Riley Consultants Limited

Graphical Peak Flow Method
(from ARC's TP108)

Project Title:	Maxwell Hills	**By:**	JEB
Project Number:	04819/6	**Checked:**	RK 15/2/11
Catchment:	D - Rural residential zone	**Date:**	15-Feb-11

Attunation Volume Summary

Average Recurrence Interval, ARI (yr)	WQ	ED	2	10	100
24-hour Rainfall Depth, P24 (mm)	25.366667	34.5	76.1	101.6	172.8
Pre Development Runoff Volume (m^3)	N/A	N/A	2774	4419	9640
Post Development Runoff Volume (m^3)	N/A	N/A	3097	4844	10274
Attenuation Volume (m^3)	**400**	800	**322**	**425**	**635**

Riley Consultants Limited

Runoff Parameters and Time of Concentration
(from ARC's TP108)

Project Title: Maxwell Hills

Project Number: 04819/6

Catchment: E

By: JEB

Checked: AK 15/2/11

Date: 15-Feb-11

1. Runoff Curve Number (CN) and Initial Abstraction (Ia) - Pre Development

Soil Name	Soil Classification	Cover Description	Pervious, Impervious	CN*	Area (Ha)	Product of CN x Area
Colluvium	Group C	Pasture	P	74	5.52	408.48
* from Appendix B, TP108 (ARC, 1999)				Totals =	5.52	408.48

CN (Weighted) = 74.0

Ia (Weighted) = 5.0 mm

1. Runoff Curve Number (CN) and Initial Abstraction (Ia) - Post Development

Soil Name	Soil Classification	Cover Description	Pervious, Impervious	CN*	Area (Ha)	Product of CN x Area
Alluvials & Limstone	Group C	roofs, pavement	Im	98	0.74	72.52
	Group C	Grass	P	74	4.78	353.72
* from Appendix B, TP108 (ARC, 1999)				Totals =	5.52	426.24

CN (Weighted) = 77.2

Ia (Weighted) = 4.3 mm

Riley Consultants Limited

Graphical Peak Flow Method
(from ARC's TP108)

Project Title: Maxwell Hills

By: JEB

Project Number: 04819/6

Checked: RK 15/2/11

Catchment: E

Date: 15-Feb-11

Scenario: Pre Development

1. Data

Catchment Area .... A = 0.0552 km^2

Runoff curve number.... CN = 74.0

Initial Abstraction.... Ia = 5.0 mm

2. Calculate Storage, S = (1000/CN - 10)25.4 = 89.2 mm

	Storm #1	Storm #2	Storm #3
3. Average Recurrence Interval, ARI (yr)	2	10	100
4. 24-hour Rainfall Depth, P_{24} (mm)	76.1	101.6	172.8
5. Compute c* = $(P_{24}-2Ia)/(P_{24}-2Ia+2S)$	0.27	0.34	0.48
6. Runoff Depth, $Q_{24} = (P_{24}-Ia)2/(P_{24}-2Ia)+S$ (mm)	31.5	50.2	109.5
7. Runoff Volume, $V_{24} = 1000Q_{24}A$ (m^3)	1740	2772	6047

Riley Consultants Limited

Graphical Peak Flow Method
(from ARC's TP108)

Project Title: Maxwell Hills

Project Number: 04819/6

Catchment: E

Scenario: Post Development

By: JEB

Checked: RK 15/2/11

Date: 15-Feb-11

1. Data

Catchment Area .... A = 0.0552 km^2

Runoff curve number.... CN = 77.2

Initial Abstraction.... Ia = 4.3 mm

2. Calculate Storage, S = (1000/CN - 10)25.4 = 74.9 mm

	Storm #1	Storm #2	Storm #3
3. Average Recurrence Interval, ARI (yr)	2	10	100
4. 24-hour Rainfall Depth, P_{24} (mm)	76.1	101.6	172.8
5. Compute c* = $(P_{24}$-2Ia)/(P_{24}-2Ia+2S)	0.31	0.38	0.52
6. Runoff Depth, Q_{24} = (P_{24}-Ia)2/(P_{24}-2Ia)+S (mm)	35.1	54.9	116.6
7. Runoff Volume, V_{24} = 1000Q_{24}A (m^3)	1938	3033	6436

Riley Consultants Limited

Graphical Peak Flow Method
(from ARC's TP108)

Project Title: Maxwell Hills
By: JEB

Project Number: 04819/6
Checked: RK 15/2/11

Catchment: E
Date: 15-Feb-11

1. Data

   Catchment Area .... $A =$ 0.0552 km^2

   Runoff curve number.... $CN =$ 77.2

   Initial Abstraction.... $Ia =$ 4.3 mm

2. Calculate Storage, $S = (1000/CN - 10)25.4$ = 74.9 mm

	Storm #4	Storm #5
3. Average Recurrence Interval, ARI (yr)	Wqevent	ED
4. 24-hour Rainfall Depth, P_{24} (mm)	25.36667	34.5
5. Compute $c^* = (P_{24}-2Ia)/(P_{24}-2Ia+2S)$	0.10	0.15
6. Runoff Depth, $Q_{24} = (P_{24}-Ia)2/(P_{24}-2Ia)+S$ (mm)	4.6	8.7
7. Runoff Volume, $V_{24} = 1000Q_{24}A$ (m^3)	300	500

Riley Consultants Limited

Graphical Peak Flow Method
(from ARC's TP108)

Project Title:	Maxwell Hills	**By:**	JEB
Project Number:	04819/6	**Checked:**	RK 15/2/11
Catchment:	E	**Date:**	15-Feb-11

Attunation Volume Summary

Average Recurrence Interval, ARI (yr)	**WQ**	**ED**	**2**	**10**	**100**
24-hour Rainfall Depth, P24 (mm)	25.366667	34.5	76.1	101.6	172.8
Pre Development Runoff Volume (m^3)	N/A	N/A	1740	2772	6047
Post Development Runoff Volume (m^3)	N/A	N/A	1938	3033	6436
Attenuation Volume (m^3)	**300**	500	**198**	**261**	**390**

Riley Consultants Limited

Runoff Parameters and Time of Concentration
(from ARC's TP108)

Project Title: Maxwell Hills

Project Number: 04819/6

Catchment: Summary

By: JEB

Checked: RK 15/2/11

Date: 15-Feb-11

Pond Volume Summary

24-hour Rainfall Depth, P24 (mm)		25.37	34.5	76.1	101.6	172.8
		Total Volume (m^3)				
Catchment	**Size (ha)**	**WQ**	**ED**	**2**	**10**	**100**
A	7	300	600	355	466	689
B	6.1	300	500	216	286	427
C	14.9	800	1400	791	1038	1533
D	8.8	400	800	322	425	635
E	5.5	300	500	198	261	390
TOTAL	42.3	2100	3800	1882	2476	3673

Riley Consultants Limited

Runoff Parameters and Time of Concentration
(from ARC's TP108)

Project Title: Maxwell Hills

By: JEB

Project Number: 04819/6

Checked: RK 15/2/11

Catchment: Summary - Rural residential zone

Date: 15-Feb-11

Pond Area Summary

		Areas				
		Pond		Forebay		Total (m^2)
Catchment	Size (ha)	Length	Width	Length	Width	
A	7	29	21	14	10	1445
B	6.1	30	22	14	10	1521
C	14.9	49	25	23	13	2558
D	8.8	34	22	17	11	1722
E	5.5	24	20	11	9	1183
TOTAL	42.3					8428

RILEY CONSULTANTS	Job No: 04819/6 Page: 1 of Pages
	Project: Maxwell Hills Plan Change
	Calc: JEB Date: 11/2/11
	Check: RK Date: 15/2/11

Description: Amend Maxwell Hills SW report for development only at the bottom of the catchment.

Pre-development (10% AEP)

Catchment A –

$A = 27.4\,ha = 274{,}000\,m^2$

$C = 0.4$

$i = 38\,mm/hr = 1.1 \times 10^{-5}\,m/s$ (10% AEP)

$Q = CiA$

$= 0.4 \times 1.1 \times 10^{-5} \times 274{,}000$

$= 1.2\,m^3/s$

Catchment B –

$A = 23.5\,ha = 235{,}000\,m^2$

$Q = 0.4 \times 1.1 \times 10^{-5} \times 235{,}000$

$= 1.0\,m^3/s$

Catchment C –

$A = 22.1\,ha = 221{,}000\,m^2$

$Q = 0.4 \times 1.1 \times 10^{-5} \times 221{,}000$

$= 0.97\,m^3/s$

Catchment D –

$A = 44.8\,ha = 448{,}000\,m^2$

$Q = 0.4 \times 1.1 \times 10^{-5} \times 448{,}000$

$= 1.97\,m^3/s$

Catchment E –

$A = 80.1\,ha = 801{,}000\,m^2$

$Q = 0.4 \times 1.1 \times 10^{-5} \times 801{,}000$

$= 3.5\,m^3/s$

Total for 10% AEP = $8.64\,m^3/s$ → Total flow of the runoff was concentrated at one location. Note assumed T_c is 10mins for the total catchment also.

RILEY CONSULTANTS	Job No: 04819/6	Page: 2	of	Pages
	Project:			
	Calc: JEB	Date: 14/2/11		
	Check: RK	Date: 15/2/11		

Description

Pre-development (1% AEP)

Catchment A -

$i = 87\ mm/hr$
$= 2.4 \times 10^{-5}\ m/s$

$Q = CiA$
$= 0.4 \times 2.4 \times 10^{-5} \times 274{,}000$
$= 2.6\ m^3/s$

Catchment B -

$Q = 0.4 \times 2.4 \times 10^{-5} \times 235{,}000$
$= 2.3\ m^3/s$

Catchment C -

$Q = 0.4 \times 2.4 \times 10^{-5} \times 221{,}000$
$= 2.1\ m^3/s$

Catchment D -

$Q = 0.4 \times 2.4 \times 10^{-5} \times 448{,}000$
$= 4.3\ m^3/s$

Catchment E -

$Q = 0.4 \times 2.4 \times 10^{-5} \times 801{,}000$
$= 7.7\ m^3/s$

Total for 1% AEP = $19.0\ m^3/s$ → Total flow if the runoff was concentrated at one location. Note assumed T_c is 10mins for the total catchment also.

Post-development (unmitigated)

- 10% AEP $C = 0.9$ (roads, hardstand areas), $C = 0.4$ (undeveloped)

Catchment A -

$A = 1.3\ ha = 13{,}000\ m^2$ IMP
$A = 5.7\ ha = 57{,}000\ m^2$ PER

$Q = 1.1 \times 10^{-5} (13000 \times 0.9 + 57000 \times 0.4)$
$= 0.4\ m^3/s$

} Rural residential

RILEY CONSULTANTS	Job No: 04819/6	Page: 3	of	Pages
	Project:			
	Calc: JEB	Date: 14/2/11		
	Check: RK	Date: 15/2/11		

Description

$A = 20.4\ ha = 204{,}000 m^2$ PER

$Q = 0.4 \times 1.1 \times 10^{-5} \times 204{,}000$
$= 0.9\ m^3/s$

$Q_A = 1.3\ m^3/s$

Catchment B –

$A = 0.81\ ha = 8{,}100 m^2$ IMP
$A = 5.3\ ha = 53{,}000 m^2$ PER

Rural resid

$Q = 1.1 \times 10^{-5}(8{,}100 \times 0.9 + 53{,}000 \times 0.4)$
$= 0.3\ m^3/s$

$A = 17.4\ ha = 174{,}000 m^2$ PER

$Q = 0.4 \times 1.1 \times 10^{-5} \times 174{,}000 m^2$
$= 0.8\ m^3/s$

$Q_B = 1.1 m^3/s$

Catchment C

$A = 2.89\ ha = 28{,}900 m^2$ IMP
$A = 12.01\ ha = 120{,}100 m^2$ PER

Rural resid

$Q = 1.1 \times 10^{-5}(28{,}900 \times 0.9 + 120{,}100 \times 0.4)$
$= 0.8 m^3/s$

$A = 7.2 ha = 72{,}000 m^2$ PER

$Q = 0.4 \times 1.1 \times 10^{-5} \times 72{,}000 m^2$
$= 0.3\ m^3/s$

$Q_c = 1.1 m^3/s$

Catchment D –

$A = 1.2 ha = 12{,}000 m^2$ IMP
$A = 7.6 ha = 76{,}000 m^2$ PER

Rural resid.

$Q = 1.1 \times 10^{-5}(12{,}000 \times 0.9 + 76{,}000 \times 0.4) = 0.5\ m^3/s$

RILEY CONSULTANTS	Job No: 04819/6	Page: 4	of	Pages
	Project:			
	Calc: JEB	Date: 14/2/11		
	Check: RK	Date: 15/2/11		

Description

$A = 36\ ha = 360{,}000\ m^2$

$Q = 0.4 \times 1.1 \times 10^{-5} \times 360{,}000$
$= 1.6\ m^3/s$

$Q_D = 2.1\ m^3/s$

Catchment E –

$A = 0.74\ ha = 7{,}400\ m^2$ IMP
$A = 4.78\ ha = 47{,}800\ m^2$ PER

$Q = 1.1 \times 10^{-5} (7{,}400 \times 0.9 + 47{,}800 \times 0.4)$
$= 0.3\ m^3/s$

} Rural resid.

$A = 74.6\ ha = 745{,}800\ m^2$

$Q = 0.4 \times 1.1 \times 10^{-5} \times 745{,}800$
$= 3.3\ m^3/s$

$Q_E = 3.6\ m^3/s$

Post-development (unmitigated)

– 1% AEP

Catchment A –

$Q = 2.4 \times 10^{-5} (13{,}000 \times 0.9 + 57{,}000 \times 0.4)$
$= 0.8\ m^3/s$

} Rural Resid.

$Q = 0.4 \times 2.4 \times 10^{-5} \times 204{,}000$
$= 2.0\ m^3/s$

$Q_A = 2.8\ m^3/s$

Catchment B –

$Q = 2.4 \times 10^{-5} (8{,}100 \times 0.9 + 53{,}000 \times 0.4)$
$= 0.7\ m^3/s$

} Rural Resid.

$Q = 0.4 \times 2.4 \times 10^{-5} \times 174{,}000$
$= 1.7\ m^3/s$

$Q_B = 2.4\ m^3/s$

RILEY CONSULTANTS	Job No: 04819/6 Page: 5 of Pages
	Project:
	Calc: JEB Date: 14/2/11
	Check: RK Date: 15/2/11

Description

Catchment C –

$Q = 2.4\times10^{-5}(28{,}900\times0.9 + 120{,}100\times0.4)$ } Rural Resid.
$= 1.8\ m^3/s$

$Q = 0.4\times2.4\times10^{-5}\times72{,}000$
$= 0.7\ m^3/s$

$Q_C = 2.5\ m^3/s$

Catchment D –

$Q = 2.4\times10^{-5}(12{,}000\times0.9 + 76{,}000\times0.4)$
$= 1.0\ m^3/s$

$Q = 0.4\times2.4\times10^{-5}\times360{,}000$
$= 3.5\ m^3/s$

$Q_D = 4.5\ m^3/s$

Catchment E –

$Q = 2.4\times10^{-5}(7{,}400\times0.9 + 47{,}800\times0.4)$
$= 0.6\ m^3/s$

$Q = 0.4\times2.4\times10^{-5}\times745{,}800$
$= 7.2\ m^3/s$

$Q_E = 7.8\ m^3/s$

Averaged C for the developed catchments ⇒

$$\text{Averaged } C = \frac{0.9\times1.3 + 0.4\times26.1 + 0.9\times0.81 + 0.4\times22.7 + 0.9\times2.9 + 0.4\times19.2 + 0.9\times1.2 + 0.4\times43.6 + 0.9\times0.7 + 0.4\times79.4}{198}$$

$= 0.42$

RILEY CONSULTANTS

Job No: 04819/6	Page: 6 of Pages
Project:	
Calc: JEB	Date: 14/2/11
Check: RK	Date: 15/2/11

Description

Post-development (mitigated)

- 10% AEP & 1% AEP

Catchment A – 1.3 m³/s & 2.8 m³/s

" B –

- 600m² (2 lots) soakage

$Q = 1.1\times10^{-5}(7500\times0.9 + 53000\times0.4)$ / $Q = 2.4\times10^{-5}(7500\times0.9\times53000\times0.4)$
$= 0.3\ m^3/s$ / $= 0.7\ m^3/s$

$Q_B = 0.3 + 0.8 = 1.1\ m^3/s$ (10% AEP) / $Q_B = 0.7 + 1.7 = 2.4\ m^3/s$ (1% AEP)

Catchment C –

- 4200m² (14 lots) soakage

$Q = 1.1\times10^{-5}(24{,}700\times0.9 + 120{,}100\times0.4)$ / $Q = 2.4\times10^{-5}(24{,}700\times0.9 + 120{,}100\times0.4)$
$= 0.8\ m^3/s$ / $= 1.7\ m^3/s$

$Q_C = 0.8 + 0.3 = 1.1\ m^3/s$ (10% AEP) / $Q_C = 1.7 + 0.7 = 2.4\ m^3/s$ (1% AEP)

Catchment D –

- 2,400m² (8 lots) soakage

$Q = 1.1\times10^{-5}(9600\times0.9 + 76{,}000\times0.4)$ / $Q = 2.4\times10^{-5}(9600\times0.9 + 76000\times0.4)$
$= 0.4\ m^3/s$ / $= 0.9\ m^3/s$

$Q_D = 0.4 + 1.6 = 2.0\ m^3/s$ (10% AEP) / $Q_D = 0.9 + 3.5 = 4.4\ m^3/s$ (1% AEP)

Catchment E –

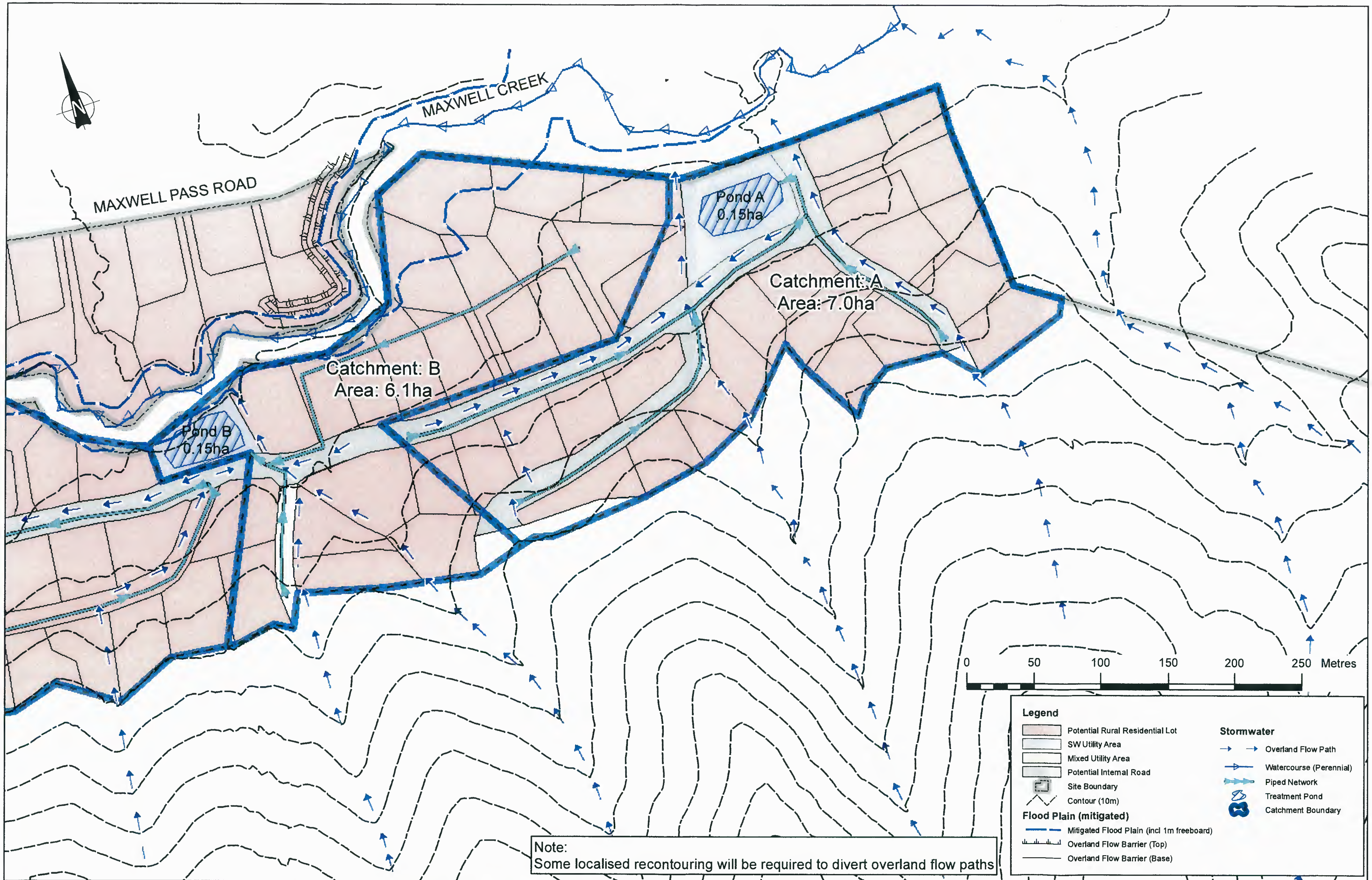
- 3,000m² (10 lots) soakage

$Q = 1.1\times10^{-5}(4400\times0.9 + 47{,}800\times0.4)$ / $Q = 2.4\times10^{-5}(4400\times0.9 + 47800\times0.4)$
$= 0.3\ m^3/s$ / $= 0.6\ m^3/s$

$Q_E = 0.3 + 3.3 = 3.6\ m^3/s$ (10% AEP) / $Q = 0.6 + 7.2 = 7.8\ m^3/s$

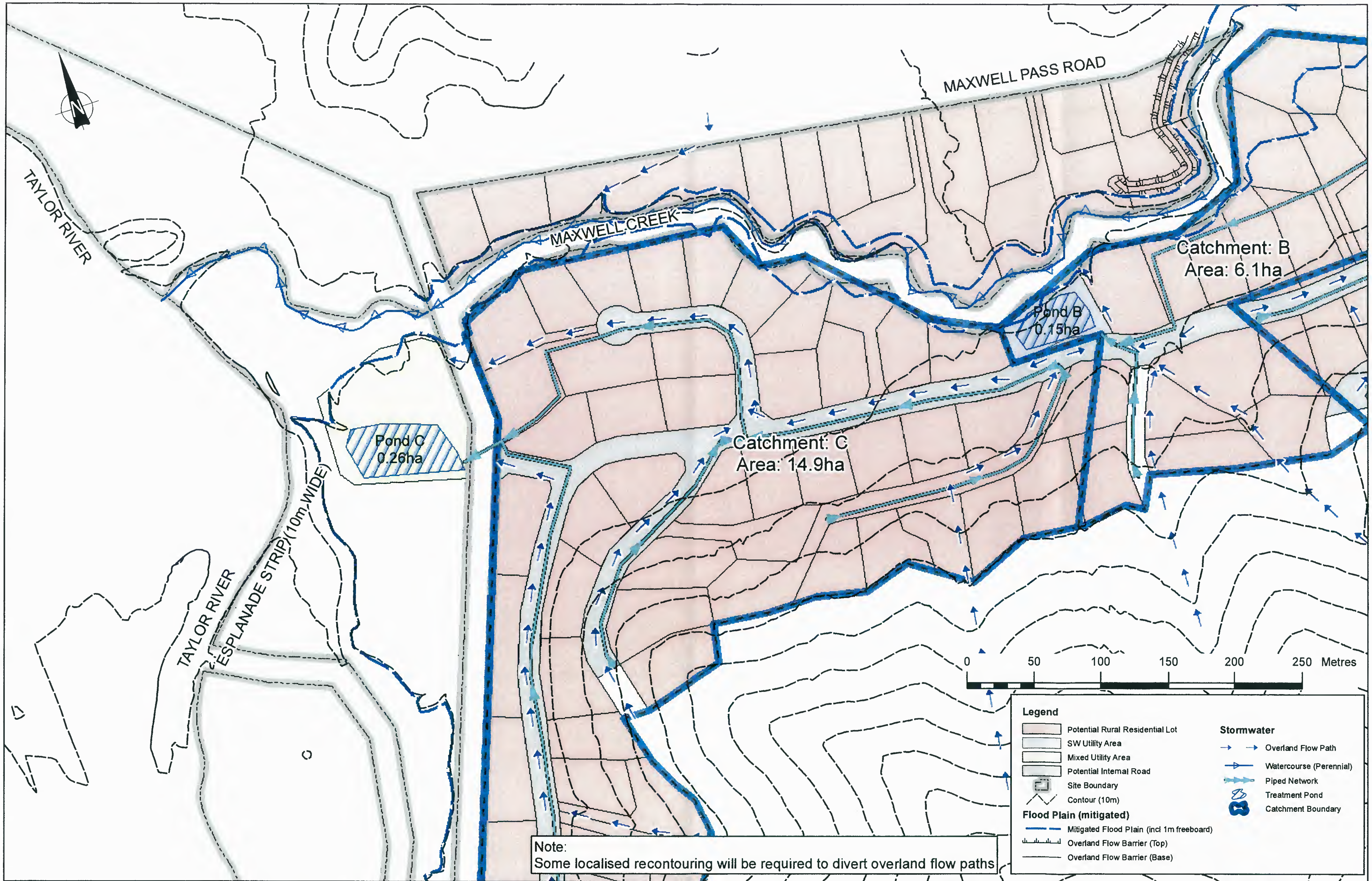
APPENDIX B

Drawings



DESIGN JEB	CHECKED	APPROVED FOR ISSUE:	RILEY CONSULTANTS P.O. BOX 100 253 N.S.M.C. AUCKLAND 0629 TEL. 09-4897872 FAX. 09-4897873	TITLE KAPITI VIEWS LIMITED RURAL RESIDENTIAL DEVELOPMENT - PRIVATE PLAN CHANGE STORMWATER NETWORK PLAN	GIS FILE 04819/6SW.MXD
DRAWN GAF	CHECKED				SCALE 1:2,500
DATE DRAWN 7/02/2011		DATE:			DRAWING No. 04819/6SW-1 REV. 0

REV	DESCRIPTION	BY	DATE
0	FIRST ISSUE		



DESIGN	CHECKED	APPROVED FOR ISSUE:
JEB		
DRAWN	CHECKED	
GAF		
DATE DRAWN		DATE:
7/02/2011		

REV	DESCRIPTION	BY	DATE
0	FIRST ISSUE		

RILEY CONSULTANTS

P.O. BOX 100 253
N.S.M.C.
AUCKLAND 0629
TEL. 09-4897872
FAX. 09-4897873

TITLE

KAPITI VIEWS LIMITED

RURAL RESIDENTIAL DEVELOPMENT - PRIVATE PLAN CHANGE

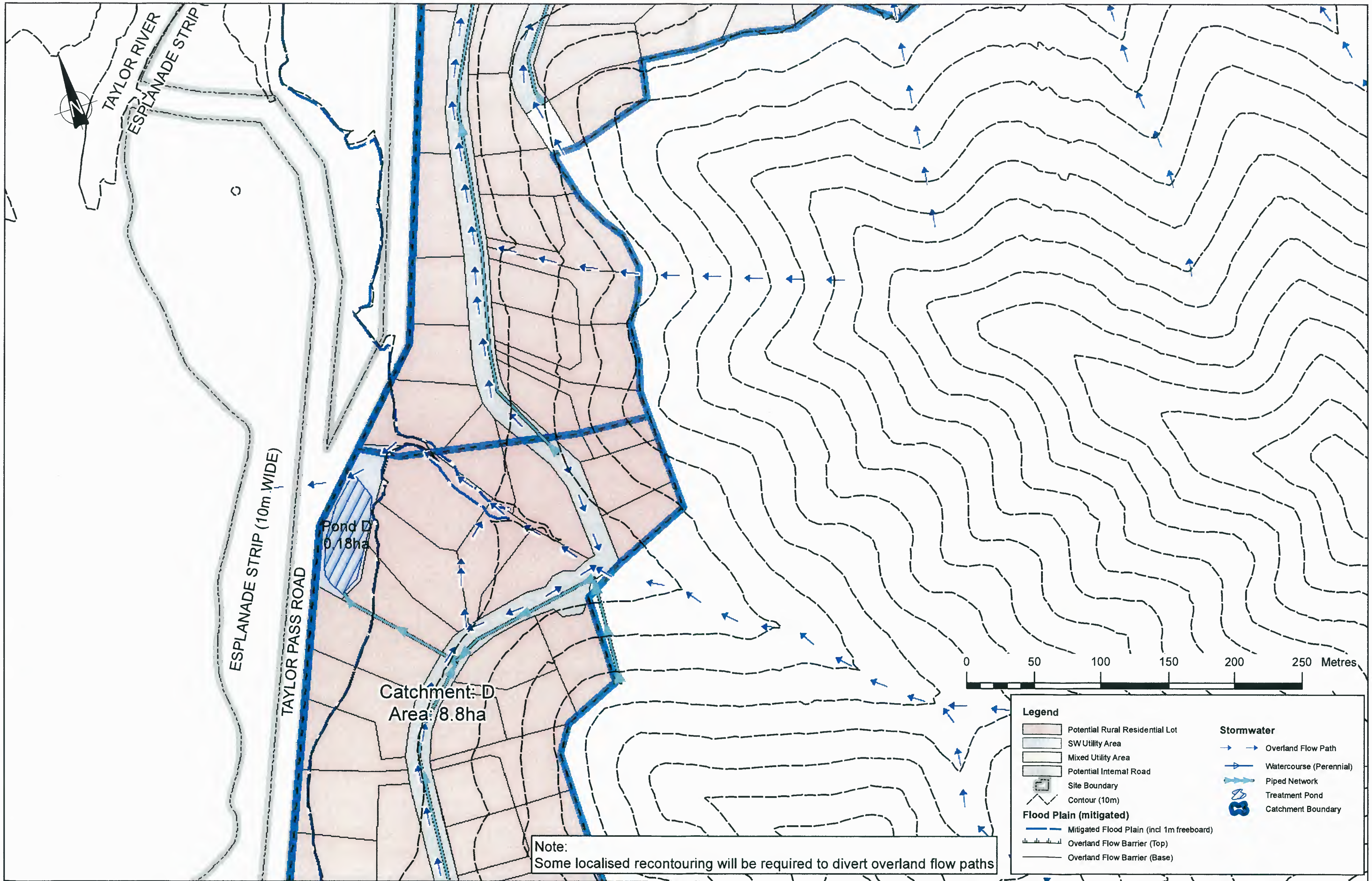
STORMWATER NETWORK PLAN

GIS FILE: 04819/6SW.MXD

SCALE: 1:2,500

DRAWING No.: 04819/6SW-2

REV.: 0



DESIGN: JEB	CHECKED	APPROVED FOR ISSUE:	
DRAWN: GAF	CHECKED		
DATE DRAWN: 7/02/2011		DATE:	
0	FIRST ISSUE		
REV	DESCRIPTION	BY	DATE

RILEY CONSULTANTS
P.O. BOX 100 253
N.S.M.C.
AUCKLAND 0629
TEL. 09-4897872
FAX. 09-4897873

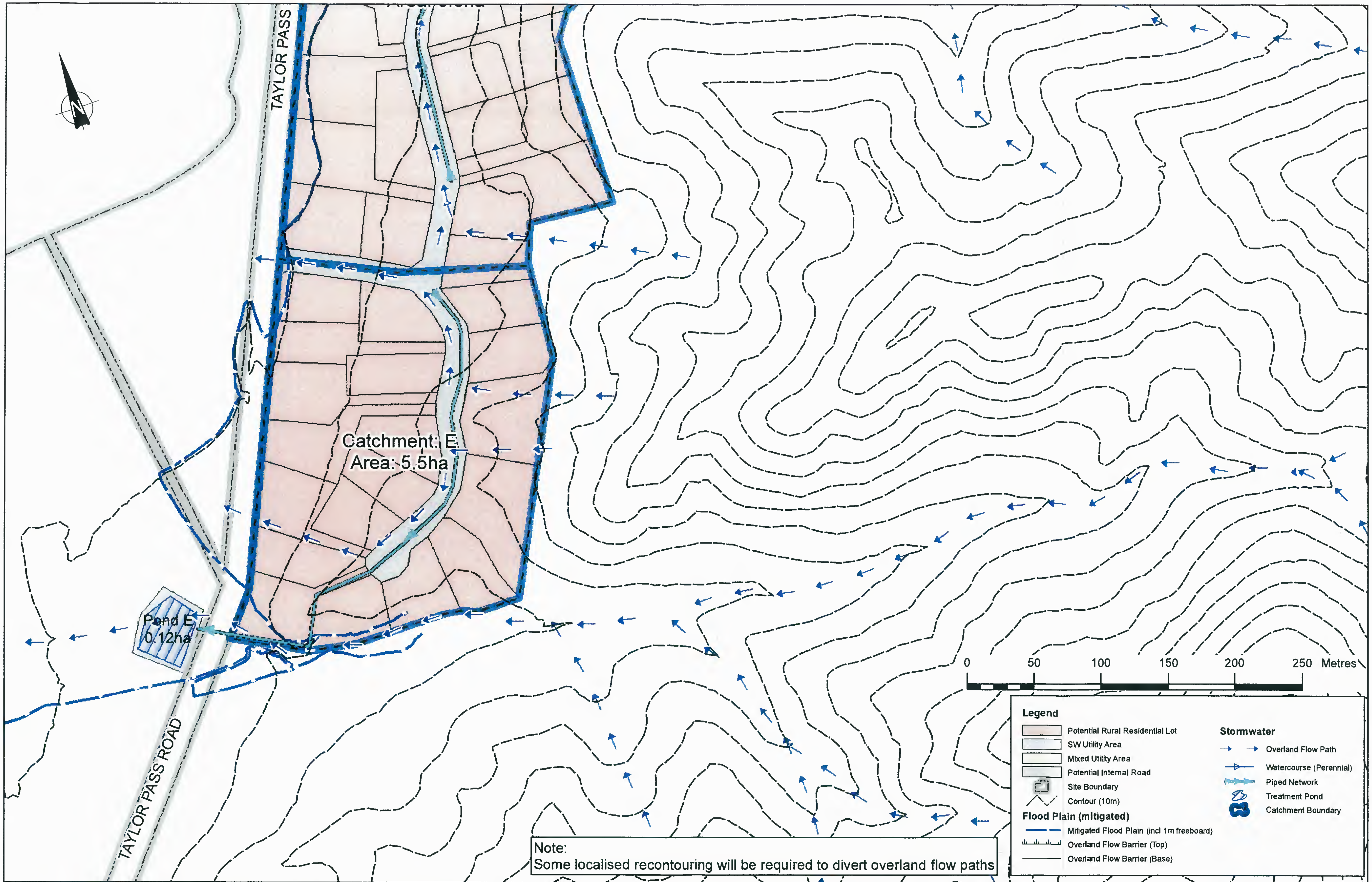
TITLE

KAPITI VIEWS LIMITED

RURAL RESIDENTIAL DEVELOPMENT - PRIVATE PLAN CHANGE

STORMWATER NETWORK PLAN

GIS FILE: 04819/6SW.MXD
SCALE: 1:2,500
DRAWING No.: 04819/6SW-3
REV.: 0



REV	DESCRIPTION	BY	DATE
0	FIRST ISSUE		

DESIGN	JEB
CHECKED	
DRAWN	GAF
CHECKED	
DATE DRAWN	7/02/2011
APPROVED FOR ISSUE:	
DATE:	

RILEY CONSULTANTS

P.O. BOX 100 253
N.S.M.C.
AUCKLAND 0629
TEL. 09-4897872
FAX. 09-4897873

TITLE

KAPITI VIEWS LIMITED

RURAL RESIDENTIAL DEVELOPMENT - PRIVATE PLAN CHANGE

STORMWATER NETWORK PLAN

GIS FILE	04819/6SW.MXD
SCALE	1:2,500
DRAWING No.	04819/6SW-4
REV.	0

APPENDIX I
Wastewater Servicing Report – Riley Consultants Limited

RILEY CONSULTANTS

MAXWELL HILLS RURAL RESIDENTIAL ZONE PROPOSED PRIVATE PLAN CHANGE WASTEWATER SERVICING REPORT

Engineers and Geologists

RILEY CONSULTANTS

Engineers and Geologists

MAXWELL HILLS RURAL RESIDENTIAL ZONE
PROPOSED PRIVATE PLAN CHANGE
WASTEWATER SERVICING REPORT

Report prepared for: Kapiti Views Trust

Report prepared by: Grant Fleming, Wastewater Engineer

....

Report reviewed by: Brett Black, Director, CPEng

....

Report Reference: 04819/6WW-A

Date: 11 February 2011

Copies to:

Kapiti Views Trust	1 copy
CPG Global	1 copy 1 electronic copy
Riley Consultants Ltd	1 copy

Issue:	Details:	Date:
1	Wastewater Servicing Report	11 February 2011

Riley Consultants Limited, 4 Fred Thomas Drive, Takapuna
PO Box 100 253, NSMC, Auckland, New Zealand
Telephone 64 9 489 7872, Facsimile 64 9 489 7873
riley@riley.co.nz www.rlley.co.nz

Contents

Appendices

MAXWELL HILLS RURAL RESIDENTIAL ZONE PROPOSED PRIVATE PLAN CHANGE WASTEWATER SERVICING REPORT

1.0 Introduction

Riley Consultants Ltd (RILEY) has prepared the following wastewater servicing report at the request of Kapiti Views Trust. This report describes our wastewater investigation and recommendations for the proposed development. It is intended to support a plan change application to Marlborough District Council (MDC).

The plan change region covers the lower terraced area of the larger lots (Lot 1, DP 9518, Section 2, SO 7014 Lots 1-3, DP357141) held by Kapiti Views Trust.

This report presents the following information:

- Site characteristics – A brief overview of the topography of the development site and its effects on wastewater servicing options.
- Wastewater servicing options – A brief overview of the options considered prior to determining the recommended servicing options.
- Wastewater design – Details of the design to service the rural residential lots with a communal collection and treatment system.
- Conclusions and recommendations.

To ensure development is sustainable and suitable, an assessment of engineering aspects has been provided by RILEY. This report should be read in conjunction with the following RILEY documents.

Planning Variation	RILEY Reference Number
Flooding Assessment	04819/6FL-A
Geotechnical Assessment	04819/6GT-A
Stormwater Design	04819/6SW-A

2.0 Proposed Wastewater Servicing Methodology

This primary focus of the report is intended as an initial assessment of the recommended wastewater servicing for the proposed rural residential community. The community has no existing or available connection to a municipal treatment plant and each lot is thus reliant on local or communal wastewater treatment and land application.

It is proposed to reticulate the lots to a communal wastewater treatment plant that will discharge to designated discharge areas located either on the slopes above the plan change area or in the land adjacent to the plan change area (across Taylor Pass Road).

3.0 Site Location and Characteristics

The site is located approximately 2.5km south of the existing urban boundary of Blenheim, Marlborough, and is bounded by Maxwell Pass Road and Taylor Pass Road. The Taylor River runs past the western boundary, with the Taylor Dam (a flood detention structure protecting the Blenheim Township) located a few hundred metres from the site's north-western corner. The site has an area of approximately 286ha.

The rural residential development area is located on the lower portion of the site which is bounded on the north and west by Maxwell Hills Road and Taylor Pass Road. The topography of the lower areas has relatively low slopes (0 to 20°) which are suitable for most wastewater reticulation options.

It is proposed to develop 160 rural residential lots with a typical area of between 0.2ha and 0.6ha, configured in a conventional type subdivisional layout pattern. The layout is shown on the appended RILEY Dwg: 04819/6WW-1.

3.1 Site Investigation

A ground investigation programme was undertaken by RILEY during June 2005 and January 2007, covering the entire site. Fieldwork comprised geological and engineering geological mapping, hand auger holes, and mechanical trial pits. The locations of the on-site testing and logs are included in the geotechnical report, RILEY Ref: 04819/6GT-A.

3.2 Geology

The geological map of the area (Geology of the Wellington area, 1:250,000 scale, 2000), indicates the site is underlain with bedrock. These rocks are commonly referred to as greywacke or Torlesse greywacke. The greywacke outcrops occur at shallow depth across roughly the southern half of the site. The near surface soils typically consist of loess gravels.

3.2.1 Subsoil Conditions

Subsoil conditions and logs are detailed in the geotechnical report. Relevant points for the proposed wastewater land application areas for the proposed subdivision are summarised below:

a) The topsoil thickness is typically 0.2m to 0.3m and generally consists of loose, dark brown silty sand or sandy silt, with organics and locally with coarse gravel to cobble clasts. The topsoil is typically an organic bearing derivative of the immediately underlying material.

b) The lower slopes (development area) generally consist of loess/colluvial silts of at least 2m depth, underlain by alluvial silts or greywacke rock.

c) The upper slopes (upper irrigation areas) generally consist of sandy gravels (Hillersden gravels) towards the top of the ridges or, in the valleys, alluvial, sandy clays to depths of 1.5m, underlain by weathered greywacke sandstones.

d) The flatter areas adjacent to the Taylor River (lower irrigation area) exhibit soils similar to the alluvial terrace deposits beneath the proposed development area, consisting of interbedded sands and gravels with occasional lenses and layers of silt and clay.

e) Minor watercourse flows were noted out of the gullies draining to the north and west sides of the site.

Groundwater was not encountered in any of the test pits situated in the proximity of the proposed land application areas, and is inferred to be greater than 3m below the ground surface.

4.0 Site Constraints on the Development

Site constraints identified at each site include:

4.1 Soil Type

The subsurface soils (alluvial and colluvial silts) on the upper irrigation areas are categorised as moderate to slow draining and therefore require moderate to low areal loading rates (2 to 4mm/day, where the higher rates are used when the slopes are low-moderate and the areas are to be planted) within the proposed areas to ensure that excessive surface wetting does not occur during periods of high discharge. Also, during the winter months, some of the south facing slopes are exposed to low levels of sunlight and therefore experience reduced evapotranspiration. This creates a requirement for a more extensive land application area than that required by free-draining soils or on the north facing sites.

Soil types on the lower irrigation area, adjacent to the Taylor River are similar, but tend to include a greater fraction of gravels which increases their permeability. These soils are expected to be able to receive higher loading rates (10 to 15mm/day) than the soils in the upper irrigation areas.

4.2 Topography

In the upper irrigation area the site is relatively to extremely steep, therefore, the application of additional water to these slopes should be controlled to prevent erosion.

4.3 Surface Water

There are a number of watercourses and permanent drainage channels within the site. It is important to provide an adequate separation between proposed land application areas and these surface waters. This will minimise the risk of runoff entering any watercourse directly without further treatment on the ground surface. The risk of this occurring will also be greatly minimised by directing any surface runoff from upslope of the disposal location clear of these areas.

4.4 Aesthetic Appearance

The nature of the development requires the wastewater system to be as inconspicuous as possible. This includes visual appearance and reduction of odours and noise from the treatment plant.

5.0 Wastewater Treatment System

The feasible servicing options considered for this subdivision consist of a mix of traditional and modern wastewater servicing approaches, including communal on-site treatment and discharge, and traditional municipal reticulation. The advantages, disadvantages and applicability to the development of each option were considered.

Following a review it was determined the most suitable servicing option for the residential development was an on-site communal system. In this scenario each of the rural residential lots will require an interceptor tank or grinder pump system connecting to a pressure sewer. The sewer discharges to a communal secondary treatment plant. This plant treats the wastewater to a high level to allow discharge via a land application system (generally a drip irrigation network).

Further details of each part of the design and treatment process are outlined below.

5.1 Design Wastewater Production

The design parameter is based on accepted figures for wastewater design (TP58[1]). This document is considered equivalent to or more conservative than the current New Zealand standard (NZS 1547).

The expected wastewater flow for a communal treatment plant is based on the sum of the discharges from the lots serviced. It is possible, due to economies of scale, to allow for a less conservative maximum dwelling size or flow allowance, but still maintain a conservative design for the subdivision as a whole (i.e. it is most unlikely that all dwellings in the subdivision would have four-bedrooms with a full occupancy of six persons at any one time).

It is likely that the subdivision would be developed with a mixture of three- and four-bedroom dwellings. This relates to a peak occupancy of between five and six people for design purposes. But, as discussed above, this could be considered overly conservative for a subdivision design, therefore, an average design occupancy of five may be assumed, as both conservative and realistic.

The wastewater production for each of the dwellings was determined based on occupancy, water supply and expected water production/reduction fixtures (TP58 - Table 6.2). A conservative design per capita allowance of 200 litres per day has been utilised.

The wastewater production for the site has been calculated as follows:

Facility	Occupancy (Persons)	Design Wastewater Flow Allowance (litres/person/day)	Maximum Daily Flow Rate (litres/day)
160 Lots	5#	200	160,000
Total Wastewater Discharge			160,000 litres/day

typical, site wide occupancy level - house sizes may vary.

[1] Auckland Regional Council Technical Publication No. 58 "On-site Wastewater Systems: Design and Management Manual", Third Edition, August 2004.

Generally, with a conventional reticulated network, an allowance for stormwater infiltration would need to be included. In this instance stormwater is prevented from entering the wastewater reticulation network and components by design. Pressure sewers are a completely watertight network which do not require manholes, observation points or pump stations, which are generally attributed to stormwater/groundwater infiltration issues.

5.2 Wastewater Treatment Concept

The preferred system to service the lots is a communal, on-site system offered by Innoflow Technologies Limited (ITL).

ITL has over 13 years experience in the New Zealand wastewater industry, and utilises the 30 years experience of the treatment system manufacturers, Orenco Systems Incorporated (OSI), an American company that supplies the products which ITL installs and maintains within New Zealand, Australasia and the South Pacific.

The recommended system consists of four main components:

- Interceptor tanks/grinder pumps located on each lot.
- Pressure sewer collection main.
- Centralised 'Advantex' recirculating textile packet bed reactor (rtPBR) treatment plant.
- Treated effluent discharge via land application through a suitable designed drip irrigation network.

The entire system can also be monitored via remote telemetry units (RTU) which collect information and allow access to control the pump runtimes and other system parameters remotely.

5.3 Proposed Wastewater Treatment System

5.3.1 On-Lot Components

The wastewater from each dwelling is to be collected within an on-site interceptor tank or suitably sized grinder pump chamber (minimum 24 hours storage). If an interceptor tank is chosen, then some level of on-site treatment (settling of solids and primary treatment via anaerobic digestion) would be undertaken. Each of the on-lot components will be connected to the pressure sewer (with pumps where required) for effluent discharge and can include a remote telemetry unit that will respond to alarm conditions and record flows for remote maintenance and monitoring.

5.3.2 Pressure Sewer

The on-lot components will discharge effluent to the pressure sewer via a service lateral. The lateral connects to the sewer main via a check valve and ball valve to allow isolation and prevent backflow.

This line is installed in the service trench and generally consists of a MDPE pipe. Due to the pressurised nature of this pipeline, the exact alignment and grade do not need to be considered. The line will be pressure tested following installation to ensure the pipe is watertight.

5.3.3 Communal Secondary Treatment Plant

The pressure main discharges into either a blend tank (if primary treatment is undertaken on-lot) or into a suitably sized primary treatment (septic) tank. This tank will discharge to the remainder of the secondary treatment plant consisting of the following components:

- Blend/septic tank.
- 'Advantex' recirculating textile packed bed reactor (rtPBR) pods.
- Recirculation tank.
- Treated effluent tank.

The location of the recommended treatment plant is directly opposite the subdivision, across Taylor Pass Road as shown on appended RILEY Dwg: 04819/4WW-1. The treatment plant should be well-separated from the road and screened by the placement of suitably selected plantings.

This treatment plant can be installed in stages to service the dwellings as they are constructed or expanded for any future development in the area.

The proposed system has a number of advantages:

- All storage and treatment components are buried, not visible to the local residents, and are shielded by aesthetic planting.
- The textile media with the 'Advantex' pods has a larger surface area for biological attachment and growth, and larger void spaces per unit area of filter than other aggregate media filters, therefore requiring less treatment plant footprint area to treat wastewater to the same level.
- Additional pods can be added without major modification to the existing system. This may be important if the system requires upgrade in the future.

All secondary treatment plant components are controlled (pump dose times, etc) and monitored (flows, float switches and alarm conditions) via a remote telemetry unit (RTU).

5.4 Land Application System

The site has a number of viable discharge locations for the land application of the treated effluent from the site. These include:

- Discharge within the elevated areas of the land immediately above the proposed subdivision.
- Discharge to the undeveloped land adjacent to the subdivision area over Taylor Pass Road.
- Landscaped areas within the site located south-east of the subdivision.

These areas exhibit differing acceptable rates of discharge due to the subsurface soils, proposed planting, aspect, and geotechnical constraints, refer to the RILEY geotechnical report Ref: 04819/GT-A. The application of treated effluent to the upper slopes of the site would be beneficial for irrigation of any planted areas. Planting would also mitigate against potential erosion.

The elevated areas within the site are capable of receiving a discharge loading rate 2 or 3mm per day, while the land adjacent to the Taylor River could potentially receive 10 to 15mm per day. The final design will need to take these differences into account.

The four areas, identified on the appended RILEY Dwg: 04819/6-WW1, have a combined capacity to receive effluent from greater than the proposed 160 lots. This includes a 50% reserve area (required as a contingency for any future requirements for expansion of the primary discharge area).

5.4.1 Proposed Land Application System

The proposed land application system will comprise a subsurface/surface drip irrigation system. The dripper lines will be pressure compensating, allowing them to be laid over uneven topography if necessary. Advantages of the irrigation system are:

- Low loading rates to minimise the potential for ground saturation.
- Maximise evapotranspiration by trees and grass.
- Effluent is spread over a large area for better assimilation by soil, bacteria and vegetation.

It is proposed to use "UNIRAAM" pressure compensating drip irrigation line at 0.5 to 1m centres to provide a uniform maximum loading rate specific for the area of discharge. The final rates will be selected based on the type of planting, aspect and slope of each area. Areas will be installed in sectors to allow for load and rest cycles.

The proposed system, regardless of the location, should be installed either subsurface or pinned to the surface and mulched. This will prevent direct contact with rainfall and reduce the risk of runoff. All areas should be planted with trees and shrubs to improve the potential for evapotranspiration. Where there is potential for human contact the areas should be either fenced or barrier planted to prevent casual access to the discharge area.

5.5 Scheme Maintenance

The wastewater treatment and land application system should be maintained by the system supplier, ITL, or an alternative approved contractor in accordance with their standard maintenance schedule and the conditions imposed by the local and regional authorities following any consent process.

5.6 Remote Monitoring

It is recommended that the treatment and discharge system be monitored and managed through remote telemetry. This system is specific to the OSI treatment plants allows remote access via a remote telemetry unit to the system for runtime statistics and control of the pump timing and other system parameters.

6.0 Assessment of Environmental Effects

6.1 Minimisation of Potential Detrimental Effects of Wastewater Discharges

Potential detrimental effects on the environment are minimised by this system due to the high quality nature of the effluent discharged. The proposed high level treatment plant using textile media filtration produces consistently high quality, environmentally benign effluent. Treated effluent loading rates into the soil are based on the specific soil and environmental constraints within the area to allow for better assimilation by the environment, match the potential for evapotranspiration within the selected areas and minimise potential for soil saturation.

Discharge into an environment other than to land would be unacceptable both in terms of adverse environmental effects and cultural considerations. Therefore, land application is the only viable option in this case.

The highly treated effluent will be disposed of via dripper lines over a land application area as specified. The dripper lines are to be covered beneath soil or suitable mulch, and will slowly release highly treated effluent into the aerobic layer within the surficial soil. This resource could be used to irrigate plantings and assist in the mitigation of erosion on the steeper slopes.

All tanks (septic etc) will be buried below the ground surface and fitted with sealed lids. The recirculating textile packed bed reactors (rtPBR) will also be buried with only access lids visible on the surface.

Odour production from this type of system is limited to the septic tanks. Anaerobic decomposition of solids release by-products such as methane and sulphide gases; it is from this type of by-product that offensive odours emanate. A septic tank in good operation is unlikely to be detectible greater than 1 or 2m from the vents.

The rtPBR is a totally aerobic process. No offensive odours are produced at the treatment stage due to the fact that the biological processes taking place within the textile media are by aerobic micro-organisms and the by-products of these processes are not offensive. The treated liquid is also high in dissolved oxygen (8 to 10 mg/litre) and is odourless.

6.2 Effluent Quality

This system has the advantage that the effluent is treated to an extremely high level, and will be of a consistent quality of better than 10mg/ml: 10 mg/ml BOD_5:TSS (Biochemical Oxygen Demand: Total Suspended Solids). This ratio measures the level of contaminants in a liquid, and as a comparison raw untreated wastewater has a BOD_5:TSS ratio of about 350:400.

The discharges nitrogen levels are generally less than 20mg/l (depending on incoming wastewater strength). The Advantex treatment system can be configured to further increase nitrogen reduction if required.

6.3 Mitigation Measures

System performance is to be monitored under a maintenance contract and a management plan prepared for the communal system. The system has been selected as it will produce consistently high quality effluent with minimal maintenance requirements. Safeguards are built into the treatment system which is automatically self-monitoring. Alarms and an automatic timer override will come into use if overloading occurs.

7.0 Conclusions and Recommendations

This report includes information and recommendations for the wastewater servicing of the rural residential development of the Maxwell Hills site. Based on our review it is considered feasible that the rural residential lots be serviced by an advanced secondary communal treatment plant, including on-lot components, which will collect all the wastewater prior to returning the effluent to the designated discharge areas as specified above.

8.0 Limitation

This report has been prepared solely for the benefit of Kapiti Views Trust as our client with respect to the brief and Marlborough District Council in processing this plan change application. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

The design detailed above is specific to the development at the time of this document's production. Should alterations be made which impact upon the expected occupancy regime of the existing or proposed dwelling, the original design may no longer be valid. This includes the placement of any components of the proposed wastewater treatment system and land application system or quantity and/or strength of any wastewater. In the event of the above, the property owner should immediately notify Riley Consultants Ltd to enable the impact to be assessed and, if required, the design to be amended accordingly.

APPENDIX A

Innoflow System Information

Project Reference: Q7259 - 0502613

innoflow
wastewater specialists

P O Box 300 572, Albany
North Shore City 0752

freephone 0800 innoflow
phone +64 9 426 1027
fax +64 9 426 1047

P O Box 263, Ormeau
Queensland 4208

freephone 1800 innoflow
phone +61 7 5549 2416
fax +61 7 5549 2416

www.innoflowtechnologies.com

Proposal For A Community Wastewater Management System for Maxwell Hills, Blenheim

Prepared for: Keith Benton

16th November 2009

Prepared by: Mr Brent Hawthorn – Technical Manager

inno flow
wastewater specialists

WASTEWATER MANAGEMENT – TECHNOLOGY SELECTION

Process Selection

Due to the complex nature of small subdivisions wastewater there are a number of factors that must be taken into account when designing a wastewater management system. It is important to identify a treatment process that meets with all of the criteria that have been identified. This project has the following factors to consider:

- Public health considerations
- End use of effluent
- Land use – aesthetic issues
- Varying flow
- Stability of treatment process
- Ongoing cost to client
- Ease of operation
- Cultural requirements

Taking the above considerations and applying them against the various types of treatment processes that are available, we have been able to identify the treatment process most suited to this project. By assigning a value (weighted attribute) to each type of treatment process under the various criteria chosen, the process with the best score is identified as the most suitable for this project. The following table summarises this method.

The three types of treatment process available for this type of project are:

1. Rotating Biological Contactor (RBC)
2. Aerated Wastewater Treatment System (AWTS)
3. Membrane Bioreactor (MBR)
4. Recirculating Packed Bed Reactor (rPBR)

Weighted Attribute Table

Criteria	RBC	AWTS	MBR	rtPBR
Land Use (amenity value)	4	3	4	4
Treatment levels	3	3	5	5
Nitrogen removal	3	2	3	4
Process stability	4	1	3	5
Sludge production	2	2	3	3
Power consumption	2	1	1	4
Operator input	3	1	2	5
Odour potential	3	3	4	5
	24	**16**	**25**	**35**

*Scores are from 1 – 5, with 1 being *not good* and 5 being *very good*.

The results of this table indicate that a Recirculating Packed Bed Reactor system is most suited for this application.

The following information pertains to recirculating packed bed reactor (rPBR) technology in general and focuses on the AdvanTex® textile (rtPBR) option as proposed for this project.

The wastewater management solution proposed for this development incorporates decentralised collection and treatment of the wastewater, along with centralised management. This provides each household with a "flush-and-forget" service. The treated effluent can be utilised to irrigate an area of common land or other reuse scenario.

The lot owner is provided with a high level of service for a fee paid to the body corporate (or other management entity, such as Council) for running costs. The high level of treatment not only provides a high level of public health security but also protects the surrounding environment. In addition, the wastewater is transformed in to a useful commodity with applications within the community (eg. irrigation).

The proposed wastewater management system consists of the following elements:

1. A wastewater collection system (*installed by others*)
2. A communal wastewater treatment plant (*An AdvanTex® recirculating textile packed bed reactor*)
3. An effluent dispersal system (UniRaam™ *drip irrigation lines*)

EFFLUENT SEWER

In order for the proposed effluent sewer to be compatible, wastewater must be pre-treated in on lot tanks and discharge into a variable grade small diameter effluent sewer.

The basis of the effluent sewer is to provide pre-treatment at each house *before* transporting only the liquid portion of the wastewater.

By removing the solids from the wastewater prior to transporting it, the effluent sewer pipeline system can be constructed from small diameter MDPE pipe (e.g. 50mm) laid in a shallow (i.e. 600 mm) common services trench at variable grade.

Along with the interceptor tank design and installation, the proposed collection system construction techniques (i.e. similar to a water main) will ensure that the pipe is completely watertight.

Infiltration can be eliminated from the collection system meaning the treatment plant can be sized considerably smaller since it doesn't have to cope with large wet weather flows. This reduces both capital expenditure and ongoing maintenance costs. In addition the reduced discharge volume has significant positive environmental benefits.

The effluent sewer collection system will be designed by Innoflow Technologies. This involves a hydraulic gradient analysis including friction losses, pipe sizing, placement of isolating valves, air release valves and placement of cleaning ports. No manholes or minimum gradients are required.

Air release assemblies are installed in the collection lines at certain places to prevent the formation of air pockets and negative pressure situations in the collection lines.

Cleanout ports are installed at the terminal ends of the effluent sewer as a contingency against potential blockage.
Isolation valves are installed on the effluent sewer line at strategic points to enable isolation of the line in an emergency. Isolation valves and non-return valves (service connection) are also incorporated into the system at each property boundary.

The Orenco effluent sewer reduces the reticulation installation and maintenance costs in a number of ways:

<u>On-Property Sewer Lines</u>
Discharge from the interceptor tanks is not only filtered but also flow modulated using either float control in pumped systems or Biotube® flow modulation orifices allowing the use of small diameter polyethylene pipes (typically 32 mm) between the tank and main line service connection.

Main Effluent Sewer Line
Since the wastewater is screened at the interceptor tank, the main sewer line is substantially free of solids. Also the main sewer is free of infiltration and inflow. This means that the main sewer line can be relatively small diameter pipeline. Design of the collection line is almost the same as for a water system but without the peak flows associated with water systems.

Excavation Expense
The sewer main is buried at a shallow depth following the contours of the terrain. Strict vertical and horizontal alignment and associated surveying is not required. In effluent sewers manholes or standard cleanouts are not necessary. There is no need to consider minimum velocities and gradients.

Standardisation of Equipment
Having standard equipment installed makes inventory of spare parts and servicing simpler and more cost-effective.

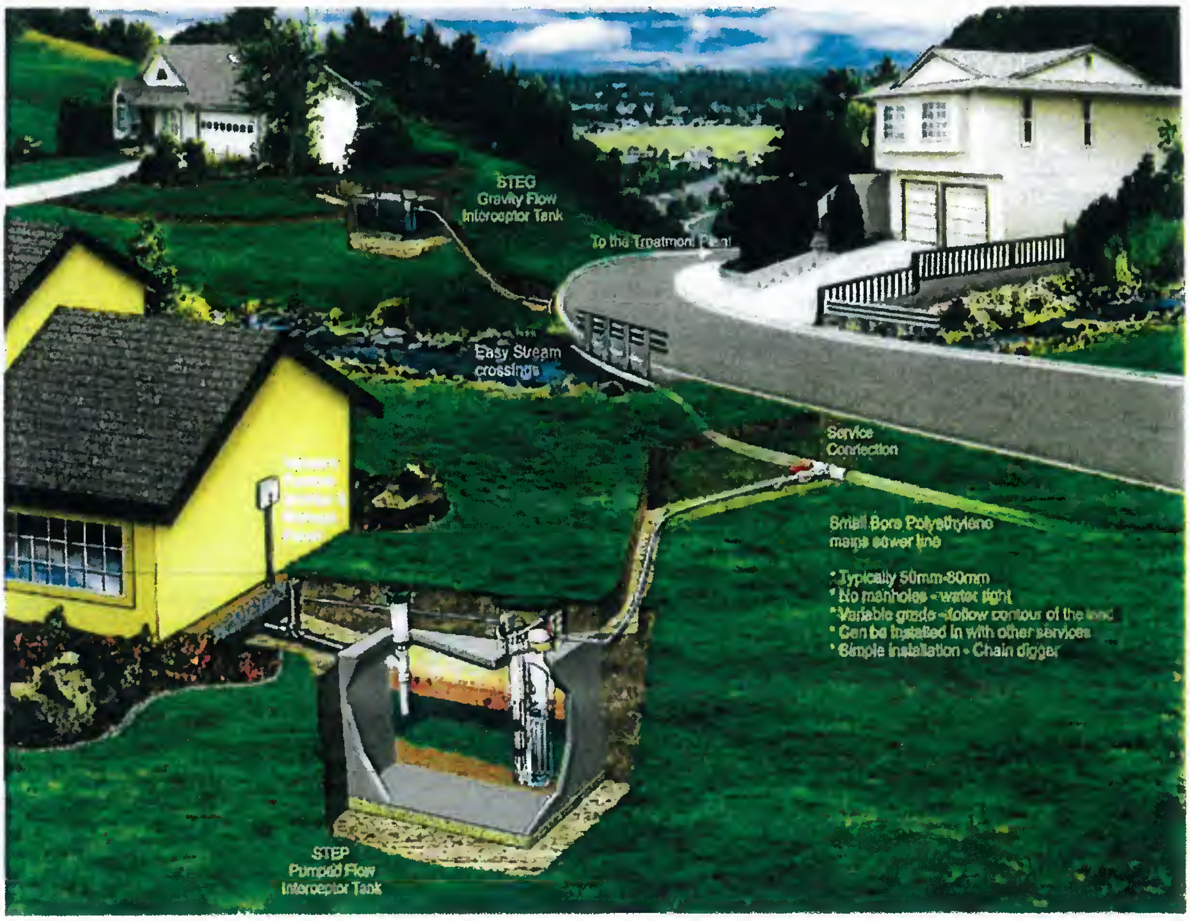


Figure 10. Diagrammatic representation of an Effluent Sewer

Well Proven Technology and Designs
There are over 500 community effluent sewer systems utilising the same technology and equipment that have been reliably operating since 1980. Orenco Systems Inc. has the world's most extensive, verifiable and long-term database on the effectiveness and reliability of these systems. Innoflow Technologies NZ Ltd has been installing effluent sewer systems since 1994.

WASTEWATER TREATMENT PLANT

All the wastewater from the houses is collected centrally and treated to a high quality using a communal treatment plant. The type of treatment plant proposed is a recirculating packed-bed reactor (rPBR). This design is well proven throughout the world and New Zealand especially for the type of project proposed. The modular nature of the system makes it ideal for staged development.

This standard design features the use of equipment specifically designed to optimise the system's treatment performance and stability and minimise its operation and maintenance requirements. A schedule of the simple operation and preventative maintenance tasks is included in the full management plan provided with every system.

Treatment Process Summary

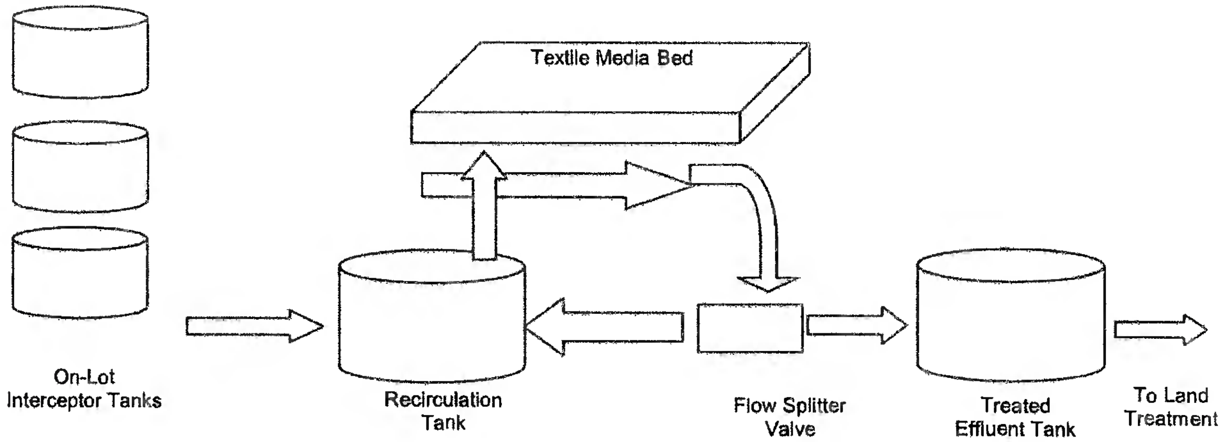


Figure 1: *Schematic of Recirculating Packed Bed Reactor Treatment Plant*

Recirculation Tank

Screened effluent from the interceptor tanks is received in a recirculation tank from where the dosing of the packed bed reactor is timer controlled and flow equalised utilising submersible pumps fitted inside screened pump vaults. Small reliable turbine pumps are used to minimise operating and maintenance costs. Biotube™ pump vaults are required to house each pumping assembly and to ensure that no gross solids are pumped onto the rtPBR.

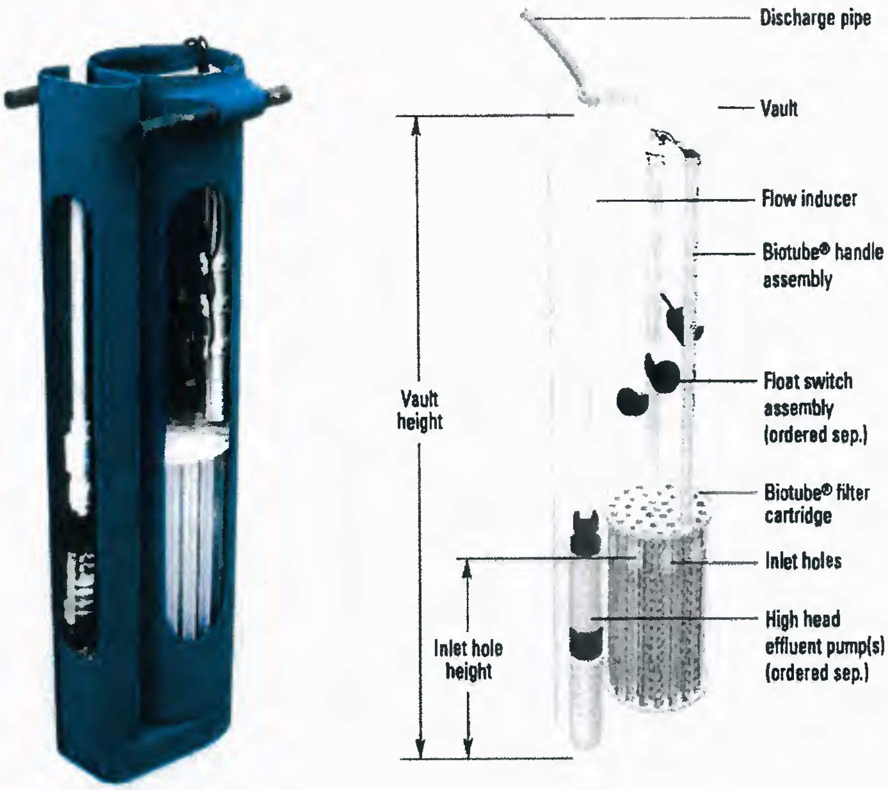


Figure 3: *Example of a typical Orenco pumping system (screened pump vault) typically used in both Septic and Recirculation Tanks*

Float level switches installed inside the pump vault control and override the timer for high water on, and alarm In the unlikely event of timer failure. By utilising timer controlled dosing we are able to buffer incoming and recycle flows, and uniformly apply effluent to the packed bed reactor.

The patented Orenco Systems Incorporated (OSI) recirculation/splitter float valve assembly ensures that the optimal recycle ratio is maintained at all times, maximising treatment efficiency for a consistently high quality effluent.

The recirculation tank ensures that the packed bed reactor receives a continuous source of oxygen and food during periods of little or no flow, ensuring that the micro-organisms are maintained at peak condition, ready to receive shock or varying loads.

AdvanTex® Recirculation Textile Packed Bed Reactor

Our Technology Partner OSI's dedication to research and development has further refined and optimised the rPBR processes to produce a design that is unsurpassed for efficiency, reliability, future expansion capabilities, and low maintenance requirements.

The sand and pebble aggregates used in sand contactor rPBR's has been replaced by an internationally patented textile media that can accept a loading rate up to 10 times higher than the recirculating sand contactor.

This produces a reactor basin with a footprint only a fraction of the size of the conventional sand contactor requirements

The AdvanTex® rtPBR is essentially a bed of highly specialised textile nestled in a pre-made POD to which the effluent is uniformly dosed through a pressure distribution system using a timer controlled dosing regime.

These small precise doses at multiple point sources across the reactor bed ensure thin film application of the effluent maximising retention times within the reactor for renovation.

This unique complex fibre structure of the textile media has an immense surface area for biomass colonisation, (up to 5 times greater than sand) and a much greater void space (~3 times higher than sand) to ensure free flow of oxygen through the media interstices. Its high field moisture capacity ensures long, intimate, contact times of the wastewater with the biomass for almost complete renovation.

The rtPBR is completely enclosed with green textured fibreglass lids and is installed level with the ground. This means that the entire treatment plant is below ground with very low visual impact.

Figure 4: *AdvanTex® pod installation - in this case an AX600 rtPBR.*

Figure 5: *the same pods shown in Fig 3*

Figure 6: *Spray nozzles in the PODs*

AdvanTex® rtPBR Features and Benefits

The packed bed reactor treatment process is well suited to this application because:

- it is reliable and robust
- can be installed incrementally to defer capital costs
- it is cost effective both in terms of capital investment and running costs
- it consistently produces a high quality of effluent under varying loads and conditions
- it has simple operational and management requirements
- It has a successful track record in similar applications both in New Zealand and world-wide
- it has virtually no impact on the development within which it is used
- because of the low visual impact and small footprint the siting of the plant is very flexible

Figure 7: *An AdvanTex AX100 Filter POD after several months of operation*

Treated Effluent Storage Tank

We propose gravity feed of the treated effluent to a discharge tank.

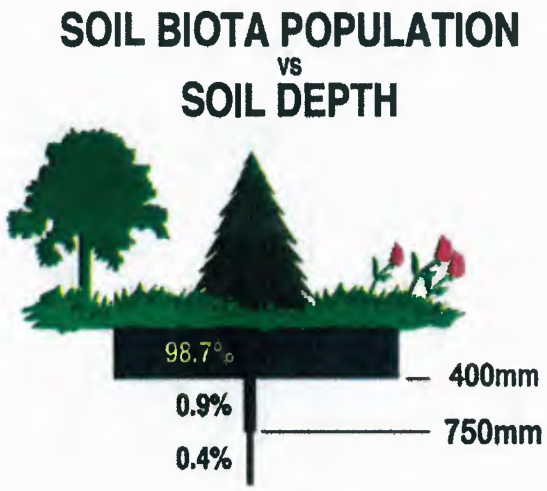
A submersible turbine pump will be installed in this tank to provide timer controlled pressure dosing to the land application area. Float level switches installed inside the tank control and override the timer for high water on, low water off, and alarm in the unlikely event of timer failure. By utilising timer control we can optimise the dispersal to the land application system. This tank will provide 24 hours emergency storage (in conjunction with the Recirculation Tank) above the high level alarm in the unlikely event of pump failure.

3. IRRIGATION DISPERSAL SYSTEM

innoflow
wastewater specialists

Almost all of our installations utilise pressure compensating drip irrigation for final effluent dispersal.

This method of dispersal offers a unique flexibility allowing installation in areas of least value, such as median strips, road verges, landscaped areas, or steep hillside slopes. It provides minimum environmental impact and is in line with the philosophy of the Tangata Whenua whereby the highly treated effluent is returned to the land in a land-based dispersal system.



Land Dispersal Process Summary

The use of trickle irrigation within the "A" soil horizon maximises the potential for evapo-transpiration in addition to ground soakage. The growth of the plants in the area will be promoted with the application of water and nutrients. The application of the treated effluent directly into the biologically active topsoil layer ensures that complete treatment of the effluent occurs.

The effluent from the main treatment plant is collected and buffered in a treated effluent tank and then pumped to the dispersal area under timer control. The effluent is dispersed in a series of irrigation lines laid on the surface (or buried if practical) throughout the dispersal area installed on a 1m x 0.5 m grid. TNL valves and air release valves must be installed at appropriate points in the system.

A manual flushing valve should be fitted to the end of each drip line. The end of each line should be marked with either stakes or valve boxes for easy location during maintenance. The disposal system will be sectorised so that reliable, low-power turbine pumps can be utilised to pressurise the disposal network and utilisation of sector areas will be rotated.

Final polishing of the effluent and natural nutrient removal occurs as the effluent is utilised by plants or soaks in to the ground.

Long Term Acceptance Rate of Irrigation Field

The effluent from the AdvanTex® packed bed reactor system is treated to an enhanced secondary level and has quite different properties and environmental effects compared to wastewater which has received primary (septic tank) treatment only. Specifically, whereas application of septic tank effluent to the ground will result in long-term clogging of the soil, application of the highly treated packed bed reactor effluent will produce no reduction in soakage capacity of the soil even in the long-term.

Land Application System Design

It is proposed to discharge highly treated effluent to a multi-sector land application systems comprising pressure compensating drip irrigation lines – laid on or below the ground surface and spaced at approximately 1 metre centres. The advantages of the irrigation system are:

- Low areal loading rates to minimise the potential for ground saturation.
- Sectorised distribution and small frequent even distribution.
- Evapo-transpiration is maximised.
- Final renovation through the soil is maximised by use of large areas for better assimilation by soil, bacteria and vegetation.

- Ideally suited over uneven terrain.
- It is cost effective, reliable and very low maintenance

Land Application Construction Methodology and Materials

Header Pipe

Treated effluent pumped from each treatment plant will convey to the land application system via a buried MDPE pipe. The pipe proposed will be rated to a maximum operating pressure of 6.3 bar. The pipe will be laid in a chain trenched or excavated trench at a minimum depth of 600 mm. The pipe will be bedded with the material excavated from the trench.

Sequencing Valve

Distribution to the land application system for each site will be achieved through one of Orenco's automatic sequencing valve assemblies. These valves are useful for distributing effluent to multiple zones so as to simplify the design and installation of the distribution system and reduce ongoing operating costs. This is particularly true where a distributing valve assembly is used instead of multiple pumps and/or electrically operated valves. Additionally, a reduction in long term operation and maintenance costs is realised due to a reduced size and/or number of pumps.

The valve itself has only a few moving parts, requires no electricity, and alternates automatically with each cycle. The sequencing valves operate on a hydraulic cam system. As water pressure is applied to the cam it lifts up and remains open, dosing only one sector, as the pressure drops once the pump stops, the cam rotates and closes ready to dose the next sector in the sequence.

The sequencing valve will be installed at the highest point of the land application system so as to avoid any back pressure disturbing the cam operation.

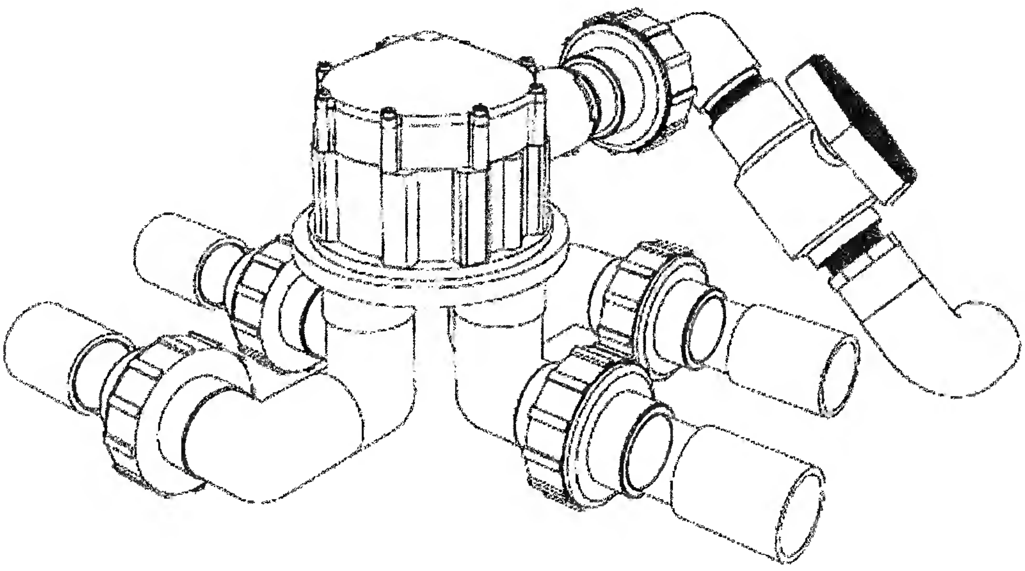


Figure 8. *An Orenco System sequencing valve. Model V4404A.*

To minimise the visual impact and to protect the valve, the entire assembly will be enclosed within a PVC access riser and covered with a fiberglass lid.

Manifold Lines

It is proposed to install MDPE manifold pipes to distribute the effluent from the sequencing valve to each treatment sector. The pipe proposed will be rated to a maximum operating pressure of 6.3 bar. The pipe will be laid in an excavated trench at a minimum depth of 300 mm. The pipe will be bedded with the material excavated from the trench.

The drip irrigation laterals will be connected to the manifold lines using a tapping barb.

Figure 9: *Surface laid manifold pipe and drip line. Tapping Barb (upper insert) and Tube Non Leakage Valve (lower insert).*

Tube Non Leakage Valves

Tube Non-Leakage Valves (TNL) will be installed at the beginning of each drip line lateral. These in-line valves have a self locking mechanism to prevent the upper drip lines and manifold pipes from draining into the lower lines when the pump stops and pressure drops.

Closing Pressure	-	0.4 bar
Operating Pressure	-	1.0 bar
Check Valve	-	0.3 bar

Pressure Compensating Drip Line

Netafim pressure compensating drip irrigation lines will be used to evenly distribute effluent over the entire land application areas of both sites. The drip line proposed is Raam17 with a drip emitter every 500 mm designed to consistently discharge 1.6 litres per hour.

These emitters are pressure compensating up to 35 m, which means the entire sector must be pressurised before any discharge and when discharge occurs, all emitters discharge together.

Manual Flushing Valves and Boxes

Flushing taps will be fitted to the terminal ends of all drip line laterals and marked with a durable valve box. The taps are used to manually flush any build-up inside the pipe on an annual basis in accordance with the manufacturer's instructions.

4. CONTROL SYSTEM

A fibreglass enclosed electrical panel to manage the treatment plant is supplied with each system. The panel will contain a microprocessor-based controller, current limiting circuit breakers with thermal magnetic tripping characteristics, timer controls, manual off/automatic control switches, audible and visual alarms, and run/fault indication. As previously mentioned a timer override, and high level alarm float control are also provided. All internal system wiring is included in this proposal.

Remote Monitor Manage Control Panel

Much of the monitoring and control of the wastewater treatment plant will be done remotely using telemetry features built in to the programmable control panel. The microprocessor-based controller in the panel integrates with standard control panel components (motor contactors, etc.) and provides digital and analogue sensor inputs as well as a two-way dialup function via a modem.

This means that the Service Company can receive remote alarm notification of any faults. For example a high level alarm could trigger the system to call Innoflow's office, or a pager. The system can then be checked remotely from the office to simplify troubleshooting, and facilitate accurate analysis.

System elements can also be controlled remotely (eg. pumps turned on/off) allowing quick response and early preventative maintenance. This could involve reprogramming the control panel remotely to by-pass a float switch until a local contractor can be sent out to attend the situation. Standard logging and trending of data are also possible. Any type of event log can be captured and stored or programmed to trigger an alarm event.

This includes pump run- times, high-level alarms, low-level alarms, effluent flows, pipe or orifice pressures, oxidation-reduction potential. Data can be stored for several years depending on input volume and report requirements. Reports can be viewed remotely or downloaded into common data management programs (eg. Microsoft Excel) for manipulation. This aids remote troubleshooting and monitoring for better maintenance and operational efficiency.

Note: The attached pricing includes Remote Monitor Manage Control at the treatment plant.

---

5. PUMP

The OSI multi-stage turbine pump has been chosen because of its quality, long life, and extreme resistance to corrosion. Its steep performance curve characteristic is a valuable asset in prevention of orifice clogging within the packed bed reactor distribution system. If a few orifices begin to clog reduced flow increases pressure enough to clear clogging. When installed inside an OSI pump vault the pump carries a full *five year* unconditional warranty.

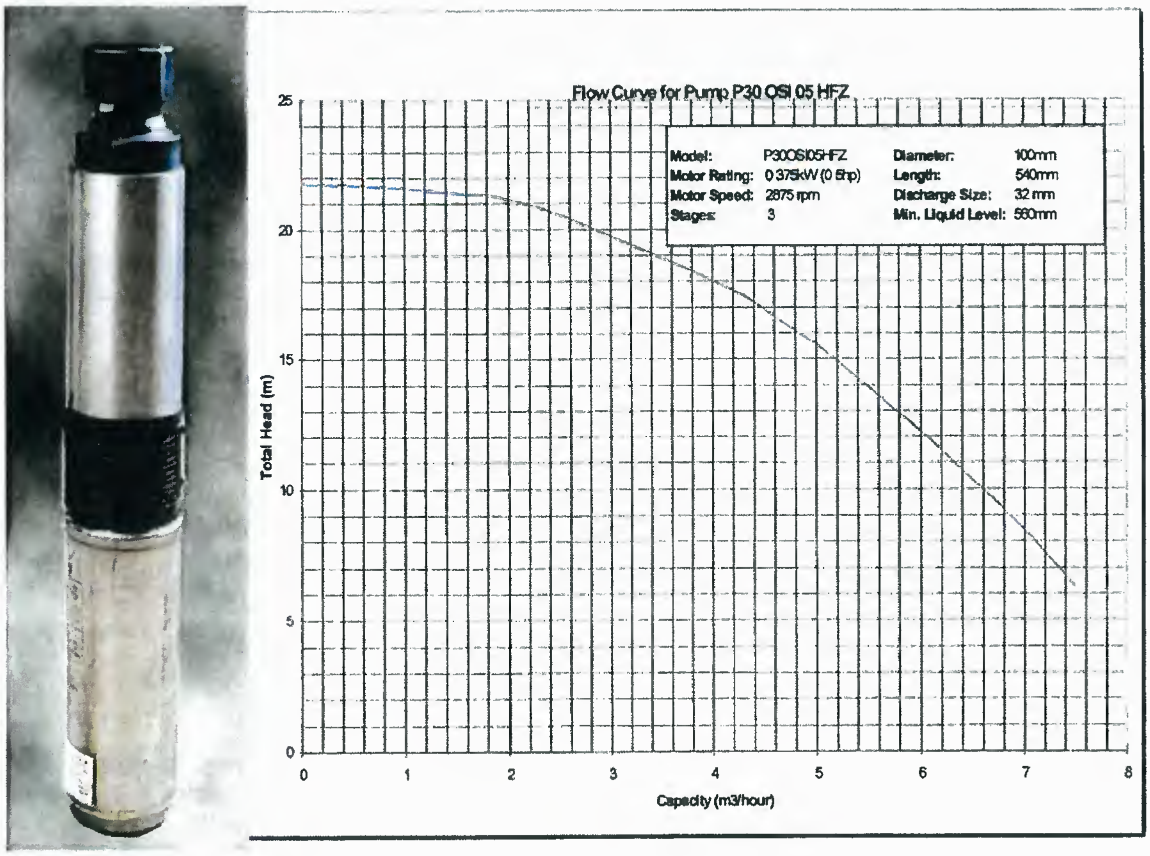


Figure 9: *P300552 Pump Curve*

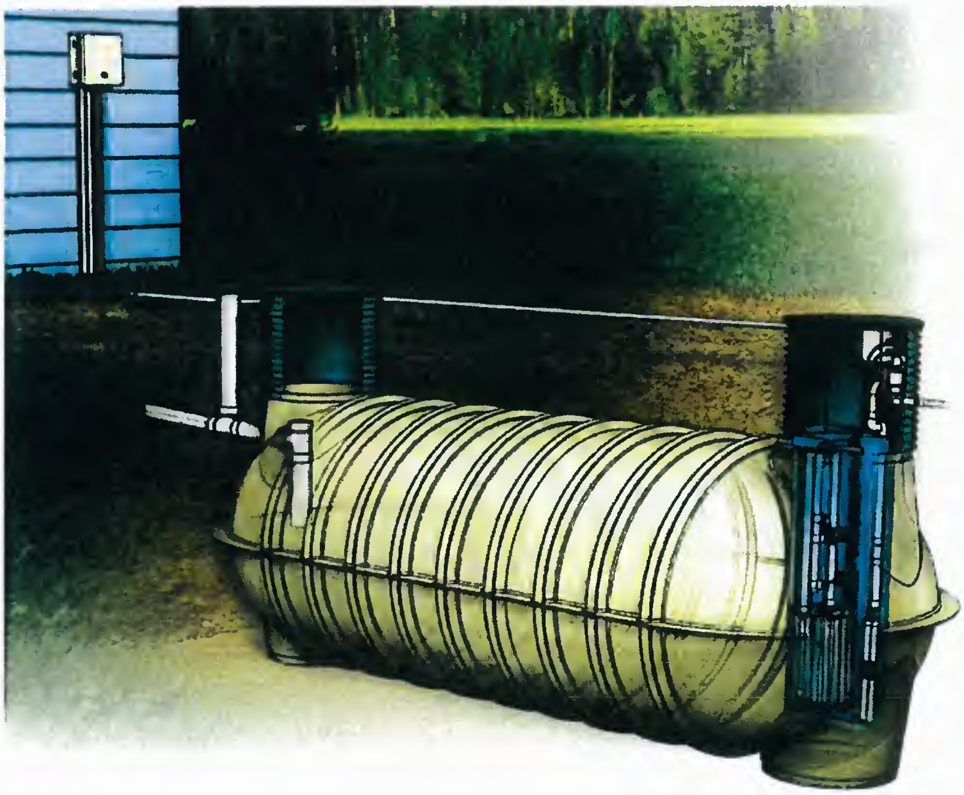
ESTIMATED EFFLUENT SEWER COSTS

The estimated per metre cost for the sewer is **$30.00 + GST**. This assumes installation in an open trench, connection and pressure testing. Opening the trench, backfill and reinstatement is by others (i.e. we are assuming all sewer pipe is installed in the same trench as power/phone). This price is based on a 63 mm OD PN9 MDPE pipe.

ONSITE COMPONENTS BUDGET COSTS

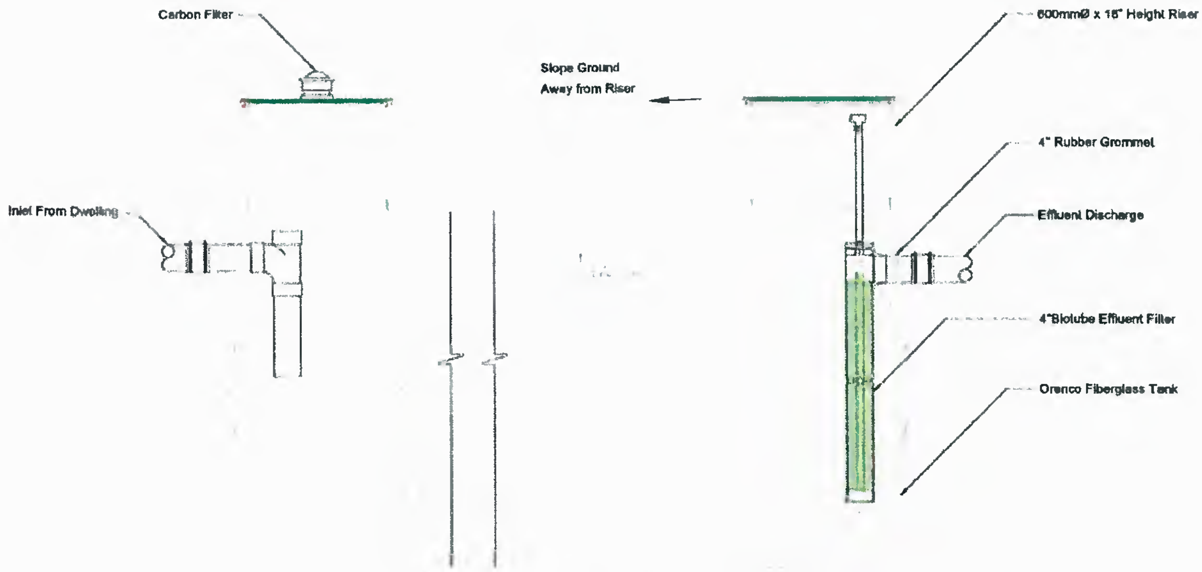
The cost of the on-lot interceptor tanks and collection pipe network is provided in the following tables (excl. house drains and electrical hookup and commissioning). As the treatment plant is located centrally, it is likely that some sites will a Septic Tank Effluent Pump (STEP), while others will require a Septic Tank Effluent Gravity (STEG) equipment package.

STEP Equipment Package	Cost (excl. GST)
4,500 litre Concrete Single Chamber Septic Tank	
Biotube Pump Vault	
Triple Float Assembly	
High Head Turbine Pump	
Control Panel with High Level Alarm (audio and visual)	
Discharge Assembly	
Lockable Watertight Access Riser and Lids	
Tank to Service Lateral Connections	
Service Lateral (up to 25 m)	
Mainline Connection	
Activated Carbon Filter or Air Vent	
Installation (excl. house drains and electrical hookup)	**$9,950.00 each**



Typical STEP Interceptor Tank (Fibreglass tank shown)

STEG Equipment Package	Cost (excl. GST)
4,500 litre Single Chamber Concrete Septic Tank Biotube Effluent Filter Two Lockable Watertight Access Risers and Lids Tank to Service Lateral Connections Service Lateral (up to 25 m) Installation (excl. sewer from buildings)	**$7,450.00 each**

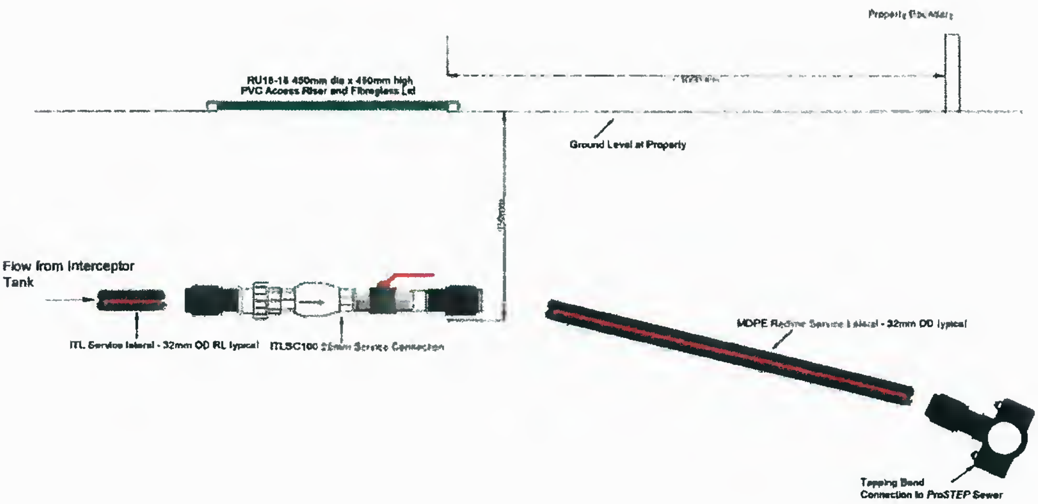


Gravity Interceptor Tank (typical)

inno flow
wastewater specialists

SERVICE CONNECTION AND CONNECTION TO MAINLINE

Service connection (incl. Installation provided this is installed at the time of the effluent sewer)	**$675.00 per lot**



Orenco **Service Connection (typical)**

inno flow
wastewater specialists

7. OPERATIONAL REQUIREMENTS

FUNCTION	WEEKLY	3 MONTHLY	12 MONTHLY
GENERAL			
Visual Inspect Plant For Obvious Faults	✓		
Record Water Discharge	As Per Resource Consent Conditions (Automated Daily by RTU)		
Forward Reports to Local Authority	As Per Resource Consent Conditions		
SEPTIC TANK			
Measure and Record Sludge & Scum Levels			✓
Check Operation of Pumps Alarms, and Floats			✓
Clean Screened Pump Vault Biotube Cartridge	As Per Site Tests – Service Report Recommendations		
Recommend De-sludge Interceptor Tanks	As Per Site Tests – Service Report Recommendations		
RECIRCULATION TANK			
Inspect and Clean Recirculation Tank SPV Filter		✓	
Check Operation of Recirc Splitter Valve Float		✓	
Record Operating Pressure of Recirc Pumps		✓	
Check Operation Recirc Tank Control Floats		✓	
Check Operation of Pumps and Alarms		✓	
Inspect Sludge Level in Recirc Tanks		✓	
PACKED BED REACTOR			
Check and Log Operating Pressure in Laterals		✓	
Confirm Orifice Flow Rate at Two Points on PBR			✓
Flush Build-up from PBR Laterals			✓
Inspect and Clean Sequencing Valve		✓	
TREATED EFFLUENT TANK			
Check Operation of Pumps, Alarms and Floats		✓	
Record Operating Pressure of TET Pumps		✓	
Check Operation of Treated Effluent Tank Floats		✓	
Inspect Control Panel Operation		✓	
Inspect Sludge Level in TET Tanks			✓
LAND APPLICATION SYSTEM			
Flush Build-up from Drip Line Pipes			✓
Visually Inspect Land Application Area		✓	