Baseflow Total Phosphorus Serial Correlation,0,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),-9,-5,-5,-9
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.13,0.12,0.12,0.12
Baseflow Total Nitrogen Estimation Method,Mean,Mean,Mean,Mean
Baseflow Total Nitrogen Serial Correlation,0,0,0,0
Flow based constituent generation - enabled,Off,Off,Off,Off
Flow based constituent generation - flow file, , , ,
Flow based constituent generation - base flow column, , , ,
Flow based constituent generation - pervious flow column, , , ,
Flow based constituent generation - impervious flow column, , , ,
Flow based constituent generation - unit, , , ,
OUT - Mean Annual Flow (ML/yr),0.999,5.87,2.91,2.36
OUT - TSS Mean Annual Load (kg/yr),5.81,117,289,186
OUT - TP Mean Annual Load (kg/yr),17.4E-3,0.756,0.868,0.557
OUT - TN Mean Annual Load (kg/yr),0.186,11.7,4.34,2.78
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,138,68.8,51.5
Rain In (ML/yr),3.85516,6.729,3.51871,6.00004
ET Loss (ML/yr),2.7628,0.8604,0.60688,3.52272
Deep Seepage Loss (ML/yr),0,0,0,0
Baseflow Out (ML/yr),0.418374,0,0.0152778,0.50789
Imp. Stormflow Out (ML/yr),0,5.8686,2.76191,1.15122
Perv. Stormflow Out (ML/yr),0.580555,0,0.131435,0.704773
Total Stormflow Out (ML/yr),0.580555,5.8686,2.89334,1.856
Total Outflow (ML/yr),0.998928,5.8686,2.90862,2.36389
Change in Soil Storage (ML/yr),0.0934398,0,0.00320425,0.113433
TSS Baseflow Out (kg/yr),0,0,2.5E-7,0
TSS Total Stormflow Out (kg/yr),5.80555,117.094,289.334,185.6
TSS Total Outflow (kg/yr),5.80555,117.094,289.334,185.6
TP Baseflow Out (kg/yr),0,0,2.5E-7,0
TP Total Stormflow Out (kg/yr),0.0174118,0.756023,0.867761,0.556643
TP Total Outflow (kg/yr),0.0174118,0.756023,0.867762,0.556643
TN Baseflow Out (kg/yr),0,0,2.5E-7,0
TN Total Stormflow Out (kg/yr),0.185714,11.7094,4.33911,2.78341
TN Total Outflow (kg/yr),0.185714,11.7094,4.33911,2.78341
GP Total Outflow (kg/yr),0,137.804,68.8309,52.4183
```

No Imported Data Source nodes

No USTM treatment nodes

No Generic treatment nodes

Other nodes

```
Location,Dummy Out,Junction
ID,1,3
Node Type,ReceivingNode,JunctionNode
IN - Mean Annual Flow (ML/yr),12.1,12.1
IN - TSS Mean Annual Load (kg/yr),598,598
IN - TP Mean Annual Load (kg/yr),2.20,2.20
IN - TN Mean Annual Load (kg/yr),19.0,19.0
IN - Gross Pollutant Mean Annual Load (kg/yr),258,258
OUT - Mean Annual Flow (ML/yr),0.00,12.1
OUT - TSS Mean Annual Load (kg/yr),0.00,598
OUT - TP Mean Annual Load (kg/yr),0.00,2.20
OUT - TN Mean Annual Load (kg/yr),0.00,19.0
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,258
% Load Reduction,-5.19E-12,-5.19E-12
TSS % Load Reduction,-20.9E-12,-20.9E-12
TN % Load Reduction,-5.04E-12,-5.04E-12
TP % Load Reduction,667E-15,667E-15
GP % Load Reduction,-264E-15,-264E-15
```

Links

```
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,2,3,4,5,6
Target node ID,3,1,3,3,3
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , ,
Muskingum theta, , , , ,
IN - Mean Annual Flow (ML/yr),0.999,12.1,5.87,2.91,2.36
IN - TSS Mean Annual Load (kg/yr),5.81,598,117,289,186
IN - TP Mean Annual Load (kg/yr),17.4E-3,2.20,0.756,0.868,0.557
IN - TN Mean Annual Load (kg/yr),0.186,19.0,11.7,4.34,2.78
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,258,138,68.8,51.5
OUT - Mean Annual Flow (ML/yr),0.999,12.1,5.87,2.91,2.36
OUT - TSS Mean Annual Load (kg/yr),5.81,598,117,289,186
OUT - TP Mean Annual Load (kg/yr),17.4E-3,2.20,0.756,0.868,0.557
OUT - TN Mean Annual Load (kg/yr),0.186,19.0,11.7,4.34,2.78
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,258,138,68.8,51.5
```

Catchment Details

```
Catchment Name,cc 003 sect8 res high d - prop no treat-v2 (26-11-13)
Timestep,30 Minutes
Start Date,1/01/1996
End Date,31/12/1999 11:30:00 PM
Rainfall Station, mid-creek-1995to1999(30min)
ET Station,User-defined monthly PET
Mean Annual Rainfall (mm), 1402
Mean Annual ET (mm), 1268
```

Proposed (Treatment)

Source nodes

Location,Pr Riparian,Roofs to 3kl tanks,Roads (with no treat),Roads & Carpark (with treat to swale),Lot Area (to raingardens),Lot Area wo raingarden,Carpark (with treat to perm),Roofs to 1kl tanks,Roofs to 10kl tanks,Cyclepath/Bioswale area
ID,2,4,5,8,11,12,13,14,16,18
Node Type,ForestSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Total Area (ha),0.275,0.235,0.107,0.017,0.25,0.178,0.077,0.215,0.03,0.05
Area Impervious (ha),0,0.235,0.101786096491228,0.017,0.0542653508771929,0.0386369298245614,0.077,0.215,0.03,0.0150614035087719
Area Pervious (ha),0.275,0,0.00521390350877193,0,0.195734649122807,0.139363070175439,0,0,0,0.0349385964912281
Field Capacity (mm),150,150,150,150,150,150,150,150,150,150
Pervious Area Infiltration Capacity coefficient - a,100,100,100,100,100,100,100,100,100,100
Pervious Area Infiltration Capacity exponent - b,0.65,0.65,0.65,0.65,0.65,0.65,0.65,0.65,0.65,0.65
Impervious Area Rainfall Threshold (mm/day),1.5,2,1.5,1.5,1.5,1.5,1.5,2,2,1.5
Pervious Area Soil Storage Capacity (mm),400,400,400,400,400,400,400,400,400,400
Pervious Area Soil Initial Storage (% of Capacity),25,25,25,25,25,25,25,25,25,25
Groundwater Initial Depth (mm),20,20,20,20,20,20,20,20,20,20
Groundwater Daily Recharge Rate (%),0.55,0.55,0.55,0.55,0.55,0.55,0.55,0.55,0.55,0.55
Groundwater Daily Baseflow Rate (%),0.65,0.65,0.65,0.65,0.65,0.65,0.65,0.65,0.65,0.65
Groundwater Daily Deep Seepage Rate (%),0,0,0,0,0,0,0,0,0,0
Stormflow Total Suspended Solids Mean (log mg/L),1,1.3,2,2,2,2,2,1.3,1.3,2
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.2,0.32,0.32,0.32,0.32,0.32,0.32,0.32,0.32,0.32
Stormflow Total Suspended Solids Estimation Method,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean
Stormflow Total Suspended Solids Serial Correlation,0,0,0,0,0,0,0,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-1.523,-0.89,-0.523,-0.523,-0.523,-0.523,-0.523,-0.89,-0.89,-0.523
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.22,0.25,0.25,0.25,0.25,0.25,0.25,0.25,0.25,0.25
Stormflow Total Phosphorus Estimation Method,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean
Stormflow Total Phosphorus Serial Correlation,0,0,0,0,0,0,0,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),-0.495,0.3,0.176,0.176,0.176,0.176,0.176,0.3,0.3,0.176
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.24,0.19,0.19,0.19,0.19,0.19,0.19,0.19,0.19,0.19
Stormflow Total Nitrogen Estimation Method,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean
Stormflow Total Nitrogen Serial Correlation,0,0,0,0,0,0,0,0,0,0
Baseflow Total Suspended Solids Mean (log mg/L),-9,-5,-9,-9,-9,-9,-9,-5,-5,-9
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.13,0.001,0.17,0.17,0,0,0.17,0.001,0.001,0
Baseflow Total Suspended Solids Estimation Method,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean
Baseflow Total Suspended Solids Serial Correlation,0,0,0,0,0,0,0,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),-9,-5,-9,-9,-9,-9,-9,-5,-5,-9
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.13,0.19,0.19,0.19,0.19,0.19,0.19,0.19,0.19,0.19
Baseflow Total Phosphorus Estimation Method,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean
Baseflow Total Phosphorus Serial Correlation,0,0,0,0,0,0,0,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),-9,-5,-9,-9,-9,-9,-9,-5,-5,-9
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.13,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12,0.12
Baseflow Total Nitrogen Estimation Method,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean,Mean
Baseflow Total Nitrogen Serial Correlation,0,0,0,0,0,0,0,0,0,0
Flow based constituent generation - enabled,Off,Off,Off,Off,Off,Off,Off,Off,Off,Off
Flow based constituent generation - flow file, , , , , , , , , ,
Flow based constituent generation - base flow column, , , , , , , , , ,
Flow based constituent generation - pervious flow column, , , , , , , , , ,
Flow based constituent generation - impervious flow column, , , , , , , , , ,
Flow based constituent generation - unit, , , , , , , , , ,
OUT - Mean Annual Flow (ML/yr),0.999,2.76,1.26,0.208,1.38,0.983,0.941,2.53,0.353,0.311
OUT - TSS Mean Annual Load (kg/yr),5.81,55.2,125,20.8,108,77.2,94.1,50.5,7.04,25.7
OUT - TP Mean Annual Load (kg/yr),17.4E-3,0.356,0.376,62.3E-3,0.325,0.232,0.282,0.326,45.5E-3,77.2E-3
OUT - TN Mean Annual Load (kg/yr),0.186,5.52,1.88,0.312,1.63,1.16,1.41,5.05,0.704,0.386
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,63.8,30.0,4.88,30.1,21.4,22.1,58.4,8.15,7.48
Rain In (ML/yr),3.85516,3.29441,1.50001,0.238319,3.50469,2.49534,1.07944,3.01403,0.420563,0.700938
ET Loss (ML/yr),2.7628,0.530216,0.235956,0.0304728,2.05765,1.46505,0.138022,0.485095,0.0676875,0.378514
Deep Seepage Loss (ML/yr),0,0,0,0,0,0,0,0,0,0
Baseflow Out (ML/yr),0.418374,0,0.00813925,0,0.296665,0.211225,0,0,0,0.0532475

Imp. Stormflow Out
(ML/yr),0,2.76419,1.2428,0.207846,0.672443,0.47878,0.941422,2.52894,0.352875,0.183394
Perv. Stormflow Out (ML/yr),0.580555,0,0.0112945,0,0.411666,0.293106,0,0,0,0.0738888
Total Stormflow Out
(ML/yr),0.580555,2.76419,1.25409,0.207846,1.08411,0.771886,0.941422,2.52894,0.352875,0.257282
Total Outflow
(ML/yr),0.998928,2.76419,1.26223,0.207846,1.38077,0.983111,0.941422,2.52894,0.352875,0.31053
Change in Soil Storage (ML/yr),0.0934398,0,0.00181775,0,0.0662573,0.0471753,0,0,0,0.0118923
TSS Baseflow Out (kg/yr),0,0,0,0,0,0,0,0,0,0
TSS Total Stormflow Out
(kg/yr),5.80555,55.1528,125.409,20.7846,108.411,77.1886,94.1422,50.4589,7.04078,25.7282
TSS Total Outflow
(kg/yr),5.80555,55.1528,125.409,20.7846,108.411,77.1886,94.1422,50.4589,7.04078,25.7282
TP Baseflow Out (kg/yr),0,0,0,0,0,0,0,0,0,0
TP Total Stormflow Out
(kg/yr),0.0174118,0.356097,0.376123,0.0623365,0.325142,0.231501,0.282347,0.32579,0.045459,0.0771633
TP Total Outflow
(kg/yr),0.0174118,0.356097,0.376123,0.0623365,0.325142,0.231501,0.282347,0.32579,0.045459,0.0771633
TN Baseflow Out (kg/yr),0,0,0,0,0,0,0,0,0,0
TN Total Stormflow Out
(kg/yr),0.185714,5.51528,1.88074,0.311704,1.62582,1.15759,1.41183,5.04589,0.704078,0.385843
TN Total Outflow
(kg/yr),0.185714,5.51528,1.88074,0.311704,1.62582,1.15759,1.41183,5.04589,0.704078,0.385843
GP Total Outflow (kg/yr),0,63.8226,30.0486,4.88054,30.6182,21.8001,22.106,58.3909,8.14757,7.57754

No Imported Data Source nodes

USTM treatment nodes
Location,Carpark/Road/Parking lot/Swale,3kl Rainwater Tank,Lot Based Rain Gardens,1kl Rainwater Tank,10kl Rainwater Tank,Infiltration Trench
ID,6,7,10,15,17,19
Node
Type,MediaFiltrationNode,RainWaterTankNode,MediaFiltrationNode,RainWaterTankNode,RainWaterTankNode,InfiltrationSystemNodeV4
Lo-flow bypass rate (cum/sec),0,0,0,0,0,0
Hi-flow bypass rate (cum/sec),0.4,0.3,0.1,0.1,0.1,1
Inlet pond volume, ,0, ,0,0,
Area (sqm),200,90,215,16,10,40
Initial Volume (m^3), ,90, ,16,10,
Extended detention depth (m),0.4,0.1,0.4,0.1,0.1,0.1
Number of Rainwater tanks, ,1, ,1,1,
Permanent Pool Volume (cubic metres), ,90, ,16,10,
Proportion vegetated, ,0, ,0,0,
Equivalent Pipe Diameter (mm), ,50, ,50,50,
Overflow weir width (m),2.5,10,2,10,10,40
Notional Detention Time (hrs), ,1.36, ,0.241,0.151,
Orifice Discharge Coefficient, ,0.6, ,0.6,0.6,
Weir Coefficient,1.7,1.7,1.7,1.7,1.7,1.7
Number of CSTR Cells,3,2,3,2,2,1
Total Suspended Solids - k (m/yr),1000,400,1000,400,400,400
Total Suspended Solids - C* (mg/L),12,12,12,12,12,12
Total Suspended Solids - C** (mg/L), ,12, ,12,12,12
Total Phosphorus - k (m/yr),500,300,500,300,300,300
Total Phosphorus - C* (mg/L),0.13,0.13,0.13,0.13,0.13,0.09
Total Phosphorus - C** (mg/L), ,0.13, ,0.13,0.13,0.09
Total Nitrogen - k (m/yr),50,40,50,40,40,40
Total Nitrogen - C* (mg/L),1.3,1.4,1.3,1.4,1.4,1
Total Nitrogen - C** (mg/L), ,1.4, ,1.4,1.4,1
Threshold Hydraulic Loading for C** (m/yr), ,3500, ,3500,3500,3500
Horizontal Flow Coefficient, , , , , ,3
Reuse Enabled,Off,On,Off,On,On,Off
Max drawdown height (m), ,1, ,1,1,
Annual Demand Enabled,Off,Off,Off,Off,Off,Off
Annual Demand Value (ML/year), , , , , ,
Annual Demand Distribution, , , , , ,
Annual Demand Monthly Distribution: Jan, , , , , ,
Annual Demand Monthly Distribution: Feb, , , , , ,
Annual Demand Monthly Distribution: Mar, , , , , ,
Annual Demand Monthly Distribution: Apr, , , , , ,
Annual Demand Monthly Distribution: May, , , , , ,
Annual Demand Monthly Distribution: Jun, , , , , ,
Annual Demand Monthly Distribution: Jul, , , , , ,
Annual Demand Monthly Distribution: Aug, , , , , ,
Annual Demand Monthly Distribution: Sep, , , , , ,

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Annual Demand Monthly Distribution: Oct, , , , , ,
Annual Demand Monthly Distribution: Nov, , , , , ,
Annual Demand Monthly Distribution: Dec, , , , , ,
Daily Demand Enabled,Off,On,Off,On,On,Off
Daily Demand Value (ML/day), ,0.005, ,0.0069,0.00026,
Custom Demand Enabled,Off,Off,Off,Off,Off,Off
Custom Demand Time Series File, , , , , ,
Custom Demand Time Series Units, , , , , ,
Filter area (sqm),100, ,108, , ,40
Filter perimeter (m), , , , , ,1
Filter depth (m),1, ,0.7, , ,1
Filter Median Particle Diameter (mm),5, ,5, , ,
Saturated Hydraulic Conductivity (mm/hr),100, ,100, , ,
Infiltration Media Porosity,0.3, ,0.3, , ,0.35
Length (m), , , , , ,
Bed slope, , , , , ,
Base Width (m), , , , , ,
Top width (m), , , , , ,
Vegetation height (m), , , , , ,
Vegetation Type, , , , , ,
Total Nitrogen Content in Filter (mg/kg), , , , , ,
Orthophosphate Content in Filter (mg/kg), , , , , ,
Is Base Lined?, , , , , ,
Is Underdrain Present?, , , , , ,
Is Submerged Zone Present?, , , , , ,
Submerged Zone Depth (m), , , , , ,
B for Media Soil Texture,-9999,-9999,-9999,-9999,-9999,-9999
Proportion of upstream impervious area treated, , , , , ,
Exfiltration Rate (mm/hr),36,0,36,0,0,68
Evaporative Loss as % of PET, ,0, ,0,0,50
Depth in metres below the drain pipe,0.05, ,0.035, , ,
TSS A Coefficient,0.52, ,0.52, , ,
TSS B Coefficient,-0.39, ,-0.39, , ,
TP A Coefficient,1.28, ,1.28, , ,
TP B Coefficient,-0.19, ,-0.19, , ,
TN A Coefficient,1.67, ,1.67, , ,
TN B Coefficient,-0.09, ,-0.09, , ,
Sfc, , , , , ,
S*, , , , , ,
Sw, , , , , ,
Sh, , , , , ,
Emax (m/day), , , , , ,
Ew (m/day), , , , , ,
IN - Mean Annual Flow (ML/yr),1.46,2.76,2.83,2.53,0.353,5.79
IN - TSS Mean Annual Load (kg/yr),141,55.2,132,50.5,7.04,51.6
IN - TP Mean Annual Load (kg/yr),0.422,0.356,0.512,0.326,45.5E-3,0.712
IN - TN Mean Annual Load (kg/yr),2.11,5.52,4.35,5.05,0.704,8.84
IN - Gross Pollutant Mean Annual Load (kg/yr),34.5,63.8,30.1,58.4,8.15,2.40
OUT - Mean Annual Flow (ML/yr),0.309,1.45,1.21,1.76,0.259,3.81
OUT - TSS Mean Annual Load (kg/yr),3.48,23.1,15.1,32.8,4.02,33.1
OUT - TP Mean Annual Load (kg/yr),31.4E-3,0.187,0.117,0.227,33.5E-3,0.457
OUT - TN Mean Annual Load (kg/yr),0.287,2.72,1.57,3.48,0.474,6.06
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
Flow In (ML/yr),1.45981,2.76415,2.82855,2.5289,0.352875,5.78728
ET Loss (ML/yr),0,0,0,0,0,0.00052125
Infiltration Loss (ML/yr),1.15743,0,1.62116,0,0,1.98061
Low Flow Bypass Out (ML/yr),0,0,0,0,0,0
High Flow Bypass Out (ML/yr),0,0,0,0,0,0
Orifice / Filter Out (ML/yr),0.309182,0.830685,0.953129,0.875525,0.249054,0
Weir Out (ML/yr),0,0.61697,0.259002,0.88589,0.0100255,3.8065
Transfer Function Out (ML/yr),0,0,0,0,0,0
Reuse Supplied (ML/yr),0,1.31834,0,0.7711,0.0939218,0
Reuse Requested (ML/yr),0,1.82472,0,2.5197,0.095051,0
% Reuse Demand Met,0,72.2486,0,30.6028,98.812,0
% Load Reduction,78.8205,47.6275,57.1466,30.3486,26.5803,34.2265
TSS Flow In (kg/yr),140.657,55.1528,131.547,50.459,7.04078,51.6015
TSS ET Loss (kg/yr),0,0,0,0,0,0
TSS Infiltration Loss (kg/yr),16.0521,0,24.8455,0,0,21.0676
TSS Low Flow Bypass Out (kg/yr),0,0,0,0,0,0
TSS High Flow Bypass Out (kg/yr),0,0,0,0,0,0
TSS Orifice / Filter Out (kg/yr),3.47587,12.738,4.98977,16.0317,3.84113,0
TSS Weir Out (kg/yr),0,10.3989,10.0984,16.7953,0.175616,33.1291
TSS Transfer Function Out (kg/yr),0,0,0,0,0,0
TSS Reuse Supplied (kg/yr),0,16.3131,0,11.1232,1.1529,0
```

TSS Reuse Requested (kg/yr),0,0,0,0,0,0
TSS % Reuse Demand Met,0,0,0,0,0,0
TSS % Load Reduction,97.5288,58.0493,88.5302,34.9432,42.9503,35.7981
TP Flow In (kg/yr),0.421844,0.356098,0.512412,0.32579,0.045459,0.712104
TP ET Loss (kg/yr),0,0,0,0,0,0
TP Infiltration Loss (kg/yr),0.160637,0,0.225782,0,0,0.205138
TP Low Flow Bypass Out (kg/yr),0,0,0,0,0,0
TP High Flow Bypass Out (kg/yr),0,0,0,0,0,0
TP Orifice / Filter Out (kg/yr),0.031443,0.107531,0.0684968,0.112964,0.03224,0
TP Weir Out (kg/yr),0,0.0797353,0.0489928,0.114233,0.00129489,0.456879
TP Transfer Function Out (kg/yr),0,0,0,0,0,0
TP Reuse Supplied (kg/yr),0,0.171349,0,0.099902,0.0121936,0
TP Reuse Requested (kg/yr),0,0,0,0,0,0
TP % Reuse Demand Met,0,0,0,0,0,0
TP % Load Reduction,92.5463,47.4115,77.0713,30.2629,26.2305,35.8411
TN Flow In (kg/yr),2.10936,5.51528,4.35018,5.0459,0.704078,8.84374
TN ET Loss (kg/yr),0,0,0,0,0,0
TN Infiltration Loss (kg/yr),1.58375,0,2.4274,0,0,2.37069
TN Low Flow Bypass Out (kg/yr),0,0,0,0,0,0
TN High Flow Bypass Out (kg/yr),0,0,0,0,0,0
TN Orifice / Filter Out (kg/yr),0.287354,1.54815,1.11854,1.72698,0.45527,0
TN Weir Out (kg/yr),0,1.17625,0.446536,1.75148,0.0191667,6.05662
TN Transfer Function Out (kg/yr),0,0,0,0,0,0
TN Reuse Supplied (kg/yr),0,2.12522,0,1.44143,0.146681,0
TN Reuse Requested (kg/yr),0,0,0,0,0,0
TN % Reuse Demand Met,0,0,0,0,0,0
TN % Load Reduction,86.3772,50.6027,64.0227,31.0635,32.6158,31.5151
GP Flow In (kg/yr),34.4689,63.8225,30.0953,58.391,8.14758,2.4017
GP ET Loss (kg/yr),0,0,0,0,0,0
GP Infiltration Loss (kg/yr),0,0,0,0,0,0
GP Low Flow Bypass Out (kg/yr),0,0,0,0,0,0
GP High Flow Bypass Out (kg/yr),0,0,0,0,0,0
GP Orifice / Filter Out (kg/yr),0,0,0,0,0,0
GP Weir Out (kg/yr),0,0,0,0,0,0
GP Transfer Function Out (kg/yr),0,0,0,0,0,0
GP Reuse Supplied (kg/yr),0,0,0,0,0,0
GP Reuse Requested (kg/yr),0,0,0,0,0,0
GP % Reuse Demand Met,0,0,0,0,0,0
GP % Load Reduction,100,100,100,100,100,100

Generic treatment nodes
Location,GPT
ID,9
Node Type,GPTNode
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),0.2
Flow Transfer Function
Input (cum/sec),0
Output (cum/sec),0
Input (cum/sec),10
Output (cum/sec),10
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Gross Pollutant Transfer Function
Enabled,True
Input (kg/ML),0
Output (kg/ML),0
Input (kg/ML),15
Output (kg/ML),0.7
Input (kg/ML),

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Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Total Nitrogen Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),50
Output (mg/L),50
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Phosphorus Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),5
Output (mg/L),3.5
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Suspended Solids Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),1000
Output (mg/L),200
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
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Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
TSS Flow based Efficiency Enabled,Off
TSS Flow based Efficiency,
TP Flow based Efficiency Enabled,Off
TP Flow based Efficiency,
TN Flow based Efficiency Enabled,Off
TN Flow based Efficiency,
GP Flow based Efficiency Enabled,Off
GP Flow based Efficiency,
IN - Mean Annual Flow (ML/yr),5.79
IN - TSS Mean Annual Load (kg/yr),258
IN - TP Mean Annual Load (kg/yr),1.02
IN - TN Mean Annual Load (kg/yr),8.84
IN - Gross Pollutant Mean Annual Load (kg/yr),51.5
OUT - Mean Annual Flow (ML/yr),5.79
OUT - TSS Mean Annual Load (kg/yr),51.6
OUT - TP Mean Annual Load (kg/yr),0.712
OUT - TN Mean Annual Load (kg/yr),8.84
OUT - Gross Pollutant Mean Annual Load (kg/yr),2.40
Flow In (ML/yr),5.78728
ET Loss (ML/yr),0
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),0
Orifice / Filter Out (ML/yr),0
Weir Out (ML/yr),0
Transfer Function Out (ML/yr),5.78728
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0
% Load Reduction,0
TSS Flow In (kg/yr),258.008
TSS ET Loss (kg/yr),0
TSS Infiltration Loss (kg/yr),0
TSS Low Flow Bypass Out (kg/yr),0
TSS High Flow Bypass Out (kg/yr),0
TSS Orifice / Filter Out (kg/yr),0
TSS Weir Out (kg/yr),0
TSS Transfer Function Out (kg/yr),51.6015
TSS Reuse Supplied (kg/yr),0
TSS Reuse Requested (kg/yr),0
TSS % Reuse Demand Met,0
TSS % Load Reduction,80.0001
TP Flow In (kg/yr),1.01729
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0
TP Orifice / Filter Out (kg/yr),0
TP Weir Out (kg/yr),0
TP Transfer Function Out (kg/yr),0.712104
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,30.0002
TN Flow In (kg/yr),8.84374
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0
TN High Flow Bypass Out (kg/yr),0
TN Orifice / Filter Out (kg/yr),0
TN Weir Out (kg/yr),0
TN Transfer Function Out (kg/yr),8.84374
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,0
GP Flow In (kg/yr),51.4649
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GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0
GP High Flow Bypass Out (kg/yr),0
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),2.4017
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,100

Other nodes
Location,Dummy Out,Junction
ID,1,3
Node Type,ReceivingNode,JunctionNode
IN - Mean Annual Flow (ML/yr),4.81,4.81
IN - TSS Mean Annual Load (kg/yr),38.9,38.9
IN - TP Mean Annual Load (kg/yr),0.474,0.474
IN - TN Mean Annual Load (kg/yr),6.24,6.24
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.00,4.81
OUT - TSS Mean Annual Load (kg/yr),0.00,38.9
OUT - TP Mean Annual Load (kg/yr),0.00,0.474
OUT - TN Mean Annual Load (kg/yr),0.00,6.24
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00
% Load Reduction,59.0,59.0
TSS % Load Reduction,93.2,93.2
TN % Load Reduction,65.7,65.7
TP % Load Reduction,77.4,77.4
GP % Load Reduction,100,100

Links
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,2,3,4,8,5,10,11,7,12,6,14,15,16,17,18,19,13,9
Target node ID,3,1,7,6,9,9,10,10,9,9,15,9,17,9,6,3,6,19
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , , , , , , , , , , , , , , , , ,
Muskingum theta, , , , , , , , , , , , , , , , , , , ,
IN - Mean Annual Flow
(ML/yr),0.999,4.81,2.76,0.208,1.26,1.21,1.38,1.45,0.983,0.309,2.53,1.76,0.353,0.259,0.311,3.81,0.941
,5.79
IN - TSS Mean Annual Load
(kg/yr),5.81,38.9,55.2,20.8,125,15.1,108,23.1,77.2,3.48,50.5,32.8,7.04,4.02,25.7,33.1,94.1,51.6
IN - TP Mean Annual Load (kg/yr),17.4E-3,0.474,0.356,62.3E-3,0.376,0.117,0.325,0.187,0.232,31.4E-
3,0.326,0.227,45.5E-3,33.5E-3,77.2E-3,0.457,0.282,0.712
IN - TN Mean Annual Load
(kg/yr),0.186,6.24,5.52,0.312,1.88,1.57,1.63,2.72,1.16,0.287,5.05,3.48,0.704,0.474,0.386,6.06,1.41,8
.84
IN - Gross Pollutant Mean Annual Load
(kg/yr),0.00,0.00,63.8,4.88,30.0,0.00,30.1,0.00,21.4,0.00,58.4,0.00,8.15,0.00,7.48,0.00,22.1,2.40
OUT - Mean Annual Flow
(ML/yr),0.999,4.81,2.76,0.208,1.26,1.21,1.38,1.45,0.983,0.309,2.53,1.76,0.353,0.259,0.311,3.81,0.941
,5.79
OUT - TSS Mean Annual Load
(kg/yr),5.81,38.9,55.2,20.8,125,15.1,108,23.1,77.2,3.48,50.5,32.8,7.04,4.02,25.7,33.1,94.1,51.6
OUT - TP Mean Annual Load (kg/yr),17.4E-3,0.474,0.356,62.3E-3,0.376,0.117,0.325,0.187,0.232,31.4E-
3,0.326,0.227,45.5E-3,33.5E-3,77.2E-3,0.457,0.282,0.712
OUT - TN Mean Annual Load
(kg/yr),0.186,6.24,5.52,0.312,1.88,1.57,1.63,2.72,1.16,0.287,5.05,3.48,0.704,0.474,0.386,6.06,1.41,8
.84
OUT - Gross Pollutant Mean Annual Load
(kg/yr),0.00,0.00,63.8,4.88,30.0,0.00,30.1,0.00,21.4,0.00,58.4,0.00,8.15,0.00,7.48,0.00,22.1,2.40

Catchment Details
Catchment Name,cc 003 sect8 res high d - prop treat opt1-v5 (18-12-13)
Timestep,30 Minutes
Start Date,1/01/1996
End Date,31/12/1999 11:30:00 PM
Rainfall Station, mid-creek-1995to1999(30min)

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ET Station,User-defined monthly PET
Mean Annual Rainfall (mm), 1402
Mean Annual ET (mm), 1268
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APPENDIX E -
WATER QUALITY AND BED SEDIMENT MONITORING RESULTS

APPENDIX F

F.1 ORIGINAL MIRVAC REPORT WQ MONITORING

Contained below are excerpts from the original WorleyParsons Mirvac reports related to WQ Monitoring (*including Addenda 1 and 2*).

The results for the original report (*Aug 08*) and addendum #1 (*Jan.09*) are summarised at **Table 1**.

The results for addendum #2 (*May 09*) are summarised at **Tables 2 and 3**.

F.1.1 18/6/08 Dry Weather

"Low flows were observed in Fern Creek at the three sampling sites during the first dry weather sampling event for Sector 8 (Mirvac Component). The water at all sites appeared clear with low turbidity and did not have any recognisable odour.

The results recorded for all three sites generally complied with Councils in stream long term objectives, where they were defined. The Total Nitrogen (TN) and Total Phosphorus (TP) across all sample locations are all below Council's medium term trigger values. The Total Suspended Solid (TSS) concentrations, turbidity and pH levels remain generally constant between the three sites and satisfy Councils long term goals. The relatively elevated levels at the downstream location are believed to be a result of the ongoing creek/culvert works being undertaken by Council at Garden Street. The Faecal Coliform (FC) levels were generally within Councils long term goals. High levels were recorded at the downstream location, which lie outside of Council's short term goals. Elevated FC levels are caused by an unknown source, possibly a septic tank or sewer leak or overflow." WP Jan. 2009.

F.1.2 15/10/08 Dry Weather

"Low flows were observed in Fern Creek at the three sampling sites during the 2nd dry weather sampling event for Sector 8 (Mirvac Component). The water at all sites appeared clear with low turbidity and did not have any recognisable odour.

The results recorded for all three sites generally complied with Councils in stream long term objectives, where they were defined. Total Nitrogen (TN) levels were slightly elevated above Council's medium term goals at the upstream and internal locations and did not satisfy short term goals at the downstream location. The Total Suspended Solid (TSS) and Turbidity levels were generally elevated along the three sites. The internal location did not satisfy medium term goals and the downstream location did not achieve short term goals. The pH levels were outside Council's long term goals with the exception of the downstream sample location. The FC levels were outside of Council's short term goals with the exception of the internal sample location where FC levels were found to be within Council's long term goals. Elevated FC levels are caused by an unknown source, possibly a septic tank or sewer leak or overflow. The deteriorating results

present at the downstream location of the site may be a result of the creek/culvert works currently being undertaken by Council." WP Jan. 2009.

F.1.3 22/10/08 Wet Weather (*Rising Limb*)

"Medium to high flows were observed in Fern Creek during the 1st rising event at Sector 8 (Mirvac Component). The water at all sites appeared clear with low turbidity and did not have any recognisable odour.

The results recorded for all three sites generally complied with Councils in stream long term objectives, where they were defined. Total Nitrogen (TN) was below Council's long term triggers value with the exception of TN at the downstream location.

The Total Phosphorous satisfied long term goals at the upstream sampling location, whilst the internal and downstream locations did not satisfy short term goals for TP. The Total Suspended Solid (TSS) and turbidity levels remained generally constant between the three sites meeting Council's short term goals. The pH levels at the internal location were found to be slightly above Council's goals, with a recorded measure of 8.3, while generally within Councils goals at both the upstream and the downstream locations. The FC levels were outside of Council's short term goals at all locations due to an unknown source of pollution. Elevated FC levels are caused by an unknown source, possibly a septic tank or sewer leak or overflow. The deteriorating results present at the downstream location of the site may be a result of the creek/culvert works currently being undertaken by Council.". WP Jan. 2009.

F.1.4 23/10/08 Wet Weather (*Falling Limb*)

"Low to medium flows were observed in Fern Creek during the 5th quarter wet weather falling event at Sector 8. The water at all sites appeared clear with low turbidity and did not have any recognisable odour.

The results recorded for all three sites generally complied with Councils in stream long term objectives where they were defined. Total Nitrogen (TN) and Total Phosphorus (TP) were within Council's long term triggers values with exception to TN at the downstream location and TP at the upstream location where concentration levels were found to be within Council's medium term goals. Total Suspended Solid (TSS) and turbidity levels remained generally constant between the three sites. The pH levels at all sample locations were found to be outside of Councils goals. It is understood that the high pH levels may be a result of runoff generated from construction upstream in Sector 8. The FC levels were outside of Council's short term goals at all locations. Elevated FC levels are caused by an unknown source, possibly a septic tank or sewer leak or overflow. The deteriorating results present at the downstream location of the site may be a result of the creek/culvert works currently being undertaken by Council. Overall the wet weather sampling event showed improvement between the rising and falling limbs as expected." WP Jan. 2009.

Table 1 – Mirvac Original and Addendum #1 WQ Monitoring Results Summary

	Units	During Const.	Short-Term Goal	Medium-Term Goal	Long-Term Goal	US	IS	DS	US	IS	DS	US	IS	DS	US	IS	DS
Variable						WS811S1	WS811IS2	WS811DS	WS813S1	WS813IS2	WS813DS	WS814S1	WS814IS2	WS814DS	WS815S1	WS815IS2	WS815DS
Date (field)						18/6/08	18/6/08	18/6/08	15/10/08	15/10/08	15/10/08	22/10/2008	22/10/2008	22/10/2008	23/10/2008	23/10/2008	23/10/2008
Rainfall over last 5 days (mm)	mm	-	-	-	-	10.8	10.8	10.8	14.4*	14.4*	14.4*	8.8*	8.8*	8.8*	19.2*	19.2*	19.2*
Ammonia – N	mg/L	NS	<2.3	<0.3	<0.3	0.01	0.01	0.03	0.18	0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Nitrogen	mg/L	<1.6	SQ	<1.6	1	1.1	1.3	0.6	[illegible]		4.2	0.8	1	1.1	1.3	1.4	1
Nitrate	mg/L	NS	NS	NS	NS	0.45	0.29	0.26	1.18	0.66	0.81	0.27	0.29	0.5	0.81	0.65	0.6
Nitrite	mg/L	NS	NS	NS	NS	0.02	0.02	0.02	0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Filterable Phosphorous	mg/L	NS	NS	NS	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Non-Filterable Phosphorous	mg/L	NS	NS	NS	NS	<0.1	<0.1	<0.1	<0.1	0.2	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Phosphorous	mg/L	<0.1	SQ	<0.1	0.04	0.02	0.02	0.02	0.02	[illegible]	0.46	0.05	0.07	[illegible]	0.02	0.07	0.06
Suspended Solids	mg/L	<100	SQ	<20	<6	1	2	1	<5	[illegible]	293	<5	[illegible]	[illegible]	<5	10	<5
Turbidity (field)	NTU	NS	SQ	<50	<20	1	0	0	2	0	6	1	0	2	1	1	1
Faecal Coliforms	#/100ml	<150	<1000	<150	<150	28	600	1600	4	1100	1300	3800	5100	25000	<2	300	[illegible]
Total Kjeidahl Nitrogen	mg/L	NS	NS	NS	NS	0.6	1	0.5	0.7	1.3	3.4	0.5	0.8	0.6	0.5	0.8	0.4
pH (field)	pH unit	NS	6.6-8	6.6-8	6.6-8	7.9	7.8	7.4	10.7	9.1	7.1	7.8	8.3	6	9.7	9.5	9.4
Dissolved Oxygen (field) %SAT	% of Sat	NS	NS	NS	NS	78	67.3	66	67	49	51	36	35	30	24	34	42
Temperature (field)	oC	NS	SQ	SQ	SQ	16	16	15	17	16	16	15	15	16	15	15	15
Conductivity (field)	ms/cm	NS	NS	NS	NS	0	0	0.4	0.43	0	0.32	0.33	0.31	0.43	0.04	0.3	0.29
Salinity (%)	(%)	NS	NS	NS	NS	0	0	0	0	0	0	0	0	0	0	0	0
Arsenic	ug/L	NS	SQ	50%SQ	50	NR	NR	NR	-	NR	<5	NR	NR	NR	NR	NR	NR
Chromium	ug/L	NS	SQ	50%SQ	10	NR	NR	NR	-	NR	16	NR	NR	NR	NR	NR	NR
Copper	ug/L	NS	SQ	50%SQ	2	NR	NR	NR	-	NR	14	NR	NR	NR	NR	NR	NR
Lead	ug/L	NS	SQ	50%SQ	1	NR	NR	NR	-	NR	20	NR	NR	NR	NR	NR	NR
Mercury	ug/L	NS	SQ	50%SQ	0.1	NR	NR	NR	-	NR	0.22	NR	NR	NR	NR	NR	NR
Zinc	ug/L	NS	SQ	50%SQ	50	NR	NR	NR	-	NR	117	NR	NR	NR	NR	NR	NR
OC Pesticides	ug/L	NS	SQ	50%SQ	NS	NR	NR	NR	<2	NR	<2	NR	NR	NR	NR	NR	NR
Phenols	ug/L	NS	SQ	50%SQ	NS	NR	NR	NR	<0.01	NR	<0.01	NR	NR	NR	NR	NR	NR
OP Pesticides	ug/L	NS	SQ	50%SQ	NS	NR	NR	NR	<4	NR	<4	NR	NR	NR	NR	NR	NR
Hardness	mg/L	NS	NS	NS	NS	NR	NR	NR	131	NR	89	NR	NR	NR	NR	NR	NR
Chlorophyll A	ug/L	NS	15	15	10	NR	NR	NR	0.6	NR	44.3	NR	NR	NR	NR	NR	NR
Oil and Grease (Hexane)	mg/L	NS	NS	NS	NS	NR	NR	NR	3	NR	<2	NR	NR	NR	NR	NR	NR
Priority PAH's	ug/L	NS	NS	NS	NS	NR	NR	NR	<2	NR	<2	NR	NR	NR	NR	NR	NR
Total Algal Count	Cells/ml	NS	NS	NS	NS	NR	NR	NR	46	NR	1841	NR	NR	NR	NR	NR	NR
Sampling Type						Dry	Dry	Dry	Dry Annual	Dry Annual	Dry Annual	Wet Rising	Wet Rising	Wet Rising	Wet Falling	Wet Falling	Wet Falling

Notes:
1. Long-Term water quality goals are derived from ANZECC, 1992 guideilnes and Councils WMS Feb 2001
2. Figures BLUE do not achieve long term goals
3. Figures in ORANGE do not achieve the medium & long term goals
4. Figures in RED do not achieve the short, medium & long term goals
5. Rainfall data obtained from the Bureau of Meteorology for the Ingleside Station (66183)
6. NS – Not Specified by Council, SQ – Status Quo, NR -- Not Required by Council, NA – Not Available
7. Refer to lab printouts for constituents results. Note that the figure included in this summary table is the highest recorded constituent value not the total value.

* Rainfall data obtained from the BoM Terry Hill Station (Station No. 66059).

F.1.5 WQ Monitoring Post Addendum #1 (*from 23 Oct 08 onwards*)

"Since the submission of Addenda #1, WorleyParsons have undertaken a single dry water sample during this period of monitoring which was collected on the 17th of March 2009.

Two wet weather events were collected during this period, and were collected between the 29th – 30th of October 2008 and the 1st – 2nd of April 2009.

A sediment sample was taken during this period of monitoring and was collected on the 17th of March 2009." WP May 2009.

E.1.5.1 Dry Weather Discussion (17/3/09)

"Due to the ephemeral behaviour of the creek, the dry weather sample was collected within 5 days of a small storm event.

Low flows were observed at Fern Creek during the dry weather sampling event. Weather conditions were generally fine on site and no apparent odours had been identified.

- *Total Suspended Solids – Total suspended solids levels at all monitoring locations were within Council's long term goals with exception to the upstream location where suspended levels were slightly elevated, yet still within Councils medium term goals;*
- *Faecal Coliforms – Faecal Coliforms levels at all monitoring locations were within Council's short term goals with exception to levels at the upstream location which were within Councils long term goals;*
- *Total Nitrogen – Total Nitrogen levels at all monitoring locations were all within Council's long term gals;*
- *Total Phosphorus – Total Phosphorus levels at all monitoring locations were all within Council's long term goals with exception to levels at the intermediate site which was slightly elevated, yet still within Councils medium term goals.*

All remaining detectable pollutants within the upstream and intermediate sample locations were found to comply with Council's long term goals." WP May 2009.

E.1.5.2 Wet Weather Discussion (29-30/8/08)

"Medium to high flows were observed in Fern Creek during this period of wet weather monitoring. The water at all monitoring locations appeared clear with low turbidity observed and no recognisable odour.

- *Total Suspended Solids – During the rising limb, TSS levels across all monitoring locations were all within Council's long term goals with the exception of the downstream location where TSS levels were slightly elevated, yet within council's long term goals. TSS levels during the falling limb were slightly elevated from rising limb results with TSS levels within Councils short term goals;*
- *Faecal Coliforms – During the rising limb, Faecal Coliforms levels across all monitoring locations were all elevated above Council's short term goals. FC levels during the falling*

limb saw much improvement from rising limb levels with FC levels dropping to Council's long term goals at the upstream location. FC levels at the intermediate and downstream monitoring sites were slightly elevated meeting Councils short term goals;

- *Total Nitrogen – During the rising limb, Total Nitrogen levels across all monitoring locations were all within Council's long term goals, with exception to levels at the downstream locations which were elevated above Council's short term goals. TN levels during the falling limb were elevated from rising limb levels with TN outside of Council's intermediate goals with exception to the upstream locations which was well within Council's long term goals;*
- *Total Phosphorus – During the rising limb, Total Phosphorus levels at all monitoring locations were within Council's intermediate goals with exception to the downstream locations where TP levels were slightly elevated, yet not far from Council's short term goals. TP levels during falling limb were similar to rising limb levels with exception of the upstream location where TP levels met with Council's long term goals.*

All remaining detectable pollutants within the upstream and intermediate sample locations were found to comply with Council's long term goals." WP May 2009.

E.1.5.3 Wet Weather Discussion (1-2/4/09)

"Medium to high levels of flow were observed within Fern Creek during this period of wet weather monitoring. The water at the upstream locations appeared slightly cloudy with water at the downstream location clear with low turbidity. No apparent odour was detected across the creek.

- *Total Suspended Solids – Total suspended solids levels at all monitoring locations during the falling limb were all within Council's medium term goals. TSS levels during the falling limb showed much improvement with levels all within Council's long term goals;*
- *Faecal Coliforms – During the rising limb, Faecal Coliforms levels were all above Council's short term goals. FC levels during the rising limb showed much improvement with levels at the intermediate and downstream locations within Council's short term goals while FC levels at the upstream locations were within Council's long term goals;*
- *Total Nitrogen – Total Nitrogen levels at all monitoring locations during both rising and falling limb events were all within Councils long term goals;*
- *Total Phosphorus – Total Phosphorus levels at all monitoring locations during the rising limb were found to be slightly elevated above Council's intermediate goals. TP levels during the falling limb have shown improvement on rising limb levels with TP levels well within Council's intermediate goals.*

All remaining detectable pollutants within the upstream and intermediate sample locations were found to comply with Council's long term goals." WP May 2009.

E.1.5.4 Bed Sediment Sample (17/3/09)

"*Bed sediment samples were collected at the upstream and downstream location on the 17th March 2009.*

The pollutant and heavy metal levels detected in the sediment sample were found to be within Councils long term trigger values." WP May 2009.

Table 2 – Bed Sediment Test Results (17/3/09)

Parameters	Units	Short-Term Goals	Medium-Term Goals	Long-Term Goals	Dry Weather (17/03/09)	Dry Weather (17/03/09)
					WS819US	**WS819DS**
					Upstream	**Downstream**
Arsenic	mg/kg	SQ	50%SQ	20	**<5**	**<5**
Chromium	mg/kg	SQ	50%SQ	80	**8**	**4**
Copper	mg/kg	SQ	50%SQ	65	**13**	**<5**
Lead	mg/kg	SQ	50%SQ	50	**17**	**13**
Mercury	mg/kg	SQ	50%SQ	0.15	**<0.1**	**<0.1**
Zinc	mg/kg	SQ	50%SQ	200	**39**	**66**
Phenolic Compounds	mg/kg	SQ	50%SQ	NS	-*	-*
OC Pesticides	mg/kg	SQ	50%SQ	NS	-*	-*
Priority PAH's	mg/kg	SQ	50%SQ	400	-*	-*

-* - results were below detectable limits
1. Long-Term water quality goals are derived from ANZECC, 1992 guidelines and Councils WMS Feb 2001
2. Figures in **BOLD** satisfy long-term water quality goals
3. Figures BLUE do not achieve long term goals
4. Figures in ORANGE do not achieve the medium & long term goals
5. Figures in RED do not achieve the short, medium & long term goals
6. Rainfall Data Obtained from Narrabeen Creek Tipping Bucket Gauge
7. NS – Not Specified by Council, SQ – Status Quo, NR – Not Required by Council, NA – Not Available
8. Refer to lab printouts for constituents results. Note that the figure included in this summary table is the highest recorded constituent value not the total value.

Table 3 – Addendum #2 WQ Monitoring Results

Parameters	Units	Short-Term Goal	Medium Term Goal	Long Term Goal	Dry Weather Sector 8 (17/03/09)		
					WS819IS	WS819US2	WS819DS
Total rain (5 days preceding)	mm				6	6	6
Ammonia – N	mg/L	NS	<0.3	<0.3	<0.01	<0.01	<0.01
Total Nitrogen	mg/L	SQ	<1.6	<1.0	1	0.7	0.5
Nitrate	mg/L	NS	NS	NS	0.53	0.21	0.20
Nitrite	mg/L	NS	NS	NS	<0.01	<0.01	<0.01
Filterable Phosphorous	mg/L	NS	NS	NS	0.02	0.09	0.03
Non-Filterable Phosphorous	mg/L	NS	NS	NS	0.01	0.04	0.03
Total Phosphorous	mg/L	SQ	<0.1	<0.04	0.02	0.13	0.03
Total Suspended Solids	mg/L	SQ	<20	<6	16	2	2
Turbidity	NTU	SQ	<50	<20	24	1	-*
Faecal Coliforms	cfu/100ml	<1000	<150	<150	86	300	220
TKN	mg/L	NS	NS	NS	0.4	0.5	0.3
pH	pH	6.6 - 8	6.6 - 8	6.6 – 8	7.83	8.04	-*
Dissolved Oxygen	% Sat	NS	NS	NS	39	39	-*
Conductivity	ms/cm	NS	NS	NS	0.411	0.404	-*
Temperature	^{O}C	SQ	SQ	SQ	18.9	18.2	-*
Salinity	PPT	NS	NS	NS	0.01	0.01	-*
Arsenic	ug/L	SQ	50%SQ	50	NA	NA	NA
Chromium	ug/L	SQ	50%SQ	10	NA	NA	NA
Copper	ug/L	SQ	50%SQ	2	NA	NA	NA
Lead	ug/L	SQ	50%SQ	1	NA	NA	NA
Mercury	ug/L	SQ	50%SQ	0.1	NA	NA	NA
Zinc	ug/L	SQ	50%SQ	50	NA	NA	NA
OC Pesticides	ug/L	SQ	50%SQ	NS	NA	NA	NA
OP Pesticides	ug/L	SQ	50%SQ	NS	NA	NA	NA
Phenols	ug/L	SQ	50%SQ	NS	NA	NA	NA
Hardness	mg/L	NS	NS	NS	NA	NA	NA
Chlorophyll A	ug/L	15	15	10	NA	NA	NA
Oil & Grease	mg/L	NS	NS	NS	NA	NA	NA
Priority PAH	ug/L	NS	NS	NS	NA	NA	NA
Total Algal Count	Cells/ml	NS	NS	NS	NA	NA	NA

-*. Insufficient depth for conducting assessment with Horiba
1. Long-Term water quality goals are derived from ANZECC, 1992 guidelines and Councils WMS Feb 2001
2. Figures in **BOLD** satisfy long-term water quality goals
3. Figures BLUE do not achieve long term goals
4. Figures in ORANGE do not achieve the medium & long term goals
5. Figures in RED do not achieve the short, medium & long term goals
6. NS – Not Specified by Council, SQ – Status Quo, NR – Not Required by Council, NA – Not Available
7. Refer to lab printouts for constituents results. Note that the figure included in this summary table is the highest recorded constituent value not the total value.
8. Rainfall collected from the Manly Hydraulic Laboratory (Narrabeen Creek).

Table 3 Cont…

Parameters	Units	Short-Term Goal	Medium Term Goal	Long Term Goal	Wet Weather Rising Sector 8 (29/10/08)		
					WS816IS	WS816US2	WS816DS
Total rain (5 days preceding)	mm				**15**	**15**	**15**
Ammonia – N	mg/L	NS	<0.3	<0.3	**0.03**	**0.02**	**0.05**
Total Nitrogen	mg/L	SQ	<1.6	1.0	**0.6**	**0.8**	2.6
Nitrate	mg/L	NS	NS	NS	**0.18**	**0.29**	**0.43**
Nitrite	mg/L	NS	NS	NS	**0.01**	**0.01**	**0.02**
Filterable Phosphorous	mg/L	NS	NS	NS	**<0.1**	**<0.1**	**<0.1**
Non-Filterable Phosphorous	mg/L	NS	NS	NS	**<0.1**	**0.1**	**0.3**
Total Phosphorous	mg/L	SQ	<0.1	<0.04	0.05	**0.08**	0.16
Total Suspended Solids	mg/L	SQ	<20	<6	**<5**	**6**	50
Turbidity	NTU	SQ	<50	<20	**4**	**9**	43
Faecal Coliforms	cfu/100ml	<1000	<150	<150	2600	6200	9300
TKN	mg/L	NS	NS	NS	**0.4**	**0.5**	**2.1**
pH	pH	6.6 - 8	6.6 - 8	6.6 – 8	10.4	8.8	8.5
Dissolved Oxygen	% Sat	NS	NS	NS	**41**	**39**	**44**
Conductivity	ms/cm	NS	NS	NS	**0.28**	**0.19**	**0.11**
Temperature	^{O}C	SQ	SQ	SQ	**18**	**18**	**18**
Salinity	PPT	NS	NS	NS	**0.00**	**0.00**	**0.00**
Arsenic	ug/L	SQ	50%SQ	50	**NR**	**NA**	**NR**
Chromium	ug/L	SQ	50%SQ	10	**NR**	**NA**	**NR**
Copper	ug/L	SQ	50%SQ	2	**NR**	**NA**	**NR**
Lead	ug/L	SQ	50%SQ	1	**NR**	**NA**	**NR**
Mercury	ug/L	SQ	50%SQ	0.1	**NR**	**NA**	**NR**
Zinc	ug/L	SQ	50%SQ	50	**NR**	**NA**	**NR**
OC Pesticides	ug/L	SQ	50%SQ	NS	**NR**	**NA**	**NR**
OP Pesticides	ug/L	SQ	50%SQ	NS	**NR**	**NA**	**NR**
Phenols	ug/L	SQ	50%SQ	NS	**NR**	**NA**	**NR**
Hardness	mg/L	NS	NS	NS	**NR**	**NA**	**NR**
Chlorophyll A	ug/L	15	15	10	**NR**	**NA**	**NR**
Oil & Grease	mg/L	NS	NS	NS	**NR**	**NA**	**NR**
Priority PAH	ug/L	NS	NS	NS	**NR**	**NA**	**NR**
Total Algal Count	Cells/ml	NS	NS	NS	**NR**	**NA**	**NR**

-*. Insufficient depth for conducting assessment with Horiba
1. Long-Term water quality goals are derived from ANZECC, 1992 guidelines and Councils WMS Feb 2001
2. Figures in **BOLD** satisfy long-term water quality goals
3. Figures BLUE do not achieve long term goals
4. Figures in ORANGE do not achieve the medium & long term goals
5. Figures in RED do not achieve the short, medium & long term goals
6. NS – Not Specified by Council, SQ – Status Quo, NR – Not Required by Council, NA – Not Available
7. Refer to lab printouts for constituents results. Note that the figure included in this summary table is the highest recorded constituent value not the total value.
8. Rainfall collected from the Manly Hydraulic Laboratory (Narrabeen Creek).

Table 3 Cont…

Parameters	Units	Short-Term Goal	Medium Term Goal	Long Term Goal	Wet Weather Falling Sector 8 (30/10/08)		
					WS817IS	WS817US2	WS817DS
Total rain (5 days preceding)	mm				16.5	16.5	16.5
Ammonia – N	mg/L	NS	<0.3	<0.3	<0.01	<0.01	<0.01
Total Nitrogen	mg/L	SQ	<1.6	1.0	0.9	4.1	1.8
Nitrate	mg/L	NS	NS	NS	0.57	0.51	0.51
Nitrite	mg/L	NS	NS	NS	0.01	0.01	0.01
Filterable Phosphorous	mg/L	NS	NS	NS	<0.1	<0.1	<0.1
Non-Filterable Phosphorous	mg/L	NS	NS	NS	<0.1	0.3	0.2
Total Phosphorous	mg/L	SQ	<0.1	<0.04	0.02	0.09	0.14
Total Suspended Solids	mg/L	SQ	<20	<6	0	31	99
Turbidity	NTU	SQ	<50	<20	<5		53
Faecal Coliforms	cfu/100ml	<1000	<150	<150	<2	380	1800
TKN	mg/L	NS	NS	NS	0.4	3.6	1.2
pH	pH	6.6 - 8	6.6 - 8	6.6 – 8	10.8	9.7	9.6
Dissolved Oxygen	% Sat	NS	NS	NS	42	40	40
Conductivity	ms/cm	NS	NS	NS	0.46	0.32	0.32
Temperature	^{O}C	SQ	SQ	SQ	18	18	18
Salinity	PPT	NS	NS	NS	0.00	0.00	0.00
Arsenic	ug/L	SQ	50%SQ	50	NR	NR	NR
Chromium	ug/L	SQ	50%SQ	10	NR	NR	NR
Copper	ug/L	SQ	50%SQ	2	NR	NR	NR
Lead	ug/L	SQ	50%SQ	1	NR	NR	NR
Mercury	ug/L	SQ	50%SQ	0.1	NR	NR	NR
Zinc	ug/L	SQ	50%SQ	50	NR	NR	NR
OC Pesticides	ug/L	SQ	50%SQ	NS	NR	NR	NR
OP Pesticides	ug/L	SQ	50%SQ	NS	NR	NR	NR
Phenols	ug/L	SQ	50%SQ	NS	NR	NR	NR
Hardness	mg/L	NS	NS	NS	NR	NR	NR
Chlorophyll A	ug/L	15	15	10	NR	NR	NR
Oil & Grease	mg/L	NS	NS	NS	NR	NR	NR
Priority PAH	ug/L	NS	NS	NS	NR	NR	NR
Total Algal Count	Cells/ml	NS	NS	NS	NR	NR	NR

-*. Insufficient depth for conducting assessment with Horiba
1. Long-Term water quality goals are derived from ANZECC, 1992 guidelines and Councils WMS Feb 2001
2. Figures in **BOLD** satisfy long-term water quality goals
3. Figures BLUE do not achieve long term goals
4. Figures in ORANGE do not achieve the medium & long term goals
5. Figures in RED do not achieve the short, medium & long term goals
6. NS – Not Specified by Council, SQ – Status Quo, NR – Not Required by Council, NA – Not Available
7. Refer to lab printouts for constituents results. Note that the figure included in this summary table is the highest recorded constituent value not the total value.
8. Rainfall collected from the Manly Hydraulic Laboratory (Narrabeen Creek).

Table 3 Cont…

Parameters	Units	Short-Term Goal	Medium Term Goal	Long Term Goal	Wet Weather Rising Sector 8 (1/04/09)		
					WS820IS	WS820US2	WS820DS
Total rain (5 days preceding)	mm				76	76	76
Ammonia – N	mg/L	NS	<0.3	<0.3	0.04	0.02	0.02
Total Nitrogen	mg/L	SQ	<1.6	1.0	1.0	1.0	0.8
Nitrate	mg/L	NS	NS	NS	0.44	0.38	0.36
Nitrite	mg/L	NS	NS	NS	<0.01	<0.01	<0.01
Filterable Phosphorous	mg/L	NS	NS	NS	0.17	0.11	0.12
Non-Filterable Phosphorous	mg/L	NS	NS	NS	0.17	0.13	0.12
Total Phosphorous	mg/L	SQ	<0.1	<0.04	0.21	0.14	0.12
Total Suspended Solids	mg/L	SQ	<20	<6	8	6	13
Turbidity	NTU	SQ	<50	<20	38	33	38
Faecal Coliforms	cfu/100ml	<1000	<150	<150	1100	4700	4400
TKN	mg/L	NS	NS	NS	0.6	0.6	0.4
pH	pH	6.6 - 8	6.6 - 8	6.6 – 8	7.84	9.4	9.46
Dissolved Oxygen	% Sat	NS	NS	NS	69	81	83
Conductivity	ms/cm	NS	NS	NS	0.22	0.222	0.219
Temperature	^{O}C	SQ	SQ	SQ	19.9	20.4	20.4
Salinity	PPT	NS	NS	NS	0	0	0
Arsenic	ug/L	SQ	50%SQ	50	NA	NA	NA
Chromium	ug/L	SQ	50%SQ	10	NA	NA	NA
Copper	ug/L	SQ	50%SQ	2	NA	NA	NA
Lead	ug/L	SQ	50%SQ	1	NA	NA	NA
Mercury	ug/L	SQ	50%SQ	0.1	NA	NA	NA
Zinc	ug/L	SQ	50%SQ	50	NA	NA	NA
OC Pesticides	ug/L	SQ	50%SQ	NS	NA	NA	NA
OP Pesticides	ug/L	SQ	50%SQ	NS	NA	NA	NA
Phenols	ug/L	SQ	50%SQ	NS	NA	NA	NA
Hardness	mg/L	NS	NS	NS	NA	NA	NA
Chlorophyll A	ug/L	15	15	10	NA	NA	NA
Oil & Grease	mg/L	NS	NS	NS	NA	NA	NA
Priority PAH	ug/L	NS	NS	NS	NA	NA	NA
Total Algal Count	Cells/ml	NS	NS	NS	NA	NA	NA

-*. Insufficient depth for conducting assessment with Horiba
1. Long-Term water quality goals are derived from ANZECC, 1992 guidelines and Councils WMS Feb 2001
2. Figures in **BOLD** satisfy long-term water quality goals
3. Figures BLUE do not achieve long term goals
4. Figures in ORANGE do not achieve the medium & long term goals
5. Figures in RED do not achieve the short, medium & long term goals
6. NS – Not Specified by Council, SQ – Status Quo, NR – Not Required by Council, NA – Not Available
7. Refer to lab printouts for constituents results. Note that the figure included in this summary table is the highest recorded constituent value not the total value.
8. Rainfall collected from the Manly Hydraulic Laboratory (Narrabeen Creek).

Table 3 Cont...

Parameters	Units	Short-Term Goal	Medium Term Goal	Long Term Goal	Wet Weather Falling Sector 8 (2/04/09)		
					WS821IS	WS821US2	WS821DS
Total rain (5 days preceding)	mm				80	80	80
Ammonia – N	mg/L	NS	<0.3	<0.3	<0.01	<0.01	<0.01
Total Nitrogen	mg/L	SQ	<1.6	1.0	0.9	0.6	0.6
Nitrate	mg/L	NS	NS	NS	0.47	0.14	0.14
Nitrite	mg/L	NS	NS	NS	<0.01	<0.01	<0.01
Filterable Phosphorous	mg/L	NS	NS	NS	0.09	0.02	0.04
Non-Filterable Phosphorous	mg/L	NS	NS	NS	0.08	0.03	0.03
Total Phosphorous	mg/L	SQ	<0.1	<0.04	0.06	0.04	0.04
Total Suspended Solids	mg/L	SQ	<20	<6	1	1	1
Turbidity	NTU	SQ	<50	<20	8	6	4
Faecal Coliforms	cfu/100ml	<1000	<150	<150	<2	380	620
TKN	mg/L	NS	NS	NS	0.5	0.5	0.5
pH	pH	6.6 - 8	6.6 - 8	6.6 – 8	9.94	9.14	9.09
Dissolved Oxygen	% Sat	NS	NS	NS	61	76	80
Conductivity	ms/cm	NS	NS	NS	20.5	20.6	20.6
Temperature	^{o}C	SQ	SQ	SQ	0.01	0.01	0.01
Salinity	PPT	NS	NS	NS	0.349	0.319	0.318
Arsenic	ug/L	SQ	50%SQ	50	NA	NA	NA
Chromium	ug/L	SQ	50%SQ	10	NA	NA	NA
Copper	ug/L	SQ	50%SQ	2	NA	NA	NA
Lead	ug/L	SQ	50%SQ	1	NA	NA	NA
Mercury	ug/L	SQ	50%SQ	0.1	NA	NA	NA
Zinc	ug/L	SQ	50%SQ	50	NA	NA	NA
OC Pesticides	ug/L	SQ	50%SQ	NS	NA	NA	NA
OP Pesticides	ug/L	SQ	50%SQ	NS	NA	NA	NA
Phenols	ug/L	SQ	50%SQ	NS	NA	NA	NA
Hardness	mg/L	NS	NS	NS	NA	NA	NA
Chlorophyll A	ug/L	15	15	10	NA	NA	NA
Oil & Grease	mg/L	NS	NS	NS	NA	NA	NA
Priority PAH	ug/L	NS	NS	NS	NA	NA	NA
Total Algal Count	Cells/ml	NS	NS	NS	NA	NA	NA

-*. Insufficient depth for conducting assessment with Horiba
1. Long-Term water quality goals are derived from ANZECC, 1992 guidelines and Councils WMS Feb 2001
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APPENDIX F -
HABITAT MONITORING RESULTS

BIOSIS
RESEARCH

Macroinvertebrate Assessment of Sector 8; Warriewood

25 June 2008

Biosis Research
Pty Ltd

BIOSIS
RESEARCH

Report for Worley Parsons

Macroinvertebrate Assessment of Sector 8; Warriewood

25 June 2008

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- Melissa Starling (Research Assistant, Biosis Research)

1.0 INTRODUCTION

Biosis Research Pty Ltd was commissioned by Worley Parsons to undertake a macroinvertebrate assessment, prior to development, of Sector 8 in Warriewood.

The study site is a section of Fern Creek that runs along the south western edge of Sector 8. Sector 8 is located on the corner of Macpherson Street and Garden St (Figure 1). The section of Fern Creek surveyed began just below a deep pool with a large concrete pipe and extended to the culvert at Garden St. The study area is located within the Pittwater Local Government Area.

2.0 METHODS

The study area was visited on 13 June 2008 by an aquatic ecologist and a field assistant. A habitat assessment and macroinvertebrate collection was undertaken along the section of creek bordering Sector 8. During the site visit, the weather conditions were cool and there was light rain. There had been rainfall in the area during the previous seven days (16.6mm at Sydney, BOM daily weather observations).

2.1 Taxonomy

Macroinvertebrates were identified to family level, with the exception of Oligochaeta (to class), Polychaeta (to class), Ostracoda (to subclass), Nematoda (to phylum), Nemertea (to phylum), Acarina (to order) and Chironomidae (to subfamily) as outlined in the NSW AUSRIVAS Sampling and Processing Manual (Turak *et al.* 2004). All macroinvertebrates were identified using the taxonomic keys and names listed in Hawking (2000). Common names for macroinvertebrates are used in the body of this report, with scientific names provided in Appendix 1.

2.2 Aquatic Survey

2.2.1 Habitat Assessment

Aquatic habitats were surveyed by undertaking visual assessments following the AUSRIVAS habitat assessment protocol, as well as recording incidental observations.

2.2.2 Water Quality Survey

Water quality measurements were taken onsite with a Yeokal 612 -Water Quality Meter and Hach Alkalinity Kit. Parameters recorded include:

- pH
- Dissolved Oxygen (DO) (mg/L)
- Temperature (^{o}C)
- Electrical Conductivity (EC) (µs/cm)
- Turbidity (NTU)
- Alkalinity (mg/L)

2.2.3 Macroinvertebrate Survey and Analysis

Macroinvertebrates were collected from the extent of the site. Collection was undertaken following AUSRIVAS protocols for edge habitats, with 10 m of habitat sampled over a study reach of 100 m, using a 250 µm sweep net (Turak *et al.* 2004). Samples were live picked at the site by one aquatic ecologist and preserved for later identification in 70% ethanol. A SIGNAL 2 analysis for the macroinvertebrate families recorded at each site was undertaken. SIGNAL 2 is an updated version of the original SIGNAL assessment and is an index of water pollution based on the tolerance or intolerance of biota to pollution (Chessman *et al.* 1997). The output is a single number, reflecting the degree of water pollution. Families of aquatic invertebrates are allocated sensitivity scores according to their tolerance or intolerance of various pollutants (the lower the number, the lower the sensitivity and the higher the tolerance). The SIGNAL 2 index is calculated by summing the grades allocated and then dividing by the number of families present to give an average grade per site. The resulting score can vary from 1 to 10, and can be used to assess a site's overall status in terms of water quality. A site with typically high water quality would have a high SIGNAL value (>6) and a site with probable severe pollution would have a low value (<4); (Chessman 1995, Chessman *et al.* 1997). Scores from the original SIGNAL index are also provided for comparison (Appendix).

2.3 Limitations

This study was a brief and targeted collection, prior to construction works in Sector 8. The site was heavily overgrown with weeds which restricted access to the creek.

3.0 RESULTS

The survey site was located along the south western boundary of Sector 8 (Figure 1). The site consisted of a narrow channel (1.0 metres wide) further constricted in places by weeds and instream rubbish (Figure 2). The majority of the site had slow flow, with some fast flow sections present. The substrate of the channel was clay and silt; leaves and woody debris were present on the surface. The water had a protein film in some sections and a wide variety of urban and industrial rubbish was observed in the channel and pool (Figure 3). The riparian zone was approximately 10 metres wide on either side of the creek. Exotic vegetation dominated the understorey, including Blackberry *Rubus fruticosus,* Lantana *Lantana camara,* and Lomandra *Lomandra longifolia*. The site was considered highly disturbed, due to its altered hydrological state and exotic plant invasions.

3.1 Water Quality

The results of the water quality analysis can be seen in Table 1.

Table 1: Water Quality Results from Sector 8

Parameter	Site	ANZECC Guidelines
pH	8.00	6.5-8
Dissolved oxygen (mg/L)	8.60	>6
Temperature. (^{o}C)	13.1	
Electrical conductivity (µS/cm)	375	125-2200
Turbidity. (NTU)	0	20-50
Alkalinity (mg/L)	35	

3.2 Macroinvertebrates

The upstream site had a SIGNAL2 score of 3.2 (original SIGNAL score of 4.8) and had a moderately low number of taxa (14). It was dominated by chironomids (midge larvae). The SIGNAL2 results suggest that the water quality at this site is severely impacted

Macroinvertebrates collected during this study indicate that the macroinvertebrate communities are low in diversity and have a number of pollution tolerant taxa. A list of macroinvertebrates collected during this survey is provided in Appendix 1.

4.0 CONCLUSION

Macroinvertebrate and basic water quality sampling was undertaken on a section of Fern Creek, prior to construction of Sector 8, Macpherson and Garden Street, Warriewood. Habitat assessment and macroinvertebrate sampling was undertaken along the extent of the creek beside Sector 8. Analysis of macroinvertebrate samples indicated poor water quality within Sector 8 with a SIGNAL2 score of 3.2. The lower number of taxa and SIGNAL2 scores indicate an impacted system.

The rubbish in the stream and banks, including glass, metal scrap, and bricks, is constricting the creek and resulting in areas of bank degradation. Further macroinvertebrate sampling could be undertaken during the construction phase. Removal of the rubbish would improve the instream habitat for macroinvertebrates. If rubbish removal were undertaken sampling would be recommended no less than two months later to allow a natural macroinvertebrate community to establish.

FIGURES

Figure 1: Survey site.

Acknowledgements: Google Maps 2008

Figure 2. Unstable bank area with rubbish and weeds within sampled area of Fern Creek

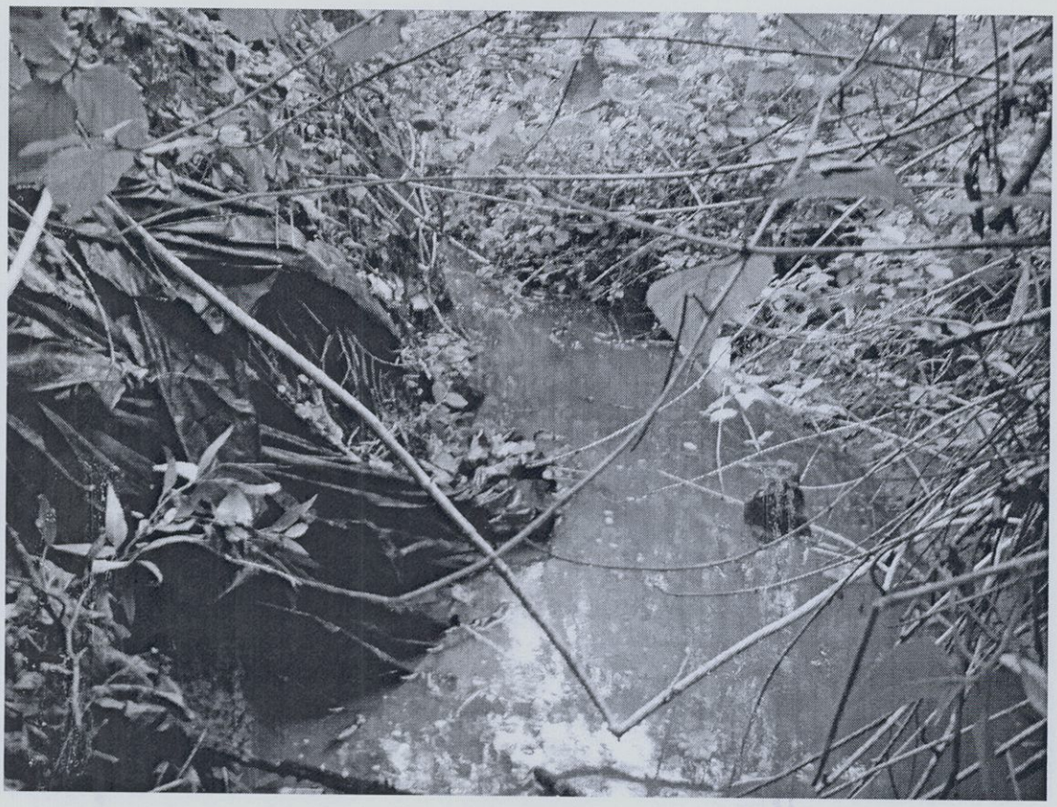

Figure 3. Rubbish encountered within site. Polystyrene blocks and metal stakes visible

APPENDICES

APPENDIX 1

Macroinvertebrate Results

Name	SignalCode	SignalCode2	2008 Sector 8 site
Ceinidae	5	2	1
Chironominae Family Chironomidae	1	6	10
Coenagrionidae	7	2	3
Corixidae	5	2	2
Dytiscidae	5	2	1
Elmidae	7	7	1
Hemicorduliidae	-	5	3
Notonectidae	4	1	1
Physidae	3	1	2
Stratiomyidae	2	2	1
Tabanidae	5	3	1
Tipulidae	5	5	1
Veliidae	4	3	4
Ostracoda Subphylum Crustacea	N/A	N/A	4
	Total Number of Taxa		**14**
	Number of Signal(2) Taxa		**13**
	SIGNAL Score		**4.8**
	SIGNAL2 Score		**3.2**

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REFERENCES

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