

LOT 311 Fifty Road, Baldivis

CITY OF ROCKINGHAM

ENGINEERING SERVICES REPORT

Prepared for: The Estate of GDR Lilburne c/ Allerding & Associates 125 Hamersley Road, Subiaco WA

Prepared by:

VDM Engineering 310 Selby Street North Osborne Park WA 6017

CONSULTING ENGINEERS AND SCIENTISTS

Offices: Western Australia Queensland Northern Territory

New South Wales Victoria Hanoi, Vietnam





Document Control Record

Prepared by:	Enzo Biagioni-Froudist
Position:	Senior Civil Engineer
Signed:	the hadit
Date:	08/08/2011

Approved by:	Enzo Biagioni-Froudist
Position:	Principal, Infrastructure
Signed:	My hadist
Date:	08/08/2011

REVISION STATUS

Revision No.	Description of Revision	Date	Approved
0	First Issue	14/04/2011	the handist
1	Revision to Include Local Stormwater Strategy	08/08/2011	- maint
2	Revision to Catchment 3 Stormwater Drainage and overall report	11/07/2012	-mait
3	Revision to Report to match revised LSP layout in Catchment 2 and part Catchment 1	25/07/2013	the hadit
4	Revision to Report to match revised LSP	23/11/2013	- maint

Recipients are responsible for eliminating all superseded documents in their possession.

VDM Consulting (WA) Pty Ltd ACN: 009 351 400

310 Selby Street North, OSBORNE PARK WA 6017

PO Box 1852, Osborne Park DC 6916

Telephone: +61 8 9241 1800 Facsimile: +61 8 9241 1999 Email: enquiries@vdmgroup.com.au Internet: www.vdmconsulting.com.au



RELIANCE, USES and LIMITATIONS

This report is copyright and is to be used only for its intended purpose by the intended recipient, and is not to be copied or used in any other way. The report may be relied upon for its intended purpose within the limits of the following disclaimer.

This study, report and analyses have been based on the information available to VDM Consulting at the time of preparation. VDM Consulting accepts responsibility for the report and its conclusions to the extent that the information was sufficient and accurate at the time of preparation. VDM Consulting does not take responsibility for errors and omissions due to incorrect information or information not available to VDM Consulting at the time of preparation of the study, report or analyses.



Contents

1.	INTRODUCTION	4
2.	SITE EVALUATION & BULK EARTHWORKS	4
2.1.	SITE TOPOGRAPHY	4
2.2.	SITE GEOLOGY	4
2.3.	GROUND WATER LEVEL	5
2.4.	BULK EARTHWORKS	5
3.	ROADWORKS	6
4.	STORMWATER DRAINAGE	7
4.1.	EXISTING SITE DRAINAGE	7
4.2.	COUNCIL REQUIREMENTS	7
4.3.	LOT 311 STORMWATER MANAGEMENT SYSTEM	7
4.	3.1 PROPOSED CATCHMENTS DRAINAGE CONCEPT DESIGN	8
4.4.	PROPOSED STORMWATER CONVEYANCE SYSTEM	8
4.	4.1 STORAGE /INFILTRATION BASINS	9
4.	4.2 PROPOSED TREATMENT TRAIN SYSTEM & STORAGE CAPACITIES	9
4.5.	STORMWATER SUMMARY	9
5.	WASTEWATER DISPOSAL	10
6.	POTABLE WATER SUPPLY	10
7.	POWER, TELECOMMUNICATION & GAS	11
7.1.	WESTERN POWER	11
7.2.	STREET LIGHTING	11
7.3.	TELECOMMUNICATION	11
7.4.	GAS SUPPLY	11

Appendices

Appendix A – Local Structure Plan Layout (with Existing Topography)	12
Appendix B – Geological Mapping Plan	13
Appendix C – Stormwater Collection, Storage/Treatment Principles and Examples	15
Appendix D – Lot Drainage Catchment Plan	17



1. INTRODUCTION

VDM Engineering was commissioned by Allerding & Associates to prepare an engineering services report to support the submission of proposed Local Structure Plan (LSP) for Lot 311 Fifty Road, Baldivis to the City of Rockingham.

The subject land comprises of 15.115 hectare (ha) land and is located approximately 10 km west of the Rockingham City. The site is triangular shaped parcel and is bounded by Fifty Road to its north, Eighty Road to the eastern boundary and to the west of site is existing undeveloped land (Lot 312 Fifty Road) which abuts the Rockingham Regional Park. The Baldivis Primary School is located to the north of subject site.

2. SITE EVALUATION & BULK EARTHWORKS

2.1. SITE TOPOGRAPHY

The subject land is currently vacant and not cleared of vegetation. It also does not appear to have been used for agricultural activities previously.

The site is well graded and gently slopes from a high point at the north closer to Fifty Road to its surroundings. The lowest point of the site is located on the southwest corner of the site along Eighty Road.

Levels across the site range from RL 15m AHD (Australian Height Datum) to RL 6m AHD. Refer to proposed layout with existing contour attached as **Appendix A**.

2.2. SITE GEOLOGY

Whilst a formal Geotechnical investigation was not undertaken for this report, a desktop study utilising existing Geological Maps was used for a global review of general soil conditions.

Reference to the Rockingham Geological Survey Map series indicates that the primary soil condition for the area is classified as Sand (S8) overlaying Limestone (LS1).

The S8 Sand is classified as of Bassendean Sand, being very light grey at surface, yellow at depth, fine to medium-grained sub-rounded quartz, moderately well sorted and of eolian origin. The S8 Sand layers may be found at depths ranging between RL5 to RL 45 AHD. The permeability of the sand unit (S8) is likely to be high according to the physical properties listed in the General Features for the material. The S8 Sand is described as well drained and drainage disposal is only problematic in area of high ground water table.

The LS1 Limestone is classified as of Tamala Limestone Sand (Qtl) and of Safety Bay Sand (Qhs) in part in origin, being pale yellowish brown, fine to course-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, and of eolian origin. The LS1 Limestone layers may be found at depths ranging between R.L.0 to R.L.60 AHD. The permeability of the sand unit (LS1) is likely to be high according to the physical properties listed in the General Features for the material. The LS1 Limestone is described as having variable bearing capacities depending on the degree of cementation. Common solution cavities and fissure could lead to severe settlement under load and also offer an easy path for pollutants to the water table.

For further reference, please refer to the Geological & Geomorphology Plan attached as Appendix B.



2.3. GROUND WATER LEVEL

Preliminary advice from the Perth Groundwater Atlas indicates that the nominal groundwater level is at RL 2m AHD with 0.5m to 3m fluctuation due to seasonal variation and flows westwards.

Formal geotechnical investigation will be undertaken to confirm ground water levels at the subdivision stage of development.

2.4. BULK EARTHWORKS

The general philosophy of the site earthworks strategy is to minimise the amount of cut and fill within the subject site while maintaining a suitable level of connection with the bordering Fifty Road, Eighty Road and Lot 312. The undulating topography of the subject site will mandate a significant amount of retaining walls to be constructed on site in order to create level building pads.

Preparatory works should be limited to the following:-

- i. Removal of fencing and other improvements as necessary, however, retaining as many existing and significant trees and vegetation as possible.
- ii. Stripping and grubbing of areas to be earth worked with due regards to vegetation preservation in selected areas.
- iii. Strip and stockpiling topsoil.
- iv. Cut to fill operations and imported fill to proposed road as required.
- v. Replace topsoil to batters and verges.
- vi. Stabilise any areas where topsoil has not been respread.

Site levels will be set in accordance with the following parameters:-

- vii. Geotechnical and soil parameters to ensure that the site achieves a minimum Class "A" site.
- viii. Building pad levels to be designed to ensure that floor levels maintain a clearance of a minimum of 0.5m to the regional 1:100 year flood level.
- ix. Finished pad levels are to conform to the regional drainage requirement as identified in the published urban stormwater drainage strategies consistent with recent government initiatives for the area.

VDM anticipates that the bulk earthwork operations for the recommended development option will be completed using material available from site plus imported clean fill to fulfil the development requirements.

Upon completion of bulk earthwork, any disturbed areas will be stabilised either by respreading the stockpiled topsoil from the bulk earthwork operations or via hydro mulching stabilisation as appropriate or in accordance with the requirements of the City of Rockingham.



3. ROADWORKS

All proposed internal road works will be designed and constructed in accordance with the requirements and standards of the City of Rockingham, as appropriate to the regulatory control requirement of the individual roads and hierarchy requirements.

The proposed development will incorporate a highly developed urban road structure with the roadworks I generally consisting of concrete kerbing and asphaltic concrete pavements.

Entrance roads into the development may be subject to intersection treatments and include refuge islands and other facilities that will provide an identity entry statement.

Minimum recommended carriageway widths will be selected with due reference to local authority and Residential R-Codes.

In order to achieve an appropriate road hierarchy within Lot 311 Fifty Road, Baldivis, it is recommended that the following carriageway widths be considered within the development area:-

i.	Main internal roads	6.0m seal width within a dedicated reserve (16 metre at entrance roadways)
ii.	Minor internal roads	6.0m seal width within a dedicated private road reserve (generally 14-15 metre max)
iii.	Laneways	6.0m seal width within a 6.0m road reserve

The proposed Nairn Road dual carriageway once constructed will connect Kerosene Lane with Eighty Road which will divide the subject site. Construction of this road has commenced as part of the infrastructure works undertaken for the development of the Baldivis North Structure Plan area.



4. STORMWATER DRAINAGE

4.1. EXISTING SITE DRAINAGE

Lot 311 Fifty Road, Baldivis currently drains rainfall runoff from the highest point at the northern section of site to the southeast and southwest low points. Two smaller catchments within the proposed development area also drain towards the northwest and northeast respectively to Fifty Road roadside table drains.

Based on a desk top study and site investigations, there are no known permanent water bodies on the subject site and all overland runoff is catered for by ground infiltration to recharge the site's ground water table. During major storm events it has also been reported that the stormwater surcharge from the site overflows southwards to adjacent Lot 312 and further to the Rockingham Lakes Regional Park stormwater system.

It should be noted that the urban zoned land north of Lot 311 has a dedicated regional drainage basin which could be utilised for either minor and or major storm flow events to be directed via a piped system to the north western corner of Lot 311.

4.2. COUNCIL REQUIREMENTS

Preliminary discussions with the Shire of Rockingham indicate that the design philosophy for stormwater drainage in the area is to ensure:

- Sufficient flood control freeboard to the proposed residential housing floor levels and
- That downstream discharge from the proposed urban development is limited to predevelopment conditions. Additional stormwater that will be generated on site due to the post urban development is to be retained and managed on the site using alternative measures to an end of pipe solution.

To achieve this, and in unison with a stormwater drainage piped system, other stormwater management facilities such as gross pollutant traps, soakaways, swales and compensation basins with nutrient stripping capability will be required to assist in the attenuation of stormwater runoff prior to discharge to downstream outlets where appropriate.

In unison with the above City of Rockingham's requirements, the Department of Environment (DOE) current urban development stormwater management policy is to encourage low frequency runoff events to be treated and stored in drainage swales /compensation basins for subsequent ground water infiltration. For maximum storm events flood routes are to be provided to stormwater drainage outfalls.

Refer to **Appendix C** for Stormwater Collection, Storage/Treatment Principles and Examples showing the integration of the drainage philosophy and the landscape strategy utilizing living stream systems and a treatment train approach to stormwater management.

4.3. LOT 311 STORMWATER MANAGEMENT SYSTEM

The stormwater management system that is envisaged for Lot 311 Fifty Road, Baldivis consists of:

- 1. Optimised layout of sub catchment drainage areas within Lot 311.
- 2. Road side kerb guttering to collect surface runoff.
- 3. Road side kerb entry gullies that will direct surface runoff to a dedicated gravity drainage system.



- 4. Construction of a drainage pipe network which will convey storm flows to a dedicated swale or compensation basin on the site.
- 5. Gross pollution traps will be strategically located prior to the swales/compensation basins to capture screenings and plastics.
- 6. Bubble-Up structure to allow stormwater entry from the drainage pipes to dedicated swales in the road reserves and compensation basins within the POS and drainage reserve (both the road reserve swales and compensation basins shall consider urban sensitive design and are to incorporate appropriate landscaping to promote nutrient stripping and bio filtration- i.e. treatment train).
- 7. Area for stormwater detention has been allowed within the entrance zones to the drainage basins incorporating bioretention sized to 2% of total connected impervious surface.
- 8. Any extreme storm event overflows within the Lot will be directed overland to either Lot 312 / Rockingham Lakes Regional Park stormwater system and to the dedicated regional drainage basin in the northwest corner.

4.3.1 PROPOSED CATCHMENTS DRAINAGE CONCEPT DESIGN

The Stormwater Management Plan for the site showing the proposed development and proposed drainage catchments are shown in Appendix D. The plan has been prepared following consideration of the proposed development and proposed stormwater treatment measures.

For further details of the catchments and stormwater conveyancing system, refer to the LWMS prepared by Peritas Civil.

4.4. PROPOSED STORMWATER CONVEYANCE SYSTEM

All roads within the development area shall be kerbed and provided with a conventional pipe drainage network consisting of collector gullies, manholes, drainage pipes and controlled outfalls to convey rainfall runoff to either compensation basins and/ or swales in accordance with the Australian Rainfall & Runoff Guidelines and the City of Rockingham's design criteria and standards.

Where utilised, the stormwater piped network will terminate into a bubble-up arrangement within the proposed swales or dry compensation (soakage) basins which shall be located within either the Public Open Space or drainage reserves being provided within the development area. The proposed stormwater retention and infiltration basin /swales that will be incorporated within the development area will be landscaped where feasible to encourage nutrient stripping and natural filtration of the stormwater drainage. These swales/basins will also incorporate water sensitive design and quality principles.

Any surcharge beyond the major storm event not contained within the proposed swales/soakage basins shall be directed and overflow into the adjacent Lot 312 and further into the Rockingham Lakes Regional Park system. Where feasible, any major storm event which cannot be contained within the north western portion of Lot 311 will be directed to the dedicated regional storage basin.



4.4.1 STORAGE /INFILTRATION BASINS

A combination of swale/ compensation basin designs will be adopted for the specified drainage sub catchment areas within the proposed development area.

For the northern eastern catchment it is proposed to build a shallow vegetated stormwater infiltration swale) adjacent to north-eastern road reserve corridor along Fifty road and Eighty road (Catchment 4). The swales will be designed to contain up to the 1-in-100 year ARI event associated with runoff from streets and verges within the site. Side slopes in each swale will be a maximum of one vertical in four horizontal for safety and ease of maintenance. The maximum depth of water in each swale is planned not to exceed 0.6 metres.

Compensation basins are planned for catchment 1 and catchment 2 respectively and will be located within the public open spaces being provided. Depths within the compensation basins will generally be no deeper than 0.6-0.9 metres and side slopes ranging from 1 to 4 and 1 to 6.

For catchment No 3 a dedicated underground storage system (similar to the Atlantis or stormtech cells design) shall be used due to limited space being available.

4.4.2 PROPOSED TREATMENT TRAIN SYSTEM & STORAGE CAPACITIES

Refer to the LWMS for details of the treatment of nutrients, storage volumes and analysis and the water management system proposed.

4.5. STORMWATER SUMMARY

In conclusion the proposed Stormwater Management Plan for Lot 311 Fifty Road, Baldivis to meets all of the design criteria, including:

- The proposed stormwater system consists of a network of piped drains and landscaped overland flow paths draining through a stormwater treatment system consisting of GPTs, sedimentation ponds, wetland and water features;
- Stormwater treatment will exceed Best Practice objectives for reductions in pollutants;
- Water Sensitive Urban Design (WSUD) integrates the stormwater system into the proposed development;
- The local street drainage system will be constructed to Local authority standards;
- There will be sufficient flood freeboard to housing floor levels as prescribed in section 2.0 of this report.
- Maintenance, lifecycle and safety issues have been considered in the design of the stormwater system;
- Flows above the retained maximum flood events will be controlled by careful placement of outlets from the site to existing downstream drainage systems (natural or installed by other development);
- External catchments have not been included in stormwater treatment analysis; and
- Flood flows from external catchments have not been considered in this report other than to recognise that they exist and will be considered in the final development analysis design



5. WASTEWATER DISPOSAL

Preliminary information from the Western Australian Water Corporation indicates that existing infrastructure exists in the area and the site may be serviced by connection to these services in Fifty Road.

A 375mm diameter gravity sewerage main currently extends to the northwest corner of the subject site. Allerding & Associates had been advised that this 375mm diameter pipeline will be extended through the subject site along the proposed Nairn Road connecting the Brownell Crescent Sewerage Pump Station (SPS) and the Baldivis STP. The second existing sewerage available is an existing sewer pressure main which is not suitable for connection.

All developed lots would need to be served with a conventional gravity sewer system with the majority of the reticulation sewers located within road reserves. The internal sewer reticulation would be designed in accordance with the Water Corporation Sewerage Manual and connect into the proposed 375mm diameter pipe along Nairn Road.

6. POTABLE WATER SUPPLY

Preliminary information from the Water Corporation indicates there is an existing 900mm diameter steel potable water main along Eighty Road, known as the Serpentine System and is being supplied via the Tamworth Hill reservoir. It is anticipated that this existing system can provide water to the proposed development.

The internal water reticulation shall be designed and constructed in accordance with standard Water Corporation requirements. Standard Water Corporation water headwork charges will also apply to this development.



7. POWER, TELECOMMUNICATION & GAS

7.1. WESTERN POWER

Preliminary information from Western Power indicates that there is a service network within the study area. It is anticipated that this network will have sufficient capacity to service the development with underground power.

Western Power will require that the development be serviced with underground power. This system will connect to the existing underground systems located in Fifty Road.

The cost of this work will need to be met in full by the developer. Standard Western Power conditions will apply. Western Power will also charge service fees which are addition to supply and installation costs that will need to be paid by the developer.

7.2. STREET LIGHTING

Standard Western Power Street lighting design principles are to be adopted for the internal lighting network.

Should non-standard Western Power Street lighting be requested, prior approval from the local authority would be required.

7.3. TELECOMMUNICATION

Preliminary information from Telstra indicates there is an extensive network in the vicinity of the subject land. It is anticipated that this network will have sufficient capacity to service the development with telecommunication services.

Telstra will install any new telecommunication network facilities to the proposed lots, subject to the developer providing, at their cost, trenching for cable laying.

No headwork charges for Telstra services are anticipated.

7.4. GAS SUPPLY

Preliminary information from WA Gas Network has indicates there is an existing 160mm diameter high pressure gas main in Fifty Road suitable for connection.

It is anticipated that the network will have sufficient capacity to service the development with reticulated gas services by extension of the existing main. Standard headwork costs will apply for the mains extension to service the development.



Appendix A – Local Structure Plan Layout (with Existing Topography)





Appendix B – Geological Mapping Plan





Matrix Deficient in Matrix Celebrat in Matrix Constant Deficient in Matrix Deficient in Matrix <thdeficient in="" matrix<="" th=""> Deficient in M</thdeficient>		Interview Classical retarments Classical retarment	$ \begin{array}{ $		$ \begin{array}{ $							FO CH KE	014			DIGSONIA VIANABTA	no 3	· · · · ·			AM30 DT81	ana -
CERENT FEATURES Districts Districts Restrictures Network Network MULT CUVT<-tarks profile Extinition Extinition Extinition Extinition Extinition MULT CUVT<-tarks profile Extinition Extinition Extinition Extinition Extinition MULT CUVT<-tarks profile Extinition Extinition Extinition Extinition Extinition MULT CUVT<-tarks protocol profile Extinition Extinition Extinition Extinition Extinition MULT CUVT<-tarks protocol protocol Extinition Extinition Extinition Extinition Extinition Extinition MULT CUVT<-tarks protocol protocol Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition Extinition E	CEREAC FEATURIS CEREAC FEATURIS Enomina	International and the normalization of the network of the	CENERGE FALTORIES A monome CENERGE FALTORIES CONTRACT CONTRACT Description Contract on the part of the par	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		Map Unit Unit	Raterial 100	Ge.	Ma	t t g	*	2 ⁵	1411	²⁵	a	Sig.	5 ¹	18,	es.	1 ¹ 2	ů,
R Anti-interiment Federicient mation Anti-interimenter Federicient mation Sourt F Discretit more Benerget mage Sourt F Discretit more Benerget mage Sourt F Discretit more Benerget mage Sourt F Discretit more Benerge mage Sourt F Discretit more Benerge mage Sourt F Discretit more Benerge mage Benerge mage Discretif Benerge mage Benerge mage Discretion Benerge mage Benerge mage Discretion Benerge mage Benergemage Discretion Based develored more Benergemage Discretion Ba	R International and the state of the state	R A Ferdinian million Raid, Stape Instant methods	R MY20001 Rest, Site, F Fortient name MY20001	R MODEL ProDUCT Federication military Rate, 4qué 3	R Monther mitely Amount of the properticity	DENERAL FEATURE	Bandian	SAUDY CLAY - the pay to back, flow, wishe quare and amenic occasionally none all in matrix, of to controperty.	PEATY DLAY - dork per are thick, oft, writele organic entret, non-quarty and is place, of locative ships	songy SitT - data broards gay sit- with deservated fire-prints training Brut, writight day contest, 4° isolation utga	ELAYEY SAND - Match find to netham- prenati 4 units and with the match, remarks agains name, of leasants ingle.	CALCARENUS SAND - white, her to redemoniated, subrandet quert and postderic, of exists and)	CALGAREOUS SAND - at S1	LMESTONE - prit veloniah troun, assity conceted, triate, meterspecied, abstrandsk speca and stel defini, al otianertyn	CALDAREDUS SAND - white, medium grated, roaded quark and shell delric, wet some, of estima with	PEATV CLAY - mid to dark any, with weter solucidad day with relatio organic connex, of allocal unign	CALCARENCE SILT - des prevent breas sits and many days, and and def typerast and forescere at wolfy control, a recorded intesting a	scale - mis ystenia surve, sector is darcegranes sub-siglia quate trans al falcas, mutanes actes of resourt actes	LINESTOUF - pols released berrea, line to councyannel sub-acculer to well counde quarts, near of fedamer vell denii, weatley thread, surfas bertar, of quan begin	SAMD - very tyti gen gen unter yohne z. cont. the zo motionegaled, wh- munited quara, motionely well sorre- of exist ones.	$\label{eq:state} S_{3} \ s_{5} \ s_{5} \ s_{6} \ s_{6} \ s_{7} \ s_{$	CLAY - strong Month and duty pre- dar, plastic in platch, addt when well, addribe off content in multip, of allocal
Skály, Saje 3 Isola-sintent moorten Saje 4 Boltenin and Saje 5 Boltenin and Saje 5 Boltenin and Saje 5 Put, ficturelis Saje 5 Boltenin and Saje 6 Linemed Ballon 5 Bolto 1 Ballon 6	Static state 5 Instruction Instruction Static state 5 Buttorinn and Labored Labo	Ratic State Insucement economy formulation Ratic State Rat	Anti-field Anti-fi	Analytic signed Terrent recorrections Marking signed Marking sig	Ratic situation Matric situation </td <td>8</td> <th>Epiteden solt an political mate</th> <td>3</td> <td>Swarp deposits</td> <td>(Christ)</td> <td></td> <td>Sefery Bay Sand Incode turned (Utran)</td> <td></td> <td>Sedeny Ear Eard (Ding)</td> <td></td> <td>Allevierr</td> <td>(MD)</td> <td>Sant derived from Tarrato Limenton (0.4)</td> <td>Turado Uchectore (04) and Salety Bay Sent (04) in part</td> <td>Basenforn Sand (0pit)</td> <td>This Beamber Sed aver Builded Formetion (Buildes)</td> <td></td>	8	Epiteden solt an political mate	3	Swarp deposits	(Christ)		Sefery Bay Sand Incode turned (Utran)		Sedeny Ear Eard (Ding)		Allevierr	(MD)	Sant derived from Tarrato Limenton (0.4)	Turado Uchectore (04) and Salety Bay Sent (04) in part	Basenforn Sand (0pit)	This Beamber Sed aver Builded Formetion (Buildes)	
IDAINTERI INCOLUME IDAINTERI INCOLUME IDA-INTERIA INCOLUMENTS	International records and Back, distriction Internation Back, distriction Internation Back, distriction Not, distriction L Not Not Sould Not Not Not Sould Not Not Not Sould Not Not Not Linement H Not Not Linement H Not Not Linement H Not Not Linement H Not Not Sectification and Not Not Not Not Backing and Not H Not Not Sectification and Not Not Not Not Sectification and Not Not Not Not Records and Not Not Not Not Not Sectification and Not Not Not Not Not Sectification and Not Not Not Not Not Sectification and Not Not Not Not <t< td=""><td>Matrixet Lat sitter is test in the second s</td><td>Americanit Americanit Inter-interaction Entry Journal (Entry Journal) Entry Journal (Entry Journal) Balanti L M L Americanit L M L Balanti L M L Linement H L M Linement H L M Linement H L M Linement H L M Muthement L M L Sectization and M L M Balantiation L M L Muthement L M L Balantiation L M L Muthement L M</td><td>Intransfort Factor Fa</td><td>Mutation in the second state in the second state in the second state is the second</td><td></td><th>Raint, sings</th><td>a ie</td><td>5-IS no. F</td><td>6 m F</td><td>3 m;F</td><td>M;m21-0</td><td>E-40 m, N-3</td><td>\$-20 m, M-5</td><td>3-10 m.F</td><td>0-3 m; F</td><td>5 m, F</td><td>10-80 m; G</td><td>5-15 m; E-N</td><td>3-42 H (</td><td>a-20m(F</td><td>4-10 m F</td></t<>	Matrixet Lat sitter is test in the second s	Americanit Americanit Inter-interaction Entry Journal (Entry Journal) Entry Journal (Entry Journal) Balanti L M L Americanit L M L Balanti L M L Linement H L M Linement H L M Linement H L M Linement H L M Muthement L M L Sectization and M L M Balantiation L M L Muthement L M L Balantiation L M L Muthement L M	Intransfort Factor Fa	Mutation in the second state in the second state in the second state is the second		Raint, sings	a ie	5-IS no. F	6 m F	3 m;F	M;m21-0	E-40 m, N-3	\$-20 m, M-5	3-10 m.F	0-3 m; F	5 m, F	10-80 m; G	5-15 m; E-N	3-42 H (a-20m(F	4-10 m F
		Image: second	NUMBER NUMBER NUMBER 3000 G 300 G	Introduction Introduction<	NUMBER NUMBR NUMBR NUMBR <td></td> <th>ack-miterial recorded</th> <td>Gisterits and</td> <td>Pas, diatavite</td> <td>Sand, domentos</td> <td>Saud</td> <td>Lease</td> <td>Linemand</td> <td>Liesand</td> <td>Lineared</td> <td>Oby far helds, pipe and the secondaries</td> <td>Ved, liersture</td> <td>Specification and</td> <td>Rimention crens, avrallagical, sercultural conf contriction grade filosome</td> <td>Construction and class cond</td> <td>Contruction and gizes card</td> <td>Carys far torick, pipe and itteresentations</td>		ack-miterial recorded	Gisterits and	Pas, diatavite	Sand, domentos	Saud	Lease	Linemand	Liesand	Lineared	Oby far helds, pipe and the secondaries	Ved, liersture	Specification and	Rimention crens, avrallagical, sercultural conf contriction grade filosome	Construction and class cond	Contruction and gizes card	Carys far torick, pipe and itteresentations
MINTERAL PROPERTIES MINTERAL PROPERTIES Result Result <td>NUMBER NUMBER Numer Numer Numer<td>PHODE ETTES State Test Sta</td><td>Item * 100</td><td>L <thl< th=""> <thl< th=""> <thl< th=""> <thl< th=""></thl<></thl<></thl<></thl<></td><td></td><td></td><th></th><td>E</td><td>5</td><td>_</td><td>8</td><td>GR File</td><td>-av vn</td><td>-sw</td><td>2</td><td>2 3</td><td>3</td><td>NS-</td><td>-3W Gro</td><td>NS NS</td><td>and firm</td><td>9 H</td></td>	NUMBER Numer Numer Numer <td>PHODE ETTES State Test Sta</td> <td>Item * 100</td> <td>L <thl< th=""> <thl< th=""> <thl< th=""> <thl< th=""></thl<></thl<></thl<></thl<></td> <td></td> <td></td> <th></th> <td>E</td> <td>5</td> <td>_</td> <td>8</td> <td>GR File</td> <td>-av vn</td> <td>-sw</td> <td>2</td> <td>2 3</td> <td>3</td> <td>NS-</td> <td>-3W Gro</td> <td>NS NS</td> <td>and firm</td> <td>9 H</td>	PHODE ETTES State Test Sta	Item * 100	L L <thl< th=""> <thl< th=""> <thl< th=""> <thl< th=""></thl<></thl<></thl<></thl<>				E	5	_	8	GR File	-av vn	-sw	2	2 3	3	NS-	-3W Gro	NS NS	and firm	9 H



<u>Appendix C – Stormwater Collection, Storage/Treatment Principles and</u> Examples

WSUD Estate Drainage - Implemented Examples

Examples of constructed swales and stormwater storage structures:-

- Waterhall Estate Guildford
- Maddington Riverside Estate

Below are typical details layout plans and photos demonstrating the typical features that will be incorporated in the Lot 311 Fifty Road Baldivis Design.

FILTRATION / AERATION BASIN DETAIL AND INTERCONNECTING LOW FLOW PIPE DETAIL





TYPICAL DETAIL DRAINAGE SWALE & BIOFILTRATION SYSTEM





Appendix D – Lot Drainage Catchment Plan

