

CONDITION 3: SURFACE WATER DRAINAGE SCHEME



ARCUS

CARDIFF OWC

DISCHARGE OF PLANNING CONDITION 3

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DISCHARGE OF PLANNING CONDITION 3: DRAINAGE FOR CARDIFF OWC

1 INTRODUCTION

This report has been produced to enable Cardiff County Council ("the Council") to discharge Planning Condition 3 ("the Condition") to the consent for the Cardiff Open Windrow Composting (OWC) facility (planning reference: 14/00195/DCO):

"No development shall take place until a scheme for the drainage of the site and any connection to the existing drainage system has been submitted to and approved writing by the Local Planning Authority. No part of the development shall be occupied until the scheme is carried out and completed as approved."

Reason:

"To ensure an orderly form of development."

Arcus Consultancy Services Ltd ("Arcus") has been engaged by Kelda Organic Energy (the Applicant) to undertake a desk study to confirm that the surface water drainage scheme initially prepared by SLR¹, for the applicant (which is attached at Appendix A to this document) is acceptable, in principal, for the pre-construction, construction and operational phases of the consented Cardiff OWC site (hereafter referred to as "the Development") near Wentloog, Cardiff.

The volume of surface water run-off from the Development has been calculated by SLR and verified by Arcus as suitable to support the discharge of the Condition.

Consultation with Welsh Water has confirmed that the maximum volume that can be discharged from the site to the existing public foul sewer is 10 l / s.

The surface water drainage scheme presented in Appendix A to this document is intended to demonstrate measures that will be used across the Development site to adequately accommodate an increase in surface water run-off for the 1 in 50 and 1 in 100 year rainfall events as a result of the installation of the Development.

The methods set out in this document are based on good practice and the following guidance:

- The Environmental Protection Act 1990²;
- The Groundwater (England and Wales) Regulations 2009³;
- BRE Digest 365 – Soakaway Design;
- The Construction Industry Research and Information Association (CIRIA), 'Environmental Good Practice On Site (C692)' (2010); and
- CIRIA, 'Control of Water Pollution from Construction Sites (C532)' (2001).

The appropriate methodologies to cover water control and the means of drainage from all hard surfaces and structures within the site are described in the following sections.

This report is supported by and makes references to the following documents:

- Flood Consequences Assessment (FCA) by Ramboll, January 2014 (submitted with the original planning application);
- Drainage Design by SLR, March 2014 (Appendix A); and
- Discharge to Sewer, Drawing D-002A by SLR June 2014 (Appendix B).

¹ SLR, March 2014 "Review of Drainage Design"

² The Environmental Protection Act 1990 [online] Available at: http://www.opsi.gov.uk/ACTS/acts1990/ukpga_19900043_en_1 [Accessed 19/01/2015].

³ The Groundwater (England and Wales) Regulations 2009 [online] Available at: <http://www.legislation.gov.uk/ukdsi/2009/9780111480816/contents> [Accessed 19/01/2015].

2 DRAINAGE PLAN

2.1 PREVIOUS FLOOD RISK ASSESSMENT

A Flood Consequences Assessment (FCA) was undertaken in January 2014 by Ramboll in support of the planning application for the Development. This concluded that the site is located in an area at risk of a 1 in 200 year tidal flood event, however the site is protected by flood defences for an event up to this return period. Therefore residual flood risk to the site is low. Other sources of flooding to the site have also been assessed and are also considered to be low risk.

The majority of the impermeable area at the Development site is drained by a network of existing surface water drains, which pass into Welsh Water public sewers.

Whilst the FCA stated that the proposals will not result in any changes to the drainage regime on site, it is now the intention to install a rising main (SPEL (or similar) pumping station) to limit the discharge rate to the drainage network at 10 l / s, in agreement with Welsh Water.

2.2 DRAINAGE ASSESSMENT

In extreme storm events, there would be high levels of run-off from the hardstanding elements of the Development relative to green-field flow rates, which has the potential to contribute to off-site flood risk.

The SLR Drainage Assessment (provided as Appendix A of this report) states that taking into account the agreed discharge rate of 10 l / s into the existing Welsh Water public foul sewer, the 1 in 50 year storm event would generate a volume of 410.8 m³ for the 240 minute winter storm.

The Drainage Assessment also concludes that the 1 in 50 year storm event would require a volume of 202.5 m³ to be attenuated for the 180 minute winter storm ('critical storm' with a conservative 5 l / s discharge rate). This takes into account the absorption for precipitation by the windrows to a saturation point of 57% for the critical storm (for a 5 l / s discharge rate). Several studies relating to compost function report optimum moisture contents for composting range from 25% to 80% on a wet basis, with values generally recommended in the 50% to 70% range, as reported by Haug (1993)⁴ and Cronjé *et al.* (2004)⁵. As such, the saturation point of 57% for compost onsite for the critical storm appears conservative and therefore suitable for use within the drainage assessment.

Based upon Table 3 in the SLR Assessment, the windrows would absorb 49.92 litres of precipitation per tonne of material for the critical 1 in 50 year storm event, with a 10 l / s discharge allowance (240 mins), there would need to be a minimum of 4,806.5 tonnes of material onsite to fully attenuate 239.9 m³ falling on the composting windrows (60% the average critical storm⁶ of 399.93 m³) with 40% falling on areas not covered by composting windrows.

Given an annual operating capacity of 38,000 tonnes of material, the site would need to be operating at approximately 12.6% annual capacity to attenuate 60% the 1 in 50 year critical storm (with a 10 l / s discharge allowance specified by Welsh Water).

This would mean that approximately 159.9 m³ (40% of the critical storm (240 mins with a 10 l / s discharge allowance not falling on windrows) would need to be attenuated by the existing drainage network.

The designer has proposed the use of additional kerbing to provide short term attenuation of stormwater subject to levels across the site; however the designer acknowledges that in reality and given the site gradients, rainwater will not distribute evenly and will instead collect

⁴ Haug RT. *The Practical Handbook of Compost Engineering*. Boca Raton: Lewis Publishers; 1993.

⁵ Cronjé AL, Turner C, Williams AG, Barker AJ, Guy S. *The respiration rate of composting pig manure*. *Compost Science and Utilization*. 2004;12:119–129.

⁶ Average volume 240 min critical storm is 399.93m³

at the lowest point of the site. Detailed topographical will be completed to allow an accurate estimate of onsite storage potential. Our own outline calculations indicate that the maximum depth of flooding to occur during the critical storm event will be of the order of 15 to 30 cm assuming that the site slopes uniformly downwards to the southwest. This would indicate that a large kerb installed around the perimeter of the lower area of the site should be adequate to collect and store flood water, allowing subsequent attenuation of the drainage of that flood water into the Welsh Water sewer. However, detailed topographical information and further design work will be completed in order to verify that this solution will work. If the storage volume cannot be achieved using the kerbing solution (whilst allowing the site to continue operating), then other options will be considered to provide sufficient storage (e.g. storage tank), enabling flows into the Welsh Water sewer to be attenuated at the agreed rate.

It should be noted that the applicant has accommodated for a separator tank in the design, which will allow some attenuation of stormwater before discharge to the existing surface water drainage network.

2.3 DRAINAGE PLAN

The Site Plan produced by SLR (see Appendix B) shows the existing surface water drainage infrastructure beneath the Development, which is currently linked to a Landfill leachate treatment plant, and this is then discharged to Welsh Water Sewer. It is proposed that surface water drainage from the site will utilise the existing drainage network under the development. This will then be intercepted and pumped at a maximum rate of 10 l / s via a SPEL (or similar) pumping station into the existing Welsh Water Sewer connection.

It is suggested that all manholes associated with the SPEL (or similar) pumping station should be at a level which guarantees that they do not over-spill in the given flood scenario.

3 CONCLUSION

It is proposed to discharge surface water from the Development into existing surface water drainage network underlying the site at a restricted rate of 10 l / s, as agreed with Welsh Water. During heavy precipitation events that may exceed a flow rate of 10 l / s. it is proposed that excess storm water will be stored within the Development site. The designer intends to store the water on the surface of the low point of the site. The feasibility of this option will be verified following receipt of detailed topographical information. If this option is not feasible, then it will be possible to store the excess water in other ways for example a sub-surface flood attenuation tank.

The information within this report, combined with the information provided in the SLR Drainage Report and the SLR Discharge to Sewer Drawing D-002A, is considered to provide sufficient information to enable the Council to discharge Planning Condition 3.

APPENDIX A: DRAINAGE DESIGN BY SLR, MARCH 2014

Project Title	Kelda Lamby Way	
Project Ref:	402 04012 00002	
Document Date:	05.03.2014	
Issue	1	
Subject:	Review of Drainage Design	

1.1 Introduction

SLR has carried out an assessment of the drainage design for the proposed Lamby Way Composting site based on the following approach

- (1) Preparation and interpretation of calculations on stormwater volumes for specified return periods and durations
- (2) Preparation of calculations on the attenuation potential associated with windrow absorption, evaporation and storage in transfer sites
- (3) Identification of potential flow rate taking into consideration the results of the aforementioned calculations assuming no attenuation
- (4) Evaluation of attenuation requirements to achieve an acceptable flowrate to sewer (yet to be defined)

The data developed from this analysis will provide an evidence base for discussion with DCWW and on which to make a decision on whether to include or exclude attenuation from the design.

1.2 TEG operational arrangements

At existing sites TEG seek to operate the facility so that during Winter periods, when the volumes of delivered green waste are low, with maximum coverage of the composting pad with composting material or final product. As such, the normal operational philosophy of 6 weeks is typically, extended to 10 weeks composting period.

For their 6 operating sites, TEG has provided details of current tonnages and proportion of the composting pad covered with material at present, which are shown below.

Table 1: Data for TEG operational sites

Site	Current capacity (ktpa)	Windrows/ Waste (ktpa)	End product (ktpa)	Over size (ktpa)	Weekly throughput	% total throughput	% of pad coverage
Acton	30000	800	3,000	400	576.92	14.00%	50%
Berkswell	20000	400	0	0	384.62	2.00%	10%
Coven	30000	3000	1,500	100	576.92	15.33%	80%
Gaydon	30000	300	6,000	300	576.92	22.00%	40%
Oxton	43000	3000	300	50	826.92	7.79%	40%
Telford	17000	2000	200	100	326.92	13.53%	70%

1.3 Task 1: Calculation of on stormwater volumes for specified return periods and durations

Stormwater volumes for 1 in 50 and 1 in 30 storm events are presented in Table 2 and, with details of all events presented in Appendix A.

Table 2: Details of Stormwater Events

Model	Storm Event	Rain (mm/hr)	Time to Vol Peak (mins)	Discharge Volume (m ³)	Σ Max Outflow (l/s)	Maximum Volume (m ³)
30 year 5l/s	600 min Winter	5.715	584	631.1	5.0	457.6
30 year 10l/s	240 min Winter	11.155	236	491.8	10.0	352.8
50 yr 5 l/s	720 min Winter	5.545	698	734.7	5.0	527.0
50yr 10l/s	240 min Winter	12.481	238	551.0	10.0	410.8

The data shows that an attenuation volume of between 350 and 527 m³ would be required to attenuate stormwater under the most significant event.

1.4 Calculations on the attenuation potential associated with windrow absorption, evaporation and storage

SLR has constructed an excel based model to evaluate the absorptive capacity of the windrows. After further consideration SLR has concluded that the evaporative effect during storm conditions is likely to be negligible for the following reasons:

- The degree of evaporation from windrows will be driven by surface evaporation rates rather than evaporation within the compost mass;
- Under storm conditions the relative humidity of the air will be extremely high and this will govern the evaporative potential
- Much of the material will be mature or reaching maturity and therefore the heat available within the material to assist in evaporation will be minimal

Thus, whilst evaporation is an important moisture loss mechanism under normal conditions the impact during storms is considered to be minimal for the aforementioned reasons and this mechanism has therefore not been included.

SLR's model is based on a temporal mass balance for 1 tonne of material taking into consideration rainfall, absorption and runoff from the windrow pile.

A number of assumptions are employed in the model most notably the maximum operating moisture content, set at 55% ww¹ and the maximum carrying capacity, set at 66% ww. It also assumes that there is no rainfall runoff down the surface of the windrows.

The model adopts a simplistic assumption that all rain falling onto the windrow will be absorbed until the maximum carrying capacity is exceeded at which point the compost will be unable to hold any additional water and excess rainfall will be released as runoff from the pile.

Additional assumptions that have been made in the analysis are as follows:

Average windrow dimensions

¹ Wet weight

Base Width	6m
Top Width	1m
Height	4m
Windrow density	450 kg/m ³

The results of the analysis for all 1 in 50 storm return periods are presented in the table below.

Table 3: Predicted windrow absorption capacity

Time period	Max volume of leachate (l/tonne)	Precipitation Absorbed per tonne (litre)	Final moisture content (%)
15	0	18.81	56%
30	0	25.40	56%
60	0	32.83	56%
120	0	41.09	57%
180	0	46.22	57%
240	0	49.92	57%
360	0	55.60	57%
480	0	59.95	57%
600	0	63.51	58%
720	0	66.54	58%
960	0	71.55	58%
1440	0	79.13	58%
2160	0	87.34	58%
2880	0	93.60	59%
4320	0	102.96	59%
5760	0	110.02	59%
7200	0	116.04	59%
8640	0	121.10	60%
10080	0	125.66	60%

Table 3 shows that for all storm events, based on the specific set of assumptions a windrow will be capable of absorbing all rainfall that falls on the windrow. Moisture content will rise from a starting point of 55% up to a maximum of 60% by the end of the storm period.

Providing that two storm events do not occur successively then the modelling indicates that the volume of runoff from areas covered by material will be minimal.

It should be noted that this result is based on the assumptions identified above; variance from these assumptions eg reduced height of windrows/storage piles or lower bulk density could result in the maximum capacity being exceeded and runoff occurring.

1.5 Identification of potential flow rate taking into consideration the results of the aforementioned calculations assuming no attenuation

Of the 6 operational sites Gaydon operates with the maximum quantity of material on site which is currently 22% of annual capacity on site.

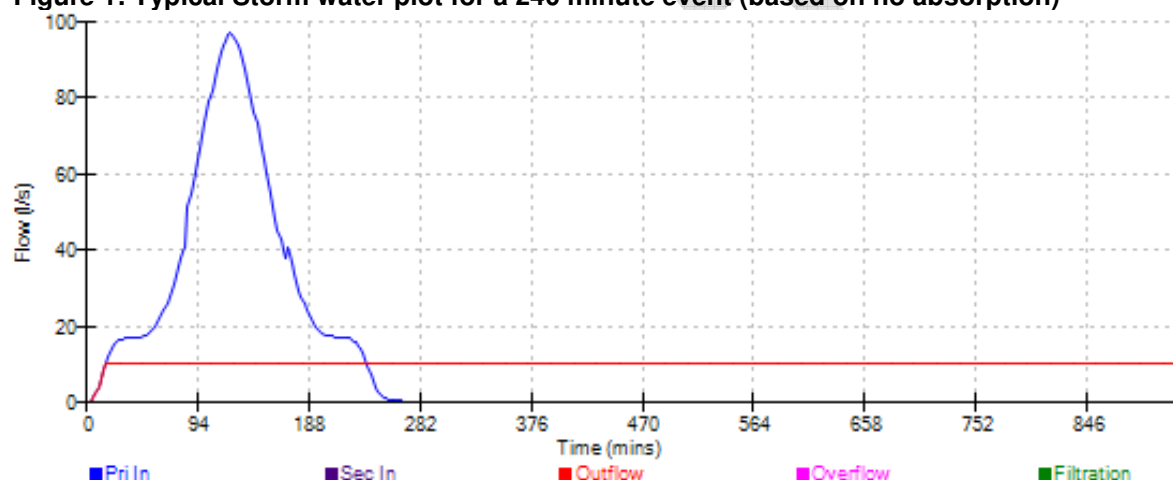
This factor has been applied to the figures identified in Section 1.4 to identify the total volume of rainfall that could be attenuated in the compost and product stored on site. The results of this analysis are shown below for 720 minute storm event and based on average rainfall figure over this period.

Table 4: Summary water balance accounting for windrow absorption

	Volume m ³	Volumetric Flow l/s	Notes
Precipitation (A)	656.99984		Precipitation for entire area of 13160 m ²
Absorbed (C)	386.43		Based on 8360 tonnes of material (22% * 38000 tonnes)
Runoff (D)	270.57	6.26	Flowrate with no attenuation and based on average rainfall across period

The analysis shows that the average flow rate from site across the duration of the storm (4 hours) would be 6.3 litres /second. However, this approach fails to consider the peak flow from the site which could be as high as 100 litres per second as shown below.

Figure 1: Typical Storm water plot for a 240 minute event (based on no absorption)



1.6 Evaluation of attenuation requirements to achieve an acceptable flowrate to sewer

An evaluation of attenuation volume has been carried out assuming that compost/product covers approximately 40% of the site as practised at Gaydon and that all rainfall falling on windrows or product is absorbed and does not contribute to runoff volume during the storm event.

A layout drawing is presented in Appendix B which indicates that the windrow and product storage areas account for approximately 60% of the overall site area. To meet the 405 factor identified above some 67% of the windrow and product storage areas would need to be covered with material.

The results for the critical storm for 1 in 30, 1 in 50 and 1 in 100 year events are shown below.

Table 5: Stormwater storage requirements incorporating absorption potential

Discharge Rate (l/s)	1:30 Year Event		1:50 Year Event		1:100 Year Event	
	Critical Storm	Storage required (m ³)	Critical Storm	Storage required (m ³)	Critical Storm	Storage required (m ³)
5	360 min Winter	226.8	360 min Winter	264.1	360 min Winter	322.5
10	120 min	170.1	180 min	202.5	180 min	252.6

Discharge	1:30 Year Event		1:50 Year Event		1:100 Year Event	
	Winter		Winter		Winter	
20	60 min Winter	121.7	120 min Winter	143.0	120 min Winter	184.5
50	30 min Winter	71.3	30 min Winter	87.2	60 min Winter	110.5

1.7 Summary

SLR has carried out a study to identify the implications of managing stormwater on the Lamby Way site incorporating an assessment of the absorptive capacity of the windrows.

The analysis shows that under all modelled storm events that there should be sufficient adsorptive capacity in the windrow and product piles to absorb rainfall and minimise the volume of runoff from the areas covered by windrows during the storm event.

However, despite the absorptive a capacity of the windrows SLR's calculations still show that in order to achieve a reasonable discharge rate from the site it will be necessary to provide some attenuation.

Depending on the discharge rate from the site the required attenuation volume ranges from 71.3 to 264 m³ for the 1:30 and 1:50 storm events, this increases to a maximum of 322.5m³ for a 1:100 year event.

In summary there are three options open to Kelda and Teg (in no particular order of preference):

1. Proceed with discussions with DCWW on the basis that this is an existing site and therefore there is no need for additional attenuation. The calculations herein show that the windrows should provide absorptive capacity and therefore provide attenuation of rainfall.
2. Subject to levels across the site consider using the site, with additional kerbing to provide short term attenuation of stormwater. Based on a free area of 7896 m² used elsewhere in this document the maximum volume (264 m³) would yield an average depth of water of 3cm across the entire site. In reality and given the site gradients rainwater will not distribute evenly and instead collect at the lowest point of the site. The level data currently available is not sufficient to allow an accurate estimate of onsite storage potential to occur
3. Include sufficient attenuation volume in line with the details set out in Table 5. The final design capacity will depend upon agreement from DCWW on the acceptable discharge rate to sewer during storm water events

Appendix A: Stormwater Events – no Windrow Absorption

30 year / 5 litres per second

Storm Event	Rain (mm/hr)	Vol Peak	Water Level	Max Depth (m)	Red Volume	ex Control (m)	Large Volume	Max Outflow	num Volum
15 min Summer	67.481	27	10.152	0.152	0.0	5.0	161.0	5.0	151.8
30 min Summer	45.360	42	10.209	0.209	0.0	5.0	223.0	5.0	209.5
60 min Summer	29.238	70	10.266	0.266	0.0	5.0	287.5	5.0	265.6
120 min Summer	18.294	128	10.320	0.320	0.0	5.0	359.3	5.0	320.4
180 min Summer	13.742	186	10.349	0.349	0.0	5.0	405.3	5.0	349.0
240 min Summer	11.155	246	10.364	0.364	0.0	5.0	438.1	5.0	364.2
360 min Summer	8.307	364	10.381	0.381	0.0	5.0	490.6	5.0	381.4
480 min Summer	6.732	482	10.386	0.386	0.0	5.0	530.3	5.0	386.1
600 min Summer	5.715	600	10.384	0.384	0.0	5.0	563.4	5.0	383.8
720 min Summer	4.997	662	10.378	0.378	0.0	5.0	590.8	5.0	377.9
960 min Summer	4.040	778	10.369	0.369	0.0	5.0	637.6	5.0	369.2
1440 min Summer	2.990	1036	10.353	0.353	0.0	5.0	707.9	5.0	353.0
2160 min Summer	2.209	1452	10.328	0.328	0.0	5.0	784.4	5.0	327.7
2880 min Summer	1.781	1852	10.301	0.301	0.0	5.0	842.8	5.0	300.8
4320 min Summer	1.312	2648	10.246	0.246	0.0	5.0	932.5	5.0	246.0
5760 min Summer	1.056	3416	10.194	0.194	0.0	5.0	1000.7	5.0	194.3
7200 min Summer	0.893	4176	10.149	0.149	0.0	5.0	1056.7	5.0	148.8
8640 min Summer	0.778	4848	10.110	0.110	0.0	5.0	1105.4	5.0	109.7
10080 min Summer	0.693	5552	10.077	0.077	0.0	5.0	1148.9	5.0	77.3
15 min Winter	67.481	19	10.167	0.167	0.0	5.0	171.8	5.0	167.1
30 min Winter	45.360	41	10.236	0.236	0.0	5.0	249.3	5.0	236.0
60 min Winter	29.238	70	10.298	0.298	0.0	5.0	319.7	5.0	298.2
120 min Winter	18.294	126	10.366	0.366	0.0	5.0	403.7	5.0	365.8
180 min Winter	13.742	184	10.400	0.400	0.0	5.0	454.8	5.0	399.8
240 min Winter	11.155	242	10.420	0.420	0.0	5.0	492.2	5.0	420.3
360 min Winter	8.307	358	10.444	0.444	0.0	5.0	550.6	5.0	444.5
480 min Winter	6.732	472	10.455	0.455	0.0	5.0	594.5	5.0	454.6
600 min Winter	5.715	584	10.458	0.458	0.0	5.0	631.1	5.0	457.6
720 min Winter	4.997	694	10.456	0.456	0.0	5.0	662.1	5.0	455.5
960 min Winter	4.040	898	10.442	0.442	0.0	5.0	713.8	5.0	442.3
1440 min Winter	2.990	1116	10.417	0.417	0.0	5.0	793.0	5.0	416.6
2160 min Winter	2.209	1580	10.378	0.378	0.0	5.0	878.4	5.0	377.9
2880 min Winter	1.781	2024	10.335	0.335	0.0	5.0	944.9	5.0	334.6
4320 min Winter	1.312	2860	10.247	0.247	0.0	5.0	1044.5	5.0	247.4
5760 min Winter	1.056	3640	10.168	0.168	0.0	5.0	1119.6	5.0	167.8
7200 min Winter	0.893	4328	10.101	0.101	0.0	5.0	1183.1	5.0	100.9
8640 min Winter	0.778	4936	10.048	0.048	0.0	5.0	1238.6	5.0	47.9
10080 min Winter	0.693	5456	10.012	0.012	0.0	5.0	1287.0	5.0	11.9

30 year 10 litres per second

Storm Event	Rain (mm/hr)	Vol Peak	Water Level	Max Depth (m)	Red Volume	Ex Control (m)	Large Volume	Max Outflow	Num Volum
15 min Summer	67.481	24	10.145	0.145	0.0	10.0	161.1	10.0	144.9
30 min Summer	45.360	38	10.199	0.199	0.0	10.0	223.1	10.0	198.6
60 min Summer	29.238	66	10.247	0.247	0.0	10.0	287.7	10.0	246.6
120 min Summer	18.294	124	10.284	0.284	0.0	10.0	359.0	10.0	284.3
180 min Summer	13.742	182	10.296	0.296	0.0	10.0	405.0	10.0	296.0
240 min Summer	11.155	240	10.295	0.295	0.0	10.0	438.7	10.0	294.5
360 min Summer	8.307	300	10.288	0.288	0.0	10.0	491.0	10.0	287.7
480 min Summer	6.732	364	10.281	0.281	0.0	10.0	531.2	10.0	281.0
600 min Summer	5.715	430	10.274	0.274	0.0	10.0	562.9	10.0	274.3
720 min Summer	4.997	498	10.266	0.266	0.0	10.0	591.4	10.0	266.4
960 min Summer	4.040	636	10.250	0.250	0.0	10.0	637.1	10.0	250.3
1440 min Summer	2.990	908	10.215	0.215	0.0	10.0	707.8	10.0	215.4
2160 min Summer	2.209	1300	10.164	0.164	0.0	10.0	784.3	10.0	163.9
2880 min Summer	1.781	1672	10.118	0.118	0.0	10.0	843.7	10.0	117.9
4320 min Summer	1.312	2344	10.050	0.050	0.0	10.0	932.3	10.0	49.6
5760 min Summer	1.056	3000	10.012	0.012	0.0	10.0	999.6	10.0	11.5
7200 min Summer	0.893	0	10.000	0.000	0.0	9.7	1057.4	9.7	0.0
8640 min Summer	0.778	0	10.000	0.000	0.0	8.4	1106.3	8.4	0.0
10080 min Summer	0.693	0	10.000	0.000	0.0	7.6	1149.5	7.6	0.0
15 min Winter	67.481	18	10.162	0.162	0.0	10.0	171.8	10.0	162.4
30 min Winter	45.360	38	10.225	0.225	0.0	10.0	249.3	10.0	225.2
60 min Winter	29.238	66	10.279	0.279	0.0	10.0	319.7	10.0	279.2
120 min Winter	18.294	122	10.331	0.331	0.0	10.0	403.4	10.0	330.6
180 min Winter	13.742	180	10.349	0.349	0.0	10.0	454.8	10.0	348.6
240 min Winter	11.155	236	10.353	0.353	0.0	10.0	491.8	10.0	352.8
360 min Winter	8.307	342	10.346	0.346	0.0	10.0	550.6	10.0	345.9
480 min Winter	6.732	390	10.333	0.333	0.0	10.0	594.8	10.0	332.8
600 min Winter	5.715	466	10.323	0.323	0.0	10.0	631.2	10.0	323.0
720 min Winter	4.997	542	10.311	0.311	0.0	10.0	662.1	10.0	311.5
960 min Winter	4.040	694	10.285	0.285	0.0	10.0	714.4	10.0	285.2
1440 min Winter	2.990	984	10.228	0.228	0.0	10.0	792.9	10.0	228.5
2160 min Winter	2.209	1380	10.147	0.147	0.0	10.0	878.4	10.0	147.4
2880 min Winter	1.781	1732	10.079	0.079	0.0	10.0	944.0	10.0	79.5
4320 min Winter	1.312	2244	10.001	0.001	0.0	10.0	1044.5	10.0	1.2
5760 min Winter	1.056	0	10.000	0.000	0.0	8.3	1120.6	8.3	0.0
7200 min Winter	0.893	0	10.000	0.000	0.0	7.0	1184.3	7.0	0.0
8640 min Winter	0.778	0	10.000	0.000	0.0	6.1	1239.1	6.1	0.0
10080 min Winter	0.693	0	10.000	0.000	0.0	5.4	1287.5	5.4	0.0

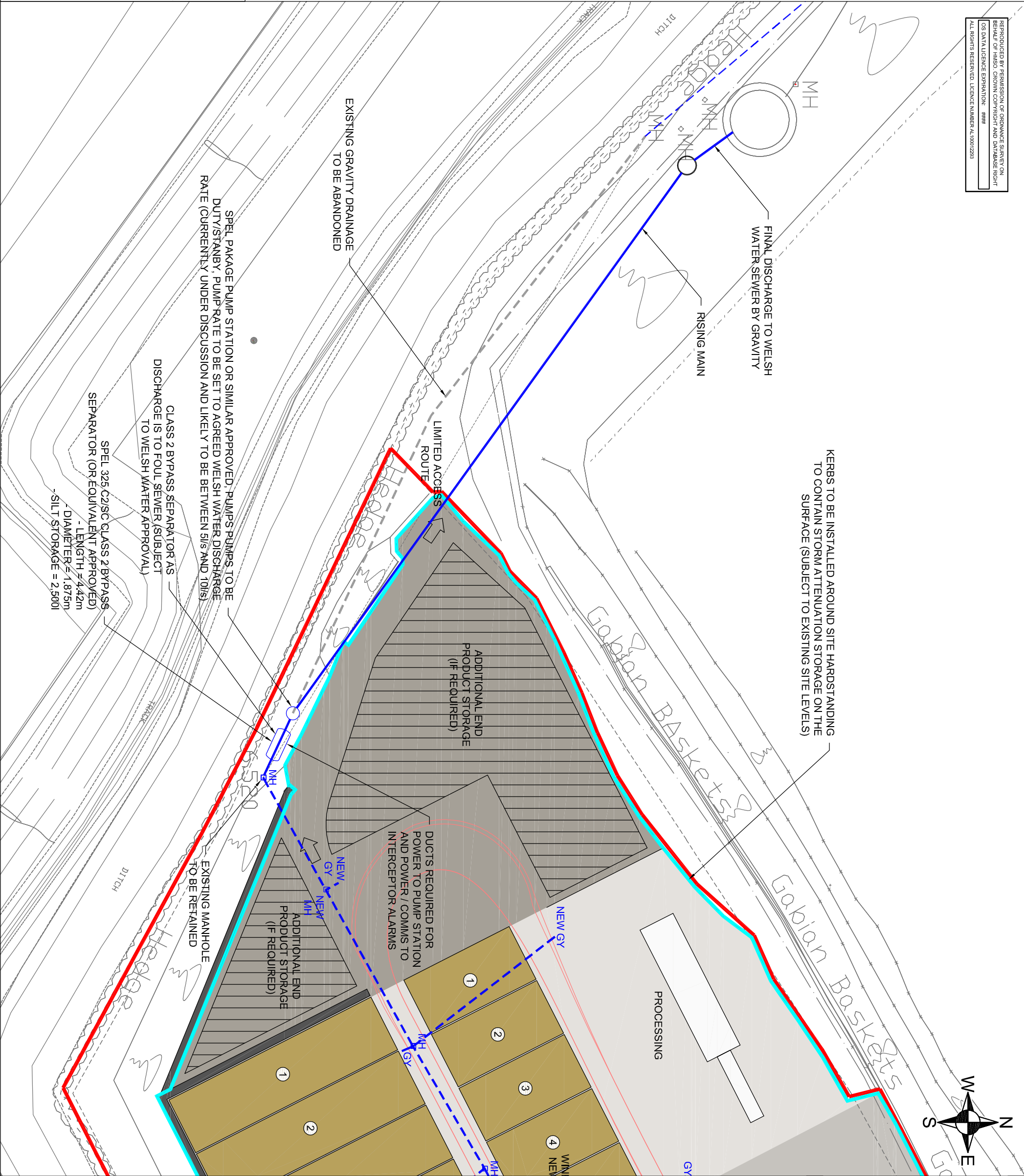
50 year 5 litres per second

Storm Event	Rain (mm/hr)	Vol Peak	Water Level	Max Depth (m)	Red Volume	ex Control (m)	Large Volume	Max Outflow	num Volum
15 min Summer	75.238	27	10.175	0.175	0.0	5.0	184.2	5.0	174.7
30 min Summer	50.792	42	10.236	0.236	0.0	5.0	250.1	5.0	236.3
60 min Summer	32.827	70	10.301	0.301	0.0	5.0	322.9	5.0	301.0
120 min Summer	20.544	128	10.365	0.365	0.0	5.0	404.3	5.0	365.0
180 min Summer	15.408	188	10.398	0.398	0.0	5.0	454.6	5.0	398.0
240 min Summer	12.481	246	10.418	0.418	0.0	5.0	492.2	5.0	417.6
360 min Summer	9.267	364	10.438	0.438	0.0	5.0	547.7	5.0	438.0
480 min Summer	7.494	484	10.446	0.446	0.0	5.0	591.2	5.0	446.0
600 min Summer	6.351	602	10.446	0.446	0.0	5.0	626.2	5.0	445.7
720 min Summer	5.545	716	10.440	0.440	0.0	5.0	655.6	5.0	440.3
960 min Summer	4.472	820	10.428	0.428	0.0	5.0	705.6	5.0	428.5
1440 min Summer	3.297	1070	10.409	0.409	0.0	5.0	780.3	5.0	409.3
2160 min Summer	2.426	1476	10.382	0.382	0.0	5.0	861.8	5.0	382.0
2880 min Summer	1.950	1880	10.353	0.353	0.0	5.0	922.5	5.0	353.3
4320 min Summer	1.430	2688	10.295	0.295	0.0	5.0	1015.9	5.0	295.3
5760 min Summer	1.146	3464	10.240	0.240	0.0	5.0	1084.9	5.0	240.0
7200 min Summer	0.967	4192	10.190	0.190	0.0	5.0	1144.5	5.0	189.8
8640 min Summer	0.841	4936	10.146	0.146	0.0	5.0	1194.5	5.0	146.3
10080 min Summer	0.748	5648	10.109	0.109	0.0	5.0	1239.0	5.0	108.7
15 min Winter	75.238	19	10.187	0.187	0.0	5.0	191.3	5.0	186.7
30 min Winter	50.792	42	10.266	0.266	0.0	5.0	280.0	5.0	266.4
60 min Winter	32.827	62	10.331	0.331	0.0	5.0	348.5	5.0	330.8
120 min Winter	20.544	126	10.415	0.415	0.0	5.0	453.6	5.0	415.4
180 min Winter	15.408	184	10.454	0.454	0.0	5.0	509.5	5.0	454.4
240 min Winter	12.481	242	10.479	0.479	0.0	5.0	551.1	5.0	478.9
360 min Winter	9.267	358	10.508	0.508	0.0	5.0	613.8	5.0	507.6
480 min Winter	7.494	474	10.521	0.521	0.0	5.0	662.0	5.0	521.3
600 min Winter	6.351	588	10.527	0.527	0.0	5.0	701.1	5.0	527.0
720 min Winter	5.545	698	10.527	0.527	0.0	5.0	734.7	5.0	527.0
960 min Winter	4.472	914	10.516	0.516	0.0	5.0	790.5	5.0	516.5
1440 min Winter	3.297	1144	10.484	0.484	0.0	5.0	840.6	5.0	484.4
2160 min Winter	2.426	1604	10.445	0.445	0.0	5.0	964.9	5.0	444.8
2880 min Winter	1.950	2052	10.400	0.400	0.0	5.0	1033.7	5.0	400.1
4320 min Winter	1.430	2904	10.308	0.308	0.0	5.0	1137.5	5.0	308.2
5760 min Winter	1.146	3696	10.222	0.222	0.0	5.0	1215.4	5.0	222.2
7200 min Winter	0.967	4416	10.148	0.148	0.0	5.0	1281.6	5.0	147.6
8640 min Winter	0.841	5104	10.086	0.086	0.0	5.0	1338.2	5.0	85.7
10080 min Winter	0.748	5664	10.038	0.038	0.0	5.0	1388.7	5.0	37.7

50 year 10 litres per second

Storm Event	Rain (mm/hr)	Vol Peak	Water Level	Max Depth (m)	Red Volume	ex Control (m)	Large Volume	Max Outflow	num Volum
15 min Summer	75.238	24	10.168	0.168	0.0	10.0	183.9	10.0	167.7
30 min Summer	50.792	39	10.225	0.225	0.0	10.0	250.2	10.0	225.3
60 min Summer	32.827	68	10.282	0.282	0.0	10.0	323.8	10.0	281.8
120 min Summer	20.544	126	10.329	0.329	0.0	10.0	404.8	10.0	328.6
180 min Summer	15.408	184	10.345	0.345	0.0	10.0	454.5	10.0	344.6
240 min Summer	12.481	242	10.347	0.347	0.0	10.0	492.2	10.0	347.1
360 min Summer	9.267	316	10.338	0.338	0.0	10.0	547.1	10.0	338.0
480 min Summer	7.494	380	10.330	0.330	0.0	10.0	590.8	10.0	330.0
600 min Summer	6.351	444	10.322	0.322	0.0	10.0	625.6	10.0	321.9
720 min Summer	5.545	512	10.314	0.314	0.0	10.0	655.3	10.0	313.7
960 min Summer	4.472	648	10.297	0.297	0.0	10.0	705.4	10.0	296.8
1440 min Summer	3.297	920	10.261	0.261	0.0	10.0	780.3	10.0	260.6
2160 min Summer	2.426	1320	10.206	0.206	0.0	10.0	861.3	10.0	205.8
2880 min Summer	1.950	1700	10.156	0.156	0.0	10.0	923.3	10.0	155.5
4320 min Summer	1.430	2384	10.076	0.076	0.0	10.0	1016.2	10.0	76.4
5760 min Summer	1.146	3056	10.027	0.027	0.0	10.0	1086.8	10.0	26.6
7200 min Summer	0.967	3680	10.003	0.003	0.0	10.0	1145.0	10.0	3.2
8640 min Summer	0.841	0	10.000	0.000	0.0	9.1	1195.6	9.1	0.0
10080 min Summer	0.748	0	10.000	0.000	0.0	8.0	1240.1	8.0	0.0
15 min Winter	75.238	18	10.182	0.182	0.0	10.0	191.0	10.0	181.8
30 min Winter	50.792	38	10.256	0.256	0.0	10.0	280.0	10.0	255.5
60 min Winter	32.827	62	10.314	0.314	0.0	10.0	348.5	10.0	313.5
120 min Winter	20.544	124	10.380	0.380	0.0	10.0	454.1	10.0	380.1
180 min Winter	15.408	180	10.403	0.403	0.0	10.0	509.2	10.0	402.6
240 min Winter	12.481	238	10.411	0.411	0.0	10.0	551.0	10.0	410.8
360 min Winter	9.267	346	10.408	0.408	0.0	10.0	613.9	10.0	407.7
480 min Winter	7.494	442	10.392	0.392	0.0	10.0	661.2	10.0	392.1
600 min Winter	6.351	478	10.381	0.381	0.0	10.0	701.0	10.0	380.8
720 min Winter	5.545	554	10.369	0.369	0.0	10.0	735.5	10.0	369.4
960 min Winter	4.472	706	10.343	0.343	0.0	10.0	790.8	10.0	343.1
1440 min Winter	3.297	1000	10.285	0.285	0.0	10.0	873.9	10.0	284.6
2160 min Winter	2.426	1408	10.198	0.198	0.0	10.0	965.2	10.0	198.3
2880 min Winter	1.950	1784	10.122	0.122	0.0	10.0	1034.7	10.0	122.3
4320 min Winter	1.430	2384	10.018	0.018	0.0	10.0	1137.5	10.0	17.9
5760 min Winter	1.146	0	10.000	0.000	0.0	8.9	1216.6	8.9	0.0
7200 min Winter	0.967	0	10.000	0.000	0.0	7.6	1282.5	7.6	0.0
8640 min Winter	0.841	0	10.000	0.000	0.0	6.6	1339.1	6.6	0.0
10080 min Winter	0.748	0	10.000	0.000	0.0	5.8	1388.9	5.8	0.0

APPENDIX B: SLR – DISCHARGE TO SEWER – DRAWING D-002A



NOTES

LEGEND

- SITE BOUNDARY
- AREA DRAINING TO FOUL SEWER (13,160 sqm)
- COMPOSTING AREA (5,100 sqm)

1	IMR	JR	16.06.14	NOTE ON DUCTING REQUIREMENTS ADDED
0	IMR	JR	11.06.14	
Revision	By	Chk'd By	Date	Comments

SLR

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Project Kelda ISOS SUBMISSION

Drawing Title
**DISCHARGE TO WW SEWER
OPTION 1**

Scale 1:500 @ A3	Date JUNE 2014
Drawing Number D-002A	Revision 0