Folkestone and Hythe District Council

Proposed Leisure Centre and Mixed-Use Development at Princes Parade Hythe

Revised Surfacewater Drainage Strategy

ES Addendum

March 2019

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environmental planning and assessment

Contents

1. Introduction

Background

1.1 Shepway District Council (now Folkestone and Hythe District Council) submitted a hybrid application in August 2017 for the redevelopment of land at Princes Parade, Hythe, for a leisure centre and mixed-use (predominantly residential) development. The application was accompanied by an environmental statement (ES) prepared under the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (the 2011 Regs).

1.2 Although new EIA Regulations were introduced in May 2017, the EIA in this case was scoped and commenced before that date. As allowed by transitional arrangements under the new Regs, the EIA was therefore carried out in accordance with the 2011 Regs.

Surfacewater Drainage

1.3 The surfacewater strategy proposed at the time of submission involved discharge to the inter-tidal zone of the beach, in accordance with the prevailing guidance (Sustainable Drainage Systems: non-statutory technical guidance, DEFRA, 2015). The scheme, however, had yet to be designed in detail, and further investigation revealed that the beach below the high-water mark was not in the Council's ownership.

1.4 An alternative strategy was therefore developed involving discharge of residual flows, following attenuation, to the Royal Military Canal (RMC). It should be noted that the site is contaminated, and that infiltration into the existing ground is unlikely to be a practicable option.

1.5 The RMC is a controlled waterway managed primarily for land drainage purposes, and is subject to tide-locking at high-water. Because of this sensitivity, the Environment Agency (EA) objected to the revised drainage strategy.

1.6 On 16th August 2018 Folkestone and Hythe District Council Planning and Licensing Committee resolved to approve the planning application, subject to the EA withdrawing its objection following further discussions and amendments to the drainage strategy.

1.7 Further work by the Council's consultants, Herrington Consulting, confirmed that the preferred strategy would operate within acceptable parameters, without increasing flood risk associated with the canal, and the EA withdrew their objection.

Purpose and Content of this Document

1.8 This document comprises an Addendum to the ES. Its primary purpose is to re-visit the environmental topics that could be affected by the revised drainage strategy, and to confirm whether it may have any implications for the predicted effects and proposed mitigation set out in the original ES.

1.9 Two topics - Flood Risk and Drainage, and Ecology – have the potential to be affected by the drainage strategy, and have been the subject of supplementary assessment. No other topics are likely to be affected to any material degree.

1.10 Following this introduction, Section 2 describes the main features of the revised drainage strategy, Sections 3 and 4 summarize its implications for the predicted effects

and proposed mitigation, and Section 5 presents a summary and conclusion. The supplementary work is presented in the following three appendices:

A. Technical Addendum, Surfacewater Drainage (December 2018);

B. Supplementary ES Chapter 7: Ecology (February 2019); and

C. Updated Ecological Mitigation Strategy (February 2019).

1.11 Appendix A supplements the original Flood Risk Assessment (**ES Technical Annex 4**) and **ES Chapter 8: Flood Risk and Drainage**.

1.12 Appendix B supplements the original **ES Chapter 7: Ecology** and the original Appendices 7.1-7.7 presented in **ES Technical Annex 3**.

1.13 Appendix C replaces the original Appendix 7.8 within **ES Technical Annex 3**.

2. Overview of the Drainage Strategy

2.1 The drainage strategy is fully described, and its performance is assessed, in **Appendix A**. The strategy aims to manage runoff from all roofs and paved surfaces within the developed site by way of a series of attenuation features, before controlled discharge to the RMC. The site would be divided into five catchments, which would be drained as follows:

A. Leisure centre roof and car park: Runoff would be directed through permeable paving to cellular storage, with discharge via an orifice plate to the RMC.

B. Roads, parking and play area: Runoff would be conveyed via a swale to a pond, which would overflow as necessary via a vortex flow control to the RMC.

C + D Residential areas: Runoff would be directed to lined permeable paving on driveways and parking spaces, and then a lined underground storage tank, with overflow to a second underground tank in catchment E.

E Communal hardstanding areas: Runoff would be directed into a lined underground storage tank, with any excess flow diverted into a ground-level detention basin.

2.2 Any excess flows (i.e. in excess of the storage capacity built into the system) from catchments A, C, D and E would be discharged to the upper part of the beach, as is currently the case with drainage from Princes Parade. The new promenade would also drain to the upper beach.

3. Implications for Flood Risk and Drainage Effects

3.1 The performance of the system has been tested under design (1:100 year) and extreme event scenarios, including tide-locking and prolonged or back-to-back storms. In comparison with existing conditions, the system delivers significant reductions in runoff rates and volumes for the design scenario, and under extreme conditions could safely store excess water for 12 hours.

3.2 Acceptable levels of water quality would be achieved through the incorporation of features such as silt traps and oil interceptors (e.g. in trafficked areas), together with

the ability of the system to contain the "first flush" of runoff in which any pollutants are likely to occur. Additional hydrological robustness could if necessary be achieved by installing variable controls for the discharges to the RMC, or by designing parking areas for temporary storage.

3.3 The greater part of the site already drains into the RMC, but with no infrastructure to control discharge or to protect water quality. On completion, the proposed system would represent an improvement in both the quantity and quality of surfacewater drainage into the canal, and in the quality of overflow to the beach. It would introduce no flooding or pollution risks additional to those identified in the original FRA.

3.4 The residual effects on hydrology and water quality would therefore remain Negligible and Minor Adverse respectively.

4. Implications for Ecological Effects

4.1 The ecological effects of the revised drainage strategy are set out in the supplementary ecology chapter attached as **Appendix B**. In summary, there have been:

- Slight changes to the policy context, notably the NPPF and the Draft Core Strategy Review;
- No changes in assessment guidance or significance criteria;
- No changes in the development's zone of influence; and
- No material changes in baseline conditions, as confirmed by a walkover survey in February 2019.

4.2 The only ecological receptors that could be affected are the RMC (which is a County-level Habitat of Principal Importance and Local Wildlife Site) and protected species using the canal corridor (notably foraging bats and common toad). As reported above, the operational system would result in no adverse hydrological or qualitative effects on the canal, and would represent an improvement over existing conditions. The residual effects on these receptors would therefore remain as reported in the original ES, i.e. Negligible for the canal and bats, and Major Adverse for common toad (due to the risk of mortality in trafficked areas).

4.3 The drainage strategy would require the construction of three outfalls into the canal, which would increase the risk of disturbance due to trespass and lighting, together with the risk of accidental pollution. In the absence of mitigation, the effects would remain as reported in the original ES, i.e. Moderate to Major for the canal, Moderate for bats and Minor for common toad. With mitigation, however, the residual effects would be reduced to Negligible in all cases.

4.4 The proposed mitigation remains as originally reported, with the exception of the Ecological Mitigation Strategy, which has been updated (**Appendix C**). In order to minimise the impact of canal-side work, it is proposed that the precise siting and construction of the outfalls be supervised by a suitably experienced ecologist or ecological clerk-of-works.

4.5 The revised strategy removes the need to construct outfalls within the inter-tidal zone. Although additional flows to the upper (shingle) beach may occur during extreme weather events, any associated pollution risk would be reduced by the incorporation of

mitigation features into the system. The upper beach is subject to periodic replenishment and reprofiling, and its ecological status is unlikely to be affected to any material degree.

5. Summary and Conclusion

5.1 The revised drainage strategy proposes that the RMC becomes the primary point of surfacewater discharge, following attenuation and pollution controls, in the event that discharge to the inter-tidal zone is unachievable. Overflows would be directed mainly to the upper (shingle) beach.

5.2 Testing of the system has confirmed that it would perform satisfactorily under design and extreme conditions, such that there would be no change to the flood and pollution risks identified in the FRA. The predicted effects would therefore remain as reported in the original ES.

5.3 Supplementary ecological work has confirmed that there have been no material changes to baseline conditions. The operational drainage system, with its incorporated mitigation, would give rise to no additional effects on habitats or protected species.

5.4 Construction of the outfalls into the canal would represent an increased risk of impact during construction, which would be mitigated by additional monitoring, as set out in an Updated Ecological Mitigation Strategy. The residual effects would therefore remain as reported in the original ES.

Appendix A

herrington
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Client: Folkestone and Hythe District Council

Technical Addendum – Discharge of Surface Water Runoff (Watercourse) for the Proposed Development at Princes Parade, Hythe, Kent

December 2018

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Technical Addendum – Discharge of Surface Water Runoff (Watercourse) for the Proposed Development at Princes Parade, Hythe, Kent

Contents Amendment Record

This report has been issued and amended as follows:

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2	1	Final report issued by email.	21 September 2018
3	2	Report revised to include additional details on volume storage. Revised Report issued in Draft.	30 November 2018
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Document Verification

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		Director Sign Off:	Simon Maiden-Brooks

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1 Background Scope of Appraisal

This report has been prepared to supplement the Flood Risk Assessment (FRA) submitted within Technical Annex 4, dated August 2017, in relation to planning application Y17/1042/SH. The objective of this Technical Addendum is to outline the details of an alternative option with regard to the discharge of surface water runoff from the development site and to demonstrate that discharge into the adjacent watercourse (Royal Military Canal - RMC) presents a viable alternative solution. It should be recognised that this addendum does not supersede the main findings of the original drainage assessment (contained within the original FRA), nor is it intended to bypass the drainage hierarchy. Instead, this report has been prepared in response to the comments received from the Environment Agency (reference KT/2017/123369/03-L01) and provides additional information to enable the outstanding objection to be removed.

The opportunities for discharging surface water runoff from the proposed development have been assessed within the FRA, in accordance with the hierarchy stated within the (Non-Statutory) Technical Standards for Sustainable Drainage (NTSS). The original assessment identified that the preferred option is to discharge surface water directly to the sea, and the text iterates that this option should be considered above *all* alternative options within the drainage hierarchy. The FRA also confirms that infiltration into the ground may not be feasible at this location and therefore, it is recognised that one of the alternative options would be to discharge surface water into the RMC. Notwithstanding this, it is acknowledged from the discussions held with the EA that the option to discharge to the RMC will be considered if it is demonstrated that a direct discharge into the sea is not viable.

For the purpose of this assessment, it is assumed that the alternative (more preferable) options mentioned above are not viable. Therefore, this report explores the technical details associated with discharging surface water from the proposed development at Princes Parade into the adjacent RMC, to ensure that a sustainable solution will be available.

2 Existing Surface Water Runoff Characteristics

2.1 Site Background and Makeup

The existing site comprises an area where refuse was historically buried (a former landfill site) and since the abandonment of this practice, the majority of the site has remained undeveloped. The exception is the highway fronting the Princes Parade site, which runs along the southern boundary of the site, and a public car park and play area to the east of the site. These developed areas comprise hardstanding consisting of concrete and asphalt.

Geological maps for this area indicate storm beach / sand dune deposits across most of the site, and typically these types of deposits are freely draining. Flood Estimation Handbook point data (FEH 13) has been obtained for the site, and from this data the BFIHOST and the PROPWET values have been extracted. These values are 0.889 and 0.34 respectively. This suggests a relatively dry, permeable catchment with limited surface water runoff from the undeveloped parts of the site.

Site specific geotechnical investigations have been undertaken, by others, to better understand the true ground condition of the site (post landfill). The results of the ground investigation report confirms that made ground deposits are present beneath most of the site and consequently, these overlying deposits will exhibit different soil characteristics to the natural values described above.

A number of trial pits were dug across the site (to depths up to 0.4m Below Ground Level) and the results indicate sandy gravelly **clay,** mixed with general refuse material. The soil descriptions are summarised in Figure 2.1 below.

Location	Depth (m)	Soil Description
HP1	0.00-0.33	Brown slightly silty sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded flint and bituminous surfacing. Two glass bottles, glass and metal fragments.
HP2	0.00-0.20	Brown slightly sandy gravelly CLAY with some rootlets. Gravel is subangular to subrounded flint.
	0.20-0.33	Pale brown gravelly CLAY. Gravel is fine to medium subangular to subrounded flint and concrete.
HP3	0.00-0.33	Brown sandy gravelly CLAY with some rootlets. Gravel is angular to surrounded flint, brick and bituminous surfacing.
HP4	0.00-0.30	Greenish brown to brown sandy slightly gravelly CLAY. Gravel is fine to medium subrounded flint and rare brick. Rare inclusions of glass and pottery fragments.
	0.30-0.40	Greenish brown to brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium coarse subrounded flint.
HP5	0.00-0.34	Greenish brown to brown sandy slightly gravelly CLAY with some rootlets. Gravel is subangular to subrounded flint, bituminous surfacing, concrete and brick.
HP6	0.00-0.20	Brown sandy CLAY with rootlets.
	0.20-0.30	Yellowish brown to light brown very sandy gravelly CLAY. Gravel is medium to coarse angular to subrounded flint, brick and concrete. Single brick cobble.
HP7	0.00-0.33	Brown sandy slightly gravelly CLAY with rootlets. Gravel is fine to medium subangular to subrounded flint and brick. Occasional inclusions of plastic, glass and metal fragments. A single boot.
HP8	0.00-0.33	Brown sandy slightly gravelly CLAY with rootlets and roots. Gravel is fine to medium angular to surrounded brick, flint and rare bituminous surfacing. and a shoe.
HP9	0.00-0.33	Brown sandy slightly gravelly CLAY. Gravel is fine to medium subrounded to rounded flint.
HP10	0.00-0.40	Yellowish brown clayey SAND with rootlets. Occasional inclusions of plastic.

Figure 2.1 – Extract of trial pit descriptions from Idom Merebrook Ltd site investigation report.

The above figure suggests that the surface topsoil is therefore significantly less permeable than the underlying made ground and superficial geology (present at depth). Given the relatively high

groundwater levels, and less permeable topsoil located over the permeable made ground and sand deposits, it is considered reasonable to assume that actual BFIHOST values are likely to be lower (i.e. will vary between 0.32 and 0.75).

Due to the makeup of the landfill and made ground it is not possible to quantify the actual HOST value, nonetheless, to quantify the greenfield discharge rates and volumes from the existing site a conservative approach can be adopted. This approach assumes a high BFI value for the site (0.889), which is based on the BGS data, rather than the BFI value attributed to the results of the site-specific ground investigations. Although this is not technically accurate, it does ensure that the greenfield runoff rates and volumes which have been calculated for the pre-developed site, using this method, are under-estimated (i.e. the rates would otherwise be higher if the site-specific data was applied).

2.2 Royal Military Canal Tide Lock Analysis

Basic analysis has been undertaken to determine the tidal Mean High Water Spring Tide (MHWS) within the vicinity of the site. The calculations show that the adjusted MHWS level at Folkestone is 3.43m Above Ordinance Datum Newlyn (AODN). A T2 surge (i.e. a surge with a 1 in 2 year return period) gives a value of 4.18m AODN.

As-built drawings for the outlet weir of the RMC show a plate level of 2.1m AODN. Assuming this is the level at which the RMC becomes tide locked, basic analysis indicates that during the MHWS tide the canal is tide locked for a period of 3 hours 45 minutes. During a T2 surge this period of tide locking is increased to 4 hours 45 minutes.

To assess the impact that discharging surface water runoff from the development into the RMC could have, both the existing (pre-developed) site and proposed (post-developed) site have been considered. To ensure a suitable comparison, the outfall from the canal has been assumed to be tide locked for 4 hours 45 minutes (i.e. 285 minute duration event) for both pre and post developed scenarios. This represents the T2 surge event, which probabilistically, has the potential to coincide with a design pluvial event at this location (i.e. 1 in 100 year rainfall scenario). A summary showing the Tide Lock Analysis Curve has been included within Appendix A.1.

2.3 Topography and Cross Sections

A topography survey has been undertaken on the site, which identifies that the majority of the site is relatively flat longitudinally from east to west. A series of cross sections have been drawn (from north to south) throughout the site and these cross sections can be found within Appendix A.3. The sections indicate a clear raised platform running through the centre of the site, which is likely to be attributed to the made ground over the landfill. The sections also indicate that the northern part of the site falls towards the RMC, whilst the southern part of the site falls towards Princes Parade (the road). There is a lowered section in the middle of the site, opposite the footbridge crossing the RMC, which would also direct surface water runoff towards the RMC.

The embankment to the north of the site slopes steeply at ~1:4 towards the RMC. The embankment to the south of the site slopes steeply towards the road.

2.4 Surface Water Flow Route Analysis

Based on the available topographical and Light Detection and Ranging (LiDAR) data for the site, a ground model has been constructed within the Causeway Professional Design Suite (PDS). The PDS software interpolates the ground data to build a Digital Ground Model (DGM) grid mesh layer. Utilising the DGM, a rolling ball flow analysis can be conducted which enables potential flow routes to be quantified. This process represents 'rain' falling on a specific point on the site and delineates the direction that the water will take if the ground is assumed to be fully saturated.

Figure 2.2 below shows the general flow trace lines on the northern part of the site, providing further clarification as to the general direction that surface water runoff would flow.

Figure 2.2 – Flow Trace lines across the site delineating flow direction.

With reference to Figure 2.2, it is evident that the flow direction is congruent with the general topography shown in the cross sections. This information suggests that when the ground is saturated, or where the ground is steeply sloped, surface water is likely to run off the surface of the site and will flow along the routes shown. In the northern part of the site, surface water currently flows northwards towards the RMC. In the southern parts of the site, water will flow towards the road.

2.5 Existing Surface Water Runoff from Undeveloped Land

From the information above, a catchment area has been derived to determine the amount of water that can currently enter the RMC. Figure 3 below shows the estimated catchment areas based on the flow route analysis and topography. This has been split into two discrete catchments (A & B respectively). Catchment A represents the undeveloped part of the site which has the potential to drain surface water into the RMC. Catchment B represents the developed area (i.e. car park and play area) which currently drains surface water into the RMC.

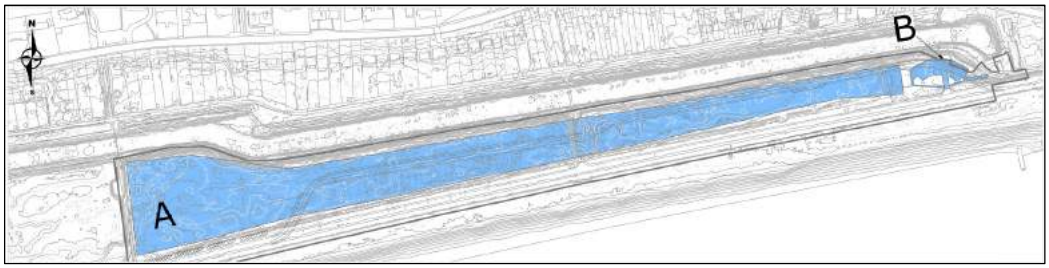


Figure 2.3 – Showing total catchment area falling towards the RMC. Undeveloped land forms part of Catchment A, developed land forms Catchment B.

Catchment Area A (comprising undeveloped land which would drain into the RMC if saturated) has been calculated as ~4.948 Hectares.

Catchment Area B (comprising developed land which drains directly into the RMC) has been calculated as 0.106 Hectares.

It is acknowledged that there are some areas within the existing site (e.g. along the canal banks), which are proposed to remain unchanged when the proposed site is developed (refer to Figure 2.4).

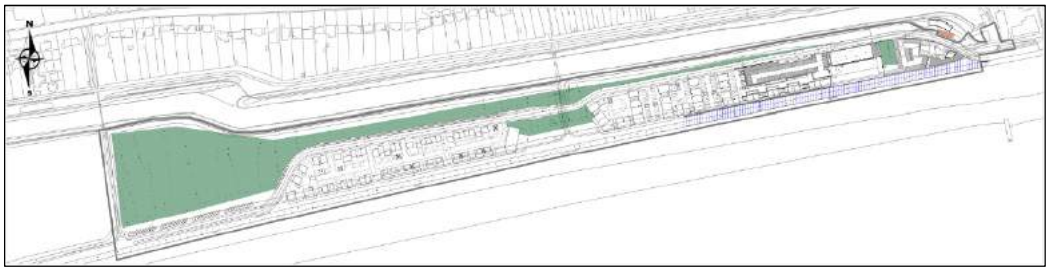


Figure 2.4 – Catchment area within the proposed development boundary which currently discharges into the RMC.

As the areas in Figure 2.4 will continue to discharge via the same mechanism post-development (i.e. directly into the RMC), these areas have been subtracted from Catchment Area A to determine the area which *currently* has the potential to discharge surface water runoff into the RMC, but is proposed to be developed. This catchment area measures ~2.636 Ha and is shown in Figure 2.5 below.

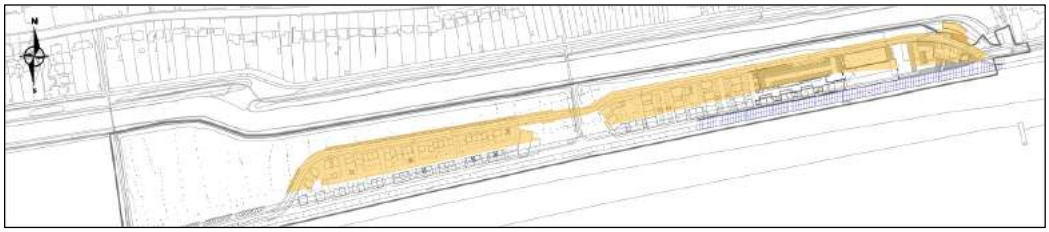


Figure 2.5 – Catchment area within the proposed development boundary which currently discharges into the RMC.

FEH13 point data has been applied to calculate both the greenfield runoff rates and volumes that are attributed to the catchment area (2.636 ha) delineated in Figure 2.5. This data includes the conservative BFIHOST value of 0.889, which does not consider the actual characteristics of the made ground (discussed in Section 2.1 of this report - which is likely to yield a lower BFIHOST value ranging between 0.32 and 0.75). To calculate the greenfield runoff rates and volumes, the SPR Host value (12.88) has been calculated using the correlation equation outlined within the IH126 report, applying both the conservative BFIHOST value (0.889) and the contributing catchment of 2.636ha. Greenfield runoff calculations have been included within Appendix A.4. of this report.

For comparison, the peak surface water runoff rates and total volumes for a pluvial event with a 285 minute duration and a 360 minute duration have been calculated for a range of return period events. These values and are shown in Table 2.1 below.

Return Period	Greenfield Surface Water Runoff Rate (BFIHOST 0.889)	Surface Water Runoff Volume (285minute)	Surface Water Runoff Volume (360minute)
1:2 year	~1.67 l/s	58.5 m^3	63 m^3
1:30 year	3.83 l/s	145 m^3	162 m^3
1:100 year	5.31 l/s	222 m^3	250 m^3

Table 2.1 – Greenfield runoff rates and volumes for the area currently draining to the RMC, that will form part of the proposed developed site.

The above figures represent the volume of surface water that can be discharged into the canal directly from the development, without having a detrimental impact. Similarly, the rate of discharge from this area has also been provided.

2.6 Surface Water Runoff from Existing Developed Land (Catchment B)

There is an existing public car park area located to the east of the site which consists of impermeable surfacing (concrete/asphalt). This existing car park currently drains informally towards the RMC, with surface water following the natural existing topography. The approximate impermeable area of the car park is 1,056m² and is shown in Figure 2.2 (labelled Catchment B). The runoff rates from this existing hardstanding area have been calculated using FEH13 data for a range of return period events (refer to Table 2.1). The CV value in the drainage model has been reduced to 0.6 to account for runoff draining across the neighbouring sloped embankment, thus providing a conservative estimate. The corresponding greenfield runoff volumes have also been provided in Table 2.2 for both the 240 minute and 360 minute duration events.

It should be recognised that a 240 minute duration has been applied instead of a 285 minute duration, as peak runoff rates from the 285 minute duration cannot be calculated within industry

standard software. Nevertheless, this will result in a slight *under estimate* when the existing pre-developed runoff volume is calculated.

Return Period	Surface Water Runoff Rate (FEH-13)	Surface Water Runoff Volume (240minute)	Surface Water Runoff Volume (360minute)
1:2 year	11.6 l/s	14.5 m^3	16.5 m^3
1:30 year	31.5 l/s	31.4 m^3	35.2 m^3
1:100 year	40.4 l/s	40.4 m^3	45.7 m^3

Table 2.2 – Catchment Area B runoff rates and volumes.

3 Proposed Development - Surface Water Runoff

3.1 Surface Water Management

The drainage strategy which discusses each of the different elements of the proposed scheme is set out below. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF and NTSS can be met at the planning stage, for the alternative option of discharging surface water runoff to the RMC.

Based on the current masterplan and the topography of the site, the development site has been sub-divided into five separate drainage catchments. Figure 3.1 (below) shows the location of each drainage catchment across the site.

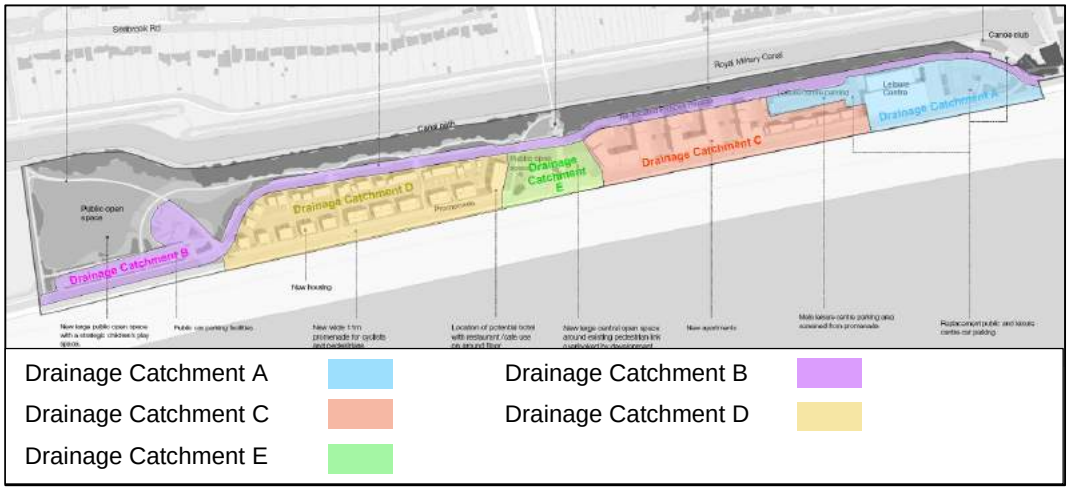


Figure 3.1 – Plan showing the drainage catchments across the site.

It is envisaged that runoff draining from the roads, buildings, and hardstanding within each of these drainage catchments will be managed within Sustainable Drainage Systems (SuDS) before being discharged at a restricted rate to the RMC.

Three separate outfalls into the canal are proposed;

- Drainage Catchments A and B will drain into the RMC via 2 separate outfall structures,
- Drainage Catchments C and D will drain into catchment E before being discharging via a single outfall into the canal.

A summary of the impermeable areas draining to SuDS within each drainage catchment is provided in Table 3.1 (below).

Drainage Catchment	Areas Draining to Drainage Catchment	Drains to	Total Impermeable Area Draining to Catchment (including a 10% allowance for urban creep)
Drainage Catchment A	Leisure centre and carpark	Royal Military Canal	0.75 ha
Drainage Catchment B	Public highway, play area, and public parking	Royal Military Canal	1.48 ha
Drainage Catchment C	Private development east	Drainage catchment E	0.92 ha
Drainage Catchment D	Private development west	Drainage catchment E	0.99 ha
Drainage Catchment E	Promenade, and public hardstanding + inflows from catchments C & D	Royal Military Canal	0.26 ha
Total			**4.4 ha**

Table 3.1 – Summary of drainage Catchments A-E.

A summary of the proposed SuDS to be used within each drainage catchment, along with calculations to confirm that the drainage system can manage the design rainfall event is provided below.

Drainage Catchment A

Runoff from the roof of the leisure centre will be discharged into permeable paving located across the carpark. The permeable paving will be laid on top of a 1m deep layer of open graded sub-base, which is proposed to be lined to ensure no interaction between any leachates and surface water. A summary of the Micro Drainage analysis for the permeable paving is shown in Table 3.2 below.

Drainage Catchment A (Leisure Centre and carpark)	Value (1:100yr+20%cc event)	
SuDS	Permeable Paving	
Storage Provided within	Permeable Paving	
Area draining to permeable paving (including 10% allowance for urban creep)	7,520 m^2	
Area of permeable paving	~ 4,490 m^2	
Sub-base depth	1000 mm	
Infiltration	Not Permitted Lined System (due to contamination)	
Flow control device	Orifice plate (30mm diameter)	
Discharges too	Royal Military Canal	
Maximum depth of water above base of the drainage system.	711 mm	
Overflow control device	Pipe set at 800mm above the base of the permeable paving, (overflows to beach)	
Critical storm duration	2880 minutes	
Return Period	**Half drain time**	**Peak discharge rate**
1 in 2yr+cc	3964 minutes	1.0 l/s
1 in 30yr+cc	4992 minutes	1.3 l/s
1 in 100yr+cc	6003 minutes	1.6 l/s

Table 3.2 – Summary of Micro Drainage analysis for Drainage Catchment A.

Drainage Catchment B

Runoff from the new trunk road, public parking areas, and play area will be drained into a swale. This swale will convey surface water runoff across the site to and discharge into a large pond. The pond will be designed to manage runoff from the design rainfall event before it is discharged via a vortex flow control device (Hydro-Brake or similar) into the RMC. To maximise the available amenity space, the pond and surrounding area will be terraced to keep low volumes of runoff from small storms within the permanently wet portion of the pond. It is envisaged that the final pond design will accommodate areas where water depths will be greater, however these areas would not be expected to be wet on a regular basis. A suitable pond profile and planting scheme will need to be specified such that “bogs” are not created (refer to Figure 3.2 below).

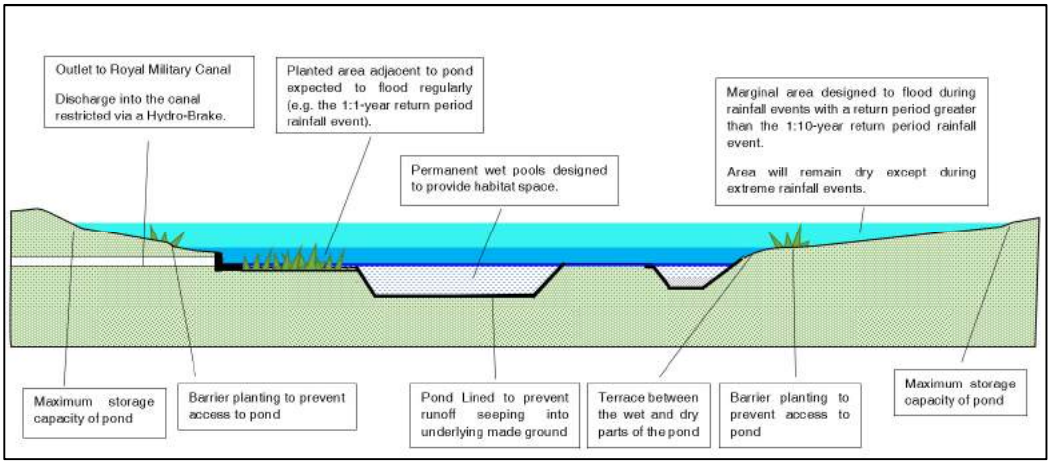


Figure 3.2 – Indicative sketch showing the profile of pond (outline design only).

A summary of the Micro Drainage analysis for Drainage Catchment B is shown in Table 3.3 below.

Drainage Catchment B (public highway, parking and play area)	**Value (1:100yr+20%cc event)**
SuDS	Swale and Pond
Storage Provided within	Pond
Area draining to permeable paving (including 10% allowance for urban creep)	14,840 m^2
Area of pond	~ 5,000 m^2
Active storage depth within pond	~ 1 m
Infiltration	Not Permitted, Lined System (due to contamination)
Flow control device	Hydro-Brake
Limiting Discharge Rate	2.0l/s
Overflow control device	200mm wide weir with crest level at 960mm above normal water level within pond. Overflows to the Royal Military Canal
Critical storm duration	5,760 minutes

Return Period	**Depth of water**	**Peak discharge rate**
1 in 2yr+cc	486 mm	1.7 l/s
1 in 30yr+cc	696 mm	1.7 l/s
1 in 100yr+cc	862 mm	1.9 l/s

Table 3.3 – Summary of Micro Drainage analysis for Drainage Catchment B.

Drainage Catchment C

Runoff from the roofs of the dwellings can be drained into a lined permeable paving system, located across the driveways and parking areas, before discharging into a lined underground storage tank. The storage tank will discharge surface water runoff at a restricted rate into a second storage tank located in Drainage Catchment E (discussed below). It is envisaged that the primary storage tank can be located underneath the existing road, thus limiting the removal of any contaminated land and providing easy access for future maintenance.

A summary of the Micro Drainage analysis for Drainage Catchment C is shown in Table 3.4 below.

Drainage Catchment C (East part of the private housing development)	**Value (1:100yr+20%cc event)**
SuDS	Permeable Paving and Underground Storage
Storage Provided within	Underground Storage
Area draining to permeable paving (including 10% allowance for urban creep)	9,160 m^2
Assumed dimensions of underground storage	~ 1,000 m^2 x 1.5m (deep)
Infiltration	Not Permitted, Lined System (due to contamination)
Flow control device	Hydro-Brake
Limiting Discharge Rate	2.0l/s
Discharges into	Drainage Catchment E
Overflow control	Pipe located ~1.3m above the base of the storage tank (discharges to beach)
Critical storm duration	2,880 minutes

Return Period	**Half Drain Time**	**Peak discharge rate**
1 in 2yr+cc	3736 Minutes	1.3 l/s
1 in 30yr+cc	4320 Minutes	1.5 l/s
1 in 100yr+cc	6397 Minutes	1.8 l/s

Table 3.4 – Summary of Micro Drainage analysis for Drainage Catchment C.

Drainage Catchment D

Runoff from the roofs of the dwellings can be drained into a lined permeable paving system located across the driveways and parking areas. This permeable paving will drain into a lined underground storage tank, designed to store surface water runoff before discharging at a restricted rate into a second storage tank located in Drainage Catchment E (discussed below). It is envisaged that the primary storage tank can be located underneath the existing road, thus limiting the removal of any contaminated land and providing easy access for future maintenance.

A summary of the Micro Drainage analysis for Drainage Catchment D is shown in Table 3.5 below.

Drainage Catchment D (West part of the private housing development)	**Value (1:100yr+20%cc event)**	
SuDS	Permeable Paving and Underground Storage	
Storage Provided within	Underground Storage	
Area draining to permeable paving (including 10% allowance for urban creep)	9860 m^2	
Assumed dimensions of underground storage	~ 1000 m^2 x 1.5m (deep)	
Infiltration	Not Permitted, Lined System (due to contamination)	
Flow control device	Hydro-Brake	
Limiting Discharge Rate	2.0l/s	
Discharges into	Drainage Catchment E	
Overflow control	Pipe located ~1.4m above the base of the storage tank (discharges to beach)	
Critical storm duration	2880 minutes	
Return Period	**Half Drain Time**	**Peak discharge rate**
1 in 2yr+cc	4050 Minutes	1.3 l/s
1 in 30yr+cc	5467 Minutes	1.6 l/s
1 in 100yr+cc	6675 Minutes	1.9 l/s

Table 3.5 – Summary of Micro Drainage analysis for Drainage Catchment D.

Drainage Catchment E

Runoff from the communal hardstanding areas will be drained directly to a lined underground storage tank located beneath the central area of public open space. Runoff exiting the storage tanks within Drainage Catchment C and Drainage Catchment D will also be drained into this storage tank at an attenuated rate. To provide additional storage, the area above the storage tank will be landscaped to form an above ground detention basin, which can be designed to flood during *extreme* rainfall events. An overflow can be installed to allow excess water to be directed towards the beach if the detention basin reaches maximum capacity. A summary of the Micro Drainage analysis for Drainage Catchment E is shown in Table 3.6 below.

Drainage Catchment C (East part of the private housing development)	**Value (1:100yr+20%cc event)**
SuDS	Underground Storage and overlying detention basin.
Storage Provided within	Underground Storage
Area draining to permeable paving (including 10% allowance for urban creep)	2,590 m^2
Assumed dimensions of underground storage	~ 800 m^2 x 0.5m (deep)
Assumed dimensions of overlying detention basin	~ 1,000 m^2 x 0.5m (deep)
Infiltration	Not Permitted (due to contamination)
Flow control device (invert level 500mm below base of storage tank)	Orifice plate (41mm diameter)
Discharges into	Royal Military Canal
Overflow control device	Minimum 300mm diameter, pipe just below the top of the detention basin, (discharges to the beach).
Critical storm duration	4,320 minutes
Return Period	**Peak discharge rate**
1 in 2yr+cc	2.7 l/s
1 in 30yr+cc	3.2 l/s
1 in 100yr+cc	4.3 l/s

Table 3.6 – Summary of Micro Drainage analysis for Drainage Catchment D.

General Considerations

Runoff from the new promenade, which will replace the existing road, will be drained directly to the beach. This will prevent saltwater from entering the drainage system and thus reaching the RMC. The current road discharges unattenuated to the beach through a series of road drains (refer to Figure 3.3) and currently there are no pollution control measures, resulting in hydrocarbons being washed onto the beach. There will be no public vehicular access along the seafront and as such, any surface water discharged to the beach from the new area of promenade will be uncontaminated.

Figure 3.3 – Existing road drainage along Princes Parade.

With respect to the proposed surface water storage system (e.g. permeable paving, cellular storage etc.), it should be recognised that these systems provide attenuation for peak flow events and do not generally hold standing water. Consequently, these systems are not cleaned with chemicals and as such, present no risk to receiving watercourse (i.e. the RMC).

3.2 Indicative Drainage Layout Plan

An indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals is located in Appendix A.6 of this report.

3.3 Proposed Surface Water Runoff Discharge Rates

It is proposed to provide 3 separate outfalls into the RMC. The first is at the proposed leisure centre, located to the east of the site, where water will be discharged directly from the permeable paving system. The second outfall will be located in the centre of the development, connecting the central storage tank to the RMC. The final outfall will be located to the west of the site, connecting the green space to the RMC. All of the proposed outfalls are likely to comprise a single pipe connected to a flow control device, ensuring the rate of discharge is both restricted and controlled.

The proposed discharge rates which are based on the above drainage strategy are summarised in Table 3.7 below:

Return Period	Leisure Centre	Residential	Highway	Combined Total
1:2 year + 20%	0.9 l/s	2.7 l/s	1.7 l/s	5.3 l/s
1:30 year +20%	1.3 l/s	3.2 l/s	1.7 l/s	6.2 l/s
1:100 year +20%	1.6 l/s	4.3 l/s	1.9 l/s	7.8 l/s

Table 3.7 – Runoff rates from the proposed development for each outfall.

The proposed surface water discharge rates have been compared to the existing surface water run off rates derived in Section 2 of this report (i.e. Table 2.0 and 2.1), for a range of return period events. The rates have been summarised in Table 3.8 below.

Return Period	Pre-development runoff rate	Proposed Development (with 20% cc) runoff rate	Betterment
1:2 year	13.0 l/s	5.3 l/s	60%
1:30 year	35.3 l/s	6.2 l/s	82%
1:100 year	45.7 l/s	7.8 l/s	83%

Table 3.8 – Comparison between pre and post development runoff rates.

The figures in Table 3.8 above demonstrate that with SuDS included within the proposed development, it is possible to restrict the discharge of surface water runoff into the RMC. In particular, under the design event (1 in 100 year return period event, including a 20% allowance for 100 years of climate change), it is evident that there is a significant reduction in the peak rate at which surface water runoff is discharged offsite when compared to the existing situation.

3.4 Proposed Surface Water Runoff Discharge Volume

An assessment has been made to determine the volume of water entering the RMC from the developed site, for two rainfall events with different durations (i.e. the 360 minute 'design event' and a 285 minute event). The latter event takes into consideration the entire period in which the RMC could be tide locked. A conservative estimate has been made when calculating the post development volume of runoff discharged to the RMC, by assuming that the flow restriction devices are discharging at the maximum rate for the entire duration of the storm event.

Table 3.9 below summarises the total volume of surface water discharged from the proposed development site during both scenarios.

Return Period	Post-development Total Volume (285min event)	Post-development Total Volume (360min event)
1:2 year + 20% cc	91m³	114 m³
1:30 year + 20% cc	106 m³	134 m³
1:100 year + 20%cc	133 m³	168 m³

Table 3.9 – Post development discharge volumes generated for rainfall events with a 285 minute and 360 minute duration, for a range of return period events. All calculations include a 20% increase in peak rainfall intensity to account for climate change.

A summary table comparing the total volume of runoff discharged into the RMC for both the pre and post developed scenarios, for a range of return period events, is provided in Table 3.10 (below).

Return Period	285min (total volume discharged to the canal)			360min (total volume discharged to the canal)		
	Existing (greenfield)	Proposed	Difference	Existing (greenfield)	Proposed	Difference
1:2 year + 20% cc	73 m³	91m³	18 m³ (increase)	80 m³	114 m³	<35 m³ (increase)
1:30 year + 20% cc	176 m³	106 m³	70 m³ (decrease)	197 m³	134 m³	63 m³ (decrease)
1:100 year + 20%cc	262 m³	133 m³	129 m³ (decrease)	296 m³	168 m³	128 m³ (decrease)

Table 3.10 – Showing approximate discharge volumes for a range of return periods (both pre and post development.

From Table 3.10 above it is evident that under the design flood event (i.e. the 1 in 100 year event including an allowance for 100 years of climate change), less water will be discharged into the RMC during the time over which the RMC is assumed to be tide locked (refer to Section 2.2). Furthermore, during the 360 minute design event, the volume of water discharged offsite has been reduced when compared to the pre-developed situation.

The exception to this is under the 1 in 2 year event, where the estimated volume discharged from the proposed development to the RMC is shown to increase by less than 35m³. However considering the number of conservative assumptions that have been made to derive this figure, it is recognised that this number is likely to be significantly lower, and in reality is unlikely to result in an increase.

Notwithstanding this, even if this small volume increase was assumed to be the 'worst case scenario', when compared to the overall size of the canal from West Hythe to Seabrook, it is evident that this volume of water would equate to an increase in the water level of less than 1cm during the design event, or tide lock scenario. Given the existing freeboard within the RMC is greater than 1cm, this small increase in water level is very unlikely to increase the risk of flooding offsite. Furthermore, given the proposed development would significantly reduce the volume of water discharged to the RMC during higher return period events, the benefits of the development significantly outweigh any marginal increase in water level (i.e. less than 1cm) under low return period events.

On balance, taking the above into consideration, it is evident that the drainage proposals will not increase the risk of flooding within the RMC during the design rainfall event, even when the RMC is tide locked during the design storm.

3.5 Drain Down Times and Long-Term Performance

Under the design rainfall event, the calculations show that the proposed drainage system would not have an adverse impact on the development site, or the RMC. Nonetheless, to achieve this, a low limiting discharge rate has been used for each of the flow control devices specified within the drainage network. These very low discharge rates result in slow drain down times for each of the SuDS, which as a result could make the drainage system susceptible to flooding during either; long duration (low intensity) rainfall events, or from multiple back to back storms. The performance of the proposed drainage system during both of these scenarios has therefore been assessed to ensure that there will be no increased risk of flooding to the RMC, or to the proposed development.

The critical storm duration defines the event where the drainage system is most susceptible to flooding. Therefore, by ensuring that the system is designed to function under the critical storm duration, it will by default ensure that the system will not flood during a storm event which has either a longer, or shorter duration.

Table 3.11 below shows each of the proposed SuDS, alongside the critical storm duration for the design event (i.e. an event with a 1 in 100 year return period).

Drainage Catchment	SuDS	Critical Storm Duration (minutes)
A	Permeable Paving	2880
B	Pond	5760
C	Underground Storage	2880
D	Underground Storage	2880
E	Underground Storage and Detention basin	4320

Table 3.11 – Critical storm durations for each of the proposed SuDS during the design rainfall event.

In addition to assessing the response of the drainage system during the critical storm event, a further sensitivity test has been undertaken to determine the impact of back to back rainfall events, e.g. the design rainfall event (1:100 year return period rainfall event, including climate change), followed by a 1:10 year return period rainfall event. The Susdrain and CIRIA factsheet *"Assessing attenuation storage volumes for SuDS",* questions the appropriateness of meeting 24 hour half drain times when long term storage for stormwater is provided. This factsheet suggests that a more appropriate solution could be to ensure that 24 hours after the design rainfall event, there is room within the drainage system to accommodate a subsequent 1:10 year event. This combination has therefore been selected to represent a realistic back to back rainfall scenario, albeit the probability of such extreme events coinciding is considered to be very low.

A summary of this analysis is provided in Table 3.12 (below).

SuDS	Max water level without overflow control (mm)	Max water level with overflow control (mm)	Volume overflowing drainage system (m^3)	Overflow discharge location
Permeable Paving (leisure centre)	984	960	155	Beach
Pond (highway & hardstanding)	954	954 (water level does not reach crest level of overflow weir)	0	RMC
Underground Storage (East)	1400	1394	44	Beach
Underground Storage (West)	1453	1452	12	Beach
Detention basin	N/A basin overflows	1414	1037	Beach

Table 3.12 – Summary of SuDS performance during the critical 1:100+cc event, combined with a 1:10 year rainfall event (60 minute duration).

From the above calculations it is evident that by oversizing the proposed SuDS, and by incorporating independent overflows within each of the proposed SuDS, there is a solution available which will ensures that no additional volume of water will be discharged to the RMC. Once the overflow is activated, any additional surface water can, in most cases, be directed onto the beach, or stored safely on site.

3.6 Additional and Alternative Opportunities for Reducing Drain Down Times

An alternative option to increasing the volume of storage provided onsite (to accommodate the additional runoff generated during back to back rainfall events), would be to increase the discharge rates to the RMC. However, it is recognised that the rate of discharge to the RMC should only be increased when the water levels within the RMC are low and flooding is unlikely to occur. This

approach allows any additional water to be discharged to the sea without having any detrimental impact to the RMC and the surrounding area.

The increase discharge rates could be achieved by incorporating mechanical float valves, or actuated valves into the flow control system for the development. These devices would change the rate at which runoff can be discharged offsite based on the water level within the RMC, only allowing more water to be discharged offsite when this approach is unlikely to present a risk of flooding.

A similar, but alternative option to a mechanical system, is to use a telemetry based system. This type of system enables the flow rates into the RMC to be controlled remotely, based on weather forecasting (i.e. closing the outlets when a storm event is predicted, thus reducing the risk of flooding to the RMC).

If the development site is prevented from discharging surface water to the RMC, the SuDS would begin to store water onsite. A sensitivity test has been undertaken to determine the maximum length of time the site could be prevented from discharging to the RMC, before the SuDS reach maximum capacity. The calculations show that there is sufficient room available within the development to store water for 12 hours, before any overflow is activated. This water can be stored safely onsite, without increasing the risk of flooding to the new properties or surrounding area. (Refer to Section 3.8 for more details). Consequently, it is evident that there is more than sufficient time for the water level within the RMC to drop, before the site is required to discharge to the RMC.

3.7 Maintenance and Management

For any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime. This can be achieved by undertaking routine inspection and maintenance of the drainage system, including all outlet and overflow controls. Any manufacturer specific requirements should also be taken into consideration.

In this case, a regulated specialist management and maintenance company will be appointed to ensure maintenance is carried out regularly and to the appropriate standards, to ensure that there is no risk of flooding to the development site or to offsite properties.

3.8 Residual Risk

When considering residual risk it is necessary to consider the impact of a flood event that exceeds the design event, or the implications if the proposed drainage system becomes blocked/fails.

The underground storage systems, detention basin and permeable paving all include an overflow system, designed to discharge excess runoff through the seawall and onto the beach, thus minimising the risk of additional water entering the RMC.

For the pond system an overflow into the beach is not considered viable, due to the lower land levels to the north west of the site where the pond is located. Consequently, an overflow weir into the RMC has been specified to control the rate at which additional runoff is discharged. However, it should be recognised that significant additional storage has been included within the public open

space to store a back to back rainfall event and as such, during an exceedance or blockage scenario this additional storage will become active. This will provide a visual warning in the event that the outlet has become blocked and will enable the problem to be rectified, without increasing the risk to the RMC.

Figure 3.4 (below) delineates the proposed overflow control systems and shows where additional runoff can be discharged offsite in the event of a blockage, or during a storm event which exceeds the design parameters for the proposed drainage system.

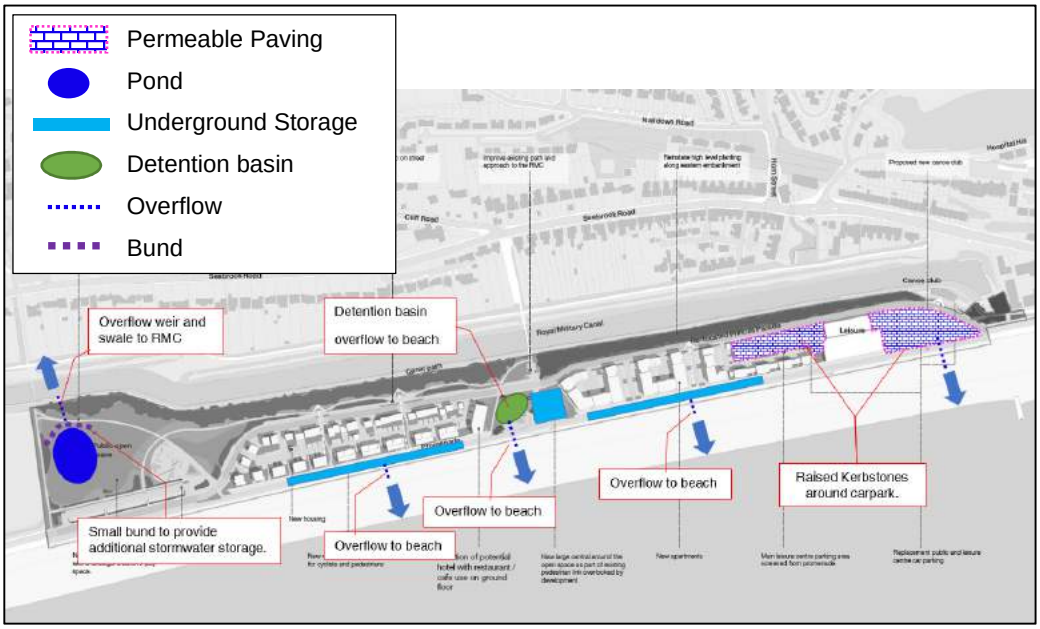


Figure 3.4 – Plan showing proposed SuDS and overflow control systems.

In addition to the overflow control systems, additional measures can also be used to further reduce the volume of water discharged offsite, either to the beach or to the RMC.

One option could be to use raised kerbstones and reprofile the land levels around the permeable car parking areas, allowing water to pond to a shallow depth above the surface of the carpark. Calculations suggest that 100mm of flooding across the entire carpark area will provide storage for an additional 450m^3 of water. Similarly, a small bund could also be located to the north of the pond, where land levels are lower. By incorporating this bund within the landscaping of the public open space it will be possible to store a large amount of additional stormwater, prevented it from entering the RMC.

3.9 Water Quality

Given the significant importance of the RMC with respect to ecology and biodiversity, it is evident that the risk of the development polluting the RMC needs to be considered. The pollution hazard indices for each part of the proposed development has been calculated using CIRIA C753 and the results of this analysis are summarised in Table 3.11 below. These values have been compared with the mitigation index for proposed SuDS at this site.

Parameter		Total suspended solids (TSS)	Metals	Hydro-Carbons
Leisure centre and carpark (permeable paving)	Pollution Hazard Index (4)	0.7	0.6	0.7
	Mitigation Index from permeable paving	0.7	0.6	0.7
Access road play area and public parking (Swale and Pond)	Pollution Hazard Index (5)	5	0.8	0.8
	Mitigation Index from swale and pond	0.85	0.95	0.85
Private dwellings parking and access (permeable paving and underground storage)	Pollution Hazard Index (3)	0.5	0.4	0.4
	Mitigation Index for permeable paving (underground storage provides no treatment)	0.7	0.6	0.7

Table 3.11 – CIRIA C753 simple index approach to water quality management.

With reference to Table 3.11 (above), the simple index approach to water quality management has been applied for each of the drainage catchments. Providing the SuDS outlined in the proposed strategy are adopted and designed in accordance with best practice (as outlined within CIRIA C753), it is evident that the pollution hazard index is considered acceptable.

The drainage system should be designed to capture the first 5mm rainfall event, which will ensure that any pollutants (such as surface hydrocarbons from the road, for example) are not discharged into the RMC. In addition, sediment traps and pollution control features (such as oil interceptors) can be specified as part of the detailed drainage design to ensure any unexpected pollution can be contained on site and prevented from reaching the RMC.

3.10 Environmental Permit for Flood Risk Activities (FRAP)

The RMC is designated as a Main River and as such, any discharge to this watercourse will require an environmental permit and agreement from the Environment Agency. Typically, a permit is required for the following reasons if work is to be carried out:

- in, under, over or near a main river (including where the river is in a culvert),
- on or near a flood defence on a main river,
- in the flood plain of a main river,
- on or near a sea defence.

It is recommended that the EA are consulted regarding the requirements for permitting at the detailed design stage.

4 Conclusions and Recommendations

The overarching objective of this report is to appraise the suitability of discharging the proposed development into the Royal Military Canal (RMC). This report provides additional details to supplement the Flood Risk Assessment and drainage strategy, submitted within Technical Annex 4 dated August 2017.

The original assessment acknowledges that the preferred method of discharging surface water runoff from the development is via a connection to the sea (in accordance with S1 of the NTSS). Although these conclusions are still valid, this assessment has been prepared on the assumption that a connection to the sea will not be viable and therefore, presents an alternative solution for draining the site in a sustainable way.

The runoff rates and the volume of surface water discharged from the existing site have been calculated, taking account of the sub-catchments within the development site. The results from a rolling ball analysis, site investigations, and hydrological data have all be used in this process to provide a baseline against which to compare the post development impacts.

The findings from the analysis show that by restricting the peak rate at which surface water is discharged from the development site, the risk of flooding will not increase. Whilst it is acknowledged that the total volume of runoff discharged from the development will be increased when compared to the exiting pre-developed conditions, under normal conditions there will be no detrimental impact to the RMC, or to the surrounding area. This is due to the flow restrictions placed on the three outfalls from the proposed development, which will limit the rate and safely control the volume of surface water runoff discharged from the development site.

The primary risk of flooding to the surrounding area is during the period when the RMC is at full capacity, during which period, discharging any additional volume of water to the RMC has the potential to exacerbate the risk of flooding. In response, several sensitivity tests have been undertaken to appraise the impact that the development could have when the RMC is tide locked. The results show that under a tide locked scenario, the development will discharge a lower volume of water into the RMC for the period at which the system is sealed and consequently, the development will have no detrimental impact under this scenario.

Notwithstanding this, it is recognised that the precautionary approach adopted to restrict the offsite discharge volumes has resulted in high half drain times and therefore, in the event that back to back storm events were to occur it is important to ensure that the risk of the drainage system flooding is not increased. Consequently, additional testing has been undertaken to confirm whether the redundant storage within the drainage system is sufficient to protect both the development and the RMC from flooding. The analysis shows that during a back to back storm event, parts of the site are susceptible to flooding, however, the depth of flooding can be managed appropriately.

The analysis also shows that during such an event, the drainage system can hold all of the surface water generated for up to 12 hours on site, without the requirement to discharge to the RMC. By including a series of overflows into the drainage system, additional flows can be directed onto the beach, further reducing the pressure on the RMC.

Alternative options including the use of telemetry, actuated values and float values have also been considered and may present a complementary solution to the final design.

In addition to the discharge rates and volumes, pollution control measures have been considered as part of the drainage strategy. It is evident that by incorporating a variety of SuDS within the development, the risk of pollutants entering the RMC can be minimised.

In conclusion, this report demonstrates that there is a drainage solution that will enable surface water runoff from the development at Princes Parade to be discharged into the RMC, as an alternative and sustainable solution for draining the site, and one which will not increase the risk of flooding.

5 Appendices

Appendix A.1 – Royal Military Canal – Tide Lock Analysis

Appendix A.2 – Catchment Area Drawing

Appendix A.3 – Topographical Sections

Appendix A.4 – Greenfield Runoff Calculations

Appendix A.5 – Surface Water Runoff Calculations & Drawings

Appendix A.6 – Indicative Drainage Layout

5 Appendices

Appendix A.1 – Royal Military Canal – Tide Lock Analysis

Appendix A.2 – Catchment Area Drawing

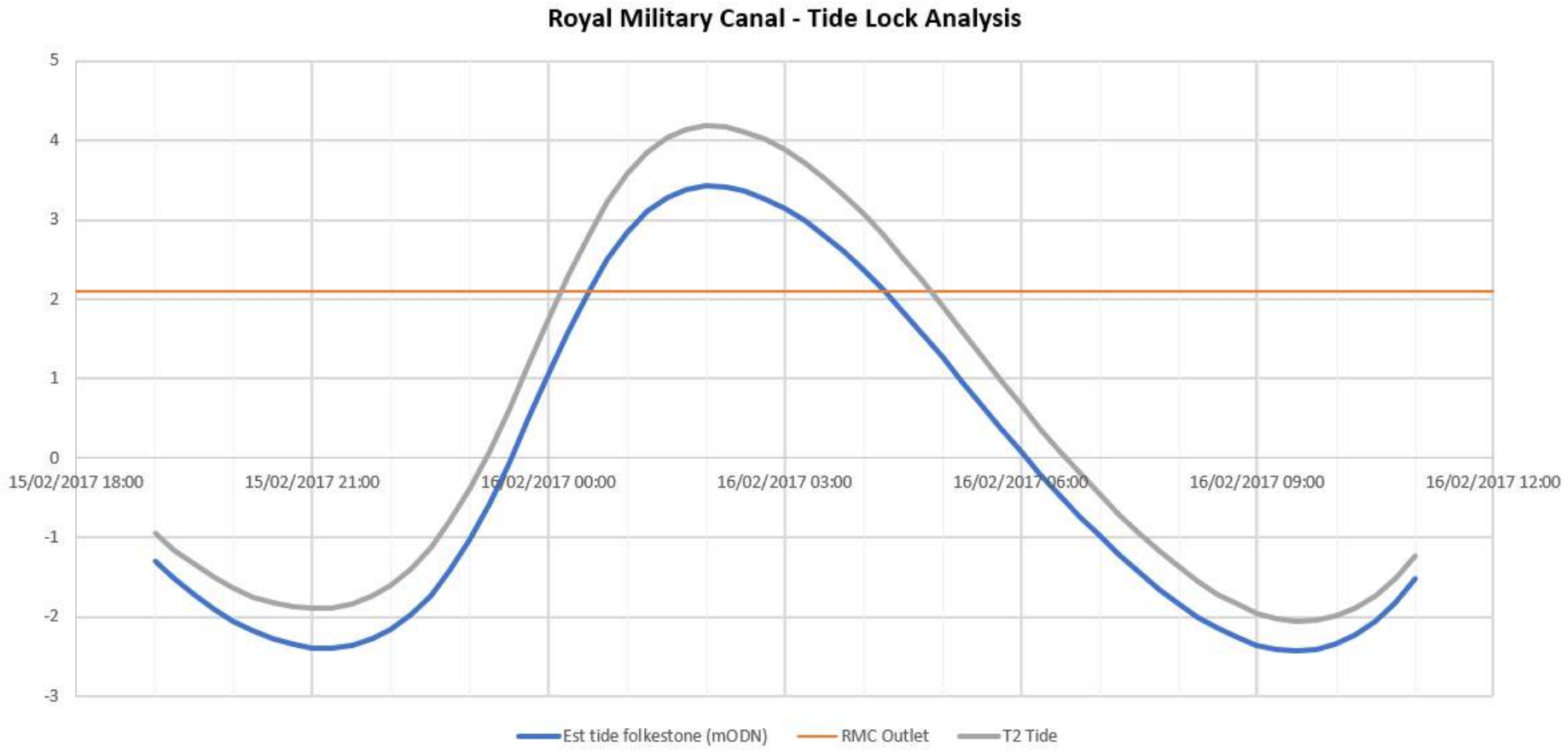
Appendix A.3 – Topographical Sections

Appendix A.4 – Greenfield Runoff Calculations

Appendix A.5 – Surface Water Runoff Calculations & Drawings

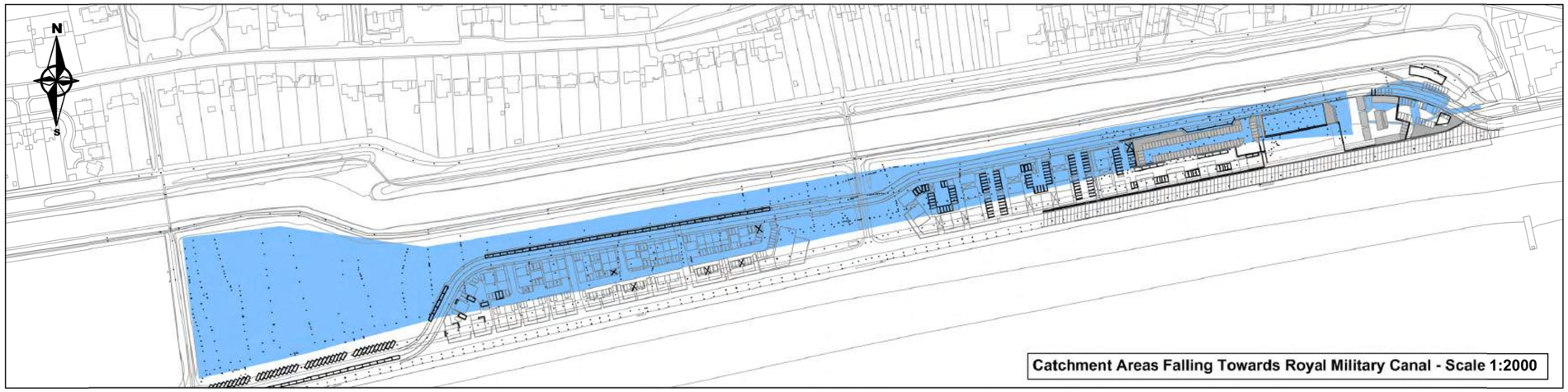
Appendix A.6 – Indicative Drainage Layout

Appendix A.1 – Royal Military Canal – Tide Lock Analysis

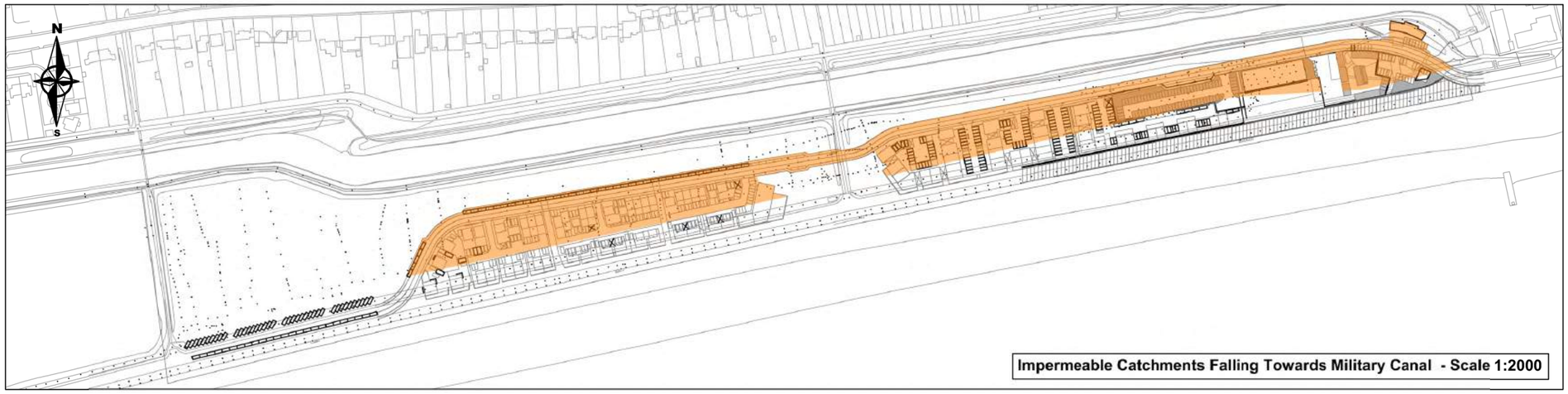


	MHWS tide	T2 surge tide
Exceedance time	03:45:00	04:45:00

Appendix A.2 – Catchment Area Drawing



Catchment Areas Falling Towards Royal Military Canal - Scale 1:2000



Impermeable Catchments Falling Towards Military Canal - Scale 1:2000

Flow Trace Showing Localized Flow Routes - Scale 1:2000

Notes

1. Contains Ordnance Survey data © Crown copyright and database right 2018.
2. All dimensions are in metres unless otherwise stated elsewhere.
3. Proposed drainage positions will be subject to detailed design.
4. The size and extent of the pond will be subject to infiltration testing and trial holes.
5. All drainage systems will need to be installed and designed for suitable loading requirements.

Key

Flow Path

Catchment Area (49475m^2)

Impermeable Catchment Area (26359m^2)

herrington CONSULTING LIMITED
Unit 6-7 Barham Business Park
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Rev	Description	Date
00	First issue	28/08/201

CLIENT: Folkestone and Hythe District Council

PROJECT: Princes Parade - Hythe

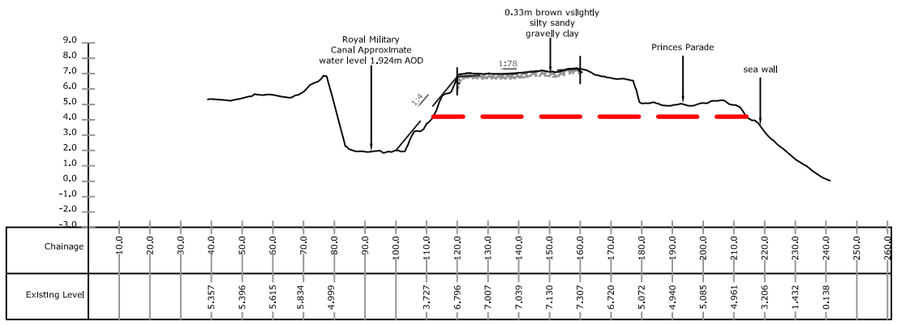
SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:1000	1494	LA	SJB

DWG REF: Long Section H-J

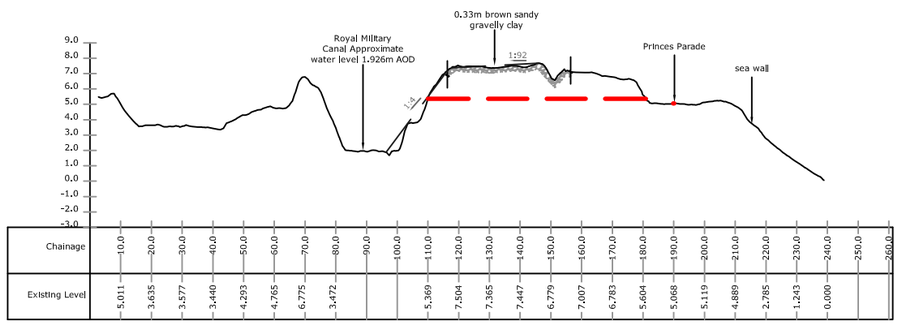
DWG No.: 1494-0003

Appendix A.3 – Topographical Sections

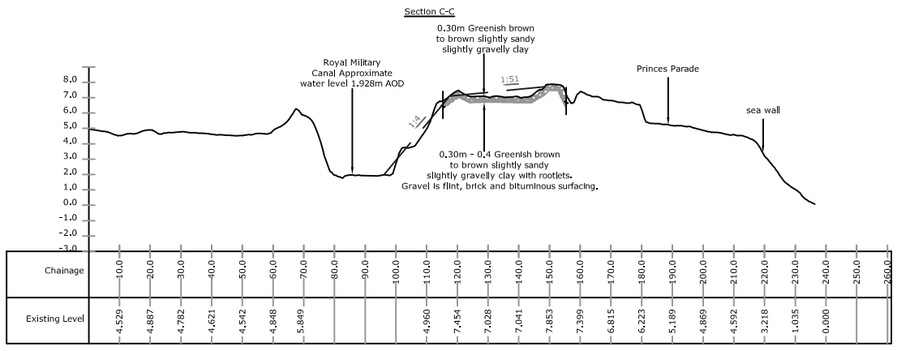
Section A-A



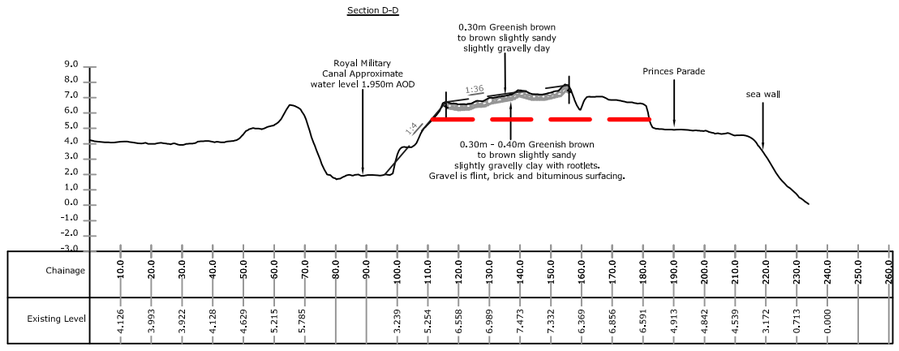
Section B-B



Section C-C



Section D-D



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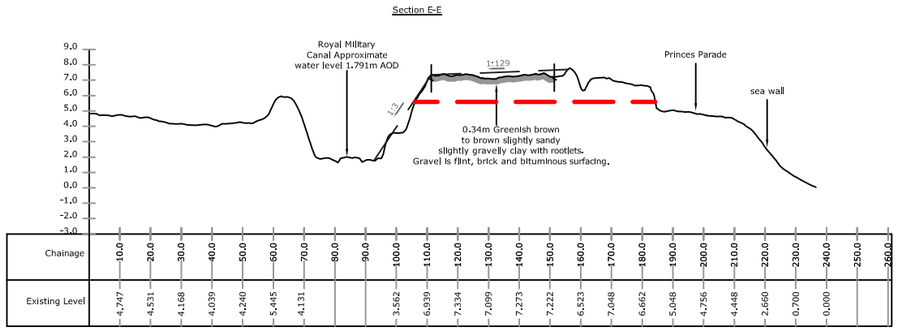

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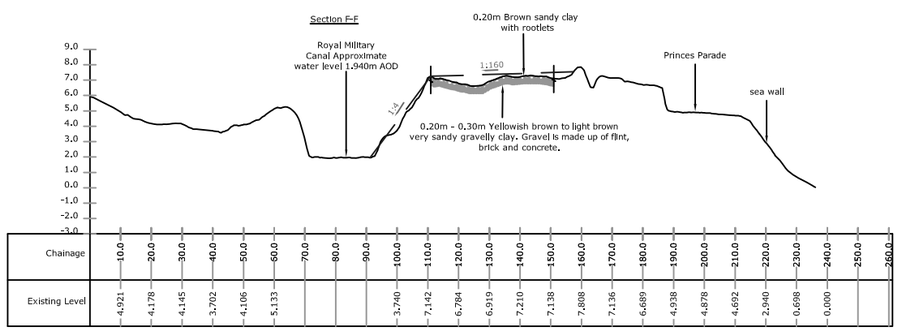

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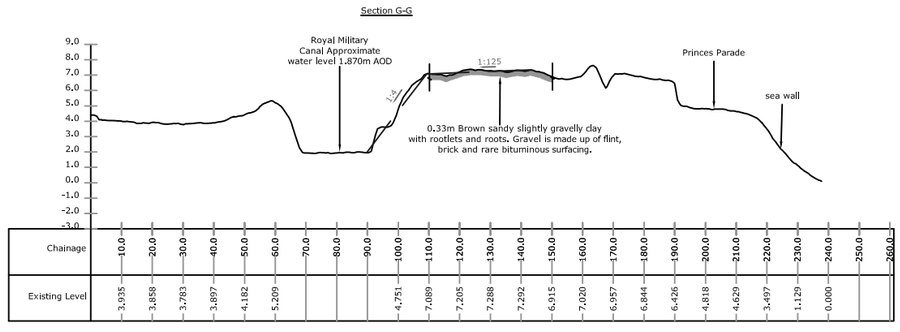
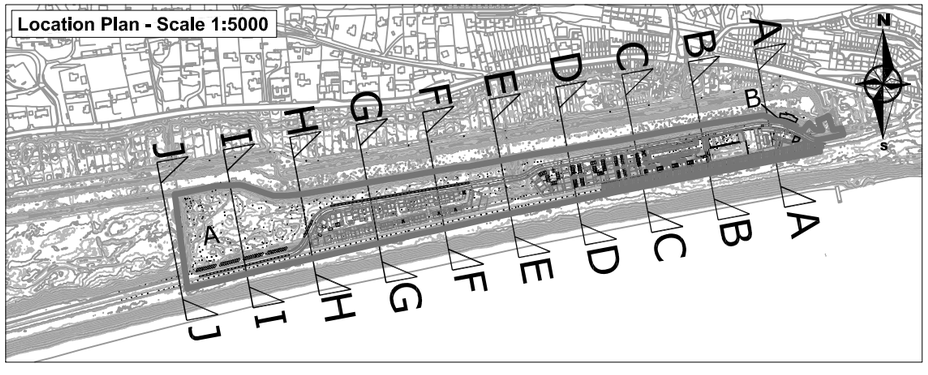


Location Plan - Scale 1:5000



Notes

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2. All dimensions are in metres unless otherwise stated elsewhere.
3. Proposed drainage positions will be subject to detailed design.
4. The size and extent of the pond will be subject to infiltration testing and trial holes.
5. All drainage systems will need to be installed and designed for suitable loading requirements.

Key

Made Ground Level

Average Gradient 1:xx

Average Gradient line taken

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Rev	Description	Date
00	First issue	28/08/2018

CLIENT: Folkestone and Hythe District Council

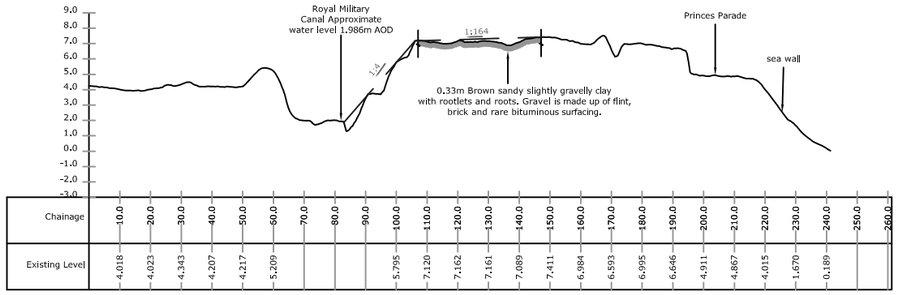
PROJECT: Princes Parade - Hythe

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:1000	1494	LA	SJB

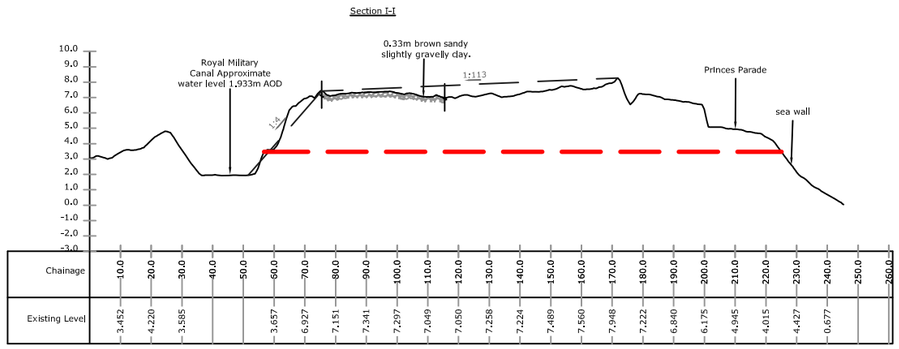
DWG REF.: Long Section A-G

DWG No.: 1494-0002

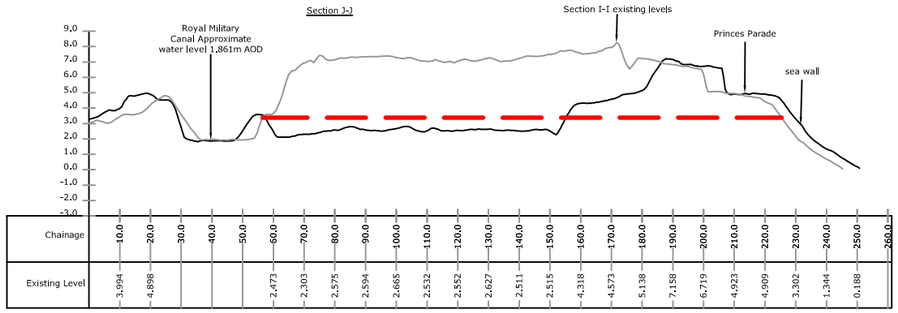
Section H-H



Section I-I



Section J-J



Notes

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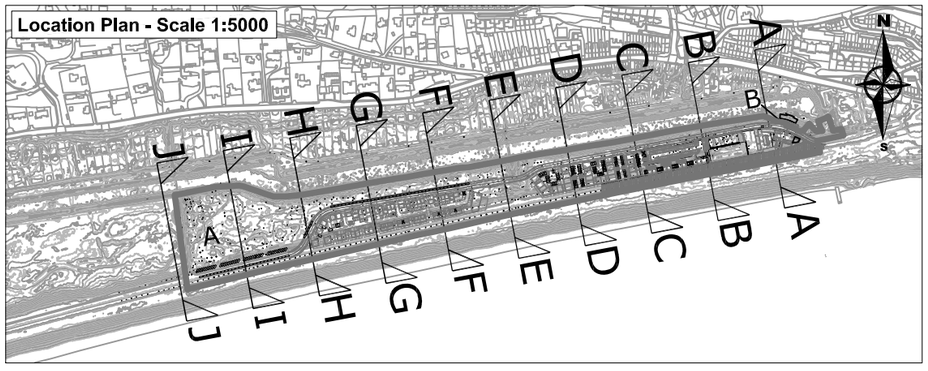
Location Plan - Scale 1:5000



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1:1000	1494	LA	SJB

DWG REF.: Long Section H-J

DWG No.: 1494-0003

5 Appendices

Appendix A.1 – Royal Military Canal – Tide Lock Analysis

Appendix A.2 – Catchment Area Drawing

Appendix A.3 – Topographical Sections

Appendix A.4 – Greenfield Runoff Calculations

Appendix A.5 – Surface Water Runoff Calculations & Drawings

Appendix A.6 – Indicative Drainage Layout

Appendix A.4 – Greenfield Runoff Calculations

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Bradley Whittaker
Site name:	Princes Parade
Site location:	Hythe

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	51.07092° N
Longitude:	1.11443° E

Reference:	6422713
Date:	2018-08-30T16:11:51

Methodology	FEH Statistical

Site characteristics

Total site area (ha)	2.6359

Methodology

Qmed estimation method	Calculate from BFI and SAAR
BFI and SPR estimation method	Specify BFI manually
HOST class	N/A
BFI / BFIHOST	0.889
Qmed (l/s)	NaN
Qbar / Qmed Conversion Factor	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm)	700	700
Hydrological region	7	7
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	NaN	1.67
1 in 1 year (l/s)	NaN	1.42
1 in 30 years (l/s)	NaN	3.83
1 in 100 years (l/s)	NaN	5.31

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 618329 134790
Data Type	Point
Areal Reduction Factor	0.99
Area (ha)	2.636
SAAR (mm)	716
CWI	107.065
SPR Host	12.880
URBEXT (1990)	0.0000

Results

Percentage Runoff (%)	13.43
Greenfield Runoff Volume (m^3)	250.535

Greenfield Runoff Volume

FEH Data

Return Period (years)	30
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 618329 134790
Data Type	Point
Areal Reduction Factor	0.99
Area (ha)	2.636
SAAR (mm)	716
CWI	107.065
SPR Host	12.880
URBEXT (1990)	0.0000

Results

Percentage Runoff (%)	11.35
Greenfield Runoff Volume (m^3)	161.851

Greenfield Runoff Volume

FEH Data

Return Period (years)	2
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 618329 134790
Data Type	Point
Areal Reduction Factor	0.99
Area (ha)	2.636
SAAR (mm)	716
CWI	107.065
SPR Host	12.880
URBEXT (1990)	0.0000

Results

Percentage Runoff (%)	8.40
Greenfield Runoff Volume (m^3)	62.999

Drainage Design Report

Flow+

v7.0

Network	Storm Network
Filename	S:\LIVE Project Files\1494 - Princes Parade, Hythe - MEET\SS Data\1 Pre VS post analysis 14_09_2018\Existing Discharge Rates Causeway\1494 - Existing Impermeable Areas.pfd
Username	Stephen Hayward (stephen@herringtonconsulting.co.uk)
Last analysed	13/09/2018 10:54:15
Report produced on	21/09/2018 11:51:36

Causeway Sales

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Email:	marketing@causeway.com
Web:	www.causeway.com

Technical support web portal:

http://support.causeway.com

	Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)	Notes
	E.Impermeable	0.106	4.00		10.000	Manhole	Adoptable	1900		110.000	100.000	2.200	Locked
	E.Outlet				9.500	Junction				120.000	100.000	2.200	Locked
	E.Discharge				9.000	Junction				130.000	100.000	2.200	Locked
	P.Impermeable	1.310	4.00		10.000	Manhole	Adoptable	1900		110.000	80.000	1.650	
	P.Outlet				9.500	Junction				120.000	80.000	2.200	
	P.Discharge				9.000	Junction				130.000	80.000	2.200	

	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)	Notes
?	E.Drain2	E.Impermeable	E.Outlet	9.362	7352.6	46.0	1.200	1.200	1.200	1.200	0.106	0.0	54	2.815	Locked | TC is outside FEH-13 range | Velocity is more than 3 m/s
?	E.Outfall	E.Outlet	E.Discharge	11.739	11738.9	46.0	1.200	1.200	1.200	1.200	0.106	0.0	35	2.600	Locked | TC is outside FEH-13 range | Velocity is more than 3 m/s
?	P.Drain2	P.Impermeable	P.Outlet	13.620	10697.0	568.1	0.650	1.200	0.650	1.200	1.310	0.0	152	7.555	TC is outside FEH-13 range | Velocity is more than 3 m/s | Upstream Depth is less than the specified minimum
?	P.Outfall	P.Outlet	P.Discharge	11.739	11738.9	568.1	1.200	1.200	1.200	1.200	1.310	0.0	168	5.775	TC is outside FEH-13 range | Velocity is more than 3 m/s

Link Name	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node Name	Dia (mm)	Width (mm)	Node Type	MH Type	DS Node Name	Dia (mm)	Width (mm)	Node Type	MH Type
E.Drain2	10.000	20.0	1000	Circular	10.000	7.800	1.200	9.500	7.300	1.200	E.Impermeable	1900		Manhole	Adoptable	E.Outlet			Junction	
E.Outfall	10.000	20.0	1000	Ditch	9.500	7.300	1.200	9.000	6.800	1.200	E.Outlet			Junction		E.Discharge			Junction	
P.Drain2	10.000	9.5	1000	Circular	10.000	8.350	0.650	9.500	7.300	1.200	P.Impermeable	1900		Manhole	Adoptable	P.Outlet			Junction	
P.Outfall	10.000	20.0	1000	Ditch	9.500	7.300	1.200	9.000	6.800	1.200	P.Outlet			Junction		P.Discharge			Junction	

Node Name	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type		Link ID	IL (m)	Dia (mm)	Link Type
E.Impermeable	110.000	100.000	10.000	2.200	1900		Manhole	Adoptable					
									0	E.Drain2	7.800	1000	Circular
E.Outlet	120.000	100.000	9.500	2.200			Junction		1	E.Drain2	7.300	1000	Circular
									0	E.Outfall	7.300	1000	Ditch
E.Discharge	130.000	100.000	9.000	2.200			Junction		1	E.Outfall	6.800	1000	Ditch
P.Impermeable	110.000	80.000	10.000	1.650	1900		Manhole	Adoptable					
									0	P.Drain2	8.350	1000	Circular
P.Outlet	120.000	80.000	9.500	2.200			Junction		1	P.Drain2	7.300	1000	Circular
									0	P.Outfall	7.300	1000	Ditch
P.Discharge	130.000	80.000	9.000	2.200			Junction		1	P.Outfall	6.800	1000	Ditch

Rainfall Methodology	FEH-13		Return Period (years)	Climate Change (%)
Summer CV	0.600		2	0
Winter CV	0.600		2	20
Analysis Speed	Normal		30	0
Drain Down Time (mins)	240		30	20
Additional Storage (m³/ha)	20.0		100	0
Storm Durations (mins)	15		100	20
	30			
	60			
	120			
	180			
	240			
	360			
	480			
	600			
	720			
	960			
	1440			
Check Discharge Rate(s)	x			
1 year (l/s)				
30 year (l/s)				
100 year (l/s)				
Check Discharge Volume	x			
100 year 360 minute (m³)				

Depth/Area/Inf Area									
Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m²)	Inf. Area (m²)
1	0.01000	0.01000	2.0	1.00	0.000		0.000	1.0	0.0
							0.500	1.0	0.0
							1.000	10.0	0.0
2	0.01000	0.01000	2.0	1.00	0.000		0.000	1.0	0.0
							0.500	1.0	0.0
							1.000	10.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.87%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E.Impermeable	10	7.831	0.031	11.6	0.1196	0.0000	OK	E.Drain2	E.Outlet	11.6	2.804	0.002	0.0452	
15 minute summer	E.Outlet	10	7.314	0.014	11.6	0.0000	0.0000	OK	E.Outfall	E.Discharge	11.6	1.659	0.001	0.0699	4.5
15 minute summer	E.Discharge	10	6.814	0.014	11.6	0.0000	0.0000	OK							
15 minute summer	P.Impermeable	10	8.432	0.082	143.0	1.5352	0.0000	OK	P.Drain2	P.Outlet	143.2	5.631	0.013	0.2550	
15 minute summer	P.Outlet	10	7.364	0.064	143.2	0.0000	0.0000	OK	P.Outfall	P.Discharge	143.2	4.189	0.012	0.3419	55.7
15 minute summer	P.Discharge	10	6.864	0.064	143.2	0.0000	0.0000	OK							

Results for 2 year +20% Critical Storm Duration. Lowest mass balance: 99.87%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E.Impermeable	10	7.834	0.034	13.9	0.1292	0.0000	OK	E.Drain2	E.Outlet	13.9	2.910	0.002	0.0513	
15 minute summer	E.Outlet	10	7.315	0.015	13.9	0.0000	0.0000	OK	E.Outfall	E.Discharge	13.9	1.778	0.001	0.0782	5.4
15 minute summer	E.Discharge	10	6.815	0.015	13.9	0.0000	0.0000	OK							
15 minute summer	P.Impermeable	10	8.440	0.090	171.7	1.6815	0.0000	OK	P.Drain2	P.Outlet	171.9	5.817	0.016	0.2960	
15 minute summer	P.Outlet	9	7.372	0.072	171.9	0.0000	0.0000	OK	P.Outfall	P.Discharge	171.9	4.458	0.015	0.3857	66.8
15 minute summer	P.Discharge	10	6.872	0.072	171.9	0.0000	0.0000	OK							

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.87%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E.Impermeable	10	7.849	0.049	31.5	0.1857	0.0000	OK	E.Drain2	E.Outlet	31.5	3.489	0.004	0.0944	
15 minute summer	E.Outlet	10	7.325	0.025	31.5	0.0000	0.0000	OK	E.Outfall	E.Discharge	31.5	2.426	0.003	0.1299	12.3
15 minute summer	E.Discharge	10	6.825	0.025	31.5	0.0000	0.0000	OK							
15 minute summer	P.Impermeable	10	8.487	0.137	388.7	2.5708	0.0000	OK	P.Drain2	P.Outlet	389.1	6.665	0.036	0.5862	
15 minute summer	P.Outlet	9	7.420	0.120	389.1	0.0000	0.0000	OK	P.Outfall	P.Discharge	389.2	5.833	0.033	0.6673	151.4
15 minute summer	P.Discharge	10	6.919	0.119	389.2	0.0000	0.0000	OK							

Results for 30 year +20% Critical Storm Duration. Lowest mass balance: 99.87%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E.Impermeable	10	7.853	0.053	37.8	0.2019	0.0000	OK	E.Drain2	E.Outlet	37.8	3.635	0.005	0.1088	
15 minute summer	E.Outlet	10	7.328	0.028	37.8	0.0000	0.0000	OK	E.Outfall	E.Discharge	37.8	2.597	0.003	0.1456	14.7
15 minute summer	E.Discharge	10	6.828	0.028	37.8	0.0000	0.0000	OK							
15 minute summer	P.Impermeable	10	8.502	0.152	466.5	2.8412	0.0000	OK	P.Drain2	P.Outlet	466.9	6.844	0.044	0.6844	
15 minute summer	P.Outlet	9	7.434	0.134	466.9	0.0000	0.0000	OK	P.Outfall	P.Discharge	467.1	6.170	0.040	0.7572	181.7
15 minute summer	P.Discharge	10	6.933	0.133	467.1	0.0000	0.0000	OK							

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.87%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E.Impermeable	10	7.855	0.055	40.3	0.2082	0.0000	OK	E.Drain2	E.Outlet	40.4	3.688	0.005	0.1145	
15 minute summer	E.Outlet	10	7.330	0.030	40.4	0.0000	0.0000	OK	E.Outfall	E.Discharge	40.4	2.663	0.003	0.1518	15.7
15 minute summer	E.Discharge	10	6.829	0.029	40.4	0.0000	0.0000	OK							
15 minute summer	P.Impermeable	10	8.507	0.157	498.2	2.9472	0.0000	OK	P.Drain2	P.Outlet	498.7	6.913	0.047	0.7249	
15 minute summer	P.Outlet	9	7.440	0.140	498.7	0.0000	0.0000	OK	P.Outfall	P.Discharge	498.9	6.298	0.043	0.7923	194.0
15 minute summer	P.Discharge	10	6.939	0.139	498.9	0.0000	0.0000	OK							

Results for 100 year +20% Critical Storm Duration. Lowest mass balance: 99.87%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E.Impermeable	9	7.860	0.060	48.3	0.2264	0.0000	OK	E.Drain2	E.Outlet	48.4	3.807	0.007	0.1313	
15 minute summer	E.Outlet	10	7.333	0.033	48.4	0.0000	0.0000	OK	E.Outfall	E.Discharge	48.4	2.847	0.004	0.1701	18.8
15 minute summer	E.Discharge	10	6.833	0.033	48.4	0.0000	0.0000	OK							
15 minute summer	P.Impermeable	9	8.525	0.175	597.9	3.2677	0.0000	OK	P.Drain2	P.Outlet	598.5	7.094	0.056	0.8473	
15 minute summer	P.Outlet	9	7.457	0.157	598.5	0.0000	0.0000	OK	P.Outfall	P.Discharge	598.7	6.653	0.051	0.9001	232.8
15 minute summer	P.Discharge	10	6.956	0.156	598.7	0.0000	0.0000	OK							

Appendix A.5 – Surface Water Runoff Calculations

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 6003 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.149	0.149	0.0	0.7	0.0	0.7	200.2	O K
30 min Summer	9.203	0.203	0.0	0.8	0.0	0.8	273.6	O K
60 min Summer	9.261	0.261	0.0	0.9	0.0	0.9	351.7	O K
120 min Summer	9.324	0.324	0.0	1.0	0.0	1.0	436.7	O K
180 min Summer	9.367	0.367	0.0	1.1	0.0	1.1	493.9	O K
240 min Summer	9.400	0.400	0.0	1.2	0.0	1.2	538.8	O K
360 min Summer	9.453	0.453	0.0	1.2	0.0	1.2	610.4	O K
480 min Summer	9.496	0.496	0.0	1.3	0.0	1.3	668.5	O K
600 min Summer	9.532	0.532	0.0	1.4	0.0	1.4	716.1	O K
720 min Summer	9.561	0.561	0.0	1.4	0.0	1.4	755.8	O K
960 min Summer	9.607	0.607	0.0	1.4	0.0	1.4	816.8	O K
1440 min Summer	9.661	0.661	0.0	1.5	0.0	1.5	890.4	O K
2160 min Summer	9.696	0.696	0.0	1.6	0.0	1.6	937.6	O K
2880 min Summer	9.708	0.708	0.0	1.6	0.0	1.6	953.1	O K
4320 min Summer	9.700	0.700	0.0	1.6	0.0	1.6	942.8	O K
5760 min Summer	9.689	0.689	0.0	1.5	0.0	1.5	927.5	O K
7200 min Summer	9.679	0.679	0.0	1.5	0.0	1.5	914.0	O K
8640 min Summer	9.670	0.670	0.0	1.5	0.0	1.5	902.0	O K
10080 min Summer	9.662	0.662	0.0	1.5	0.0	1.5	891.2	O K
15 min Winter	9.149	0.149	0.0	0.7	0.0	0.7	200.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	118.731	0.0	54.2	0.0	19
30 min Summer	79.046	0.0	65.0	0.0	34
60 min Summer	50.083	0.0	140.7	0.0	64
120 min Summer	30.883	0.0	159.1	0.0	124
180 min Summer	23.263	0.0	170.0	0.0	184
240 min Summer	19.052	0.0	177.6	0.0	244
360 min Summer	14.441	0.0	188.3	0.0	364
480 min Summer	11.921	0.0	195.6	0.0	484
600 min Summer	10.272	0.0	200.6	0.0	604
720 min Summer	9.088	0.0	203.8	0.0	724
960 min Summer	7.457	0.0	206.5	0.0	962
1440 min Summer	5.562	0.0	203.0	0.0	1442
2160 min Summer	4.067	0.0	425.1	0.0	2160
2880 min Summer	3.231	0.0	414.5	0.0	2880
4320 min Summer	2.313	0.0	377.7	0.0	4020
5760 min Summer	1.823	0.0	780.0	0.0	4672
7200 min Summer	1.519	0.0	753.6	0.0	5400
8640 min Summer	1.311	0.0	720.4	0.0	6144
10080 min Summer	1.160	0.0	681.6	0.0	6968
15 min Winter	118.731	0.0	54.2	0.0	19

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	9.203	0.203	0.0	0.8	0.0	0.8	273.6	O K
60 min Winter	9.261	0.261	0.0	0.9	0.0	0.9	351.7	O K
120 min Winter	9.324	0.324	0.0	1.0	0.0	1.0	436.6	O K
180 min Winter	9.367	0.367	0.0	1.1	0.0	1.1	493.9	O K
240 min Winter	9.400	0.400	0.0	1.2	0.0	1.2	538.9	O K
360 min Winter	9.453	0.453	0.0	1.2	0.0	1.2	610.4	O K
480 min Winter	9.496	0.496	0.0	1.3	0.0	1.3	668.6	O K
600 min Winter	9.532	0.532	0.0	1.4	0.0	1.4	716.3	O K
720 min Winter	9.561	0.561	0.0	1.4	0.0	1.4	756.1	O K
960 min Winter	9.607	0.607	0.0	1.4	0.0	1.4	817.2	O K
1440 min Winter	9.662	0.662	0.0	1.5	0.0	1.5	891.3	O K
2160 min Winter	9.698	0.698	0.0	1.6	0.0	1.6	939.7	O K
2880 min Winter	9.711	0.711	0.0	1.6	0.0	1.6	956.8	O K
4320 min Winter	9.706	0.706	0.0	1.6	0.0	1.6	950.2	O K
5760 min Winter	9.688	0.688	0.0	1.5	0.0	1.5	926.9	O K
7200 min Winter	9.676	0.676	0.0	1.5	0.0	1.5	910.7	O K
8640 min Winter	9.664	0.664	0.0	1.5	0.0	1.5	894.4	O K
10080 min Winter	9.652	0.652	0.0	1.5	0.0	1.5	878.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	79.046	0.0	65.0	0.0	34
60 min Winter	50.083	0.0	140.7	0.0	64
120 min Winter	30.883	0.0	159.2	0.0	124
180 min Winter	23.263	0.0	170.0	0.0	182
240 min Winter	19.052	0.0	177.7	0.0	242
360 min Winter	14.441	0.0	188.4	0.0	360
480 min Winter	11.921	0.0	195.8	0.0	478
600 min Winter	10.272	0.0	200.7	0.0	596
720 min Winter	9.088	0.0	204.0	0.0	714
960 min Winter	7.457	0.0	206.8	0.0	952
1440 min Winter	5.562	0.0	203.4	0.0	1414
2160 min Winter	4.067	0.0	425.7	0.0	2116
2880 min Winter	3.231	0.0	415.3	0.0	2792
4320 min Winter	2.313	0.0	378.9	0.0	4104
5760 min Winter	1.823	0.0	781.3	0.0	4848
7200 min Winter	1.519	0.0	755.4	0.0	5616
8640 min Winter	1.311	0.0	722.8	0.0	6488
10080 min Winter	1.160	0.0	684.6	0.0	7456

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 618329 134790	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.752

Time (mins) From:	To:	Area (ha)
0	4	0.752

Model Details

Storage is Online Cover Level (m) 10.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	67.0
Membrane Percolation (mm/hr)	1000	Length (m)	67.0
Max Percolation (l/s)	1246.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.000	Membrane Depth (m)	0

Orifice Outflow Control

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 9.000

Pipe Overflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	9.800
Manning's n	0.015		

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.287	0.287	1.6	0.0	1.6	439.6	O K
30 min Summer	9.360	0.360	1.6	0.0	1.6	584.7	O K
60 min Summer	9.431	0.431	1.7	0.0	1.7	739.4	O K
120 min Summer	9.501	0.501	1.7	0.0	1.7	908.5	O K
180 min Summer	9.545	0.545	1.7	0.0	1.7	1023.1	O K
240 min Summer	9.578	0.578	1.7	0.0	1.7	1113.7	O K
360 min Summer	9.628	0.628	1.7	0.0	1.7	1258.9	O K
480 min Summer	9.665	0.665	1.7	0.0	1.7	1378.3	O K
600 min Summer	9.695	0.695	1.7	0.0	1.7	1477.2	O K
720 min Summer	9.720	0.720	1.7	0.0	1.7	1560.9	O K
960 min Summer	9.756	0.756	1.7	0.0	1.7	1692.1	O K
1440 min Summer	9.801	0.801	1.8	0.0	1.8	1860.3	O K
2160 min Summer	9.833	0.833	1.8	0.0	1.8	1988.2	O K
2880 min Summer	9.849	0.849	1.9	0.0	1.9	2052.7	O K
4320 min Summer	9.859	0.859	1.9	0.0	1.9	2094.6	O K
5760 min Summer	9.858	0.858	1.9	0.0	1.9	2092.8	O K
7200 min Summer	9.853	0.853	1.9	0.0	1.9	2072.6	O K
8640 min Summer	9.847	0.847	1.8	0.0	1.8	2044.4	O K
10080 min Summer	9.841	0.841	1.8	0.0	1.8	2021.1	O K
15 min Winter	9.287	0.287	1.6	0.0	1.6	439.6	O K
30 min Winter	9.360	0.360	1.7	0.0	1.7	584.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	118.731	0.0	89.8	0.0	19
30 min Summer	79.046	0.0	101.0	0.0	34
60 min Summer	50.083	0.0	215.3	0.0	64
120 min Summer	30.883	0.0	233.4	0.0	124
180 min Summer	23.263	0.0	243.6	0.0	184
240 min Summer	19.052	0.0	250.7	0.0	244
360 min Summer	14.441	0.0	260.3	0.0	364
480 min Summer	11.921	0.0	266.6	0.0	484
600 min Summer	10.272	0.0	270.8	0.0	604
720 min Summer	9.088	0.0	273.5	0.0	724
960 min Summer	7.457	0.0	275.9	0.0	964
1440 min Summer	5.562	0.0	274.0	0.0	1444
2160 min Summer	4.067	0.0	568.8	0.0	2164
2880 min Summer	3.231	0.0	561.2	0.0	2884
4320 min Summer	2.313	0.0	536.0	0.0	4320
5760 min Summer	1.823	0.0	1117.9	0.0	5760
7200 min Summer	1.519	0.0	1096.5	0.0	7200
8640 min Summer	1.311	0.0	1070.6	0.0	8216
10080 min Summer	1.160	0.0	1040.8	0.0	8776
15 min Winter	118.731	0.0	89.8	0.0	19
30 min Winter	79.046	0.0	101.0	0.0	34

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	9.431	0.431	1.7	0.0	1.7	739.4	O K
120 min Winter	9.501	0.501	1.7	0.0	1.7	908.6	O K
180 min Winter	9.545	0.545	1.7	0.0	1.7	1023.3	O K
240 min Winter	9.578	0.578	1.7	0.0	1.7	1114.1	O K
360 min Winter	9.628	0.628	1.7	0.0	1.7	1259.6	O K
480 min Winter	9.666	0.666	1.7	0.0	1.7	1379.2	O K
600 min Winter	9.696	0.696	1.7	0.0	1.7	1478.4	O K
720 min Winter	9.720	0.720	1.7	0.0	1.7	1562.2	O K
960 min Winter	9.757	0.757	1.7	0.0	1.7	1694.0	O K
1440 min Winter	9.802	0.802	1.8	0.0	1.8	1863.2	O K
2160 min Winter	9.834	0.834	1.8	0.0	1.8	1992.6	O K
2880 min Winter	9.850	0.850	1.9	0.0	1.9	2059.0	O K
4320 min Winter	9.861	0.861	1.9	0.0	1.9	2105.7	O K
5760 min Winter	9.862	0.862	1.9	0.0	1.9	2109.7	O K
7200 min Winter	9.859	0.859	1.9	0.0	1.9	2096.4	O K
8640 min Winter	9.854	0.854	1.9	0.0	1.9	2074.8	O K
10080 min Winter	9.848	0.848	1.8	0.0	1.8	2049.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	50.083	0.0	215.3	0.0	64
120 min Winter	30.883	0.0	233.3	0.0	124
180 min Winter	23.263	0.0	243.5	0.0	182
240 min Winter	19.052	0.0	250.5	0.0	242
360 min Winter	14.441	0.0	259.9	0.0	362
480 min Winter	11.921	0.0	266.0	0.0	480
600 min Winter	10.272	0.0	270.0	0.0	598
720 min Winter	9.088	0.0	272.6	0.0	716
960 min Winter	7.457	0.0	274.7	0.0	954
1440 min Winter	5.562	0.0	272.2	0.0	1428
2160 min Winter	4.067	0.0	566.3	0.0	2136
2880 min Winter	3.231	0.0	557.9	0.0	2828
4320 min Winter	2.313	0.0	530.9	0.0	4232
5760 min Winter	1.823	0.0	1111.4	0.0	5592
7200 min Winter	1.519	0.0	1088.1	0.0	6912
8640 min Winter	1.311	0.0	1060.4	0.0	8208
10080 min Winter	1.160	0.0	1029.0	0.0	9472

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 618329 134790	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.484

Time (mins) From:	To:	Area (ha)
0	4	1.484

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1200.0	0.500	2500.0	1.000	5000.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0064-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	No
Diameter (mm)	64
Invert Level (m)	9.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.156	1.7
Kick-Flo®	0.223	1.0
Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	1.200	2.2	3.000	3.4	7.000	5.2
0.200	1.1	1.400	2.4	3.500	3.7	7.500	5.4
0.300	1.1	1.600	2.5	4.000	4.0	8.000	5.6
0.400	1.3	1.800	2.7	4.500	4.2	8.500	5.7
0.500	1.4	2.000	2.8	5.000	4.4	9.000	5.9
0.600	1.6	2.200	2.9	5.500	4.6	9.500	6.0
0.800	1.8	2.400	3.1	6.000	4.8		
1.000	2.0	2.600	3.2	6.500	5.0		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.200 Invert Level (m) 9.960

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 6397 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	8.285	0.285	0.0	1.2	0.0	1.2	271.2	O K
30 min Summer	8.380	0.380	0.0	1.3	0.0	1.3	360.6	O K
60 min Summer	8.480	0.480	0.0	1.3	0.0	1.3	455.7	O K
120 min Summer	8.589	0.589	0.0	1.3	0.0	1.3	559.1	O K
180 min Summer	8.662	0.662	0.0	1.3	0.0	1.3	628.8	O K
240 min Summer	8.720	0.720	0.0	1.4	0.0	1.4	683.6	O K
360 min Summer	8.811	0.811	0.0	1.5	0.0	1.5	770.8	O K
480 min Summer	8.886	0.886	0.0	1.5	0.0	1.5	841.9	O K
600 min Summer	8.947	0.947	0.0	1.6	0.0	1.6	900.1	O K
720 min Summer	8.999	0.999	0.0	1.6	0.0	1.6	948.8	O K
960 min Summer	9.078	1.078	0.0	1.7	0.0	1.7	1023.8	O K
1440 min Summer	9.174	1.174	0.0	1.8	0.0	1.8	1115.1	O K
2160 min Summer	9.237	1.237	0.0	1.8	0.0	1.8	1175.1	O K
2880 min Summer	9.259	1.259	0.0	1.8	0.0	1.8	1196.4	O K
4320 min Summer	9.249	1.249	0.0	1.8	0.0	1.8	1186.6	O K
5760 min Summer	9.221	1.221	0.0	1.8	0.0	1.8	1159.7	O K
7200 min Summer	9.197	1.197	0.0	1.8	0.0	1.8	1136.9	O K
8640 min Summer	9.176	1.176	0.0	1.8	0.0	1.8	1116.9	O K
10080 min Summer	9.158	1.158	0.0	1.8	0.0	1.8	1099.8	O K
15 min Winter	8.285	0.285	0.0	1.3	0.0	1.3	271.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	118.731	0.0	71.4	0.0	19
30 min Summer	79.046	0.0	82.6	0.0	34
60 min Summer	50.083	0.0	176.6	0.0	64
120 min Summer	30.883	0.0	196.9	0.0	124
180 min Summer	23.263	0.0	209.2	0.0	184
240 min Summer	19.052	0.0	218.0	0.0	244
360 min Summer	14.441	0.0	230.7	0.0	364
480 min Summer	11.921	0.0	239.8	0.0	484
600 min Summer	10.272	0.0	246.2	0.0	604
720 min Summer	9.088	0.0	250.8	0.0	724
960 min Summer	7.457	0.0	255.7	0.0	962
1440 min Summer	5.562	0.0	255.7	0.0	1442
2160 min Summer	4.067	0.0	527.1	0.0	2160
2880 min Summer	3.231	0.0	521.1	0.0	2880
4320 min Summer	2.313	0.0	492.1	0.0	4320
5760 min Summer	1.823	0.0	992.1	0.0	4968
7200 min Summer	1.519	0.0	973.4	0.0	5696
8640 min Summer	1.311	0.0	946.7	0.0	6480
10080 min Summer	1.160	0.0	912.8	0.0	7264
15 min Winter	118.731	0.0	71.4	0.0	19

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	8.380	0.380	0.0	1.3	0.0	1.3	360.6	O K
60 min Winter	8.480	0.480	0.0	1.3	0.0	1.3	455.7	O K
120 min Winter	8.589	0.589	0.0	1.3	0.0	1.3	559.2	O K
180 min Winter	8.662	0.662	0.0	1.3	0.0	1.3	629.0	O K
240 min Winter	8.720	0.720	0.0	1.4	0.0	1.4	683.9	O K
360 min Winter	8.812	0.812	0.0	1.5	0.0	1.5	771.4	O K
480 min Winter	8.887	0.887	0.0	1.5	0.0	1.5	842.6	O K
600 min Winter	8.949	0.949	0.0	1.6	0.0	1.6	901.1	O K
720 min Winter	9.000	1.000	0.0	1.6	0.0	1.6	950.0	O K
960 min Winter	9.079	1.079	0.0	1.7	0.0	1.7	1025.5	O K
1440 min Winter	9.177	1.177	0.0	1.8	0.0	1.8	1117.7	O K
2160 min Winter	9.242	1.242	0.0	1.8	0.0	1.8	1179.7	O K
2880 min Winter	9.267	1.267	0.0	1.8	0.0	1.8	1203.2	O K
4320 min Winter	9.263	1.263	0.0	1.8	0.0	1.8	1199.6	O K
5760 min Winter	9.235	1.235	0.0	1.8	0.0	1.8	1173.3	O K
7200 min Winter	9.204	1.204	0.0	1.8	0.0	1.8	1144.2	O K
8640 min Winter	9.182	1.182	0.0	1.8	0.0	1.8	1122.8	O K
10080 min Winter	9.160	1.160	0.0	1.8	0.0	1.8	1102.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	79.046	0.0	82.7	0.0	34
60 min Winter	50.083	0.0	176.6	0.0	64
120 min Winter	30.883	0.0	196.9	0.0	124
180 min Winter	23.263	0.0	209.1	0.0	182
240 min Winter	19.052	0.0	217.9	0.0	242
360 min Winter	14.441	0.0	230.4	0.0	360
480 min Winter	11.921	0.0	239.4	0.0	478
600 min Winter	10.272	0.0	245.7	0.0	596
720 min Winter	9.088	0.0	250.1	0.0	716
960 min Winter	7.457	0.0	254.9	0.0	952
1440 min Winter	5.562	0.0	254.5	0.0	1424
2160 min Winter	4.067	0.0	525.5	0.0	2116
2880 min Winter	3.231	0.0	519.0	0.0	2796
4320 min Winter	2.313	0.0	488.6	0.0	4148
5760 min Winter	1.823	0.0	988.4	0.0	5408
7200 min Winter	1.519	0.0	968.6	0.0	5840
8640 min Winter	1.311	0.0	940.9	0.0	6736
10080 min Winter	1.160	0.0	906.2	0.0	7656

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 618329 134790	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.916

Time (mins) From:	To:	Area (ha)
0	4	0.916

Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 8.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1000.0	1000.0	1.501	0.0	1189.8
1.500	1000.0	1189.7			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0058-2000-1500-2000
Design Head (m)	1.500
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	No
Diameter (mm)	58
Invert Level (m)	8.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.0
Flush-Flo™	0.141	1.3
Kick-Flo®	0.202	0.8
Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	1.200	1.8	3.000	2.8	7.000	4.3
0.200	0.8	1.400	1.9	3.500	3.0	7.500	4.4
0.300	0.9	1.600	2.1	4.000	3.2	8.000	4.5
0.400	1.0	1.800	2.2	4.500	3.4	8.500	4.7
0.500	1.2	2.000	2.3	5.000	3.6	9.000	4.8
0.600	1.3	2.200	2.4	5.500	3.8	9.500	4.9
0.800	1.5	2.400	2.5	6.000	3.9		
1.000	1.6	2.600	2.6	6.500	4.1		

Pipe Overflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	9.300
Manning's n	0.015		

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 6675 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	8.307	0.307	0.0	1.3	0.0	1.3	292.0	O K
30 min Summer	8.409	0.409	0.0	1.3	0.0	1.3	388.2	O K
60 min Summer	8.516	0.516	0.0	1.3	0.0	1.3	490.6	O K
120 min Summer	8.634	0.634	0.0	1.3	0.0	1.3	602.1	O K
180 min Summer	8.713	0.713	0.0	1.4	0.0	1.4	677.3	O K
240 min Summer	8.775	0.775	0.0	1.4	0.0	1.4	736.5	O K
360 min Summer	8.874	0.874	0.0	1.5	0.0	1.5	830.7	O K
480 min Summer	8.955	0.955	0.0	1.6	0.0	1.6	907.6	O K
600 min Summer	9.022	1.022	0.0	1.7	0.0	1.7	970.7	O K
720 min Summer	9.077	1.077	0.0	1.7	0.0	1.7	1023.5	O K
960 min Summer	9.163	1.163	0.0	1.8	0.0	1.8	1105.0	O K
1440 min Summer	9.268	1.268	0.0	1.8	0.0	1.8	1205.0	O K
2160 min Summer	9.339	1.339	0.0	1.9	0.0	1.9	1272.1	O K
2880 min Summer	9.366	1.366	0.0	1.9	0.0	1.9	1297.4	O K
4320 min Summer	9.359	1.359	0.0	1.9	0.0	1.9	1291.3	O K
5760 min Summer	9.330	1.330	0.0	1.9	0.0	1.9	1263.8	O K
7200 min Summer	9.306	1.306	0.0	1.9	0.0	1.9	1240.4	O K
8640 min Summer	9.284	1.284	0.0	1.9	0.0	1.9	1219.8	O K
10080 min Summer	9.265	1.265	0.0	1.8	0.0	1.8	1202.2	O K
15 min Winter	8.307	0.307	0.0	1.3	0.0	1.3	291.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	118.731	0.0	74.2	0.0	19
30 min Summer	79.046	0.0	85.9	0.0	34
60 min Summer	50.083	0.0	183.9	0.0	64
120 min Summer	30.883	0.0	204.9	0.0	124
180 min Summer	23.263	0.0	217.6	0.0	184
240 min Summer	19.052	0.0	226.8	0.0	244
360 min Summer	14.441	0.0	239.9	0.0	364
480 min Summer	11.921	0.0	249.2	0.0	484
600 min Summer	10.272	0.0	255.8	0.0	604
720 min Summer	9.088	0.0	260.4	0.0	724
960 min Summer	7.457	0.0	265.5	0.0	962
1440 min Summer	5.562	0.0	265.2	0.0	1442
2160 min Summer	4.067	0.0	548.2	0.0	2160
2880 min Summer	3.231	0.0	541.5	0.0	2880
4320 min Summer	2.313	0.0	510.6	0.0	4320
5760 min Summer	1.823	0.0	1036.1	0.0	5128
7200 min Summer	1.519	0.0	1015.9	0.0	5832
8640 min Summer	1.311	0.0	987.4	0.0	6568
10080 min Summer	1.160	0.0	951.9	0.0	7352
15 min Winter	118.731	0.0	74.2	0.0	19

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	8.409	0.409	0.0	1.3	0.0	1.3	388.2	O K
60 min Winter	8.516	0.516	0.0	1.3	0.0	1.3	490.6	O K
120 min Winter	8.634	0.634	0.0	1.3	0.0	1.3	602.2	O K
180 min Winter	8.713	0.713	0.0	1.4	0.0	1.4	677.5	O K
240 min Winter	8.776	0.776	0.0	1.4	0.0	1.4	736.8	O K
360 min Winter	8.875	0.875	0.0	1.5	0.0	1.5	831.3	O K
480 min Winter	8.956	0.956	0.0	1.6	0.0	1.6	908.3	O K
600 min Winter	9.023	1.023	0.0	1.7	0.0	1.7	971.6	O K
720 min Winter	9.079	1.079	0.0	1.7	0.0	1.7	1024.7	O K
960 min Winter	9.165	1.165	0.0	1.8	0.0	1.8	1106.7	O K
1440 min Winter	9.271	1.271	0.0	1.8	0.0	1.8	1207.5	O K
2160 min Winter	9.344	1.344	0.0	1.9	0.0	1.9	1276.5	O K
2880 min Winter	9.373	1.373	0.0	1.9	0.0	1.9	1304.0	O K
4320 min Winter	9.373	1.373	0.0	1.9	0.0	1.9	1304.1	O K
5760 min Winter	9.346	1.346	0.0	1.9	0.0	1.9	1279.1	O K
7200 min Winter	9.314	1.314	0.0	1.9	0.0	1.9	1247.9	O K
8640 min Winter	9.291	1.291	0.0	1.9	0.0	1.9	1226.4	O K
10080 min Winter	9.270	1.270	0.0	1.8	0.0	1.8	1206.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	79.046	0.0	85.9	0.0	34
60 min Winter	50.083	0.0	183.8	0.0	64
120 min Winter	30.883	0.0	204.8	0.0	124
180 min Winter	23.263	0.0	217.5	0.0	182
240 min Winter	19.052	0.0	226.6	0.0	242
360 min Winter	14.441	0.0	239.6	0.0	360
480 min Winter	11.921	0.0	248.8	0.0	478
600 min Winter	10.272	0.0	255.3	0.0	596
720 min Winter	9.088	0.0	259.8	0.0	716
960 min Winter	7.457	0.0	264.7	0.0	952
1440 min Winter	5.562	0.0	264.0	0.0	1426
2160 min Winter	4.067	0.0	546.8	0.0	2120
2880 min Winter	3.231	0.0	539.6	0.0	2800
4320 min Winter	2.313	0.0	507.4	0.0	4148
5760 min Winter	1.823	0.0	1032.6	0.0	5416
7200 min Winter	1.519	0.0	1011.2	0.0	5976
8640 min Winter	1.311	0.0	981.6	0.0	6744
10080 min Winter	1.160	0.0	945.0	0.0	7664

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 618329 134790	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.986

Time (mins) From:	To:	Area (ha)
0	4	0.986

Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 8.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1000.0	1000.0	1.501	0.0	1189.8
1.500	1000.0	1189.7			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0058-2000-1500-2000
Design Head (m)	1.500
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	No
Diameter (mm)	58
Invert Level (m)	8.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.0
Flush-Flo™	0.141	1.3
Kick-Flo®	0.202	0.8
Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	1.200	1.8	3.000	2.8	7.000	4.3
0.200	0.8	1.400	1.9	3.500	3.0	7.500	4.4
0.300	0.9	1.600	2.1	4.000	3.2	8.000	4.5
0.400	1.0	1.800	2.2	4.500	3.4	8.500	4.7
0.500	1.2	2.000	2.3	5.000	3.6	9.000	4.8
0.600	1.3	2.200	2.4	5.500	3.8	9.500	4.9
0.800	1.5	2.400	2.5	6.000	3.9		
1.000	1.6	2.600	2.6	6.500	4.1		

Pipe Overflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	9.400
Manning's n	0.015		

Cascade Summary of Results for Drainage Area E, Basin and Storage.SRCX

Upstream Structures	Outflow To	Overflow To
Drainage Area C, Private East.SRCX Drainage Area D, Private West.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.594	0.094	2.7	75.5	O K
30 min Summer	8.625	0.125	2.7	100.0	O K
60 min Summer	8.658	0.158	2.8	126.1	O K
120 min Summer	8.692	0.192	2.9	153.8	O K
180 min Summer	8.716	0.216	2.9	172.6	O K
240 min Summer	8.734	0.234	3.0	187.5	O K
360 min Summer	8.765	0.265	3.0	211.6	O K
480 min Summer	8.791	0.291	3.1	232.8	O K
600 min Summer	8.815	0.315	3.1	252.2	O K
720 min Summer	8.837	0.337	3.2	269.7	O K
960 min Summer	8.874	0.374	3.2	299.2	O K
1440 min Summer	8.925	0.425	3.3	339.7	O K
2160 min Summer	8.968	0.468	3.4	374.8	O K
2880 min Summer	8.994	0.494	3.5	395.4	O K
4320 min Summer	9.501	1.001	4.3	400.8	O K
5760 min Summer	9.437	0.937	4.2	400.7	O K
7200 min Summer	9.374	0.874	4.1	400.6	O K
8640 min Summer	9.328	0.828	4.0	400.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.731	0.0	220.3	19
30 min Summer	79.046	0.0	228.5	34
60 min Summer	50.083	0.0	461.3	64
120 min Summer	30.883	0.0	480.5	124
180 min Summer	23.263	0.0	492.2	184
240 min Summer	19.052	0.0	500.6	244
360 min Summer	14.441	0.0	512.4	364
480 min Summer	11.921	0.0	520.7	914
600 min Summer	10.272	0.0	526.4	1380
720 min Summer	9.088	0.0	530.0	1754
960 min Summer	7.457	0.0	532.5	2340
1440 min Summer	5.562	0.0	526.9	2880
2160 min Summer	4.067	0.0	1094.7	3964
2880 min Summer	3.231	0.0	1075.2	4612
4320 min Summer	2.313	0.0	1033.8	4320
5760 min Summer	1.823	0.0	2163.8	5248
7200 min Summer	1.519	0.0	2111.8	6264
8640 min Summer	1.311	0.0	2049.3	7256

Cascade Summary of Results for Drainage Area E, Basin and Storage.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	9.286	0.786	3.9	400.6	O K
15 min Winter	8.594	0.094	2.7	75.5	O K
30 min Winter	8.625	0.125	2.7	100.1	O K
60 min Winter	8.658	0.158	2.8	126.0	O K
120 min Winter	8.692	0.192	2.9	153.9	O K
180 min Winter	8.716	0.216	2.9	172.7	O K
240 min Winter	8.734	0.234	3.0	187.5	O K
360 min Winter	8.765	0.265	3.0	211.7	O K
480 min Winter	8.791	0.291	3.1	233.1	O K
600 min Winter	8.816	0.316	3.1	252.6	O K
720 min Winter	8.838	0.338	3.2	270.2	O K
960 min Winter	8.875	0.375	3.2	299.6	O K
1440 min Winter	8.925	0.425	3.3	340.0	O K
2160 min Winter	8.969	0.469	3.4	375.0	O K
2880 min Winter	8.994	0.494	3.5	395.5	O K
4320 min Winter	9.426	0.926	4.2	400.7	O K
5760 min Winter	9.501	1.001	4.3	400.8	O K
7200 min Winter	9.425	0.925	4.2	400.7	O K
8640 min Winter	9.352	0.852	4.0	400.6	O K
10080 min Winter	9.295	0.795	4.0	400.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.160	0.0	1979.0	8264
15 min Winter	118.731	0.0	220.3	19
30 min Winter	79.046	0.0	228.5	34
60 min Winter	50.083	0.0	461.3	64
120 min Winter	30.883	0.0	480.4	124
180 min Winter	23.263	0.0	491.9	182
240 min Winter	19.052	0.0	500.1	242
360 min Winter	14.441	0.0	511.7	364
480 min Winter	11.921	0.0	519.6	920
600 min Winter	10.272	0.0	524.9	1380
720 min Winter	9.088	0.0	528.2	1756
960 min Winter	7.457	0.0	530.4	2336
1440 min Winter	5.562	0.0	524.3	2880
2160 min Winter	4.067	0.0	1091.3	3976
2880 min Winter	3.231	0.0	1070.9	4632
4320 min Winter	2.313	0.0	1027.1	4192
5760 min Winter	1.823	0.0	2155.3	5304
7200 min Winter	1.519	0.0	2100.8	6384
8640 min Winter	1.311	0.0	2036.4	7392
10080 min Winter	1.160	0.0	1964.7	8456

Cascade Rainfall Details for Drainage Area E, Basin and Storage.SRCX

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 618329 134790	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.259

Time (mins) From:	To:	Area (ha)
0	4	0.259

Cascade Model Details for Drainage Area E, Basin and Storage.SRCX

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	800.0	0.501	1.0	1.001	640.0
0.500	800.0	1.000	1.0	1.500	1000.0

Orifice Outflow Control

Diameter (m) 0.041 Discharge Coefficient 0.600 Invert Level (m) 8.000

Summary of Results for Input Hydrograph

Half Drain Time : 7035 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
Input Hydrograph	9.984	0.984	0.0	1.8	1.8	1325.1	O K

Storm Event	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	623.9	3008

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4	0.0	204	0.0	404	2.8	604	3.1	804	4.9	1004	8.6
8	0.0	208	0.0	408	2.8	608	3.3	808	5.1	1008	8.6
12	0.0	212	0.0	412	2.8	612	3.3	812	5.3	1012	9.2
16	0.0	216	0.0	416	2.8	616	3.3	816	5.3	1016	9.2
20	0.0	220	0.0	420	2.8	620	3.3	820	5.3	1020	9.2
24	0.0	224	0.0	424	2.8	624	3.3	824	5.3	1024	9.2
28	0.0	228	0.0	428	2.8	628	3.3	828	5.3	1028	9.2
32	0.0	232	2.4	432	2.8	632	3.3	832	5.3	1032	9.2
36	0.0	236	2.7	436	2.8	636	3.4	836	5.4	1036	9.2
40	0.0	240	2.7	440	2.8	640	3.5	840	5.8	1040	9.7
44	0.0	244	2.7	444	2.8	644	3.5	844	5.8	1044	9.8
48	0.0	248	2.7	448	2.8	648	3.5	848	5.8	1048	9.8
52	0.0	252	2.7	452	2.8	652	3.5	852	5.8	1052	9.8
56	0.0	256	2.7	456	2.8	656	3.5	856	5.8	1056	9.8
60	0.0	260	2.8	460	2.8	660	3.5	860	5.8	1060	9.8
64	0.0	264	2.8	464	2.9	664	3.5	864	5.8	1064	9.8
68	0.0	268	2.8	468	2.9	668	3.7	868	6.3	1068	10.2
72	0.0	272	2.8	472	2.9	672	3.7	872	6.3	1072	10.5
76	0.0	276	2.8	476	2.9	676	3.7	876	6.3	1076	10.5
80	0.0	280	2.8	480	2.9	680	3.7	880	6.3	1080	10.5
84	0.0	284	2.8	484	2.9	684	3.7	884	6.3	1084	10.5
88	0.0	288	2.8	488	2.9	688	3.7	888	6.3	1088	10.5
92	0.0	292	2.8	492	2.9	692	3.7	892	6.3	1092	10.5
96	0.0	296	2.8	496	2.9	696	3.9	896	6.7	1096	10.8
100	0.0	300	2.8	500	2.9	700	3.9	900	6.8	1100	11.2
104	0.0	304	2.8	504	2.9	704	3.9	904	6.8	1104	11.2
108	0.0	308	2.8	508	2.9	708	3.9	908	6.8	1108	11.2
112	0.0	312	2.8	512	2.9	712	3.9	912	6.8	1112	11.2
116	0.0	316	2.8	516	2.9	716	3.9	916	6.8	1116	11.2
120	0.0	320	2.8	520	2.9	720	3.9	920	6.8	1120	11.2
124	0.0	324	2.9	524	2.9	724	4.2	924	7.1	1124	11.3
128	0.0	328	2.9	528	2.9	728	4.2	928	7.4	1128	11.9
132	0.0	332	2.9	532	2.9	732	4.2	932	7.4	1132	11.9
136	0.0	336	2.9	536	2.9	736	4.2	936	7.4	1136	11.9
140	0.0	340	2.9	540	2.9	740	4.2	940	7.4	1140	11.9
144	0.0	344	2.9	544	2.9	744	4.2	944	7.4	1144	11.9
148	0.0	348	2.9	548	3.0	748	4.2	948	7.4	1148	11.9
152	0.0	352	2.9	552	3.0	752	4.5	952	7.6	1152	11.9
156	0.0	356	2.9	556	3.0	756	4.6	956	7.9	1156	12.5
160	0.0	360	2.9	560	3.0	760	4.6	960	7.9	1160	12.5
164	0.0	364	2.9	564	3.0	764	4.6	964	7.9	1164	12.5
168	0.0	368	2.9	568	3.0	768	4.6	968	7.9	1168	12.5
172	0.0	372	2.9	572	3.0	772	4.6	972	7.9	1172	12.5
176	0.0	376	2.9	576	3.0	776	4.6	976	7.9	1176	12.5
180	0.0	380	2.8	580	3.1	780	4.8	980	8.1	1180	12.5
184	0.0	384	2.8	584	3.1	784	4.9	984	8.6	1184	13.0
188	0.0	388	2.8	588	3.1	788	4.9	988	8.6	1188	13.2
192	0.0	392	2.8	592	3.1	792	4.9	992	8.6	1192	13.2
196	0.0	396	2.8	596	3.1	796	4.9	996	8.6	1196	13.2
200	0.0	400	2.8	600	3.1	800	4.9	1000	8.6	1200	13.2

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
1204	13.2	1404	16.7	1604	15.0	1804	10.5	2004	6.3	2204	3.7
1208	13.2	1408	16.7	1608	15.0	1808	10.5	2008	6.3	2208	3.7
1212	13.6	1412	16.7	1612	15.0	1812	10.5	2012	6.3	2212	3.7
1216	13.8	1416	16.9	1616	14.5	1816	10.2	2016	6.3	2216	3.7
1220	13.8	1420	16.9	1620	14.4	1820	9.8	2020	5.8	2220	3.5
1224	13.8	1424	16.9	1624	14.4	1824	9.8	2024	5.8	2224	3.5
1228	13.8	1428	16.9	1628	14.4	1828	9.8	2028	5.8	2228	3.5
1232	13.8	1432	16.9	1632	14.4	1832	9.8	2032	5.8	2232	3.5
1236	13.8	1436	16.9	1636	14.4	1836	9.8	2036	5.8	2236	3.5
1240	14.0	1440	16.9	1640	14.4	1840	9.8	2040	5.8	2240	3.5
1244	14.4	1444	16.9	1644	14.0	1844	9.7	2044	5.8	2244	3.5
1248	14.4	1448	16.9	1648	13.8	1848	9.2	2048	5.4	2248	3.4
1252	14.4	1452	16.9	1652	13.8	1852	9.2	2052	5.3	2252	3.3
1256	14.4	1456	16.9	1656	13.8	1856	9.2	2056	5.3	2256	3.3
1260	14.4	1460	16.9	1660	13.8	1860	9.2	2060	5.3	2260	3.3
1264	14.4	1464	16.9	1664	13.8	1864	9.2	2064	5.3	2264	3.3
1268	14.5	1468	16.9	1668	13.8	1868	9.2	2068	5.3	2268	3.3
1272	15.0	1472	16.7	1672	13.6	1872	9.2	2072	5.3	2272	3.3
1276	15.0	1476	16.7	1676	13.2	1876	8.6	2076	5.1	2276	3.3
1280	15.0	1480	16.7	1680	13.2	1880	8.6	2080	4.9	2280	3.1
1284	15.0	1484	16.7	1684	13.2	1884	8.6	2084	4.9	2284	3.1
1288	15.0	1488	16.7	1688	13.2	1888	8.6	2088	4.9	2288	3.1
1292	15.0	1492	16.7	1692	13.2	1892	8.6	2092	4.9	2292	3.1
1296	15.0	1496	16.7	1696	13.2	1896	8.6	2096	4.9	2296	3.1
1300	15.5	1500	16.5	1700	13.0	1900	8.6	2100	4.9	2300	3.1
1304	15.5	1504	16.4	1704	12.5	1904	8.1	2104	4.8	2304	3.1
1308	15.5	1508	16.4	1708	12.5	1908	7.9	2108	4.6	2308	3.0
1312	15.5	1512	16.4	1712	12.5	1912	7.9	2112	4.6	2312	3.0
1316	15.5	1516	16.4	1716	12.5	1916	7.9	2116	4.6	2316	3.0
1320	15.5	1520	16.4	1720	12.5	1920	7.9	2120	4.6	2320	3.0
1324	15.5	1524	16.4	1724	12.5	1924	7.9	2124	4.6	2324	3.0
1328	15.9	1528	16.2	1728	12.5	1928	7.9	2128	4.6	2328	3.0
1332	16.0	1532	16.0	1732	11.9	1932	7.6	2132	4.5	2332	3.0
1336	16.0	1536	16.0	1736	11.9	1936	7.4	2136	4.2	2336	3.0
1340	16.0	1540	16.0	1740	11.9	1940	7.4	2140	4.2	2340	2.9
1344	16.0	1544	16.0	1744	11.9	1944	7.4	2144	4.2	2344	2.9
1348	16.0	1548	16.0	1748	11.9	1948	7.4	2148	4.2	2348	2.9
1352	16.0	1552	16.0	1752	11.9	1952	7.4	2152	4.2	2352	2.9
1356	16.2	1556	15.9	1756	11.9	1956	7.4	2156	4.2	2356	2.9
1360	16.4	1560	15.5	1760	11.3	1960	7.1	2160	4.2	2360	2.9
1364	16.4	1564	15.5	1764	11.2	1964	6.8	2164	3.9	2364	2.9
1368	16.4	1568	15.5	1768	11.2	1968	6.8	2168	3.9	2368	2.9
1372	16.4	1572	15.5	1772	11.2	1972	6.8	2172	3.9	2372	2.9
1376	16.4	1576	15.5	1776	11.2	1976	6.8	2176	3.9	2376	2.9
1380	16.4	1580	15.5	1780	11.2	1980	6.8	2180	3.9	2380	2.9
1384	16.5	1584	15.5	1784	11.2	1984	6.8	2184	3.9	2384	2.9
1388	16.7	1588	15.0	1788	10.8	1988	6.7	2188	3.9	2388	2.9
1392	16.7	1592	15.0	1792	10.5	1992	6.3	2192	3.7	2392	2.9
1396	16.7	1596	15.0	1796	10.5	1996	6.3	2196	3.7	2396	2.9
1400	16.7	1600	15.0	1800	10.5	2000	6.3	2200	3.7	2400	2.9

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
2404	2.9	2604	2.8	2804	1.2	3004	9.7	3204	0.0	3404	0.0
2408	2.9	2608	2.8	2808	1.2	3008	0.0	3208	0.0	3408	0.0
2412	2.9	2612	2.8	2812	1.2	3012	0.0	3212	0.0	3412	0.0
2416	2.9	2616	2.8	2816	1.2	3016	0.0	3216	0.0	3416	0.0
2420	2.9	2620	2.8	2820	1.2	3020	0.0	3220	0.0	3420	0.0
2424	2.8	2624	2.8	2824	1.0	3024	0.0	3224	0.0	3424	0.0
2428	2.8	2628	2.7	2828	0.7	3028	0.0	3228	0.0	3428	0.0
2432	2.8	2632	2.7	2832	0.7	3032	0.0	3232	0.0	3432	0.0
2436	2.8	2636	2.7	2836	0.7	3036	0.0	3236	0.0	3436	0.0
2440	2.8	2640	2.7	2840	0.7	3040	0.0	3240	0.0	3440	0.0
2444	2.8	2644	2.7	2844	0.7	3044	0.0	3244	0.0	3444	0.0
2448	2.8	2648	2.7	2848	0.7	3048	0.0	3248	0.0	3448	0.0
2452	2.8	2652	2.7	2852	0.6	3052	0.0	3252	0.0	3452	0.0
2456	2.8	2656	2.6	2856	0.1	3056	0.0	3256	0.0	3456	0.0
2460	2.8	2660	2.6	2860	0.1	3060	0.0	3260	0.0	3460	0.0
2464	2.8	2664	2.6	2864	0.1	3064	0.0	3264	0.0	3464	0.0
2468	2.8	2668	2.6	2868	0.1	3068	0.0	3268	0.0	3468	0.0
2472	2.8	2672	2.6	2872	0.1	3072	0.0	3272	0.0	3472	0.0
2476	2.8	2676	2.6	2876	0.1	3076	0.0	3276	0.0	3476	0.0
2480	2.8	2680	2.6	2880	0.1	3080	0.0	3280	0.0	3480	0.0
2484	2.8	2684	2.5	2884	0.0	3084	0.0	3284	0.0	3484	0.0
2488	2.8	2688	2.5	2888	0.0	3088	0.0	3288	0.0	3488	0.0
2492	2.8	2692	2.5	2892	0.0	3092	0.0	3292	0.0	3492	0.0
2496	2.8	2696	2.5	2896	0.0	3096	0.0	3296	0.0	3496	0.0
2500	2.8	2700	2.5	2900	0.0	3100	0.0	3300	0.0	3500	0.0
2504	2.8	2704	2.5	2904	0.0	3104	0.0	3304	0.0	3504	0.0
2508	2.9	2708	2.5	2908	0.0	3108	0.0	3308	0.0	3508	0.0
2512	2.9	2712	2.3	2912	0.0	3112	0.0	3312	0.0	3512	0.0
2516	2.9	2716	2.3	2916	25.9	3116	0.0	3316	0.0	3516	0.0
2520	2.9	2720	2.3	2920	40.1	3120	0.0	3320	0.0	3520	0.0
2524	2.9	2724	2.3	2924	50.7	3124	0.0	3324	0.0	3524	0.0
2528	2.9	2728	2.3	2928	68.9	3128	0.0	3328	0.0	3528	0.0
2532	2.9	2732	2.3	2932	97.9	3132	0.0	3332	0.0	3532	0.0
2536	2.9	2736	2.3	2936	136.5	3136	0.0	3336	0.0	3536	0.0
2540	2.9	2740	2.0	2940	184.7	3140	0.0	3340	0.0	3540	0.0
2544	2.9	2744	2.0	2944	211.9	3144	0.0	3344	0.0	3544	0.0
2548	2.9	2748	2.0	2948	184.7	3148	0.0	3348	0.0	3548	0.0
2552	2.9	2752	2.0	2952	136.5	3152	0.0	3352	0.0	3552	0.0
2556	2.9	2756	2.0	2956	97.9	3156	0.0	3356	0.0	3556	0.0
2560	2.9	2760	2.0	2960	68.9	3160	0.0	3360	0.0	3560	0.0
2564	2.8	2764	2.0	2964	50.7	3164	0.0	3364	0.0	3564	0.0
2568	2.8	2768	1.7	2968	40.1	3168	0.0	3368	0.0	3568	0.0
2572	2.8	2772	1.7	2972	34.0	3172	0.0	3372	0.0	3572	0.0
2576	2.8	2776	1.7	2976	30.2	3176	0.0	3376	0.0	3576	0.0
2580	2.8	2780	1.7	2980	27.4	3180	0.0	3380	0.0	3580	0.0
2584	2.8	2784	1.7	2984	25.1	3184	0.0	3384	0.0	3584	0.0
2588	2.8	2788	1.7	2988	23.3	3188	0.0	3388	0.0	3588	0.0
2592	2.8	2792	1.7	2992	22.0	3192	0.0	3392	0.0	3592	0.0
2596	2.8	2796	1.4	2996	21.1	3196	0.0	3396	0.0	3596	0.0
2600	2.8	2800	1.2	3000	20.0	3200	0.0	3400	0.0	3600	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
3604	0.0	3804	0.0	4004	0.0	4204	0.0	4404	0.0	4604	0.0
3608	0.0	3808	0.0	4008	0.0	4208	0.0	4408	0.0	4608	0.0
3612	0.0	3812	0.0	4012	0.0	4212	0.0	4412	0.0	4612	0.0
3616	0.0	3816	0.0	4016	0.0	4216	0.0	4416	0.0	4616	0.0
3620	0.0	3820	0.0	4020	0.0	4220	0.0	4420	0.0	4620	0.0
3624	0.0	3824	0.0	4024	0.0	4224	0.0	4424	0.0	4624	0.0
3628	0.0	3828	0.0	4028	0.0	4228	0.0	4428	0.0	4628	0.0
3632	0.0	3832	0.0	4032	0.0	4232	0.0	4432	0.0	4632	0.0
3636	0.0	3836	0.0	4036	0.0	4236	0.0	4436	0.0	4636	0.0
3640	0.0	3840	0.0	4040	0.0	4240	0.0	4440	0.0	4640	0.0
3644	0.0	3844	0.0	4044	0.0	4244	0.0	4444	0.0	4644	0.0
3648	0.0	3848	0.0	4048	0.0	4248	0.0	4448	0.0	4648	0.0
3652	0.0	3852	0.0	4052	0.0	4252	0.0	4452	0.0	4652	0.0
3656	0.0	3856	0.0	4056	0.0	4256	0.0	4456	0.0	4656	0.0
3660	0.0	3860	0.0	4060	0.0	4260	0.0	4460	0.0	4660	0.0
3664	0.0	3864	0.0	4064	0.0	4264	0.0	4464	0.0	4664	0.0
3668	0.0	3868	0.0	4068	0.0	4268	0.0	4468	0.0	4668	0.0
3672	0.0	3872	0.0	4072	0.0	4272	0.0	4472	0.0	4672	0.0
3676	0.0	3876	0.0	4076	0.0	4276	0.0	4476	0.0	4676	0.0
3680	0.0	3880	0.0	4080	0.0	4280	0.0	4480	0.0	4680	0.0
3684	0.0	3884	0.0	4084	0.0	4284	0.0	4484	0.0	4684	0.0
3688	0.0	3888	0.0	4088	0.0	4288	0.0	4488	0.0	4688	0.0
3692	0.0	3892	0.0	4092	0.0	4292	0.0	4492	0.0	4692	0.0
3696	0.0	3896	0.0	4096	0.0	4296	0.0	4496	0.0	4696	0.0
3700	0.0	3900	0.0	4100	0.0	4300	0.0	4500	0.0	4700	0.0
3704	0.0	3904	0.0	4104	0.0	4304	0.0	4504	0.0	4704	0.0
3708	0.0	3908	0.0	4108	0.0	4308	0.0	4508	0.0	4708	0.0
3712	0.0	3912	0.0	4112	0.0	4312	0.0	4512	0.0	4712	0.0
3716	0.0	3916	0.0	4116	0.0	4316	0.0	4516	0.0	4716	0.0
3720	0.0	3920	0.0	4120	0.0	4320	0.0	4520	0.0	4720	0.0
3724	0.0	3924	0.0	4124	0.0	4324	0.0	4524	0.0	4724	0.0
3728	0.0	3928	0.0	4128	0.0	4328	0.0	4528	0.0	4728	0.0
3732	0.0	3932	0.0	4132	0.0	4332	0.0	4532	0.0	4732	0.0
3736	0.0	3936	0.0	4136	0.0	4336	0.0	4536	0.0	4736	0.0
3740	0.0	3940	0.0	4140	0.0	4340	0.0	4540	0.0	4740	0.0
3744	0.0	3944	0.0	4144	0.0	4344	0.0	4544	0.0	4744	0.0
3748	0.0	3948	0.0	4148	0.0	4348	0.0	4548	0.0	4748	0.0
3752	0.0	3952	0.0	4152	0.0	4352	0.0	4552	0.0	4752	0.0
3756	0.0	3956	0.0	4156	0.0	4356	0.0	4556	0.0	4756	0.0
3760	0.0	3960	0.0	4160	0.0	4360	0.0	4560	0.0	4760	0.0
3764	0.0	3964	0.0	4164	0.0	4364	0.0	4564	0.0	4764	0.0
3768	0.0	3968	0.0	4168	0.0	4368	0.0	4568	0.0	4768	0.0
3772	0.0	3972	0.0	4172	0.0	4372	0.0	4572	0.0	4772	0.0
3776	0.0	3976	0.0	4176	0.0	4376	0.0	4576	0.0	4776	0.0
3780	0.0	3980	0.0	4180	0.0	4380	0.0	4580	0.0	4780	0.0
3784	0.0	3984	0.0	4184	0.0	4384	0.0	4584	0.0	4784	0.0
3788	0.0	3988	0.0	4188	0.0	4388	0.0	4588	0.0	4788	0.0
3792	0.0	3992	0.0	4192	0.0	4392	0.0	4592	0.0	4792	0.0
3796	0.0	3996	0.0	4196	0.0	4396	0.0	4596	0.0	4796	0.0
3800	0.0	4000	0.0	4200	0.0	4400	0.0	4600	0.0	4800	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4804	0.0	5004	0.0	5204	0.0	5404	0.0	5604	0.0	5804	0.0
4808	0.0	5008	0.0	5208	0.0	5408	0.0	5608	0.0	5808	0.0
4812	0.0	5012	0.0	5212	0.0	5412	0.0	5612	0.0	5812	0.0
4816	0.0	5016	0.0	5216	0.0	5416	0.0	5616	0.0	5816	0.0
4820	0.0	5020	0.0	5220	0.0	5420	0.0	5620	0.0	5820	0.0
4824	0.0	5024	0.0	5224	0.0	5424	0.0	5624	0.0	5824	0.0
4828	0.0	5028	0.0	5228	0.0	5428	0.0	5628	0.0	5828	0.0
4832	0.0	5032	0.0	5232	0.0	5432	0.0	5632	0.0	5832	0.0
4836	0.0	5036	0.0	5236	0.0	5436	0.0	5636	0.0	5836	0.0
4840	0.0	5040	0.0	5240	0.0	5440	0.0	5640	0.0	5840	0.0
4844	0.0	5044	0.0	5244	0.0	5444	0.0	5644	0.0	5844	0.0
4848	0.0	5048	0.0	5248	0.0	5448	0.0	5648	0.0	5848	0.0
4852	0.0	5052	0.0	5252	0.0	5452	0.0	5652	0.0	5852	0.0
4856	0.0	5056	0.0	5256	0.0	5456	0.0	5656	0.0	5856	0.0
4860	0.0	5060	0.0	5260	0.0	5460	0.0	5660	0.0	5860	0.0
4864	0.0	5064	0.0	5264	0.0	5464	0.0	5664	0.0	5864	0.0
4868	0.0	5068	0.0	5268	0.0	5468	0.0	5668	0.0	5868	0.0
4872	0.0	5072	0.0	5272	0.0	5472	0.0	5672	0.0	5872	0.0
4876	0.0	5076	0.0	5276	0.0	5476	0.0	5676	0.0	5876	0.0
4880	0.0	5080	0.0	5280	0.0	5480	0.0	5680	0.0	5880	0.0
4884	0.0	5084	0.0	5284	0.0	5484	0.0	5684	0.0	5884	0.0
4888	0.0	5088	0.0	5288	0.0	5488	0.0	5688	0.0	5888	0.0
4892	0.0	5092	0.0	5292	0.0	5492	0.0	5692	0.0	5892	0.0
4896	0.0	5096	0.0	5296	0.0	5496	0.0	5696	0.0	5896	0.0
4900	0.0	5100	0.0	5300	0.0	5500	0.0	5700	0.0	5900	0.0
4904	0.0	5104	0.0	5304	0.0	5504	0.0	5704	0.0	5904	0.0
4908	0.0	5108	0.0	5308	0.0	5508	0.0	5708	0.0	5908	0.0
4912	0.0	5112	0.0	5312	0.0	5512	0.0	5712	0.0	5912	0.0
4916	0.0	5116	0.0	5316	0.0	5516	0.0	5716	0.0	5916	0.0
4920	0.0	5120	0.0	5320	0.0	5520	0.0	5720	0.0	5920	0.0
4924	0.0	5124	0.0	5324	0.0	5524	0.0	5724	0.0	5924	0.0
4928	0.0	5128	0.0	5328	0.0	5528	0.0	5728	0.0	5928	0.0
4932	0.0	5132	0.0	5332	0.0	5532	0.0	5732	0.0	5932	0.0
4936	0.0	5136	0.0	5336	0.0	5536	0.0	5736	0.0	5936	0.0
4940	0.0	5140	0.0	5340	0.0	5540	0.0	5740	0.0	5940	0.0
4944	0.0	5144	0.0	5344	0.0	5544	0.0	5744	0.0	5944	0.0
4948	0.0	5148	0.0	5348	0.0	5548	0.0	5748	0.0	5948	0.0
4952	0.0	5152	0.0	5352	0.0	5552	0.0	5752	0.0	5952	0.0
4956	0.0	5156	0.0	5356	0.0	5556	0.0	5756	0.0	5956	0.0
4960	0.0	5160	0.0	5360	0.0	5560	0.0	5760	0.0	5960	0.0
4964	0.0	5164	0.0	5364	0.0	5564	0.0	5764	0.0	5964	0.0
4968	0.0	5168	0.0	5368	0.0	5568	0.0	5768	0.0	5968	0.0
4972	0.0	5172	0.0	5372	0.0	5572	0.0	5772	0.0	5972	0.0
4976	0.0	5176	0.0	5376	0.0	5576	0.0	5776	0.0	5976	0.0
4980	0.0	5180	0.0	5380	0.0	5580	0.0	5780	0.0	5980	0.0
4984	0.0	5184	0.0	5384	0.0	5584	0.0	5784	0.0	5984	0.0
4988	0.0	5188	0.0	5388	0.0	5588	0.0	5788	0.0	5988	0.0
4992	0.0	5192	0.0	5392	0.0	5592	0.0	5792	0.0	5992	0.0
4996	0.0	5196	0.0	5396	0.0	5596	0.0	5796	0.0	5996	0.0
5000	0.0	5200	0.0	5400	0.0	5600	0.0	5800	0.0	6000	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
6004	0.0	6008	0.0								

Model Details

Storage is Online Cover Level (m) 10.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	67.0
Membrane Percolation (mm/hr)	1000	Length (m)	67.0
Max Percolation (l/s)	1246.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.000	Membrane Depth (m)	0

Orifice Outflow Control

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 9.000

Summary of Results for Input Hydrograph

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
Input Hydrograph	9.954	0.954	2.0	2521.3	O K

Storm Event	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	1148.7	5792

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
8	0.2	408	3.0	808	3.3	1208	3.7	1608	5.7	2008	9.7
16	0.2	416	3.1	816	3.3	1216	3.8	1616	5.8	2016	9.7
24	0.2	424	3.1	824	3.3	1224	3.8	1624	6.1	2024	10.4
32	0.2	432	3.1	832	3.3	1232	3.8	1632	6.1	2032	10.4
40	0.2	440	3.1	840	3.3	1240	3.8	1640	6.1	2040	10.4
48	0.2	448	3.1	848	3.3	1248	3.8	1648	6.1	2048	10.4
56	0.2	456	3.1	856	3.3	1256	3.8	1656	6.1	2056	10.4
64	0.8	464	3.2	864	3.3	1264	3.8	1664	6.1	2064	10.4
72	1.0	472	3.2	872	3.3	1272	3.9	1672	6.2	2072	10.4
80	1.0	480	3.2	880	3.3	1280	4.0	1680	6.6	2080	11.0
88	1.0	488	3.2	888	3.3	1288	4.0	1688	6.6	2088	11.1
96	1.0	496	3.2	896	3.3	1296	4.0	1696	6.6	2096	11.1
104	1.0	504	3.2	904	3.3	1304	4.0	1704	6.6	2104	11.1
112	1.0	512	3.2	912	3.3	1312	4.0	1712	6.6	2112	11.1
120	1.3	520	3.2	920	3.3	1320	4.0	1720	6.6	2120	11.1
128	1.6	528	3.3	928	3.4	1328	4.1	1728	6.6	2128	11.1
136	1.6	536	3.3	936	3.4	1336	4.3	1736	7.2	2136	11.6
144	1.6	544	3.3	944	3.4	1344	4.3	1744	7.2	2144	11.9
152	1.6	552	3.3	952	3.4	1352	4.3	1752	7.2	2152	11.9
160	1.6	560	3.3	960	3.4	1360	4.3	1760	7.2	2160	11.9
168	1.6	568	3.3	968	3.4	1368	4.3	1768	7.2	2168	11.9
176	1.8	576	3.3	976	3.4	1376	4.3	1776	7.2	2176	11.9
184	2.0	584	3.3	984	3.4	1384	4.3	1784	7.2	2184	11.9
192	2.0	592	3.3	992	3.4	1392	4.5	1792	7.6	2192	12.2
200	2.0	600	3.3	1000	3.4	1400	4.5	1800	7.8	2200	12.6
208	2.0	608	3.3	1008	3.4	1408	4.5	1808	7.8	2208	12.6
216	2.0	616	3.3	1016	3.4	1416	4.5	1816	7.8	2216	12.6
224	2.0	624	3.3	1024	3.4	1424	4.5	1824	7.8	2224	12.6
232	2.1	632	3.3	1032	3.4	1432	4.5	1832	7.8	2232	12.6
240	2.4	640	3.3	1040	3.4	1440	4.5	1840	7.8	2240	12.6
248	2.4	648	3.3	1048	3.5	1448	4.9	1848	8.1	2248	12.8
256	2.4	656	3.3	1056	3.5	1456	4.9	1856	8.4	2256	13.4
264	2.4	664	3.3	1064	3.5	1464	4.9	1864	8.4	2264	13.4
272	2.4	672	3.3	1072	3.5	1472	4.9	1872	8.4	2272	13.4
280	2.4	680	3.3	1080	3.5	1480	4.9	1880	8.4	2280	13.4
288	2.4	688	3.3	1088	3.5	1488	4.9	1888	8.4	2288	13.4
296	2.7	696	3.4	1096	3.5	1496	4.9	1896	8.4	2296	13.4
304	2.7	704	3.4	1104	3.5	1504	5.2	1904	8.6	2304	13.4
312	2.7	712	3.4	1112	3.5	1512	5.2	1912	9.0	2312	14.1
320	2.7	720	3.4	1120	3.5	1520	5.2	1920	9.0	2320	14.1
328	2.7	728	3.4	1128	3.5	1528	5.2	1928	9.0	2328	14.1
336	2.7	736	3.4	1136	3.5	1536	5.2	1936	9.0	2336	14.1
344	2.7	744	3.4	1144	3.5	1544	5.2	1944	9.0	2344	14.1
352	2.9	752	3.3	1152	3.5	1552	5.2	1952	9.0	2352	14.1
360	3.0	760	3.3	1160	3.7	1560	5.5	1960	9.2	2360	14.1
368	3.0	768	3.3	1168	3.7	1568	5.7	1968	9.7	2368	14.7
376	3.0	776	3.3	1176	3.7	1576	5.7	1976	9.7	2376	14.8
384	3.0	784	3.3	1184	3.7	1584	5.7	1984	9.7	2384	14.8
392	3.0	792	3.3	1192	3.7	1592	5.7	1992	9.7	2392	14.8
400	3.0	800	3.3	1200	3.7	1600	5.7	2000	9.7	2400	14.8

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
2408	14.8	2808	18.8	3208	16.9	3608	11.9	4008	7.2	4408	4.3
2416	14.8	2816	18.8	3216	16.9	3616	11.9	4016	7.2	4416	4.3
2424	15.3	2824	18.8	3224	16.9	3624	11.9	4024	7.2	4424	4.3
2432	15.6	2832	19.0	3232	16.3	3632	11.6	4032	7.2	4432	4.3
2440	15.6	2840	19.0	3240	16.2	3640	11.1	4040	6.6	4440	4.1
2448	15.6	2848	19.0	3248	16.2	3648	11.1	4048	6.6	4448	4.0
2456	15.6	2856	19.0	3256	16.2	3656	11.1	4056	6.6	4456	4.0
2464	15.6	2864	19.0	3264	16.2	3664	11.1	4064	6.6	4464	4.0
2472	15.6	2872	19.0	3272	16.2	3672	11.1	4072	6.6	4472	4.0
2480	15.8	2880	19.0	3280	16.2	3680	11.1	4080	6.6	4480	4.0
2488	16.2	2888	19.0	3288	15.8	3688	11.0	4088	6.6	4488	4.0
2496	16.2	2896	19.0	3296	15.6	3696	10.4	4096	6.2	4496	3.9
2504	16.2	2904	19.0	3304	15.6	3704	10.4	4104	6.1	4504	3.8
2512	16.2	2912	19.0	3312	15.6	3712	10.4	4112	6.1	4512	3.8
2520	16.2	2920	19.0	3320	15.6	3720	10.4	4120	6.1	4520	3.8
2528	16.2	2928	19.0	3328	15.6	3728	10.4	4128	6.1	4528	3.8
2536	16.3	2936	19.0	3336	15.6	3736	10.4	4136	6.1	4536	3.8
2544	16.9	2944	18.8	3344	15.3	3744	10.4	4144	6.1	4544	3.8
2552	16.9	2952	18.8	3352	14.8	3752	9.7	4152	5.8	4552	3.8
2560	16.9	2960	18.8	3360	14.8	3760	9.7	4160	5.7	4560	3.7
2568	16.9	2968	18.8	3368	14.8	3768	9.7	4168	5.7	4568	3.7
2576	16.9	2976	18.8	3376	14.8	3776	9.7	4176	5.7	4576	3.7
2584	16.9	2984	18.8	3384	14.8	3784	9.7	4184	5.7	4584	3.7
2592	16.9	2992	18.8	3392	14.8	3792	9.7	4192	5.7	4592	3.7
2600	17.4	3000	18.5	3400	14.7	3800	9.7	4200	5.7	4600	3.7
2608	17.4	3008	18.4	3408	14.1	3808	9.2	4208	5.5	4608	3.7
2616	17.4	3016	18.4	3416	14.1	3816	9.0	4216	5.2	4616	3.5
2624	17.4	3024	18.4	3424	14.1	3824	9.0	4224	5.2	4624	3.5
2632	17.4	3032	18.4	3432	14.1	3832	9.0	4232	5.2	4632	3.5
2640	17.4	3040	18.4	3440	14.1	3840	9.0	4240	5.2	4640	3.5
2648	17.4	3048	18.4	3448	14.1	3848	9.0	4248	5.2	4648	3.5
2656	17.8	3056	18.2	3456	14.1	3856	9.0	4256	5.2	4656	3.5
2664	17.9	3064	17.9	3464	13.4	3864	8.6	4264	5.2	4664	3.5
2672	17.9	3072	17.9	3472	13.4	3872	8.4	4272	4.9	4672	3.5
2680	17.9	3080	17.9	3480	13.4	3880	8.4	4280	4.9	4680	3.5
2688	17.9	3088	17.9	3488	13.4	3888	8.4	4288	4.9	4688	3.5
2696	17.9	3096	17.9	3496	13.4	3896	8.4	4296	4.9	4696	3.5
2704	17.9	3104	17.9	3504	13.4	3904	8.4	4304	4.9	4704	3.5
2712	18.2	3112	17.8	3512	13.4	3912	8.4	4312	4.9	4712	3.5
2720	18.4	3120	17.4	3520	12.8	3920	8.1	4320	4.9	4720	3.5
2728	18.4	3128	17.4	3528	12.6	3928	7.8	4328	4.5	4728	3.4
2736	18.4	3136	17.4	3536	12.6	3936	7.8	4336	4.5	4736	3.4
2744	18.4	3144	17.4	3544	12.6	3944	7.8	4344	4.5	4744	3.4
2752	18.4	3152	17.4	3552	12.6	3952	7.8	4352	4.5	4752	3.4
2760	18.4	3160	17.4	3560	12.6	3960	7.8	4360	4.5	4760	3.4
2768	18.5	3168	17.4	3568	12.6	3968	7.8	4368	4.5	4768	3.4
2776	18.8	3176	16.9	3576	12.2	3976	7.6	4376	4.5	4776	3.4
2784	18.8	3184	16.9	3584	11.9	3984	7.2	4384	4.3	4784	3.4
2792	18.8	3192	16.9	3592	11.9	3992	7.2	4392	4.3	4792	3.4
2800	18.8	3200	16.9	3600	11.9	4000	7.2	4400	4.3	4800	3.4

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4808	3.4	5208	3.3	5608	1.6	6008	0.0	6408	0.0	6808	0.0
4816	3.4	5216	3.3	5616	1.6	6016	0.0	6416	0.0	6816	0.0
4824	3.4	5224	3.3	5624	1.6	6024	0.0	6424	0.0	6824	0.0
4832	3.4	5232	3.3	5632	1.6	6032	0.0	6432	0.0	6832	0.0
4840	3.4	5240	3.3	5640	1.6	6040	0.0	6440	0.0	6840	0.0
4848	3.3	5248	3.2	5648	1.3	6048	0.0	6448	0.0	6848	0.0
4856	3.3	5256	3.2	5656	1.0	6056	0.0	6456	0.0	6856	0.0
4864	3.3	5264	3.2	5664	1.0	6064	0.0	6464	0.0	6864	0.0
4872	3.3	5272	3.2	5672	1.0	6072	0.0	6472	0.0	6872	0.0
4880	3.3	5280	3.2	5680	1.0	6080	0.0	6480	0.0	6880	0.0
4888	3.3	5288	3.2	5688	1.0	6088	0.0	6488	0.0	6888	0.0
4896	3.3	5296	3.2	5696	1.0	6096	0.0	6496	0.0	6896	0.0
4904	3.3	5304	3.2	5704	0.8	6104	0.0	6504	0.0	6904	0.0
4912	3.3	5312	3.1	5712	0.8	6112	0.0	6512	0.0	6912	0.0
4920	3.3	5320	3.1	5720	0.2	6120	0.0	6520	0.0	6920	0.0
4928	3.3	5328	3.1	5728	19.4	6128	0.0	6528	0.0	6928	0.0
4936	3.3	5336	3.1	5736	46.4	6136	0.0	6536	0.0	6936	0.0
4944	3.3	5344	3.1	5744	67.3	6144	0.0	6544	0.0	6944	0.0
4952	3.3	5352	3.1	5752	193.5	6152	0.0	6552	0.0	6952	0.0
4960	3.3	5360	3.0	5760	364.8	6160	0.0	6560	0.0	6960	0.0
4968	3.3	5368	3.0	5768	100.4	6168	0.0	6568	0.0	6968	0.0
4976	3.3	5376	3.0	5776	54.3	6176	0.0	6576	0.0	6976	0.0
4984	3.3	5384	3.0	5784	41.9	6184	0.0	6584	0.0	6984	0.0
4992	3.3	5392	3.0	5792	0.0	6192	0.0	6592	0.0	6992	0.0
5000	3.3	5400	3.0	5800	0.0	6200	0.0	6600	0.0	7000	0.0
5008	3.3	5408	3.0	5808	0.0	6208	0.0	6608	0.0	7008	0.0
5016	3.3	5416	2.9	5816	0.0	6216	0.0	6616	0.0	7016	0.0
5024	3.4	5424	2.7	5824	0.0	6224	0.0	6624	0.0	7024	0.0
5032	3.4	5432	2.7	5832	0.0	6232	0.0	6632	0.0	7032	0.0
5040	3.4	5440	2.7	5840	0.0	6240	0.0	6640	0.0	7040	0.0
5048	3.4	5448	2.7	5848	0.0	6248	0.0	6648	0.0	7048	0.0
5056	3.4	5456	2.7	5856	0.0	6256	0.0	6656	0.0	7056	0.0
5064	3.4	5464	2.7	5864	0.0	6264	0.0	6664	0.0	7064	0.0
5072	3.4	5472	2.7	5872	0.0	6272	0.0	6672	0.0	7072	0.0
5080	3.4	5480	2.4	5880	0.0	6280	0.0	6680	0.0	7080	0.0
5088	3.4	5488	2.4	5888	0.0	6288	0.0	6688	0.0	7088	0.0
5096	3.4	5496	2.4	5896	0.0	6296	0.0	6696	0.0	7096	0.0
5104	3.4	5504	2.4	5904	0.0	6304	0.0	6704	0.0	7104	0.0
5112	3.4	5512	2.4	5912	0.0	6312	0.0	6712	0.0	7112	0.0
5120	3.4	5520	2.4	5920	0.0	6320	0.0	6720	0.0	7120	0.0
5128	3.3	5528	2.4	5928	0.0	6328	0.0	6728	0.0	7128	0.0
5136	3.3	5536	2.1	5936	0.0	6336	0.0	6736	0.0	7136	0.0
5144	3.3	5544	2.0	5944	0.0	6344	0.0	6744	0.0	7144	0.0
5152	3.3	5552	2.0	5952	0.0	6352	0.0	6752	0.0	7152	0.0
5160	3.3	5560	2.0	5960	0.0	6360	0.0	6760	0.0	7160	0.0
5168	3.3	5568	2.0	5968	0.0	6368	0.0	6768	0.0	7168	0.0
5176	3.3	5576	2.0	5976	0.0	6376	0.0	6776	0.0	7176	0.0
5184	3.3	5584	2.0	5984	0.0	6384	0.0	6784	0.0	7184	0.0
5192	3.3	5592	1.8	5992	0.0	6392	0.0	6792	0.0	7192	0.0
5200	3.3	5600	1.6	6000	0.0	6400	0.0	6800	0.0	7200	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
7208	0.0	7608	0.0	8008	0.0	8408	0.0	8808	0.0	9208	0.0
7216	0.0	7616	0.0	8016	0.0	8416	0.0	8816	0.0	9216	0.0
7224	0.0	7624	0.0	8024	0.0	8424	0.0	8824	0.0	9224	0.0
7232	0.0	7632	0.0	8032	0.0	8432	0.0	8832	0.0	9232	0.0
7240	0.0	7640	0.0	8040	0.0	8440	0.0	8840	0.0	9240	0.0
7248	0.0	7648	0.0	8048	0.0	8448	0.0	8848	0.0	9248	0.0
7256	0.0	7656	0.0	8056	0.0	8456	0.0	8856	0.0	9256	0.0
7264	0.0	7664	0.0	8064	0.0	8464	0.0	8864	0.0	9264	0.0
7272	0.0	7672	0.0	8072	0.0	8472	0.0	8872	0.0	9272	0.0
7280	0.0	7680	0.0	8080	0.0	8480	0.0	8880	0.0	9280	0.0
7288	0.0	7688	0.0	8088	0.0	8488	0.0	8888	0.0	9288	0.0
7296	0.0	7696	0.0	8096	0.0	8496	0.0	8896	0.0	9296	0.0
7304	0.0	7704	0.0	8104	0.0	8504	0.0	8904	0.0	9304	0.0
7312	0.0	7712	0.0	8112	0.0	8512	0.0	8912	0.0	9312	0.0
7320	0.0	7720	0.0	8120	0.0	8520	0.0	8920	0.0	9320	0.0
7328	0.0	7728	0.0	8128	0.0	8528	0.0	8928	0.0	9328	0.0
7336	0.0	7736	0.0	8136	0.0	8536	0.0	8936	0.0	9336	0.0
7344	0.0	7744	0.0	8144	0.0	8544	0.0	8944	0.0	9344	0.0
7352	0.0	7752	0.0	8152	0.0	8552	0.0	8952	0.0	9352	0.0
7360	0.0	7760	0.0	8160	0.0	8560	0.0	8960	0.0	9360	0.0
7368	0.0	7768	0.0	8168	0.0	8568	0.0	8968	0.0	9368	0.0
7376	0.0	7776	0.0	8176	0.0	8576	0.0	8976	0.0	9376	0.0
7384	0.0	7784	0.0	8184	0.0	8584	0.0	8984	0.0	9384	0.0
7392	0.0	7792	0.0	8192	0.0	8592	0.0	8992	0.0	9392	0.0
7400	0.0	7800	0.0	8200	0.0	8600	0.0	9000	0.0	9400	0.0
7408	0.0	7808	0.0	8208	0.0	8608	0.0	9008	0.0	9408	0.0
7416	0.0	7816	0.0	8216	0.0	8616	0.0	9016	0.0	9416	0.0
7424	0.0	7824	0.0	8224	0.0	8624	0.0	9024	0.0	9424	0.0
7432	0.0	7832	0.0	8232	0.0	8632	0.0	9032	0.0	9432	0.0
7440	0.0	7840	0.0	8240	0.0	8640	0.0	9040	0.0	9440	0.0
7448	0.0	7848	0.0	8248	0.0	8648	0.0	9048	0.0	9448	0.0
7456	0.0	7856	0.0	8256	0.0	8656	0.0	9056	0.0	9456	0.0
7464	0.0	7864	0.0	8264	0.0	8664	0.0	9064	0.0	9464	0.0
7472	0.0	7872	0.0	8272	0.0	8672	0.0	9072	0.0	9472	0.0
7480	0.0	7880	0.0	8280	0.0	8680	0.0	9080	0.0	9480	0.0
7488	0.0	7888	0.0	8288	0.0	8688	0.0	9088	0.0	9488	0.0
7496	0.0	7896	0.0	8296	0.0	8696	0.0	9096	0.0	9496	0.0
7504	0.0	7904	0.0	8304	0.0	8704	0.0	9104	0.0	9504	0.0
7512	0.0	7912	0.0	8312	0.0	8712	0.0	9112	0.0	9512	0.0
7520	0.0	7920	0.0	8320	0.0	8720	0.0	9120	0.0	9520	0.0
7528	0.0	7928	0.0	8328	0.0	8728	0.0	9128	0.0	9528	0.0
7536	0.0	7936	0.0	8336	0.0	8736	0.0	9136	0.0	9536	0.0
7544	0.0	7944	0.0	8344	0.0	8744	0.0	9144	0.0	9544	0.0
7552	0.0	7952	0.0	8352	0.0	8752	0.0	9152	0.0	9552	0.0
7560	0.0	7960	0.0	8360	0.0	8760	0.0	9160	0.0	9560	0.0
7568	0.0	7968	0.0	8368	0.0	8768	0.0	9168	0.0	9568	0.0
7576	0.0	7976	0.0	8376	0.0	8776	0.0	9176	0.0	9576	0.0
7584	0.0	7984	0.0	8384	0.0	8784	0.0	9184	0.0	9584	0.0
7592	0.0	7992	0.0	8392	0.0	8792	0.0	9192	0.0	9592	0.0
7600	0.0	8000	0.0	8400	0.0	8800	0.0	9200	0.0	9600	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
9608	0.0	9688	0.0	9768	0.0	9848	0.0	9928	0.0	10008	0.0
9616	0.0	9696	0.0	9776	0.0	9856	0.0	9936	0.0	10016	0.0
9624	0.0	9704	0.0	9784	0.0	9864	0.0	9944	0.0	10024	0.0
9632	0.0	9712	0.0	9792	0.0	9872	0.0	9952	0.0	10032	0.0
9640	0.0	9720	0.0	9800	0.0	9880	0.0	9960	0.0	10040	0.0
9648	0.0	9728	0.0	9808	0.0	9888	0.0	9968	0.0	10048	0.0
9656	0.0	9736	0.0	9816	0.0	9896	0.0	9976	0.0	10056	0.0
9664	0.0	9744	0.0	9824	0.0	9904	0.0	9984	0.0	10064	0.0
9672	0.0	9752	0.0	9832	0.0	9912	0.0	9992	0.0	10072	0.0
9680	0.0	9760	0.0	9840	0.0	9920	0.0	10000	0.0	10080	0.0

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1200.0	0.500	2500.0	1.000	5000.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0064-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	No
Diameter (mm)	64
Invert Level (m)	9.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.156	1.7
Kick-Flo®	0.223	1.0
Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	1.200	2.2	3.000	3.4	7.000	5.2
0.200	1.1	1.400	2.4	3.500	3.7	7.500	5.4
0.300	1.1	1.600	2.5	4.000	4.0	8.000	5.6
0.400	1.3	1.800	2.7	4.500	4.2	8.500	5.7
0.500	1.4	2.000	2.8	5.000	4.4	9.000	5.9
0.600	1.6	2.200	2.9	5.500	4.6	9.500	6.0
0.800	1.8	2.400	3.1	6.000	4.8		
1.000	2.0	2.600	3.2	6.500	5.0		

Summary of Results for Input Hydrograph

Half Drain Time : 7381 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
Input Hydrograph	9.400	1.400	0.0	1.9	1.9	1463.4	O K

Storm Event	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	1049.5	2948

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4	0.3	204	3.3	404	3.7	604	4.0	804	6.2	1004	10.6
8	0.3	208	3.4	408	3.7	608	4.2	808	6.4	1008	10.6
12	0.3	212	3.4	412	3.7	612	4.2	812	6.7	1012	11.4
16	0.3	216	3.4	416	3.7	616	4.2	816	6.7	1016	11.4
20	0.3	220	3.4	420	3.7	620	4.2	820	6.7	1020	11.4
24	0.3	224	3.4	424	3.7	624	4.2	824	6.7	1024	11.4
28	0.3	228	3.4	428	3.7	628	4.2	828	6.7	1028	11.4
32	0.9	232	3.5	432	3.7	632	4.2	832	6.7	1032	11.4
36	1.1	236	3.5	436	3.7	636	4.3	836	6.8	1036	11.4
40	1.1	240	3.5	440	3.7	640	4.4	840	7.2	1040	12.0
44	1.1	244	3.5	444	3.7	644	4.4	844	7.2	1044	12.2
48	1.1	248	3.5	448	3.7	648	4.4	848	7.2	1048	12.2
52	1.1	252	3.5	452	3.7	652	4.4	852	7.2	1052	12.2
56	1.1	256	3.5	456	3.7	656	4.4	856	7.2	1056	12.2
60	1.4	260	3.5	460	3.7	660	4.4	860	7.2	1060	12.2
64	1.7	264	3.6	464	3.7	664	4.5	864	7.2	1064	12.2
68	1.7	268	3.6	468	3.7	668	4.7	868	7.8	1068	12.7
72	1.7	272	3.6	472	3.7	672	4.7	872	7.8	1072	13.0
76	1.7	276	3.6	476	3.7	676	4.7	876	7.8	1076	13.0
80	1.7	280	3.6	480	3.7	680	4.7	880	7.8	1080	13.0
84	1.7	284	3.6	484	3.7	684	4.7	884	7.8	1084	13.0
88	1.9	288	3.6	488	3.7	688	4.7	888	7.8	1088	13.0
92	2.2	292	3.6	492	3.7	692	4.7	892	7.8	1092	13.0
96	2.2	296	3.6	496	3.7	696	5.0	896	8.4	1096	13.3
100	2.2	300	3.6	500	3.7	700	5.0	900	8.5	1100	13.8
104	2.2	304	3.6	504	3.7	704	5.0	904	8.5	1104	13.8
108	2.2	308	3.6	508	3.7	708	5.0	908	8.5	1108	13.8
112	2.2	312	3.6	512	3.7	712	5.0	912	8.5	1112	13.8
116	2.3	316	3.6	516	3.7	716	5.0	916	8.5	1116	13.8
120	2.7	320	3.7	520	3.7	720	5.0	920	8.5	1120	13.8
124	2.7	324	3.7	524	3.8	724	5.3	924	8.9	1124	14.0
128	2.7	328	3.7	528	3.8	728	5.3	928	9.2	1128	14.6
132	2.7	332	3.7	532	3.8	732	5.3	932	9.2	1132	14.6
136	2.7	336	3.7	536	3.8	736	5.3	936	9.2	1136	14.6
140	2.7	340	3.7	540	3.8	740	5.3	940	9.2	1140	14.6
144	2.7	344	3.7	544	3.8	744	5.3	944	9.2	1144	14.6
148	3.0	348	3.7	548	3.8	748	5.3	948	9.2	1148	14.6
152	3.0	352	3.7	552	3.9	752	5.7	952	9.4	1152	14.6
156	3.0	356	3.7	556	3.9	756	5.7	956	9.9	1156	15.4
160	3.0	360	3.7	560	3.9	760	5.7	960	9.9	1160	15.4
164	3.0	364	3.7	564	3.9	764	5.7	964	9.9	1164	15.4
168	3.0	368	3.7	568	3.9	768	5.7	968	9.9	1168	15.4
172	3.0	372	3.7	572	3.9	772	5.7	972	9.9	1172	15.4
176	3.2	376	3.7	576	3.9	776	5.7	976	9.9	1176	15.4
180	3.2	380	3.7	580	4.0	780	6.0	980	10.0	1180	15.4
184	3.2	384	3.7	584	4.0	784	6.2	984	10.6	1184	16.1
188	3.2	388	3.7	588	4.0	788	6.2	988	10.6	1188	16.2
192	3.2	392	3.7	592	4.0	792	6.2	992	10.6	1192	16.2
196	3.2	396	3.7	596	4.0	796	6.2	996	10.6	1196	16.2
200	3.2	400	3.7	600	4.0	800	6.2	1000	10.6	1200	16.2

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
1204	16.2	1404	20.5	1604	18.4	1804	13.0	2004	7.8	2204	4.7
1208	16.2	1408	20.5	1608	18.4	1808	13.0	2008	7.8	2208	4.7
1212	16.7	1412	20.6	1612	18.4	1812	13.0	2012	7.8	2212	4.7
1216	17.0	1416	20.8	1616	17.9	1816	12.7	2016	7.8	2216	4.7
1220	17.0	1420	20.8	1620	17.7	1820	12.2	2020	7.2	2220	4.5
1224	17.0	1424	20.8	1624	17.7	1824	12.2	2024	7.2	2224	4.4
1228	17.0	1428	20.8	1628	17.7	1828	12.2	2028	7.2	2228	4.4
1232	17.0	1432	20.8	1632	17.7	1832	12.2	2032	7.2	2232	4.4
1236	17.0	1436	20.8	1636	17.7	1836	12.2	2036	7.2	2236	4.4
1240	17.3	1440	20.8	1640	17.7	1840	12.2	2040	7.2	2240	4.4
1244	17.7	1444	20.8	1644	17.3	1844	12.0	2044	7.2	2244	4.4
1248	17.7	1448	20.8	1648	17.0	1848	11.4	2048	6.8	2248	4.3
1252	17.7	1452	20.8	1652	17.0	1852	11.4	2052	6.7	2252	4.2
1256	17.7	1456	20.8	1656	17.0	1856	11.4	2056	6.7	2256	4.2
1260	17.7	1460	20.8	1660	17.0	1860	11.4	2060	6.7	2260	4.2
1264	17.7	1464	20.8	1664	17.0	1864	11.4	2064	6.7	2264	4.2
1268	17.9	1468	20.8	1668	17.0	1868	11.4	2068	6.7	2268	4.2
1272	18.4	1472	20.6	1672	16.7	1872	11.4	2072	6.7	2272	4.2
1276	18.4	1476	20.5	1676	16.2	1876	10.6	2076	6.4	2276	4.2
1280	18.4	1480	20.5	1680	16.2	1880	10.6	2080	6.2	2280	4.0
1284	18.4	1484	20.5	1684	16.2	1884	10.6	2084	6.2	2284	4.0
1288	18.4	1488	20.5	1688	16.2	1888	10.6	2088	6.2	2288	4.0
1292	18.4	1492	20.5	1692	16.2	1892	10.6	2092	6.2	2292	4.0
1296	18.4	1496	20.5	1696	16.2	1896	10.6	2096	6.2	2296	4.0
1300	19.1	1500	20.3	1700	16.1	1900	10.6	2100	6.2	2300	4.0
1304	19.1	1504	20.1	1704	15.4	1904	10.0	2104	6.0	2304	4.0
1308	19.1	1508	20.1	1708	15.4	1908	9.9	2108	5.7	2308	3.9
1312	19.1	1512	20.1	1712	15.4	1912	9.9	2112	5.7	2312	3.9
1316	19.1	1516	20.1	1716	15.4	1916	9.9	2116	5.7	2316	3.9
1320	19.1	1520	20.1	1720	15.4	1920	9.9	2120	5.7	2320	3.9
1324	19.1	1524	20.1	1724	15.4	1924	9.9	2124	5.7	2324	3.9
1328	19.5	1528	19.9	1728	15.4	1928	9.9	2128	5.7	2328	3.9
1332	19.6	1532	19.6	1732	14.6	1932	9.4	2132	5.7	2332	3.9
1336	19.6	1536	19.6	1736	14.6	1936	9.2	2136	5.3	2336	3.8
1340	19.6	1540	19.6	1740	14.6	1940	9.2	2140	5.3	2340	3.8
1344	19.6	1544	19.6	1744	14.6	1944	9.2	2144	5.3	2344	3.8
1348	19.6	1548	19.6	1748	14.6	1948	9.2	2148	5.3	2348	3.8
1352	19.6	1552	19.6	1752	14.6	1952	9.2	2152	5.3	2352	3.8
1356	19.9	1556	19.5	1756	14.6	1956	9.2	2156	5.3	2356	3.8
1360	20.1	1560	19.1	1760	14.0	1960	8.9	2160	5.3	2360	3.8
1364	20.1	1564	19.1	1764	13.8	1964	8.5	2164	5.0	2364	3.7
1368	20.1	1568	19.1	1768	13.8	1968	8.5	2168	5.0	2368	3.7
1372	20.1	1572	19.1	1772	13.8	1972	8.5	2172	5.0	2372	3.7
1376	20.1	1576	19.1	1776	13.8	1976	8.5	2176	5.0	2376	3.7
1380	20.1	1580	19.1	1780	13.8	1980	8.5	2180	5.0	2380	3.7
1384	20.3	1584	19.1	1784	13.8	1984	8.5	2184	5.0	2384	3.7
1388	20.5	1588	18.4	1788	13.3	1988	8.4	2188	5.0	2388	3.7
1392	20.5	1592	18.4	1792	13.0	1992	7.8	2192	4.7	2392	3.7
1396	20.5	1596	18.4	1796	13.0	1996	7.8	2196	4.7	2396	3.7
1400	20.5	1600	18.4	1800	13.0	2000	7.8	2200	4.7	2400	3.7

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
2404	3.7	2604	3.6	2804	1.7	3004	0.0	3204	0.0	3404	0.0
2408	3.7	2608	3.6	2808	1.7	3008	0.0	3208	0.0	3408	0.0
2412	3.7	2612	3.6	2812	1.7	3012	0.0	3212	0.0	3412	0.0
2416	3.7	2616	3.6	2816	1.7	3016	0.0	3216	0.0	3416	0.0
2420	3.7	2620	3.6	2820	1.7	3020	0.0	3220	0.0	3420	0.0
2424	3.7	2624	3.5	2824	1.4	3024	0.0	3224	0.0	3424	0.0
2428	3.7	2628	3.5	2828	1.1	3028	0.0	3228	0.0	3428	0.0
2432	3.7	2632	3.5	2832	1.1	3032	0.0	3232	0.0	3432	0.0
2436	3.7	2636	3.5	2836	1.1	3036	0.0	3236	0.0	3436	0.0
2440	3.7	2640	3.5	2840	1.1	3040	0.0	3240	0.0	3440	0.0
2444	3.7	2644	3.5	2844	1.1	3044	0.0	3244	0.0	3444	0.0
2448	3.7	2648	3.5	2848	1.1	3048	0.0	3248	0.0	3448	0.0
2452	3.7	2652	3.5	2852	0.9	3052	0.0	3252	0.0	3452	0.0
2456	3.7	2656	3.4	2856	0.3	3056	0.0	3256	0.0	3456	0.0
2460	3.7	2660	3.4	2860	0.3	3060	0.0	3260	0.0	3460	0.0
2464	3.7	2664	3.4	2864	0.3	3064	0.0	3264	0.0	3464	0.0
2468	3.7	2668	3.4	2868	0.3	3068	0.0	3268	0.0	3468	0.0
2472	3.7	2672	3.4	2872	0.3	3072	0.0	3272	0.0	3472	0.0
2476	3.7	2676	3.4	2876	0.3	3076	0.0	3276	0.0	3476	0.0
2480	3.7	2680	3.3	2880	0.3	3080	0.0	3280	0.0	3480	0.0
2484	3.7	2684	3.2	2884	12.0	3084	0.0	3284	0.0	3484	0.0
2488	3.7	2688	3.2	2888	25.8	3088	0.0	3288	0.0	3488	0.0
2492	3.7	2692	3.2	2892	28.6	3092	0.0	3292	0.0	3492	0.0
2496	3.7	2696	3.2	2896	33.5	3096	0.0	3296	0.0	3496	0.0
2500	3.7	2700	3.2	2900	41.5	3100	0.0	3300	0.0	3500	0.0
2504	3.7	2704	3.2	2904	62.0	3104	0.0	3304	0.0	3504	0.0
2508	3.7	2708	3.2	2908	119.5	3108	0.0	3308	0.0	3508	0.0
2512	3.7	2712	3.0	2912	225.2	3112	0.0	3312	0.0	3512	0.0
2516	3.7	2716	3.0	2916	225.2	3116	0.0	3316	0.0	3516	0.0
2520	3.7	2720	3.0	2920	119.5	3120	0.0	3320	0.0	3520	0.0
2524	3.7	2724	3.0	2924	62.0	3124	0.0	3324	0.0	3524	0.0
2528	3.7	2728	3.0	2928	41.5	3128	0.0	3328	0.0	3528	0.0
2532	3.7	2732	3.0	2932	33.5	3132	0.0	3332	0.0	3532	0.0
2536	3.7	2736	3.0	2936	28.6	3136	0.0	3336	0.0	3536	0.0
2540	3.7	2740	2.7	2940	25.8	3140	0.0	3340	0.0	3540	0.0
2544	3.7	2744	2.7	2944	12.0	3144	0.0	3344	0.0	3544	0.0
2548	3.7	2748	2.7	2948	0.0	3148	0.0	3348	0.0	3548	0.0
2552	3.7	2752	2.7	2952	0.0	3152	0.0	3352	0.0	3552	0.0
2556	3.7	2756	2.7	2956	0.0	3156	0.0	3356	0.0	3556	0.0
2560	3.7	2760	2.7	2960	0.0	3160	0.0	3360	0.0	3560	0.0
2564	3.7	2764	2.7	2964	0.0	3164	0.0	3364	0.0	3564	0.0
2568	3.6	2768	2.3	2968	0.0	3168	0.0	3368	0.0	3568	0.0
2572	3.6	2772	2.2	2972	0.0	3172	0.0	3372	0.0	3572	0.0
2576	3.6	2776	2.2	2976	0.0	3176	0.0	3376	0.0	3576	0.0
2580	3.6	2780	2.2	2980	0.0	3180	0.0	3380	0.0	3580	0.0
2584	3.6	2784	2.2	2984	0.0	3184	0.0	3384	0.0	3584	0.0
2588	3.6	2788	2.2	2988	0.0	3188	0.0	3388	0.0	3588	0.0
2592	3.6	2792	2.2	2992	0.0	3192	0.0	3392	0.0	3592	0.0
2596	3.6	2796	1.9	2996	0.0	3196	0.0	3396	0.0	3596	0.0
2600	3.6	2800	1.7	3000	0.0	3200	0.0	3400	0.0	3600	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
3604	0.0	3804	0.0	4004	0.0	4204	0.0	4404	0.0	4604	0.0
3608	0.0	3808	0.0	4008	0.0	4208	0.0	4408	0.0	4608	0.0
3612	0.0	3812	0.0	4012	0.0	4212	0.0	4412	0.0	4612	0.0
3616	0.0	3816	0.0	4016	0.0	4216	0.0	4416	0.0	4616	0.0
3620	0.0	3820	0.0	4020	0.0	4220	0.0	4420	0.0	4620	0.0
3624	0.0	3824	0.0	4024	0.0	4224	0.0	4424	0.0	4624	0.0
3628	0.0	3828	0.0	4028	0.0	4228	0.0	4428	0.0	4628	0.0
3632	0.0	3832	0.0	4032	0.0	4232	0.0	4432	0.0	4632	0.0
3636	0.0	3836	0.0	4036	0.0	4236	0.0	4436	0.0	4636	0.0
3640	0.0	3840	0.0	4040	0.0	4240	0.0	4440	0.0	4640	0.0
3644	0.0	3844	0.0	4044	0.0	4244	0.0	4444	0.0	4644	0.0
3648	0.0	3848	0.0	4048	0.0	4248	0.0	4448	0.0	4648	0.0
3652	0.0	3852	0.0	4052	0.0	4252	0.0	4452	0.0	4652	0.0
3656	0.0	3856	0.0	4056	0.0	4256	0.0	4456	0.0	4656	0.0
3660	0.0	3860	0.0	4060	0.0	4260	0.0	4460	0.0	4660	0.0
3664	0.0	3864	0.0	4064	0.0	4264	0.0	4464	0.0	4664	0.0
3668	0.0	3868	0.0	4068	0.0	4268	0.0	4468	0.0	4668	0.0
3672	0.0	3872	0.0	4072	0.0	4272	0.0	4472	0.0	4672	0.0
3676	0.0	3876	0.0	4076	0.0	4276	0.0	4476	0.0	4676	0.0
3680	0.0	3880	0.0	4080	0.0	4280	0.0	4480	0.0	4680	0.0
3684	0.0	3884	0.0	4084	0.0	4284	0.0	4484	0.0	4684	0.0
3688	0.0	3888	0.0	4088	0.0	4288	0.0	4488	0.0	4688	0.0
3692	0.0	3892	0.0	4092	0.0	4292	0.0	4492	0.0	4692	0.0
3696	0.0	3896	0.0	4096	0.0	4296	0.0	4496	0.0	4696	0.0
3700	0.0	3900	0.0	4100	0.0	4300	0.0	4500	0.0	4700	0.0
3704	0.0	3904	0.0	4104	0.0	4304	0.0	4504	0.0	4704	0.0
3708	0.0	3908	0.0	4108	0.0	4308	0.0	4508	0.0	4708	0.0
3712	0.0	3912	0.0	4112	0.0	4312	0.0	4512	0.0	4712	0.0
3716	0.0	3916	0.0	4116	0.0	4316	0.0	4516	0.0	4716	0.0
3720	0.0	3920	0.0	4120	0.0	4320	0.0	4520	0.0	4720	0.0
3724	0.0	3924	0.0	4124	0.0	4324	0.0	4524	0.0	4724	0.0
3728	0.0	3928	0.0	4128	0.0	4328	0.0	4528	0.0	4728	0.0
3732	0.0	3932	0.0	4132	0.0	4332	0.0	4532	0.0	4732	0.0
3736	0.0	3936	0.0	4136	0.0	4336	0.0	4536	0.0	4736	0.0
3740	0.0	3940	0.0	4140	0.0	4340	0.0	4540	0.0	4740	0.0
3744	0.0	3944	0.0	4144	0.0	4344	0.0	4544	0.0	4744	0.0
3748	0.0	3948	0.0	4148	0.0	4348	0.0	4548	0.0	4748	0.0
3752	0.0	3952	0.0	4152	0.0	4352	0.0	4552	0.0	4752	0.0
3756	0.0	3956	0.0	4156	0.0	4356	0.0	4556	0.0	4756	0.0
3760	0.0	3960	0.0	4160	0.0	4360	0.0	4560	0.0	4760	0.0
3764	0.0	3964	0.0	4164	0.0	4364	0.0	4564	0.0	4764	0.0
3768	0.0	3968	0.0	4168	0.0	4368	0.0	4568	0.0	4768	0.0
3772	0.0	3972	0.0	4172	0.0	4372	0.0	4572	0.0	4772	0.0
3776	0.0	3976	0.0	4176	0.0	4376	0.0	4576	0.0	4776	0.0
3780	0.0	3980	0.0	4180	0.0	4380	0.0	4580	0.0	4780	0.0
3784	0.0	3984	0.0	4184	0.0	4384	0.0	4584	0.0	4784	0.0
3788	0.0	3988	0.0	4188	0.0	4388	0.0	4588	0.0	4788	0.0
3792	0.0	3992	0.0	4192	0.0	4392	0.0	4592	0.0	4792	0.0
3796	0.0	3996	0.0	4196	0.0	4396	0.0	4596	0.0	4796	0.0
3800	0.0	4000	0.0	4200	0.0	4400	0.0	4600	0.0	4800	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4804	0.0	5004	0.0	5204	0.0	5404	0.0	5604	0.0	5804	0.0
4808	0.0	5008	0.0	5208	0.0	5408	0.0	5608	0.0	5808	0.0
4812	0.0	5012	0.0	5212	0.0	5412	0.0	5612	0.0	5812	0.0
4816	0.0	5016	0.0	5216	0.0	5416	0.0	5616	0.0	5816	0.0
4820	0.0	5020	0.0	5220	0.0	5420	0.0	5620	0.0	5820	0.0
4824	0.0	5024	0.0	5224	0.0	5424	0.0	5624	0.0	5824	0.0
4828	0.0	5028	0.0	5228	0.0	5428	0.0	5628	0.0	5828	0.0
4832	0.0	5032	0.0	5232	0.0	5432	0.0	5632	0.0	5832	0.0
4836	0.0	5036	0.0	5236	0.0	5436	0.0	5636	0.0	5836	0.0
4840	0.0	5040	0.0	5240	0.0	5440	0.0	5640	0.0	5840	0.0
4844	0.0	5044	0.0	5244	0.0	5444	0.0	5644	0.0	5844	0.0
4848	0.0	5048	0.0	5248	0.0	5448	0.0	5648	0.0	5848	0.0
4852	0.0	5052	0.0	5252	0.0	5452	0.0	5652	0.0	5852	0.0
4856	0.0	5056	0.0	5256	0.0	5456	0.0	5656	0.0	5856	0.0
4860	0.0	5060	0.0	5260	0.0	5460	0.0	5660	0.0	5860	0.0
4864	0.0	5064	0.0	5264	0.0	5464	0.0	5664	0.0	5864	0.0
4868	0.0	5068	0.0	5268	0.0	5468	0.0	5668	0.0	5868	0.0
4872	0.0	5072	0.0	5272	0.0	5472	0.0	5672	0.0	5872	0.0
4876	0.0	5076	0.0	5276	0.0	5476	0.0	5676	0.0	5876	0.0
4880	0.0	5080	0.0	5280	0.0	5480	0.0	5680	0.0	5880	0.0
4884	0.0	5084	0.0	5284	0.0	5484	0.0	5684	0.0	5884	0.0
4888	0.0	5088	0.0	5288	0.0	5488	0.0	5688	0.0	5888	0.0
4892	0.0	5092	0.0	5292	0.0	5492	0.0	5692	0.0	5892	0.0
4896	0.0	5096	0.0	5296	0.0	5496	0.0	5696	0.0	5896	0.0
4900	0.0	5100	0.0	5300	0.0	5500	0.0	5700	0.0	5900	0.0
4904	0.0	5104	0.0	5304	0.0	5504	0.0	5704	0.0	5904	0.0
4908	0.0	5108	0.0	5308	0.0	5508	0.0	5708	0.0	5908	0.0
4912	0.0	5112	0.0	5312	0.0	5512	0.0	5712	0.0	5912	0.0
4916	0.0	5116	0.0	5316	0.0	5516	0.0	5716	0.0	5916	0.0
4920	0.0	5120	0.0	5320	0.0	5520	0.0	5720	0.0	5920	0.0
4924	0.0	5124	0.0	5324	0.0	5524	0.0	5724	0.0	5924	0.0
4928	0.0	5128	0.0	5328	0.0	5528	0.0	5728	0.0	5928	0.0
4932	0.0	5132	0.0	5332	0.0	5532	0.0	5732	0.0	5932	0.0
4936	0.0	5136	0.0	5336	0.0	5536	0.0	5736	0.0	5936	0.0
4940	0.0	5140	0.0	5340	0.0	5540	0.0	5740	0.0	5940	0.0
4944	0.0	5144	0.0	5344	0.0	5544	0.0	5744	0.0	5944	0.0
4948	0.0	5148	0.0	5348	0.0	5548	0.0	5748	0.0	5948	0.0
4952	0.0	5152	0.0	5352	0.0	5552	0.0	5752	0.0	5952	0.0
4956	0.0	5156	0.0	5356	0.0	5556	0.0	5756	0.0	5956	0.0
4960	0.0	5160	0.0	5360	0.0	5560	0.0	5760	0.0	5960	0.0
4964	0.0	5164	0.0	5364	0.0	5564	0.0	5764	0.0	5964	0.0
4968	0.0	5168	0.0	5368	0.0	5568	0.0	5768	0.0	5968	0.0
4972	0.0	5172	0.0	5372	0.0	5572	0.0	5772	0.0	5972	0.0
4976	0.0	5176	0.0	5376	0.0	5576	0.0	5776	0.0	5976	0.0
4980	0.0	5180	0.0	5380	0.0	5580	0.0	5780	0.0	5980	0.0
4984	0.0	5184	0.0	5384	0.0	5584	0.0	5784	0.0	5984	0.0
4988	0.0	5188	0.0	5388	0.0	5588	0.0	5788	0.0	5988	0.0
4992	0.0	5192	0.0	5392	0.0	5592	0.0	5792	0.0	5992	0.0
4996	0.0	5196	0.0	5396	0.0	5596	0.0	5796	0.0	5996	0.0
5000	0.0	5200	0.0	5400	0.0	5600	0.0	5800	0.0	6000	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
6004	0.0	6204	0.0	6404	0.0	6604	0.0	6804	0.0	7004	0.0
6008	0.0	6208	0.0	6408	0.0	6608	0.0	6808	0.0	7008	0.0
6012	0.0	6212	0.0	6412	0.0	6612	0.0	6812	0.0	7012	0.0
6016	0.0	6216	0.0	6416	0.0	6616	0.0	6816	0.0	7016	0.0
6020	0.0	6220	0.0	6420	0.0	6620	0.0	6820	0.0	7020	0.0
6024	0.0	6224	0.0	6424	0.0	6624	0.0	6824	0.0	7024	0.0
6028	0.0	6228	0.0	6428	0.0	6628	0.0	6828	0.0	7028	0.0
6032	0.0	6232	0.0	6432	0.0	6632	0.0	6832	0.0	7032	0.0
6036	0.0	6236	0.0	6436	0.0	6636	0.0	6836	0.0	7036	0.0
6040	0.0	6240	0.0	6440	0.0	6640	0.0	6840	0.0	7040	0.0
6044	0.0	6244	0.0	6444	0.0	6644	0.0	6844	0.0	7044	0.0
6048	0.0	6248	0.0	6448	0.0	6648	0.0	6848	0.0	7048	0.0
6052	0.0	6252	0.0	6452	0.0	6652	0.0	6852	0.0	7052	0.0
6056	0.0	6256	0.0	6456	0.0	6656	0.0	6856	0.0	7056	0.0
6060	0.0	6260	0.0	6460	0.0	6660	0.0	6860	0.0	7060	0.0
6064	0.0	6264	0.0	6464	0.0	6664	0.0	6864	0.0	7064	0.0
6068	0.0	6268	0.0	6468	0.0	6668	0.0	6868	0.0	7068	0.0
6072	0.0	6272	0.0	6472	0.0	6672	0.0	6872	0.0	7072	0.0
6076	0.0	6276	0.0	6476	0.0	6676	0.0	6876	0.0	7076	0.0
6080	0.0	6280	0.0	6480	0.0	6680	0.0	6880	0.0	7080	0.0
6084	0.0	6284	0.0	6484	0.0	6684	0.0	6884	0.0	7084	0.0
6088	0.0	6288	0.0	6488	0.0	6688	0.0	6888	0.0	7088	0.0
6092	0.0	6292	0.0	6492	0.0	6692	0.0	6892	0.0	7092	0.0
6096	0.0	6296	0.0	6496	0.0	6696	0.0	6896	0.0	7096	0.0
6100	0.0	6300	0.0	6500	0.0	6700	0.0	6900	0.0	7100	0.0
6104	0.0	6304	0.0	6504	0.0	6704	0.0	6904	0.0	7104	0.0
6108	0.0	6308	0.0	6508	0.0	6708	0.0	6908	0.0	7108	0.0
6112	0.0	6312	0.0	6512	0.0	6712	0.0	6912	0.0	7112	0.0
6116	0.0	6316	0.0	6516	0.0	6716	0.0	6916	0.0	7116	0.0
6120	0.0	6320	0.0	6520	0.0	6720	0.0	6920	0.0	7120	0.0
6124	0.0	6324	0.0	6524	0.0	6724	0.0	6924	0.0	7124	0.0
6128	0.0	6328	0.0	6528	0.0	6728	0.0	6928	0.0	7128	0.0
6132	0.0	6332	0.0	6532	0.0	6732	0.0	6932	0.0	7132	0.0
6136	0.0	6336	0.0	6536	0.0	6736	0.0	6936	0.0	7136	0.0
6140	0.0	6340	0.0	6540	0.0	6740	0.0	6940	0.0	7140	0.0
6144	0.0	6344	0.0	6544	0.0	6744	0.0	6944	0.0	7144	0.0
6148	0.0	6348	0.0	6548	0.0	6748	0.0	6948	0.0	7148	0.0
6152	0.0	6352	0.0	6552	0.0	6752	0.0	6952	0.0	7152	0.0
6156	0.0	6356	0.0	6556	0.0	6756	0.0	6956	0.0	7156	0.0
6160	0.0	6360	0.0	6560	0.0	6760	0.0	6960	0.0	7160	0.0
6164	0.0	6364	0.0	6564	0.0	6764	0.0	6964	0.0	7164	0.0
6168	0.0	6368	0.0	6568	0.0	6768	0.0	6968	0.0	7168	0.0
6172	0.0	6372	0.0	6572	0.0	6772	0.0	6972	0.0	7172	0.0
6176	0.0	6376	0.0	6576	0.0	6776	0.0	6976	0.0	7176	0.0
6180	0.0	6380	0.0	6580	0.0	6780	0.0	6980	0.0	7180	0.0
6184	0.0	6384	0.0	6584	0.0	6784	0.0	6984	0.0	7184	0.0
6188	0.0	6388	0.0	6588	0.0	6788	0.0	6988	0.0	7188	0.0
6192	0.0	6392	0.0	6592	0.0	6792	0.0	6992	0.0	7192	0.0
6196	0.0	6396	0.0	6596	0.0	6796	0.0	6996	0.0	7196	0.0
6200	0.0	6400	0.0	6600	0.0	6800	0.0	7000	0.0	7200	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
7204	0.0	7404	0.0	7604	0.0	7804	0.0	8004	0.0	8204	0.0
7208	0.0	7408	0.0	7608	0.0	7808	0.0	8008	0.0	8208	0.0
7212	0.0	7412	0.0	7612	0.0	7812	0.0	8012	0.0	8212	0.0
7216	0.0	7416	0.0	7616	0.0	7816	0.0	8016	0.0	8216	0.0
7220	0.0	7420	0.0	7620	0.0	7820	0.0	8020	0.0	8220	0.0
7224	0.0	7424	0.0	7624	0.0	7824	0.0	8024	0.0	8224	0.0
7228	0.0	7428	0.0	7628	0.0	7828	0.0	8028	0.0	8228	0.0
7232	0.0	7432	0.0	7632	0.0	7832	0.0	8032	0.0	8232	0.0
7236	0.0	7436	0.0	7636	0.0	7836	0.0	8036	0.0	8236	0.0
7240	0.0	7440	0.0	7640	0.0	7840	0.0	8040	0.0	8240	0.0
7244	0.0	7444	0.0	7644	0.0	7844	0.0	8044	0.0	8244	0.0
7248	0.0	7448	0.0	7648	0.0	7848	0.0	8048	0.0	8248	0.0
7252	0.0	7452	0.0	7652	0.0	7852	0.0	8052	0.0	8252	0.0
7256	0.0	7456	0.0	7656	0.0	7856	0.0	8056	0.0	8256	0.0
7260	0.0	7460	0.0	7660	0.0	7860	0.0	8060	0.0	8260	0.0
7264	0.0	7464	0.0	7664	0.0	7864	0.0	8064	0.0	8264	0.0
7268	0.0	7468	0.0	7668	0.0	7868	0.0	8068	0.0	8268	0.0
7272	0.0	7472	0.0	7672	0.0	7872	0.0	8072	0.0	8272	0.0
7276	0.0	7476	0.0	7676	0.0	7876	0.0	8076	0.0	8276	0.0
7280	0.0	7480	0.0	7680	0.0	7880	0.0	8080	0.0	8280	0.0
7284	0.0	7484	0.0	7684	0.0	7884	0.0	8084	0.0	8284	0.0
7288	0.0	7488	0.0	7688	0.0	7888	0.0	8088	0.0	8288	0.0
7292	0.0	7492	0.0	7692	0.0	7892	0.0	8092	0.0	8292	0.0
7296	0.0	7496	0.0	7696	0.0	7896	0.0	8096	0.0	8296	0.0
7300	0.0	7500	0.0	7700	0.0	7900	0.0	8100	0.0	8300	0.0
7304	0.0	7504	0.0	7704	0.0	7904	0.0	8104	0.0	8304	0.0
7308	0.0	7508	0.0	7708	0.0	7908	0.0	8108	0.0	8308	0.0
7312	0.0	7512	0.0	7712	0.0	7912	0.0	8112	0.0	8312	0.0
7316	0.0	7516	0.0	7716	0.0	7916	0.0	8116	0.0	8316	0.0
7320	0.0	7520	0.0	7720	0.0	7920	0.0	8120	0.0	8320	0.0
7324	0.0	7524	0.0	7724	0.0	7924	0.0	8124	0.0	8324	0.0
7328	0.0	7528	0.0	7728	0.0	7928	0.0	8128	0.0	8328	0.0
7332	0.0	7532	0.0	7732	0.0	7932	0.0	8132	0.0	8332	0.0
7336	0.0	7536	0.0	7736	0.0	7936	0.0	8136	0.0	8336	0.0
7340	0.0	7540	0.0	7740	0.0	7940	0.0	8140	0.0	8340	0.0
7344	0.0	7544	0.0	7744	0.0	7944	0.0	8144	0.0	8344	0.0
7348	0.0	7548	0.0	7748	0.0	7948	0.0	8148	0.0	8348	0.0
7352	0.0	7552	0.0	7752	0.0	7952	0.0	8152	0.0	8352	0.0
7356	0.0	7556	0.0	7756	0.0	7956	0.0	8156	0.0	8356	0.0
7360	0.0	7560	0.0	7760	0.0	7960	0.0	8160	0.0	8360	0.0
7364	0.0	7564	0.0	7764	0.0	7964	0.0	8164	0.0	8364	0.0
7368	0.0	7568	0.0	7768	0.0	7968	0.0	8168	0.0	8368	0.0
7372	0.0	7572	0.0	7772	0.0	7972	0.0	8172	0.0	8372	0.0
7376	0.0	7576	0.0	7776	0.0	7976	0.0	8176	0.0	8376	0.0
7380	0.0	7580	0.0	7780	0.0	7980	0.0	8180	0.0	8380	0.0
7384	0.0	7584	0.0	7784	0.0	7984	0.0	8184	0.0	8384	0.0
7388	0.0	7588	0.0	7788	0.0	7988	0.0	8188	0.0	8388	0.0
7392	0.0	7592	0.0	7792	0.0	7992	0.0	8192	0.0	8392	0.0
7396	0.0	7596	0.0	7796	0.0	7996	0.0	8196	0.0	8396	0.0
7400	0.0	7600	0.0	7800	0.0	8000	0.0	8200	0.0	8400	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
8404	0.0	8604	0.0	8804	0.0	9004	0.0	9204	0.0	9404	0.0
8408	0.0	8608	0.0	8808	0.0	9008	0.0	9208	0.0	9408	0.0
8412	0.0	8612	0.0	8812	0.0	9012	0.0	9212	0.0	9412	0.0
8416	0.0	8616	0.0	8816	0.0	9016	0.0	9216	0.0	9416	0.0
8420	0.0	8620	0.0	8820	0.0	9020	0.0	9220	0.0	9420	0.0
8424	0.0	8624	0.0	8824	0.0	9024	0.0	9224	0.0	9424	0.0
8428	0.0	8628	0.0	8828	0.0	9028	0.0	9228	0.0	9428	0.0
8432	0.0	8632	0.0	8832	0.0	9032	0.0	9232	0.0	9432	0.0
8436	0.0	8636	0.0	8836	0.0	9036	0.0	9236	0.0	9436	0.0
8440	0.0	8640	0.0	8840	0.0	9040	0.0	9240	0.0	9440	0.0
8444	0.0	8644	0.0	8844	0.0	9044	0.0	9244	0.0	9444	0.0
8448	0.0	8648	0.0	8848	0.0	9048	0.0	9248	0.0	9448	0.0
8452	0.0	8652	0.0	8852	0.0	9052	0.0	9252	0.0	9452	0.0
8456	0.0	8656	0.0	8856	0.0	9056	0.0	9256	0.0	9456	0.0
8460	0.0	8660	0.0	8860	0.0	9060	0.0	9260	0.0	9460	0.0
8464	0.0	8664	0.0	8864	0.0	9064	0.0	9264	0.0	9464	0.0
8468	0.0	8668	0.0	8868	0.0	9068	0.0	9268	0.0	9468	0.0
8472	0.0	8672	0.0	8872	0.0	9072	0.0	9272	0.0	9472	0.0
8476	0.0	8676	0.0	8876	0.0	9076	0.0	9276	0.0	9476	0.0
8480	0.0	8680	0.0	8880	0.0	9080	0.0	9280	0.0	9480	0.0
8484	0.0	8684	0.0	8884	0.0	9084	0.0	9284	0.0	9484	0.0
8488	0.0	8688	0.0	8888	0.0	9088	0.0	9288	0.0	9488	0.0
8492	0.0	8692	0.0	8892	0.0	9092	0.0	9292	0.0	9492	0.0
8496	0.0	8696	0.0	8896	0.0	9096	0.0	9296	0.0	9496	0.0
8500	0.0	8700	0.0	8900	0.0	9100	0.0	9300	0.0	9500	0.0
8504	0.0	8704	0.0	8904	0.0	9104	0.0	9304	0.0	9504	0.0
8508	0.0	8708	0.0	8908	0.0	9108	0.0	9308	0.0	9508	0.0
8512	0.0	8712	0.0	8912	0.0	9112	0.0	9312	0.0	9512	0.0
8516	0.0	8716	0.0	8916	0.0	9116	0.0	9316	0.0	9516	0.0
8520	0.0	8720	0.0	8920	0.0	9120	0.0	9320	0.0	9520	0.0
8524	0.0	8724	0.0	8924	0.0	9124	0.0	9324	0.0	9524	0.0
8528	0.0	8728	0.0	8928	0.0	9128	0.0	9328	0.0	9528	0.0
8532	0.0	8732	0.0	8932	0.0	9132	0.0	9332	0.0	9532	0.0
8536	0.0	8736	0.0	8936	0.0	9136	0.0	9336	0.0	9536	0.0
8540	0.0	8740	0.0	8940	0.0	9140	0.0	9340	0.0	9540	0.0
8544	0.0	8744	0.0	8944	0.0	9144	0.0	9344	0.0	9544	0.0
8548	0.0	8748	0.0	8948	0.0	9148	0.0	9348	0.0	9548	0.0
8552	0.0	8752	0.0	8952	0.0	9152	0.0	9352	0.0	9552	0.0
8556	0.0	8756	0.0	8956	0.0	9156	0.0	9356	0.0	9556	0.0
8560	0.0	8760	0.0	8960	0.0	9160	0.0	9360	0.0	9560	0.0
8564	0.0	8764	0.0	8964	0.0	9164	0.0	9364	0.0	9564	0.0
8568	0.0	8768	0.0	8968	0.0	9168	0.0	9368	0.0	9568	0.0
8572	0.0	8772	0.0	8972	0.0	9172	0.0	9372	0.0	9572	0.0
8576	0.0	8776	0.0	8976	0.0	9176	0.0	9376	0.0	9576	0.0
8580	0.0	8780	0.0	8980	0.0	9180	0.0	9380	0.0	9580	0.0
8584	0.0	8784	0.0	8984	0.0	9184	0.0	9384	0.0	9584	0.0
8588	0.0	8788	0.0	8988	0.0	9188	0.0	9388	0.0	9588	0.0
8592	0.0	8792	0.0	8992	0.0	9192	0.0	9392	0.0	9592	0.0
8596	0.0	8796	0.0	8996	0.0	9196	0.0	9396	0.0	9596	0.0
8600	0.0	8800	0.0	9000	0.0	9200	0.0	9400	0.0	9600	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
9604	0.0	9684	0.0	9764	0.0	9844	0.0	9924	0.0	10004	0.0
9608	0.0	9688	0.0	9768	0.0	9848	0.0	9928	0.0	10008	0.0
9612	0.0	9692	0.0	9772	0.0	9852	0.0	9932	0.0	10012	0.0
9616	0.0	9696	0.0	9776	0.0	9856	0.0	9936	0.0	10016	0.0
9620	0.0	9700	0.0	9780	0.0	9860	0.0	9940	0.0	10020	0.0
9624	0.0	9704	0.0	9784	0.0	9864	0.0	9944	0.0	10024	0.0
9628	0.0	9708	0.0	9788	0.0	9868	0.0	9948	0.0	10028	0.0
9632	0.0	9712	0.0	9792	0.0	9872	0.0	9952	0.0	10032	0.0
9636	0.0	9716	0.0	9796	0.0	9876	0.0	9956	0.0	10036	0.0
9640	0.0	9720	0.0	9800	0.0	9880	0.0	9960	0.0	10040	0.0
9644	0.0	9724	0.0	9804	0.0	9884	0.0	9964	0.0	10044	0.0
9648	0.0	9728	0.0	9808	0.0	9888	0.0	9968	0.0	10048	0.0
9652	0.0	9732	0.0	9812	0.0	9892	0.0	9972	0.0	10052	0.0
9656	0.0	9736	0.0	9816	0.0	9896	0.0	9976	0.0	10056	0.0
9660	0.0	9740	0.0	9820	0.0	9900	0.0	9980	0.0	10060	0.0
9664	0.0	9744	0.0	9824	0.0	9904	0.0	9984	0.0	10064	0.0
9668	0.0	9748	0.0	9828	0.0	9908	0.0	9988	0.0	10068	0.0
9672	0.0	9752	0.0	9832	0.0	9912	0.0	9992	0.0	10072	0.0
9676	0.0	9756	0.0	9836	0.0	9916	0.0	9996	0.0	10076	0.0
9680	0.0	9760	0.0	9840	0.0	9920	0.0	10000	0.0	10080	0.0

Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 8.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1100.0	1100.0	1.501	0.0	1299.1
1.500	1100.0	1299.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0058-2000-1500-2000
Design Head (m)	1.500
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	No
Diameter (mm)	58
Invert Level (m)	8.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.0
Flush-Flo™	0.141	1.3
Kick-Flo®	0.202	0.8
Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	1.200	1.8	3.000	2.8	7.000	4.3
0.200	0.8	1.400	1.9	3.500	3.0	7.500	4.4
0.300	0.9	1.600	2.1	4.000	3.2	8.000	4.5
0.400	1.0	1.800	2.2	4.500	3.4	8.500	4.7
0.500	1.2	2.000	2.3	5.000	3.6	9.000	4.8
0.600	1.3	2.200	2.4	5.500	3.8	9.500	4.9
0.800	1.5	2.400	2.5	6.000	3.9		
1.000	1.6	2.600	2.6	6.500	4.1		

Summary of Results for Input Hydrograph

Half Drain Time : 7884 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
Input Hydrograph	9.453	1.453	0.0	2.0	2.0	1587.8	O K

Storm Event	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	1078.6	2948

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4	0.3	204	3.6	404	3.9	604	4.3	804	6.7	1004	11.4
8	0.3	208	3.7	408	3.9	608	4.5	808	6.9	1008	11.4
12	0.3	212	3.7	412	3.9	612	4.5	812	7.2	1012	12.3
16	0.3	216	3.7	416	3.9	616	4.5	816	7.2	1016	12.3
20	0.3	220	3.7	420	3.9	620	4.5	820	7.2	1020	12.3
24	0.3	224	3.7	424	3.9	624	4.5	824	7.2	1024	12.3
28	0.3	228	3.7	428	3.9	628	4.5	828	7.2	1028	12.3
32	1.0	232	3.7	432	3.9	632	4.5	832	7.2	1032	12.3
36	1.1	236	3.8	436	3.9	636	4.6	836	7.3	1036	12.3
40	1.1	240	3.8	440	3.9	640	4.7	840	7.8	1040	12.9
44	1.1	244	3.8	444	3.9	644	4.7	844	7.8	1044	13.1
48	1.1	248	3.8	448	3.9	648	4.7	848	7.8	1048	13.1
52	1.1	252	3.8	452	3.9	652	4.7	852	7.8	1052	13.1
56	1.1	256	3.8	456	3.9	656	4.7	856	7.8	1056	13.1
60	1.6	260	3.8	460	3.9	660	4.7	860	7.8	1060	13.1
64	1.8	264	3.9	464	4.0	664	4.9	864	7.8	1064	13.1
68	1.8	268	3.9	468	4.0	668	5.0	868	8.4	1068	13.6
72	1.8	272	3.9	472	4.0	672	5.0	872	8.4	1072	14.0
76	1.8	276	3.9	476	4.0	676	5.0	876	8.4	1076	14.0
80	1.8	280	3.9	480	4.0	680	5.0	880	8.4	1080	14.0
84	1.8	284	3.9	484	4.0	684	5.0	884	8.4	1084	14.0
88	2.1	288	3.9	488	4.0	688	5.0	888	8.4	1088	14.0
92	2.4	292	3.9	492	4.0	692	5.1	892	8.4	1092	14.0
96	2.4	296	3.9	496	4.0	696	5.4	896	9.0	1096	14.3
100	2.4	300	3.9	500	4.0	700	5.4	900	9.1	1100	14.9
104	2.4	304	3.9	504	4.0	704	5.4	904	9.1	1104	14.9
108	2.4	308	3.9	508	4.0	708	5.4	908	9.1	1108	14.9
112	2.4	312	3.9	512	4.0	712	5.4	912	9.1	1112	14.9
116	2.5	316	3.9	516	4.0	716	5.4	916	9.1	1116	14.9
120	2.9	320	3.9	520	4.0	720	5.4	920	9.1	1120	14.9
124	2.9	324	3.9	524	4.1	724	5.7	924	9.6	1124	15.0
128	2.9	328	3.9	528	4.1	728	5.7	928	9.9	1128	15.7
132	2.9	332	3.9	532	4.1	732	5.7	932	9.9	1132	15.7
136	2.9	336	3.9	536	4.1	736	5.7	936	9.9	1136	15.7
140	2.9	340	3.9	540	4.1	740	5.7	940	9.9	1140	15.7
144	2.9	344	3.9	544	4.1	744	5.7	944	9.9	1144	15.7
148	3.2	348	3.9	548	4.1	748	5.7	948	9.9	1148	15.7
152	3.2	352	3.9	552	4.2	752	6.1	952	10.2	1152	15.7
156	3.2	356	3.9	556	4.2	756	6.2	956	10.6	1156	16.6
160	3.2	360	3.9	560	4.2	760	6.2	960	10.6	1160	16.6
164	3.2	364	3.9	564	4.2	764	6.2	964	10.6	1164	16.6
168	3.2	368	3.9	568	4.2	768	6.2	968	10.6	1168	16.6
172	3.2	372	3.9	572	4.2	772	6.2	972	10.6	1172	16.6
176	3.4	376	3.9	576	4.2	776	6.2	976	10.6	1176	16.6
180	3.5	380	3.9	580	4.3	780	6.5	980	10.8	1180	16.6
184	3.5	384	3.9	584	4.3	784	6.7	984	11.4	1184	17.3
188	3.5	388	3.9	588	4.3	788	6.7	988	11.4	1188	17.5
192	3.5	392	3.9	592	4.3	792	6.7	992	11.4	1192	17.5
196	3.5	396	3.9	596	4.3	796	6.7	996	11.4	1196	17.5
200	3.5	400	3.9	600	4.3	800	6.7	1000	11.4	1200	17.5

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
1204	17.5	1404	22.1	1604	19.8	1804	14.0	2004	8.4	2204	5.0
1208	17.5	1408	22.1	1608	19.8	1808	14.0	2008	8.4	2208	5.0
1212	18.0	1412	22.1	1612	19.8	1812	14.0	2012	8.4	2212	5.0
1216	18.3	1416	22.4	1616	19.2	1816	13.6	2016	8.4	2216	5.0
1220	18.3	1420	22.4	1620	19.1	1820	13.1	2020	7.8	2220	4.9
1224	18.3	1424	22.4	1624	19.1	1824	13.1	2024	7.8	2224	4.7
1228	18.3	1428	22.4	1628	19.1	1828	13.1	2028	7.8	2228	4.7
1232	18.3	1432	22.4	1632	19.1	1832	13.1	2032	7.8	2232	4.7
1236	18.3	1436	22.4	1636	19.1	1836	13.1	2036	7.8	2236	4.7
1240	18.6	1440	22.4	1640	19.1	1840	13.1	2040	7.8	2240	4.7
1244	19.1	1444	22.4	1644	18.6	1844	12.9	2044	7.8	2244	4.7
1248	19.1	1448	22.4	1648	18.3	1848	12.3	2048	7.3	2248	4.6
1252	19.1	1452	22.4	1652	18.3	1852	12.3	2052	7.2	2252	4.5
1256	19.1	1456	22.4	1656	18.3	1856	12.3	2056	7.2	2256	4.5
1260	19.1	1460	22.4	1660	18.3	1860	12.3	2060	7.2	2260	4.5
1264	19.1	1464	22.4	1664	18.3	1864	12.3	2064	7.2	2264	4.5
1268	19.2	1468	22.4	1668	18.3	1868	12.3	2068	7.2	2268	4.5
1272	19.8	1472	22.1	1672	18.0	1872	12.3	2072	7.2	2272	4.5
1276	19.8	1476	22.1	1676	17.5	1876	11.4	2076	6.9	2276	4.5
1280	19.8	1480	22.1	1680	17.5	1880	11.4	2080	6.7	2280	4.3
1284	19.8	1484	22.1	1684	17.5	1884	11.4	2084	6.7	2284	4.3
1288	19.8	1488	22.1	1688	17.5	1888	11.4	2088	6.7	2288	4.3
1292	19.8	1492	22.1	1692	17.5	1892	11.4	2092	6.7	2292	4.3
1296	19.8	1496	22.1	1696	17.5	1896	11.4	2096	6.7	2296	4.3
1300	20.5	1500	21.8	1700	17.3	1900	11.4	2100	6.7	2300	4.3
1304	20.5	1504	21.7	1704	16.6	1904	10.8	2104	6.5	2304	4.3
1308	20.5	1508	21.7	1708	16.6	1908	10.6	2108	6.2	2308	4.2
1312	20.5	1512	21.7	1712	16.6	1912	10.6	2112	6.2	2312	4.2
1316	20.5	1516	21.7	1716	16.6	1916	10.6	2116	6.2	2316	4.2
1320	20.5	1520	21.7	1720	16.6	1920	10.6	2120	6.2	2320	4.2
1324	20.5	1524	21.7	1724	16.6	1924	10.6	2124	6.2	2324	4.2
1328	21.0	1528	21.4	1728	16.6	1928	10.6	2128	6.2	2328	4.2
1332	21.1	1532	21.1	1732	15.7	1932	10.2	2132	6.1	2332	4.2
1336	21.1	1536	21.1	1736	15.7	1936	9.9	2136	5.7	2336	4.1
1340	21.1	1540	21.1	1740	15.7	1940	9.9	2140	5.7	2340	4.1
1344	21.1	1544	21.1	1744	15.7	1944	9.9	2144	5.7	2344	4.1
1348	21.1	1548	21.1	1748	15.7	1948	9.9	2148	5.7	2348	4.1
1352	21.1	1552	21.1	1752	15.7	1952	9.9	2152	5.7	2352	4.1
1356	21.4	1556	21.0	1756	15.7	1956	9.9	2156	5.7	2356	4.1
1360	21.7	1560	20.5	1760	15.0	1960	9.6	2160	5.7	2360	4.1
1364	21.7	1564	20.5	1764	14.9	1964	9.1	2164	5.4	2364	4.0
1368	21.7	1568	20.5	1768	14.9	1968	9.1	2168	5.4	2368	4.0
1372	21.7	1572	20.5	1772	14.9	1972	9.1	2172	5.4	2372	4.0
1376	21.7	1576	20.5	1776	14.9	1976	9.1	2176	5.4	2376	4.0
1380	21.7	1580	20.5	1780	14.9	1980	9.1	2180	5.4	2380	4.0
1384	21.8	1584	20.5	1784	14.9	1984	9.1	2184	5.4	2384	4.0
1388	22.1	1588	19.8	1788	14.3	1988	9.0	2188	5.4	2388	4.0
1392	22.1	1592	19.8	1792	14.0	1992	8.4	2192	5.1	2392	4.0
1396	22.1	1596	19.8	1796	14.0	1996	8.4	2196	5.0	2396	4.0
1400	22.1	1600	19.8	1800	14.0	2000	8.4	2200	5.0	2400	4.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
2404	4.0	2604	3.9	2804	1.8	3004	0.0	3204	0.0	3404	0.0
2408	4.0	2608	3.9	2808	1.8	3008	0.0	3208	0.0	3408	0.0
2412	4.0	2612	3.9	2812	1.8	3012	0.0	3212	0.0	3412	0.0
2416	4.0	2616	3.9	2816	1.8	3016	0.0	3216	0.0	3416	0.0
2420	4.0	2620	3.9	2820	1.8	3020	0.0	3220	0.0	3420	0.0
2424	3.9	2624	3.8	2824	1.6	3024	0.0	3224	0.0	3424	0.0
2428	3.9	2628	3.8	2828	1.1	3028	0.0	3228	0.0	3428	0.0
2432	3.9	2632	3.8	2832	1.1	3032	0.0	3232	0.0	3432	0.0
2436	3.9	2636	3.8	2836	1.1	3036	0.0	3236	0.0	3436	0.0
2440	3.9	2640	3.8	2840	1.1	3040	0.0	3240	0.0	3440	0.0
2444	3.9	2644	3.8	2844	1.1	3044	0.0	3244	0.0	3444	0.0
2448	3.9	2648	3.8	2848	1.1	3048	0.0	3248	0.0	3448	0.0
2452	3.9	2652	3.7	2852	1.0	3052	0.0	3252	0.0	3452	0.0
2456	3.9	2656	3.7	2856	0.3	3056	0.0	3256	0.0	3456	0.0
2460	3.9	2660	3.7	2860	0.3	3060	0.0	3260	0.0	3460	0.0
2464	3.9	2664	3.7	2864	0.3	3064	0.0	3264	0.0	3464	0.0
2468	3.9	2668	3.7	2868	0.3	3068	0.0	3268	0.0	3468	0.0
2472	3.9	2672	3.7	2872	0.3	3072	0.0	3272	0.0	3472	0.0
2476	3.9	2676	3.7	2876	0.3	3076	0.0	3276	0.0	3476	0.0
2480	3.9	2680	3.6	2880	0.3	3080	0.0	3280	0.0	3480	0.0
2484	3.9	2684	3.5	2884	12.9	3084	0.0	3284	0.0	3484	0.0
2488	3.9	2688	3.5	2888	27.8	3088	0.0	3288	0.0	3488	0.0
2492	3.9	2692	3.5	2892	30.8	3092	0.0	3292	0.0	3492	0.0
2496	3.9	2696	3.5	2896	36.1	3096	0.0	3296	0.0	3496	0.0
2500	3.9	2700	3.5	2900	44.7	3100	0.0	3300	0.0	3500	0.0
2504	3.9	2704	3.5	2904	66.7	3104	0.0	3304	0.0	3504	0.0
2508	3.9	2708	3.4	2908	128.6	3108	0.0	3308	0.0	3508	0.0
2512	3.9	2712	3.2	2912	242.4	3112	0.0	3312	0.0	3512	0.0
2516	3.9	2716	3.2	2916	242.4	3116	0.0	3316	0.0	3516	0.0
2520	3.9	2720	3.2	2920	128.6	3120	0.0	3320	0.0	3520	0.0
2524	3.9	2724	3.2	2924	66.7	3124	0.0	3324	0.0	3524	0.0
2528	3.9	2728	3.2	2928	44.7	3128	0.0	3328	0.0	3528	0.0
2532	3.9	2732	3.2	2932	36.1	3132	0.0	3332	0.0	3532	0.0
2536	3.9	2736	3.2	2936	30.8	3136	0.0	3336	0.0	3536	0.0
2540	3.9	2740	2.9	2940	27.8	3140	0.0	3340	0.0	3540	0.0
2544	3.9	2744	2.9	2944	12.9	3144	0.0	3344	0.0	3544	0.0
2548	3.9	2748	2.9	2948	0.0	3148	0.0	3348	0.0	3548	0.0
2552	3.9	2752	2.9	2952	0.0	3152	0.0	3352	0.0	3552	0.0
2556	3.9	2756	2.9	2956	0.0	3156	0.0	3356	0.0	3556	0.0
2560	3.9	2760	2.9	2960	0.0	3160	0.0	3360	0.0	3560	0.0
2564	3.9	2764	2.9	2964	0.0	3164	0.0	3364	0.0	3564	0.0
2568	3.9	2768	2.5	2968	0.0	3168	0.0	3368	0.0	3568	0.0
2572	3.9	2772	2.4	2972	0.0	3172	0.0	3372	0.0	3572	0.0
2576	3.9	2776	2.4	2976	0.0	3176	0.0	3376	0.0	3576	0.0
2580	3.9	2780	2.4	2980	0.0	3180	0.0	3380	0.0	3580	0.0
2584	3.9	2784	2.4	2984	0.0	3184	0.0	3384	0.0	3584	0.0
2588	3.9	2788	2.4	2988	0.0	3188	0.0	3388	0.0	3588	0.0
2592	3.9	2792	2.4	2992	0.0	3192	0.0	3392	0.0	3592	0.0
2596	3.9	2796	2.1	2996	0.0	3196	0.0	3396	0.0	3596	0.0
2600	3.9	2800	1.8	3000	0.0	3200	0.0	3400	0.0	3600	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
3604	0.0	3804	0.0	4004	0.0	4204	0.0	4404	0.0	4604	0.0
3608	0.0	3808	0.0	4008	0.0	4208	0.0	4408	0.0	4608	0.0
3612	0.0	3812	0.0	4012	0.0	4212	0.0	4412	0.0	4612	0.0
3616	0.0	3816	0.0	4016	0.0	4216	0.0	4416	0.0	4616	0.0
3620	0.0	3820	0.0	4020	0.0	4220	0.0	4420	0.0	4620	0.0
3624	0.0	3824	0.0	4024	0.0	4224	0.0	4424	0.0	4624	0.0
3628	0.0	3828	0.0	4028	0.0	4228	0.0	4428	0.0	4628	0.0
3632	0.0	3832	0.0	4032	0.0	4232	0.0	4432	0.0	4632	0.0
3636	0.0	3836	0.0	4036	0.0	4236	0.0	4436	0.0	4636	0.0
3640	0.0	3840	0.0	4040	0.0	4240	0.0	4440	0.0	4640	0.0
3644	0.0	3844	0.0	4044	0.0	4244	0.0	4444	0.0	4644	0.0
3648	0.0	3848	0.0	4048	0.0	4248	0.0	4448	0.0	4648	0.0
3652	0.0	3852	0.0	4052	0.0	4252	0.0	4452	0.0	4652	0.0
3656	0.0	3856	0.0	4056	0.0	4256	0.0	4456	0.0	4656	0.0
3660	0.0	3860	0.0	4060	0.0	4260	0.0	4460	0.0	4660	0.0
3664	0.0	3864	0.0	4064	0.0	4264	0.0	4464	0.0	4664	0.0
3668	0.0	3868	0.0	4068	0.0	4268	0.0	4468	0.0	4668	0.0
3672	0.0	3872	0.0	4072	0.0	4272	0.0	4472	0.0	4672	0.0
3676	0.0	3876	0.0	4076	0.0	4276	0.0	4476	0.0	4676	0.0
3680	0.0	3880	0.0	4080	0.0	4280	0.0	4480	0.0	4680	0.0
3684	0.0	3884	0.0	4084	0.0	4284	0.0	4484	0.0	4684	0.0
3688	0.0	3888	0.0	4088	0.0	4288	0.0	4488	0.0	4688	0.0
3692	0.0	3892	0.0	4092	0.0	4292	0.0	4492	0.0	4692	0.0
3696	0.0	3896	0.0	4096	0.0	4296	0.0	4496	0.0	4696	0.0
3700	0.0	3900	0.0	4100	0.0	4300	0.0	4500	0.0	4700	0.0
3704	0.0	3904	0.0	4104	0.0	4304	0.0	4504	0.0	4704	0.0
3708	0.0	3908	0.0	4108	0.0	4308	0.0	4508	0.0	4708	0.0
3712	0.0	3912	0.0	4112	0.0	4312	0.0	4512	0.0	4712	0.0
3716	0.0	3916	0.0	4116	0.0	4316	0.0	4516	0.0	4716	0.0
3720	0.0	3920	0.0	4120	0.0	4320	0.0	4520	0.0	4720	0.0
3724	0.0	3924	0.0	4124	0.0	4324	0.0	4524	0.0	4724	0.0
3728	0.0	3928	0.0	4128	0.0	4328	0.0	4528	0.0	4728	0.0
3732	0.0	3932	0.0	4132	0.0	4332	0.0	4532	0.0	4732	0.0
3736	0.0	3936	0.0	4136	0.0	4336	0.0	4536	0.0	4736	0.0
3740	0.0	3940	0.0	4140	0.0	4340	0.0	4540	0.0	4740	0.0
3744	0.0	3944	0.0	4144	0.0	4344	0.0	4544	0.0	4744	0.0
3748	0.0	3948	0.0	4148	0.0	4348	0.0	4548	0.0	4748	0.0
3752	0.0	3952	0.0	4152	0.0	4352	0.0	4552	0.0	4752	0.0
3756	0.0	3956	0.0	4156	0.0	4356	0.0	4556	0.0	4756	0.0
3760	0.0	3960	0.0	4160	0.0	4360	0.0	4560	0.0	4760	0.0
3764	0.0	3964	0.0	4164	0.0	4364	0.0	4564	0.0	4764	0.0
3768	0.0	3968	0.0	4168	0.0	4368	0.0	4568	0.0	4768	0.0
3772	0.0	3972	0.0	4172	0.0	4372	0.0	4572	0.0	4772	0.0
3776	0.0	3976	0.0	4176	0.0	4376	0.0	4576	0.0	4776	0.0
3780	0.0	3980	0.0	4180	0.0	4380	0.0	4580	0.0	4780	0.0
3784	0.0	3984	0.0	4184	0.0	4384	0.0	4584	0.0	4784	0.0
3788	0.0	3988	0.0	4188	0.0	4388	0.0	4588	0.0	4788	0.0
3792	0.0	3992	0.0	4192	0.0	4392	0.0	4592	0.0	4792	0.0
3796	0.0	3996	0.0	4196	0.0	4396	0.0	4596	0.0	4796	0.0
3800	0.0	4000	0.0	4200	0.0	4400	0.0	4600	0.0	4800	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4804	0.0	5004	0.0	5204	0.0	5404	0.0	5604	0.0	5804	0.0
4808	0.0	5008	0.0	5208	0.0	5408	0.0	5608	0.0	5808	0.0
4812	0.0	5012	0.0	5212	0.0	5412	0.0	5612	0.0	5812	0.0
4816	0.0	5016	0.0	5216	0.0	5416	0.0	5616	0.0	5816	0.0
4820	0.0	5020	0.0	5220	0.0	5420	0.0	5620	0.0	5820	0.0
4824	0.0	5024	0.0	5224	0.0	5424	0.0	5624	0.0	5824	0.0
4828	0.0	5028	0.0	5228	0.0	5428	0.0	5628	0.0	5828	0.0
4832	0.0	5032	0.0	5232	0.0	5432	0.0	5632	0.0	5832	0.0
4836	0.0	5036	0.0	5236	0.0	5436	0.0	5636	0.0	5836	0.0
4840	0.0	5040	0.0	5240	0.0	5440	0.0	5640	0.0	5840	0.0
4844	0.0	5044	0.0	5244	0.0	5444	0.0	5644	0.0	5844	0.0
4848	0.0	5048	0.0	5248	0.0	5448	0.0	5648	0.0	5848	0.0
4852	0.0	5052	0.0	5252	0.0	5452	0.0	5652	0.0	5852	0.0
4856	0.0	5056	0.0	5256	0.0	5456	0.0	5656	0.0	5856	0.0
4860	0.0	5060	0.0	5260	0.0	5460	0.0	5660	0.0	5860	0.0
4864	0.0	5064	0.0	5264	0.0	5464	0.0	5664	0.0	5864	0.0
4868	0.0	5068	0.0	5268	0.0	5468	0.0	5668	0.0	5868	0.0
4872	0.0	5072	0.0	5272	0.0	5472	0.0	5672	0.0	5872	0.0
4876	0.0	5076	0.0	5276	0.0	5476	0.0	5676	0.0	5876	0.0
4880	0.0	5080	0.0	5280	0.0	5480	0.0	5680	0.0	5880	0.0
4884	0.0	5084	0.0	5284	0.0	5484	0.0	5684	0.0	5884	0.0
4888	0.0	5088	0.0	5288	0.0	5488	0.0	5688	0.0	5888	0.0
4892	0.0	5092	0.0	5292	0.0	5492	0.0	5692	0.0	5892	0.0
4896	0.0	5096	0.0	5296	0.0	5496	0.0	5696	0.0	5896	0.0
4900	0.0	5100	0.0	5300	0.0	5500	0.0	5700	0.0	5900	0.0
4904	0.0	5104	0.0	5304	0.0	5504	0.0	5704	0.0	5904	0.0
4908	0.0	5108	0.0	5308	0.0	5508	0.0	5708	0.0	5908	0.0
4912	0.0	5112	0.0	5312	0.0	5512	0.0	5712	0.0	5912	0.0
4916	0.0	5116	0.0	5316	0.0	5516	0.0	5716	0.0	5916	0.0
4920	0.0	5120	0.0	5320	0.0	5520	0.0	5720	0.0	5920	0.0
4924	0.0	5124	0.0	5324	0.0	5524	0.0	5724	0.0	5924	0.0
4928	0.0	5128	0.0	5328	0.0	5528	0.0	5728	0.0	5928	0.0
4932	0.0	5132	0.0	5332	0.0	5532	0.0	5732	0.0	5932	0.0
4936	0.0	5136	0.0	5336	0.0	5536	0.0	5736	0.0	5936	0.0
4940	0.0	5140	0.0	5340	0.0	5540	0.0	5740	0.0	5940	0.0
4944	0.0	5144	0.0	5344	0.0	5544	0.0	5744	0.0	5944	0.0
4948	0.0	5148	0.0	5348	0.0	5548	0.0	5748	0.0	5948	0.0
4952	0.0	5152	0.0	5352	0.0	5552	0.0	5752	0.0	5952	0.0
4956	0.0	5156	0.0	5356	0.0	5556	0.0	5756	0.0	5956	0.0
4960	0.0	5160	0.0	5360	0.0	5560	0.0	5760	0.0	5960	0.0
4964	0.0	5164	0.0	5364	0.0	5564	0.0	5764	0.0	5964	0.0
4968	0.0	5168	0.0	5368	0.0	5568	0.0	5768	0.0	5968	0.0
4972	0.0	5172	0.0	5372	0.0	5572	0.0	5772	0.0	5972	0.0
4976	0.0	5176	0.0	5376	0.0	5576	0.0	5776	0.0	5976	0.0
4980	0.0	5180	0.0	5380	0.0	5580	0.0	5780	0.0	5980	0.0
4984	0.0	5184	0.0	5384	0.0	5584	0.0	5784	0.0	5984	0.0
4988	0.0	5188	0.0	5388	0.0	5588	0.0	5788	0.0	5988	0.0
4992	0.0	5192	0.0	5392	0.0	5592	0.0	5792	0.0	5992	0.0
4996	0.0	5196	0.0	5396	0.0	5596	0.0	5796	0.0	5996	0.0
5000	0.0	5200	0.0	5400	0.0	5600	0.0	5800	0.0	6000	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
6004	0.0	6204	0.0	6404	0.0	6604	0.0	6804	0.0	7004	0.0
6008	0.0	6208	0.0	6408	0.0	6608	0.0	6808	0.0	7008	0.0
6012	0.0	6212	0.0	6412	0.0	6612	0.0	6812	0.0	7012	0.0
6016	0.0	6216	0.0	6416	0.0	6616	0.0	6816	0.0	7016	0.0
6020	0.0	6220	0.0	6420	0.0	6620	0.0	6820	0.0	7020	0.0
6024	0.0	6224	0.0	6424	0.0	6624	0.0	6824	0.0	7024	0.0
6028	0.0	6228	0.0	6428	0.0	6628	0.0	6828	0.0	7028	0.0
6032	0.0	6232	0.0	6432	0.0	6632	0.0	6832	0.0	7032	0.0
6036	0.0	6236	0.0	6436	0.0	6636	0.0	6836	0.0	7036	0.0
6040	0.0	6240	0.0	6440	0.0	6640	0.0	6840	0.0	7040	0.0
6044	0.0	6244	0.0	6444	0.0	6644	0.0	6844	0.0	7044	0.0
6048	0.0	6248	0.0	6448	0.0	6648	0.0	6848	0.0	7048	0.0
6052	0.0	6252	0.0	6452	0.0	6652	0.0	6852	0.0	7052	0.0
6056	0.0	6256	0.0	6456	0.0	6656	0.0	6856	0.0	7056	0.0
6060	0.0	6260	0.0	6460	0.0	6660	0.0	6860	0.0	7060	0.0
6064	0.0	6264	0.0	6464	0.0	6664	0.0	6864	0.0	7064	0.0
6068	0.0	6268	0.0	6468	0.0	6668	0.0	6868	0.0	7068	0.0
6072	0.0	6272	0.0	6472	0.0	6672	0.0	6872	0.0	7072	0.0
6076	0.0	6276	0.0	6476	0.0	6676	0.0	6876	0.0	7076	0.0
6080	0.0	6280	0.0	6480	0.0	6680	0.0	6880	0.0	7080	0.0
6084	0.0	6284	0.0	6484	0.0	6684	0.0	6884	0.0	7084	0.0
6088	0.0	6288	0.0	6488	0.0	6688	0.0	6888	0.0	7088	0.0
6092	0.0	6292	0.0	6492	0.0	6692	0.0	6892	0.0	7092	0.0
6096	0.0	6296	0.0	6496	0.0	6696	0.0	6896	0.0	7096	0.0
6100	0.0	6300	0.0	6500	0.0	6700	0.0	6900	0.0	7100	0.0
6104	0.0	6304	0.0	6504	0.0	6704	0.0	6904	0.0	7104	0.0
6108	0.0	6308	0.0	6508	0.0	6708	0.0	6908	0.0	7108	0.0
6112	0.0	6312	0.0	6512	0.0	6712	0.0	6912	0.0	7112	0.0
6116	0.0	6316	0.0	6516	0.0	6716	0.0	6916	0.0	7116	0.0
6120	0.0	6320	0.0	6520	0.0	6720	0.0	6920	0.0	7120	0.0
6124	0.0	6324	0.0	6524	0.0	6724	0.0	6924	0.0	7124	0.0
6128	0.0	6328	0.0	6528	0.0	6728	0.0	6928	0.0	7128	0.0
6132	0.0	6332	0.0	6532	0.0	6732	0.0	6932	0.0	7132	0.0
6136	0.0	6336	0.0	6536	0.0	6736	0.0	6936	0.0	7136	0.0
6140	0.0	6340	0.0	6540	0.0	6740	0.0	6940	0.0	7140	0.0
6144	0.0	6344	0.0	6544	0.0	6744	0.0	6944	0.0	7144	0.0
6148	0.0	6348	0.0	6548	0.0	6748	0.0	6948	0.0	7148	0.0
6152	0.0	6352	0.0	6552	0.0	6752	0.0	6952	0.0	7152	0.0
6156	0.0	6356	0.0	6556	0.0	6756	0.0	6956	0.0	7156	0.0
6160	0.0	6360	0.0	6560	0.0	6760	0.0	6960	0.0	7160	0.0
6164	0.0	6364	0.0	6564	0.0	6764	0.0	6964	0.0	7164	0.0
6168	0.0	6368	0.0	6568	0.0	6768	0.0	6968	0.0	7168	0.0
6172	0.0	6372	0.0	6572	0.0	6772	0.0	6972	0.0	7172	0.0
6176	0.0	6376	0.0	6576	0.0	6776	0.0	6976	0.0	7176	0.0
6180	0.0	6380	0.0	6580	0.0	6780	0.0	6980	0.0	7180	0.0
6184	0.0	6384	0.0	6584	0.0	6784	0.0	6984	0.0	7184	0.0
6188	0.0	6388	0.0	6588	0.0	6788	0.0	6988	0.0	7188	0.0
6192	0.0	6392	0.0	6592	0.0	6792	0.0	6992	0.0	7192	0.0
6196	0.0	6396	0.0	6596	0.0	6796	0.0	6996	0.0	7196	0.0
6200	0.0	6400	0.0	6600	0.0	6800	0.0	7000	0.0	7200	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
7204	0.0	7404	0.0	7604	0.0	7804	0.0	8004	0.0	8204	0.0
7208	0.0	7408	0.0	7608	0.0	7808	0.0	8008	0.0	8208	0.0
7212	0.0	7412	0.0	7612	0.0	7812	0.0	8012	0.0	8212	0.0
7216	0.0	7416	0.0	7616	0.0	7816	0.0	8016	0.0	8216	0.0
7220	0.0	7420	0.0	7620	0.0	7820	0.0	8020	0.0	8220	0.0
7224	0.0	7424	0.0	7624	0.0	7824	0.0	8024	0.0	8224	0.0
7228	0.0	7428	0.0	7628	0.0	7828	0.0	8028	0.0	8228	0.0
7232	0.0	7432	0.0	7632	0.0	7832	0.0	8032	0.0	8232	0.0
7236	0.0	7436	0.0	7636	0.0	7836	0.0	8036	0.0	8236	0.0
7240	0.0	7440	0.0	7640	0.0	7840	0.0	8040	0.0	8240	0.0
7244	0.0	7444	0.0	7644	0.0	7844	0.0	8044	0.0	8244	0.0
7248	0.0	7448	0.0	7648	0.0	7848	0.0	8048	0.0	8248	0.0
7252	0.0	7452	0.0	7652	0.0	7852	0.0	8052	0.0	8252	0.0
7256	0.0	7456	0.0	7656	0.0	7856	0.0	8056	0.0	8256	0.0
7260	0.0	7460	0.0	7660	0.0	7860	0.0	8060	0.0	8260	0.0
7264	0.0	7464	0.0	7664	0.0	7864	0.0	8064	0.0	8264	0.0
7268	0.0	7468	0.0	7668	0.0	7868	0.0	8068	0.0	8268	0.0
7272	0.0	7472	0.0	7672	0.0	7872	0.0	8072	0.0	8272	0.0
7276	0.0	7476	0.0	7676	0.0	7876	0.0	8076	0.0	8276	0.0
7280	0.0	7480	0.0	7680	0.0	7880	0.0	8080	0.0	8280	0.0
7284	0.0	7484	0.0	7684	0.0	7884	0.0	8084	0.0	8284	0.0
7288	0.0	7488	0.0	7688	0.0	7888	0.0	8088	0.0	8288	0.0
7292	0.0	7492	0.0	7692	0.0	7892	0.0	8092	0.0	8292	0.0
7296	0.0	7496	0.0	7696	0.0	7896	0.0	8096	0.0	8296	0.0
7300	0.0	7500	0.0	7700	0.0	7900	0.0	8100	0.0	8300	0.0
7304	0.0	7504	0.0	7704	0.0	7904	0.0	8104	0.0	8304	0.0
7308	0.0	7508	0.0	7708	0.0	7908	0.0	8108	0.0	8308	0.0
7312	0.0	7512	0.0	7712	0.0	7912	0.0	8112	0.0	8312	0.0
7316	0.0	7516	0.0	7716	0.0	7916	0.0	8116	0.0	8316	0.0
7320	0.0	7520	0.0	7720	0.0	7920	0.0	8120	0.0	8320	0.0
7324	0.0	7524	0.0	7724	0.0	7924	0.0	8124	0.0	8324	0.0
7328	0.0	7528	0.0	7728	0.0	7928	0.0	8128	0.0	8328	0.0
7332	0.0	7532	0.0	7732	0.0	7932	0.0	8132	0.0	8332	0.0
7336	0.0	7536	0.0	7736	0.0	7936	0.0	8136	0.0	8336	0.0
7340	0.0	7540	0.0	7740	0.0	7940	0.0	8140	0.0	8340	0.0
7344	0.0	7544	0.0	7744	0.0	7944	0.0	8144	0.0	8344	0.0
7348	0.0	7548	0.0	7748	0.0	7948	0.0	8148	0.0	8348	0.0
7352	0.0	7552	0.0	7752	0.0	7952	0.0	8152	0.0	8352	0.0
7356	0.0	7556	0.0	7756	0.0	7956	0.0	8156	0.0	8356	0.0
7360	0.0	7560	0.0	7760	0.0	7960	0.0	8160	0.0	8360	0.0
7364	0.0	7564	0.0	7764	0.0	7964	0.0	8164	0.0	8364	0.0
7368	0.0	7568	0.0	7768	0.0	7968	0.0	8168	0.0	8368	0.0
7372	0.0	7572	0.0	7772	0.0	7972	0.0	8172	0.0	8372	0.0
7376	0.0	7576	0.0	7776	0.0	7976	0.0	8176	0.0	8376	0.0
7380	0.0	7580	0.0	7780	0.0	7980	0.0	8180	0.0	8380	0.0
7384	0.0	7584	0.0	7784	0.0	7984	0.0	8184	0.0	8384	0.0
7388	0.0	7588	0.0	7788	0.0	7988	0.0	8188	0.0	8388	0.0
7392	0.0	7592	0.0	7792	0.0	7992	0.0	8192	0.0	8392	0.0
7396	0.0	7596	0.0	7796	0.0	7996	0.0	8196	0.0	8396	0.0
7400	0.0	7600	0.0	7800	0.0	8000	0.0	8200	0.0	8400	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
8404	0.0	8604	0.0	8804	0.0	9004	0.0	9204	0.0	9404	0.0
8408	0.0	8608	0.0	8808	0.0	9008	0.0	9208	0.0	9408	0.0
8412	0.0	8612	0.0	8812	0.0	9012	0.0	9212	0.0	9412	0.0
8416	0.0	8616	0.0	8816	0.0	9016	0.0	9216	0.0	9416	0.0
8420	0.0	8620	0.0	8820	0.0	9020	0.0	9220	0.0	9420	0.0
8424	0.0	8624	0.0	8824	0.0	9024	0.0	9224	0.0	9424	0.0
8428	0.0	8628	0.0	8828	0.0	9028	0.0	9228	0.0	9428	0.0
8432	0.0	8632	0.0	8832	0.0	9032	0.0	9232	0.0	9432	0.0
8436	0.0	8636	0.0	8836	0.0	9036	0.0	9236	0.0	9436	0.0
8440	0.0	8640	0.0	8840	0.0	9040	0.0	9240	0.0	9440	0.0
8444	0.0	8644	0.0	8844	0.0	9044	0.0	9244	0.0	9444	0.0
8448	0.0	8648	0.0	8848	0.0	9048	0.0	9248	0.0	9448	0.0
8452	0.0	8652	0.0	8852	0.0	9052	0.0	9252	0.0	9452	0.0
8456	0.0	8656	0.0	8856	0.0	9056	0.0	9256	0.0	9456	0.0
8460	0.0	8660	0.0	8860	0.0	9060	0.0	9260	0.0	9460	0.0
8464	0.0	8664	0.0	8864	0.0	9064	0.0	9264	0.0	9464	0.0
8468	0.0	8668	0.0	8868	0.0	9068	0.0	9268	0.0	9468	0.0
8472	0.0	8672	0.0	8872	0.0	9072	0.0	9272	0.0	9472	0.0
8476	0.0	8676	0.0	8876	0.0	9076	0.0	9276	0.0	9476	0.0
8480	0.0	8680	0.0	8880	0.0	9080	0.0	9280	0.0	9480	0.0
8484	0.0	8684	0.0	8884	0.0	9084	0.0	9284	0.0	9484	0.0
8488	0.0	8688	0.0	8888	0.0	9088	0.0	9288	0.0	9488	0.0
8492	0.0	8692	0.0	8892	0.0	9092	0.0	9292	0.0	9492	0.0
8496	0.0	8696	0.0	8896	0.0	9096	0.0	9296	0.0	9496	0.0
8500	0.0	8700	0.0	8900	0.0	9100	0.0	9300	0.0	9500	0.0
8504	0.0	8704	0.0	8904	0.0	9104	0.0	9304	0.0	9504	0.0
8508	0.0	8708	0.0	8908	0.0	9108	0.0	9308	0.0	9508	0.0
8512	0.0	8712	0.0	8912	0.0	9112	0.0	9312	0.0	9512	0.0
8516	0.0	8716	0.0	8916	0.0	9116	0.0	9316	0.0	9516	0.0
8520	0.0	8720	0.0	8920	0.0	9120	0.0	9320	0.0	9520	0.0
8524	0.0	8724	0.0	8924	0.0	9124	0.0	9324	0.0	9524	0.0
8528	0.0	8728	0.0	8928	0.0	9128	0.0	9328	0.0	9528	0.0
8532	0.0	8732	0.0	8932	0.0	9132	0.0	9332	0.0	9532	0.0
8536	0.0	8736	0.0	8936	0.0	9136	0.0	9336	0.0	9536	0.0
8540	0.0	8740	0.0	8940	0.0	9140	0.0	9340	0.0	9540	0.0
8544	0.0	8744	0.0	8944	0.0	9144	0.0	9344	0.0	9544	0.0
8548	0.0	8748	0.0	8948	0.0	9148	0.0	9348	0.0	9548	0.0
8552	0.0	8752	0.0	8952	0.0	9152	0.0	9352	0.0	9552	0.0
8556	0.0	8756	0.0	8956	0.0	9156	0.0	9356	0.0	9556	0.0
8560	0.0	8760	0.0	8960	0.0	9160	0.0	9360	0.0	9560	0.0
8564	0.0	8764	0.0	8964	0.0	9164	0.0	9364	0.0	9564	0.0
8568	0.0	8768	0.0	8968	0.0	9168	0.0	9368	0.0	9568	0.0
8572	0.0	8772	0.0	8972	0.0	9172	0.0	9372	0.0	9572	0.0
8576	0.0	8776	0.0	8976	0.0	9176	0.0	9376	0.0	9576	0.0
8580	0.0	8780	0.0	8980	0.0	9180	0.0	9380	0.0	9580	0.0
8584	0.0	8784	0.0	8984	0.0	9184	0.0	9384	0.0	9584	0.0
8588	0.0	8788	0.0	8988	0.0	9188	0.0	9388	0.0	9588	0.0
8592	0.0	8792	0.0	8992	0.0	9192	0.0	9392	0.0	9592	0.0
8596	0.0	8796	0.0	8996	0.0	9196	0.0	9396	0.0	9596	0.0
8600	0.0	8800	0.0	9000	0.0	9200	0.0	9400	0.0	9600	0.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
9604	0.0	9684	0.0	9764	0.0	9844	0.0	9924	0.0	10004	0.0
9608	0.0	9688	0.0	9768	0.0	9848	0.0	9928	0.0	10008	0.0
9612	0.0	9692	0.0	9772	0.0	9852	0.0	9932	0.0	10012	0.0
9616	0.0	9696	0.0	9776	0.0	9856	0.0	9936	0.0	10016	0.0
9620	0.0	9700	0.0	9780	0.0	9860	0.0	9940	0.0	10020	0.0
9624	0.0	9704	0.0	9784	0.0	9864	0.0	9944	0.0	10024	0.0
9628	0.0	9708	0.0	9788	0.0	9868	0.0	9948	0.0	10028	0.0
9632	0.0	9712	0.0	9792	0.0	9872	0.0	9952	0.0	10032	0.0
9636	0.0	9716	0.0	9796	0.0	9876	0.0	9956	0.0	10036	0.0
9640	0.0	9720	0.0	9800	0.0	9880	0.0	9960	0.0	10040	0.0
9644	0.0	9724	0.0	9804	0.0	9884	0.0	9964	0.0	10044	0.0
9648	0.0	9728	0.0	9808	0.0	9888	0.0	9968	0.0	10048	0.0
9652	0.0	9732	0.0	9812	0.0	9892	0.0	9972	0.0	10052	0.0
9656	0.0	9736	0.0	9816	0.0	9896	0.0	9976	0.0	10056	0.0
9660	0.0	9740	0.0	9820	0.0	9900	0.0	9980	0.0	10060	0.0
9664	0.0	9744	0.0	9824	0.0	9904	0.0	9984	0.0	10064	0.0
9668	0.0	9748	0.0	9828	0.0	9908	0.0	9988	0.0	10068	0.0
9672	0.0	9752	0.0	9832	0.0	9912	0.0	9992	0.0	10072	0.0
9676	0.0	9756	0.0	9836	0.0	9916	0.0	9996	0.0	10076	0.0
9680	0.0	9760	0.0	9840	0.0	9920	0.0	10000	0.0	10080	0.0

Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 8.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1150.0	1150.0	1.501	0.0	1353.5
1.500	1150.0	1353.5			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-CHE-0058-2000-1500-2000
Design Head (m)	1.500
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	No
Diameter (mm)	58
Invert Level (m)	8.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.0
Flush-Flo™	0.141	1.3
Kick-Flo®	0.202	0.8
Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	1.200	1.8	3.000	2.8	7.000	4.3
0.200	0.8	1.400	1.9	3.500	3.0	7.500	4.4
0.300	0.9	1.600	2.1	4.000	3.2	8.000	4.5
0.400	1.0	1.800	2.2	4.500	3.4	8.500	4.7
0.500	1.2	2.000	2.3	5.000	3.6	9.000	4.8
0.600	1.3	2.200	2.4	5.500	3.8	9.500	4.9
0.800	1.5	2.400	2.5	6.000	3.9		
1.000	1.6	2.600	2.6	6.500	4.1		

Summary of Results for 10 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.870	1.370	4.8	99.8	104.5	283.6	O K
30 min Summer	9.909	1.409	4.8	101.0	105.8	319.1	O K
60 min Summer	9.909	1.409	4.8	101.0	105.8	319.0	O K
120 min Summer	9.908	1.408	4.8	101.0	105.8	318.2	O K
180 min Summer	9.881	1.381	4.8	100.1	104.9	292.9	O K
240 min Summer	9.844	1.344	4.7	98.9	103.7	260.2	O K
360 min Summer	9.764	1.264	4.6	96.3	100.9	192.0	O K
480 min Summer	9.687	1.187	4.5	93.7	98.3	130.8	O K
600 min Summer	9.620	1.120	4.4	91.5	95.9	81.9	O K
720 min Summer	9.568	1.068	4.4	89.6	94.0	44.8	O K
960 min Summer	9.507	1.007	4.3	87.4	91.7	4.5	O K
1440 min Summer	9.323	0.823	4.0	65.4	69.4	0.3	O K
2160 min Summer	9.263	0.763	3.9	46.7	50.6	0.3	O K
2880 min Summer	9.226	0.726	3.9	36.7	40.6	0.2	O K
4320 min Summer	9.181	0.681	3.8	26.6	30.4	0.2	O K
5760 min Summer	9.162	0.662	3.7	21.3	25.1	0.2	O K
7200 min Summer	9.150	0.650	3.7	17.8	21.5	0.2	O K
8640 min Summer	9.143	0.643	3.7	15.7	19.5	0.2	O K
10080 min Summer	9.135	0.635	3.7	14.0	17.7	0.1	O K
15 min Winter	9.872	1.372	4.8	99.8	104.6	285.3	O K
30 min Winter	9.914	1.414	4.8	101.1	106.0	323.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	70.251	0.0	380.2	362.3	16
30 min Summer	45.840	0.0	495.8	472.7	28
60 min Summer	28.723	0.0	623.9	594.3	46
120 min Summer	18.561	0.0	803.2	762.0	80
180 min Summer	14.151	0.0	919.4	869.2	114
240 min Summer	11.591	0.0	1002.4	941.1	148
360 min Summer	8.654	0.0	1122.1	1034.9	212
480 min Summer	6.973	0.0	1205.4	1092.6	272
600 min Summer	5.875	0.0	1269.6	1130.9	330
720 min Summer	5.097	0.0	1321.8	1157.5	384
960 min Summer	4.061	0.0	1403.9	1188.7	492
1440 min Summer	2.947	0.0	1528.3	1210.7	722
2160 min Summer	2.146	0.0	1668.8	1199.7	1076
2880 min Summer	1.723	0.0	1785.8	1168.5	1428
4320 min Summer	1.281	0.0	1976.3	1137.9	2184
5760 min Summer	1.051	0.0	2171.7	1135.8	2896
7200 min Summer	0.911	0.0	2353.1	1135.1	3544
8640 min Summer	0.817	0.0	2531.0	1148.4	4376
10080 min Summer	0.748	0.0	2704.3	1163.3	4952
15 min Winter	70.251	0.0	380.7	362.8	16
30 min Winter	45.840	0.0	496.1	472.7	29

Summary of Results for 10 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	9.905	1.405	4.8	100.9	105.7	315.6	O K
120 min Winter	9.881	1.381	4.8	100.1	104.9	293.4	O K
180 min Winter	9.827	1.327	4.7	98.4	103.1	244.9	O K
240 min Winter	9.765	1.265	4.6	96.3	101.0	192.6	O K
360 min Winter	9.643	1.143	4.5	92.2	96.7	98.1	O K
480 min Winter	9.544	1.044	4.3	88.8	93.1	28.8	O K
600 min Winter	9.442	0.942	4.2	85.1	89.2	0.4	O K
720 min Winter	9.349	0.849	4.0	73.4	77.5	0.3	O K
960 min Winter	9.299	0.799	4.0	57.7	61.6	0.3	O K
1440 min Winter	9.244	0.744	3.9	41.1	45.0	0.2	O K
2160 min Winter	9.191	0.691	3.8	29.0	32.8	0.2	O K
2880 min Winter	9.166	0.666	3.8	22.6	26.4	0.2	O K
4320 min Winter	9.143	0.643	3.7	15.9	19.6	0.2	O K
5760 min Winter	9.125	0.625	3.7	12.4	16.0	0.1	O K
7200 min Winter	9.113	0.613	3.7	10.2	13.9	0.1	O K
8640 min Winter	9.106	0.606	3.7	9.0	12.7	0.1	O K
10080 min Winter	9.100	0.600	3.6	8.0	11.6	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	28.723	0.0	624.7	595.1	48
120 min Winter	18.561	0.0	805.6	765.0	86
180 min Winter	14.151	0.0	920.3	871.3	122
240 min Winter	11.591	0.0	1003.6	943.8	156
360 min Winter	8.654	0.0	1122.3	1037.0	216
480 min Winter	6.973	0.0	1205.4	1094.9	270
600 min Winter	5.875	0.0	1269.6	1134.3	300
720 min Winter	5.097	0.0	1321.8	1161.0	356
960 min Winter	4.061	0.0	1403.9	1192.7	488
1440 min Winter	2.947	0.0	1528.3	1217.8	724
2160 min Winter	2.146	0.0	1669.1	1213.7	1044
2880 min Winter	1.723	0.0	1786.4	1190.1	1412
4320 min Winter	1.281	0.0	1986.8	1144.1	2240
5760 min Winter	1.051	0.0	2167.7	1119.5	2904
7200 min Winter	0.911	0.0	2356.2	1107.9	3680
8640 min Winter	0.817	0.0	2536.7	1103.3	4160
10080 min Winter	0.748	0.0	2712.4	1102.3	4928

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	1.000
FEH Rainfall Version	2013	Cv (Winter)	1.000
Site Location	GB 618329 134790	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 2.161

Time (mins) From:	To:	Area (ha)
0	4	2.161

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.501	1.0	1.001	640.0
0.500	0.0	1.000	1.0	1.500	1000.0

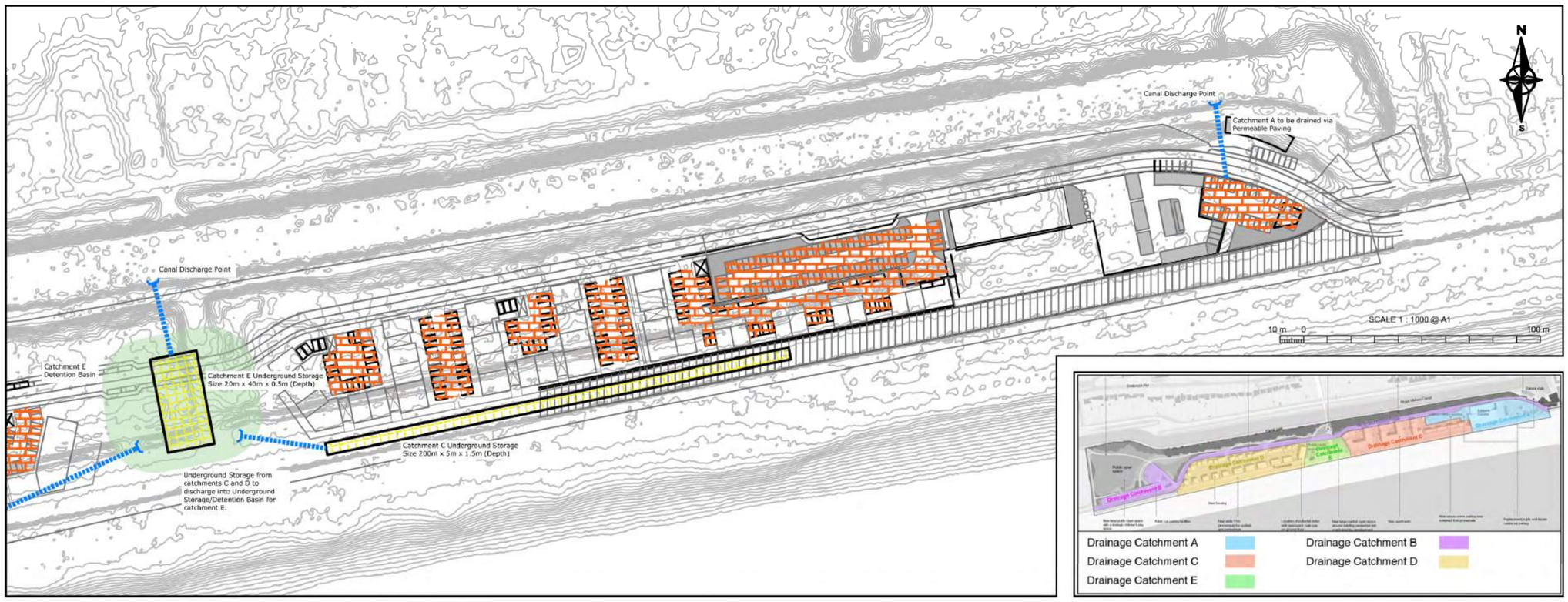
Orifice Outflow Control

Diameter (m) 0.041 Discharge Coefficient 0.600 Invert Level (m) 8.000

Pipe Overflow Control

Diameter (m)	0.300	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	100.000	Upstream Invert Level (m)	9.001
Manning's n	0.015		

Appendix A.6 – Indicative Drainage Layout



PRIVATE DRAINAGE AND LEVELS KEY

- Surface Water Drain
- Underground Storage
- Permanent Wet Area
- Planted Area (1:1 Year use)
- Marginal Area (1:10 Year use)
- Detention Basin
- Permeable Paving
- Headwall

Notes

1. Contains Ordnance Survey data © Crown copyright and database right 2018.
2. All dimensions are in metres unless otherwise stated elsewhere.
3. Proposed drainage positions will be subject to detailed design.
4. The size and extent of the pond will be subject to infiltration testing and trial holes.
5. All drainage systems will need to be installed and designed for suitable loading requirements.

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Rev	Description	Date
P1	First issue	14/09/2018

CLIENT: Folkestone and Hythe District Council

PROJECT: Princes Parade, Hythe

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:1000	1494	LA	SJB

DWG REF: INDICATIVE DRAINAGE LAYOUT

DWG No.: HC-1494-500

Appendix B

7. Ecology

Introduction

7.1.1 This chapter assesses the likely significant effects of the Proposed Development, including Drainage Option B (as per the Herrington Consulting Ltd Indicative Drainage Layout drawing (drawing no.: HC-1494-500)) with regards to ecology and nature conservation.

7.1.2 Because the Proposed Development footprint remains the same, with the sole exception of the revised drainage outfall locations, this chapter does not replicate the full detail of the original ecology chapter of the submitted 2017 Environmental Statement (ES).

7.1.3 Instead, this chapter provides a comparison between the predicted ecological impacts of the Proposed Development - including the original drainage option and those of the Proposed Development including drainage Option B.

7.1.4 This chapter also considers any updates or changes to legislation, planning policy and good practice guidance since the time of the 2017 ES submission.

7.1.5 Within this chapter, the entire Site, which is the subject of a hybrid planning application, is referred to as the 'Site'.

Scope

7.1.6 This chapter considers construction and operational effects upon important ecological features located within the potential Zone of Influence (ZoI) of the Proposed Development, and is supported by the following appendices: -

- **Appendix 7.1**: Botany Report (Lloyd Bore Ltd)
- **Appendix 7.2**: Invertebrate Survey (Jonty Denton)
- **Appendix 7.3**: Amphibian Report (Lloyd Bore Ltd)
- **Appendix 7.4**: Reptile Report (Lloyd Bore Ltd)
- **Appendix 7.5**: Breeding Bird Report (Lloyd Bore Ltd)
- **Appendix 7.6**: Mammal Report (Lloyd Bore Ltd)
- **Appendix 7.7**: Bat Report (Lloyd Bore Ltd)
- **Appendix 7.8:** Ecological Mitigation Strategy (Drainage Option B) (Lloyd Bore, 2019)

7.1.7 Appendices 7.1 to 7.7 (inclusive) remain unchanged and are the exact same copies that were submitted with the 2017 ES.

7.1.8 Since the time that these documents were produced, there have been updates to relevant legislation, national and local planning policy.

7.1.9 These changes are summarised and assessed below, and do not materially affect any of the content of Technical Appendices 7.1 to 7.7 (inclusive).

7.1.10 For this reason, the references to legislation and planning policy within Technical Appendices 7.1 to 7.7 (inclusive) have not been updated.

7.1.11 Appendix 7.8 has been updated to consider the revised drainage strategy (drainage Option B), and all references to legislation and national planning policy have been updated within this Technical Appendix.

Legislative Framework

7.1.12 The Conservation of Habitats and Species Regulations 2010 (as amended) have now been consolidated into the Conservation of Habitats and Species Regulations 2017.

7.1.13 The consolidated Regulations do not include any material changes from the 2010 version of the Regulations that informed the 2017 Environmental Statement (ES).

7.1.14 There are no material changes to the legal protection afforded to protected species considered in this chapter.

Relevant policy

National Planning Policy Framework (NPPF)

7.1.15 Paragraph 170(d) of the Government's 2019 National Planning Policy Framework (NPPF) includes a more definitive requirement for the planning system to deliver net gains for biodiversity. Previously, Paragraph 109 of the 2012 NPPF stated that *'the planning system should contribute to and enhance the natural and local environment by… minimising impacts on biodiversity and providing net gains in biodiversity where possible'.* Paragraph 170(d) of the 2019 NPPF replaces this statement with: *'Planning policies and decisions should contribute to and enhance the natural and local environment by… minimising impacts on and providing net gains for biodiversity.'*

7.1.16 There are no other material changes to the NPPF that are of relevance for the purposes of this chapter.

Planning Practice Guidance

7.1.17 The most relevant paragraphs within Government's online Planning Practice Guidance (PPG) are contained within the 'Natural environment' guidance section. This guidance section was last updated on 21st January 2016, which is prior to the date of submission of the 2016 Environmental Statement.

7.1.18 On this basis, there are no changes to the PPG that relate specifically to ecology.

Local planning policy

7.1.19 On 28th September 2018, Folkestone and Hythe District Council (FHDC) submitted their Places and Policies Local Plan (Ref. 7.4) to the Secretary of State for Housing, Communities and Local Government for independent examination.

7.1.20 The 2018 Places and Policies Local Plan includes one Policy that was not considered within the 2017 ES. This is: -

- **Policy NE2:** Biodiversity.

7.1.21 The Proposed Development, and the associated ecological mitigation strategy (see Technical Appendix 7.8), complies with the requirements of this Policy.

7.1.22 FHDC are currently consulting on the Submission Draft Core Strategy Review. The Core Strategy (Ref. 7.5), when published, will set out how the development needs of the district will be met up to 2037.

7.1.23 Of the four policies considered in the 2017 ES, only one has been updated within the Submission Draft Core Strategy Review. This is: -

- **Policy CSD4:** Green Infrastructure of Natural Networks, Open Spaces and Recreation.

7.1.24 The only material change to this policy is a new requirement for the delivery of biodiversity net gain through development.

7.1.25 Previously, Policy CSD4 stated that: *'Development must avoid a net loss of biodiversity.'* Policy CSD4 (within the Submission Draft Core Strategy Review) now states that: *'Development must avoid a net loss of biodiversity,* [and] *achieve net gain over and above residual loss.'*

7.1.26 It is considered unlikely that the Proposed Development will achieve a measurable biodiversity net gain. However, a robust ecological avoidance, mitigation, compensation and enhancement strategy has been devised

(Technical Appendix 7.8). Effective implementation of this strategy will minimise and/or compensate for the adverse ecological impacts of the Proposed Development and will deliver targeted ecological enhancements.

7.1.27 To achieve a measurable biodiversity net gain, substantial areas of additional semi-natural habitat would need to be created and/or enhanced on the application site and/or immediately adjacent areas.

7.1.28 The Proposed Development does not allow sufficient space to accommodate any such additional habitat areas, and the semi-natural habitats within the adjacent RMC cannot be substantially enhanced above and beyond the reptile enhancement measures that have already been committed to.

7.1.29 Given that the Proposed Development has been through a rigorous design and consultation process, at this stage it is not possible or appropriate to revise the proposals to include extensive additional habitat areas.

7.1.30 It is therefore not possible for the Proposed Development to meet the criteria set out under requirement a) of Policy CSD4 of the Submission Draft Core Strategy Review document.

7.1.31 However, the Proposed Development can meet the criteria set out under requirement a) of Policy CSD4 of the 2013 Shepway Core Strategy Local Plan, which was current at the time of the planning application.

Methodology

Assessment methodology

7.1.32 Since the submission of the 2017 Environmental Statement, the Chartered Institute of Ecology and Environmental Management (CIEEM) have issued consolidated ecological impact assessment (EcIA) guidance (Ref. 7.1).

7.1.33 The consolidated guidance combines CIEEM's previous guidance document for terrestrial, freshwater and coastal ecological impact assessment (Ref. 7.2) with their previous guidance document for marine and coastal ecological impact assessment (Ref. 7.3).

7.1.34 The combined 2018 EcIA guidance document does not contain any changes that are of material importance for the purposes of this assessment.

Study area

7.1.35 The Study Area areas remains unchanged.

7.1.36 The Zone of Influence (ZoI) of the Proposed Development in relation to each important ecological feature has been considered in light of the revised drainage outfall proposal.

7.1.37 There are no material changes to the ZoI of the Proposed Development for any important ecological features.

Identifying and assessing the importance of ecological features

7.1.38 Primarily, this chapter considers the ecological importance of the Site, and in particular whether the Proposed Development is likely to affect sites, habitats or species that are protected by UK legislation or are of national or local conservation importance.

7.1.39 The CIEEM 2018 EcIA guidelines (Ref. 7.1) have been used to identify and assess the geographic level of importance of ecological resources and features.

7.1.40 As recommended within the guidance, the geographic level of importance categories have been adapted to ensure that they are site and project-specific.

7.1.41 The criteria used to identify important ecological resources and features and assess their geographic level of importance do not differ materially from those used in the 2017 Environmental Statement.

7.1.42 The importance of an ecological resource or feature has been determined within a geographic context using the following frame of reference and these are used within this chapter: -

- International and European;
- National;
- Regional;
- County (or Metropolitan – e.g. London);
- District (or Borough);
- Local; and
- Within ZoI only (which may be a development site or a larger area).

Predicting and characterising ecological effects

7.1.43 Within the ZoI, effects are assessed in the context of the baseline conditions that are expected to occur if the Proposed Development were not to take place

(see the Projected Future Baseline section of this chapter). When examining the likelihood of significant ecological effects, both the construction and operational stages of the Proposed Development are considered. When describing changes and effects on ecosystem structure and function, the following parameters are considered: -

- Type (positive or negative);
- Extent;
- Magnitude;
- Duration;
- Timing;
- Frequency; and
- Reversibility.

7.1.44 The degree of confidence in the assessment of the effect on ecological features is stated using the categories below: -

- Certain/near certain: probability estimated at 95% chance or higher
- Probable: probability estimated above 50% but below 95%
- Unlikely: probability estimated above 5% but less than 50%
- Extremely unlikely: probability estimated at less than 5%.

Significance criteria

7.1.45 To determine the significance of specific environmental effects, the magnitude of the effect is examined in combination with the importance or sensitivity of the ecological feature.

7.1.46 For the purposes of this chapter, the significance criteria used are described in Tables 7.1 to 7.3. Examples in relation to ecology are provided below.

7.1.47 These significance criteria remain unchanged from those used in the 2017 ES.

Table 7.1: Magnitude of impacts

	Large	Moderate	Small	Negligible
Designated sites	The Proposed Development may adversely impact the integrity of a site in terms of its ability to sustain the habitat and/or species population for which the site was designated.	The site integrity is not substantially impacted, but the on-site impact is likely to be significant in terms of its ecological objectives.	Neither a large nor a moderate impact, but some negative / beneficial impact is evident.	There is neither an adverse nor a beneficial impact.
Habitats	The Proposed Development may adversely impact the habitat to a point where the coherence of ecological structure and function across its whole area is disrupted and/or there is a total loss of the habitat.	Habitat integrity is not substantially impacted, but the impact is likely to be significant in terms of its "favourable condition."	Neither a large nor a moderate impact, but some negative / beneficial impact is evident.	There is neither an adverse nor a beneficial impact.
Species	The Proposed Development may adversely impact the population to a point where it is not able to sustain itself and/or is likely to become locally extinct.	The population can sustain itself, but the impact is likely to be significant in terms of maintaining the favourable conservation status of the population.	Neither a large or moderate impact, but some negative / beneficial impact is evident.	There is neither an adverse nor a beneficial impact.

Table 7.2: Sensitivity (or importance) of features

	High	Medium	Low	Negligible
Designated sites	Designated sites of importance at an International / European or National level.	Designated sites of importance at a Regional or County level.	Designated sites of importance at a Local (District) level.	Designated sites of importance at a Local (ZoI) level. Non-designated areas.
Habitats	Habitats that are of importance at an International / European or National level.	Habitats that are of importance at a Regional or County level.	Habitats that are of importance at a Local (District) level.	Habitats that are of importance at a Local (ZoI) level, or of negligible ecological importance.
Species	Species (or populations) that are of importance at an International / European or National level.	Species (or populations) that are of importance at a Regional or County level.	Species (or populations) that are of importance at a Local (District) level.	Species (or populations) that are of importance at a Local (ZoI) level, or those that are common and widespread (even though they might be legally protected - e.g. badger).

Table 7.3: Significance of effects

MAGNITUDE	SENSITIVITY			
	High	Medium	Low	Negligible
Large	Major	Major	Moderate	Minor
Moderate	Major	Moderate	Minor	Negligible
Small	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Uncertainties and limitations

7.1.48 The detailed design of the large majority of the Proposed Development is not available at the present stage of the Planning process.

7.1.49 The assessment included within the 2017 Environmental Statement provides mechanisms to address the level of uncertainty associated with the lack of detailed design. These mechanisms remain valid and appropriate for the purposes of this Addendum.

7.1.50 While the 2018 EcIA guidelines (Ref 7.1) discourage the use of the 'matrix approach,' they recognise that ecologists can work to this assessment process to ensure consistency across all the topics of an ES. The matrix approach is appropriate for the purposes of this ES because the levels of importance attributed to ecological features (receptors) are informed by detailed ecological survey work and because the levels of significance attributed to effects have been determined using a robust and consistent assessment methodology.

7.1.51 For this reason, the levels of importance and levels of significance determined in this Addendum are evidence-based.

Baseline Conditions

7.1.52 The baseline conditions reported in the 2017 ES considered the area in which the Option B drainage outfalls will be delivered. For this reason, there is no material change to the area for the Proposed Development.

7.1.53 The study area for the Proposed Development (including drainage Option B) remains as per the study area for the submitted development proposal (including the original drainage outfall proposal).

7.1.54 An ecological walkover survey was conducted by Samuel Durham BSc (Hons) of Lloyd Bore Ltd on 9th February 2019. The walkover survey was undertaken to check whether there had been any material change in the type and extent of habitats present on site since the conclusion of the 2016 botanical survey work that was completed on site.

7.1.55 The update walkover survey did not include any detailed botanical or species survey work.

7.1.56 The update walkover survey confirmed that the on-site habitats remain broadly the same as reported in the 2017 ES.

7.1.57 For this reason, the suitability of the site for relevant protected and priority species has not materially changed since the submission of the 2017 ES.

7.1.58 No additional important ecological features were identified during the update walkover survey.

7.1.59 For this reason, no additional important ecological features have been considered in this chapter.

7.1.60 For the reasons set out above, there are no material changes to the ecological baseline conditions.

The projected future baseline

7.1.61 There are no material changes to the factors considered when assessing the projected future baseline for the Site if the Proposed Development does not proceed.

7.1.62 For this reason, there are no material changes to the projected future baseline.

Potential effects

Construction stage

7.1.63 Given that there has been no material change in the ecological baseline or the Proposed Development, the potential effects reported within the 2017 Environmental Statement remain as reported.

Operational stage

7.1.64 Given that there has been no material change in the ecological baseline or the Proposed Development, the potential effects reported within the 2017 Environmental Statement remain as reported.

Mitigation measures

Construction stage

7.1.65 Given that there has been no material change in the ecological baseline or the Proposed Development, the proposed mitigation measures reported within the 2017 Environmental Statement remain as reported.

7.1.66 The only additional (precautionary) mitigation measure proposed in relation to the Option B drainage outfall locations is a requirement (as reported in Technical Appendix 7.8) for the specific locations to be informed by guidance

from a suitably experienced ecologist and, if necessary, supervised by an Ecological Clerk of Works.

7.1.67 In the absence of the above mitigation measures, the Proposed Development is unlikely to result in any material increase in impacts upon ecological features associated with the RMC - Habitat of Principal Importance ('Eutrophic standing water'), foraging bats and common toad (*Bufo bufo*).

7.1.68 However, the above additional (precautionary) mitigation measure has been specified to further reduce the risk of minor (non-significant) ecological impacts during the construction stage.

7.1.69 For this reason, no additional mitigation measures, beyond the precautionary measure outlined above, are required to avoid significant effects upon important ecological features.

Operational stage

7.1.70 The inbuilt surface water drainage features for the Option B (as reported in Technical Appendix 7.8) will ensure that the Proposed Development does not result in any significant contamination of the RMC.

7.1.71 Given that there has been no material change in the ecological baseline or the Proposed Development, the proposed mitigation measures reported within the 2017 Environmental Statement remain as reported.

Residual Effects

Construction stage

7.1.72 Given that there has been no material change in the ecological baseline, the Proposed Development or the proposed mitigation measures, the potential residual effects reported within the 2017 Environmental Statement remain as reported.

Operational stage

7.1.73 Given that there has been no material change in the ecological baseline, the Proposed Development or the proposed mitigation measures, the potential residual effects reported within the 2017 Environmental Statement remain as reported.

Summary of effects

7.1.74 Given that there has been no material change in the ecological baseline, the Proposed Development or the proposed mitigation measures, the potential residual effects reported within the 2017 Environmental Statement remain as reported.

Cumulative Effects

7.1.75 As per the 2017 Environmental Statement, the 2019 assessment of cumulative ecological effects has specifically focused on those arising from the proposed development in combination with the planned development of: -

- Seapoint Canoe Centre (planning reference no: Y14/1248/SH);
- Imperial Green (planning reference no: Y08/1036/SH); and
- Shorncliffe Garrison (planning reference no: Y14/0300/SH).

7.1.76 There are no new development proposals that are relevant to the assessment of cumulative ecological effects.

7.1.77 Given that there has been no material change in the ecological baseline, the Proposed Development, or the proposed mitigation measures, and that there are no new developments that need to be considered in relation to cumulative ecological effects, the potential cumulative effects reported within the 2017 ES remain as reported.

References

7.1 Chartered Institute for Ecology and Environmental Management (CIEEM) (2016). *Guidelines for ecological impact assessment in the UK and Ireland*. Institute of Ecology and Environmental Management, Winchester.

7.2 CIEEM (2016). *Guidelines for ecological impact assessment in the United Kingdom and Ireland: Terrestrial, Freshwater and Coastal*. 2nd Edition. Chartered Institute of Ecology and Environmental Management, Winchester.

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7.4 Folkestone and Hythe District Council (2018). *Places and Policies Local Plan, Submission Draft* [Accessed via: https://www.folkestone-hythe.gov.uk/media/4793/Places-and-Policies-Local-Plan-Submission-Draft---February-2018/pdf/Places_and_Policies_Local_Plan_Submission_Draft.pdf] [Accessed: 28/02/2019].

7.5 Folkestone and Hythe District Council (2019). Submission Draft Core Strategy Review. [Accessed via: https://www.folkestone-hythe.gov.uk/media/5566/Core-Strategy-Review-Submission-Document/pdf/Core_Strategy_Review_Submission_Draft.pdf]. [Accessed: 28/02/2019].

Appendix C

ECOLOGICAL MITIGATION STRATEGY (DRAINAGE OPTION B)

PRINCES PARADE, HYTHE
PRINCES PARADE

REF: 3609-LLB-RP-EC-0013-S4-P02

STATUS: PLANNING

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1. INTRODUCTION

INSTRUCTION

1.1. Lloyd Bore was instructed to produce an Ecological Mitigation Strategy in respect of an alternative drainage option (Option B) for the discharge of surface water runoff from the development site on land at Princes Parade, Hythe (Planning ref: Y17/1042/SH).

1.2. Option B has been prepared to supplement the Flood Risk Assessment (FRA) submitted with the planning application and has been prepared in response to comments received from the Environment Agency (reference KT/2017/123369/03-L01).

1.3. Details of the Option B drainage strategy can be found in '*Technical Addendum – Discharge of Surface water Runoff (Watercourse) for the proposed Development at Princes Parade, Hythe, Kent*' produced by Herrington Consulting Limited, 2018.

1.4. This Ecological Mitigation Strategy is associated with the hybrid planning application for a new leisure centre, *c.*4.9ha of public open space, 150 new homes, new public parking and commercial uses on land at Princes Parade, Hythe.

1.5. This Ecological Mitigation Strategy builds on and supersedes the Ecological Mitigation and Enhancement Plan (Lloyd Bore, 2017b) and is the primary document detailing ecological mitigation, compensation and enhancements for the proposed development (including drainage Option B).

1.6. This document captures all detail provided in the detailed Ecological Mitigation Strategy document (Lloyd Bore, 2018c) that was produced by Lloyd Bore in response to local planning authority and stakeholder comments following the issue of the formal Environmental Statement (ES).

1.7. This document has been informed by the results of ecological survey work conducted in 2015 and 2016 (as detailed in Technical Appendices 7.1 to 7.7, inclusive, of the ES (Lloyd Bore, 2017a), as well as the information provided in the Ecological Mitigation and Enhancement Plan (Lloyd Bore 2017b) that was submitted with the ES.

1.8. This document has been produced to provide as much certainty as possible in relation to the proposed ecological mitigation measures. Updates to this document may be necessary as additional design and construction detail emerges.

1.9. The Site Plan produced by BDB (ref: 2512-02), which was submitted with the planning application, has also informed this document.

PROPOSED DEVELOPMENT

1.10. The Site is *c.*10.7ha in area. It is bounded to the north by the Royal Military Canal (RMC), to the south by Princes Parade and to the west by the Hythe Imperial golf course. A plan showing the red line boundary for the Site is provided within the Planning Design and Access Statement (PDAS).

1.11. The detailed description of the proposed development is provided in the submitted PDAS and the ES.

1.12. Almost half of the Site will be retained and delivered as open space, which will comprise: -

- A large informal western space which will be located adjacent to the proposed replacement public parking, and may potentially contain a strategic play space;

- A central open space which will link with the existing central footbridge that connects to Seabrook Road and provide pedestrian access from the footbridge to the promenade and seafront;
- A linear open space that connects the two larger spaces along the canal bank;
- A hard-landscaped space east of the leisure centre building that will host the relocated existing children's play area; and
- The promenade - which will comprise over a kilometre of widened public promenade.

1.13. Commercial uses are likely to be contained within a single building near the central open space.

1.14. The Prince's Parade road will be realigned from its current location. The realigned road will be located to the north of the proposed built development areas.

1.15. The height of buildings varies across the proposed development. Buildings in the south-east of the Site, facing onto the promenade adjacent to the leisure centre, will be a maximum of 3-4 storeys in height. Buildings facing onto the canal in the eastern development zone will be a maximum of 3 storeys. The commercial building in the central open space will be a maximum of 4 storeys. Buildings within the western development zone will typically be a maximum of 2.5 storeys - with a limited amount of 3 storey development facing the central open space and the promenade.

1.16. A Parameter Plan showing the boundary between the detailed and outline application sites is included in Appendix 3.

1.17. Appendix 6 shows the Indicative Drainage Layout drawing produced by Herrington Consulting Limited (2018).

1.18. The only known off-site impacts (i.e. impact beyond the red-line boundary of the Site) are the proposed water discharge points to the RMC and the proposed overflow control system where additional runoff can be discharged off-site on to the beach in the event of a blockage, or during a storm event which exceeds the design parameters for the proposed drainage system.

1.19. These off-site impacts are addressed within this document and, where appropriate, reference has been made to the control measures that will be used.

SCOPE OF MITIGATION STRATEGY

1.20. This mitigation strategy details ecological avoidance, mitigation and compensation measures associated with the proposed development at Prince's Parade, Hythe and aims to address comments received from Kent County Council Ecological Advice Service (KCC EAS).

1.21. A single detailed mitigation strategy has been produced to ensure that the measures proposed for different species do not conflict and that an integrated and co-ordinated approach is followed.

1.22. These measures have been designed, and will be implemented, in line with the requirement for the planning system to deliver net gains for biodiversity, as set out under Paragraph 170 of the National Planning Policy Framework (NPPF).

1.23. This strategy also details the ecological enhancement measures that have been designed to maximise the importance of the Site for Species of Principal Importance (SPI).

1.24. These enhancement measures have been developed in line with Paragraph 170(d) of the NPPF, which states that: '*Planning policies and decisions should contribute to and enhance the natural and local environment by… minimising impacts on and providing net gains for biodiversity.*', and Paragraph 175(d) of the NPPF, which states that '*...opportunities to incorporate biodiversity*

improvements in and around developments should be encouraged, especially where this can secure measurable net gains for biodiversity.'

1.25. This document provides additional detail of the measures already set out in Technical Appendix 7.8 of the ES (Lloyd Bore, 2017b) with particular reference to: -

- Enhancement of habitats outside the footprint of the proposed development;
- Habitat creation works that will be carried out upon completion of the remediation works;
- Methods for ecological mitigation works;
- Details of compensatory plantings; and
- Timings (where possible) for the implementation of ecological measures.

OBJECTIVES

1.26. The objectives of this mitigation strategy are to: -

- Set-out an ecological mitigation timeline with regards to the habitats and species detailed in the ecological baseline section of this document;
- Describe the avoidance, mitigation, compensation and enhancement measures with regards to the proposed development that will be delivered to maintain the favourable conservation status of European Protected Species (EPS) that are included within the ecological baseline;
- Describe the avoidance, mitigation, compensation and enhancement measures with regards to the proposed development that will maintain the long-term viability of other protected species populations and Species and Habitats of Principal Importance that are included within the ecological baseline; and
- Set-out general ecological enhancement measures appropriate to the local environment.

RESPONSIBILITIES

1.27. Folkestone and Hythe District Council (FHDC) currently own the Site and will continue to own the areas of the Site outside of the proposed residential and commercial development area.

1.28. It is likely that FHDC will be responsible for implementing and funding the ecological avoidance and mitigation measures associated with clearing the Site and providing the compensation measures.

1.29. It is likely that the developer will fund the enhancements measures within the development footprint.

1.30. It is likely that FHDC will be responsible for the management of areas of the Site outside of the proposed residential and commercial development area during the occupational stage.

1.31. This document will be updated with detail of responsibilities, administration ownership and habitat management funding as additional details emerge.

1.32. The Landscape and Ecology Management Plan (LEMP), which will be submitted at the Reserved Matters stage, will provide additional detail of the habitat management responsibilities, ownership and funding that will be adopted and implemented.

2. ECOLOGICAL BASELINE

2.1. Baseline conditions of ecological features are detailed within the Ecology Chapter of the Environmental Statement (Lloyd Bore, 2017a). This section summarises the most important ecological features present on and immediately adjacent to the Site.

NON-STATUTORY DESIGNATED SITES

2.2. Two Local Wildlife Sites (LWS) are located within 1km of the Site.

2.3. Paraker Wood and Seabrook Stream, Shorncliffe LWS is located *c.*750m north of the Site at its closest point.

2.4. The RMC LWS is located adjacent to the northern boundary of the Site. Based on publicly available information, this LWS is designated for its rare plant species, as well as twelve species of Odonata (dragonflies and damselflies), its bird assemblage, grass snake (*Natrix natrix*), common toad (*Bufo bufo*), foraging pipistrelle (*Pipistrelle sp.*) and Daubenton's bat (*Myotis daubentonii*).

HABITATS OF PRINCIPAL IMPORTANCE

2.5. The RMC qualifies as Eutrophic standing water, which is a Habitat of Principal Importance.

OTHER HABITATS AND FLORA

2.6. A maritime grassland community occurs within the Site. This 'maritime' grassland community is of 'local' botanical importance and will need to be cleared to facilitate development.

2.7. The rest of the Site comprises habitats that are of negligible ecological importance.

INVASIVE FLORA

2.8. Giant hogweed (*Heracleum mantegazzianum*), Japanese rose (*Rosa rugosa*) and Spanish bluebell (*Hyacinthoides hispanica*), which are all non-native plant species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), have been recorded on-site.

INVERTEBRATES

2.9. Based on the findings of an invertebrate survey and habitat assessment, and the fact that the grassland strip that is located adjacent to Princes Parade is not common within the surrounding local landscape, this habitat is of ecological importance for invertebrates at the Local level.

2.10. The remainder of the other habitats are of negligible sensitivity or importance for invertebrates.

2.11. Based on the survey results, the reasons for designation of the RMC LWS, and the extent of habitats present, the adjacent (off-site) section of the RMC is of ecological importance for invertebrates at the County level.

COMMON TOAD

2.12. The Site supports terrestrial habitats suitable for common toad, and the adjacent section of the RMC provides a suitable breeding site for this species.

2.13. Results from a common toad survey indicate that the Site supports a ‘low’ population of common toad (ARC, 2011).

REPTILES

2.14. Slow worm (*Anguis fragilis*), common lizard (*Zootoca vivipara*) and grass snake are present on the Site.

2.15. The reptile survey results indicate that the Site supports 'good' populations of slow worm and common lizard and a 'low' population of grass snake (Froglife, 1999).

BREEDING BIRDS

2.16. Four red-status bird species utilise on-site habitats. These are song thrush (*Turdus philomelos*), starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*) and linnet (*Linaria cannabina*).

2.17. The Site is of ecological importance at the local level for Cetti's warbler (*Cettia cetti*), house sparrow (foraging only) and reed bunting (*Emberiza schoeniclus*).

2.18. Kingfisher (*Alcedo atthis*) was recorded along the RMC, and reported breeding along the canal, west of the Site, by a local bird watcher.

2.19. Both Cetti's warbler and kingfisher are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

BADGER

2.20. During badger (*Meles meles*) sett monitoring work conducted in May and June 2018, it was concluded that Setts A and D are not in 'current use' by badger.

2.21. During the same monitoring work, it was concluded that Setts B and C are in 'current use' by badger.

2.22. Sett locations are indicated in Figure 1.

2.23. Further detail of sett monitoring work, including detailed survey results, is provided in the associated *Badger Report* (Lloyd Bore, 2018b).

BATS

2.24. The Site does not support any features suitable for roosting bats.

2.25. Eight bat species were confirmed using the Site and adjacent section of the RMC during the 2016 bat activity survey. It is possible that additional Myotis species are also present.

2.26. There were differences in the recorded levels of bat activity across the survey area. Bat activity was higher along the adjacent section of the RMC and vegetation on the northern embankment of the Site. Bat activity was low across the remainder of the Site.

3. ECOLOGIAL CONSTRAINTS PLAN

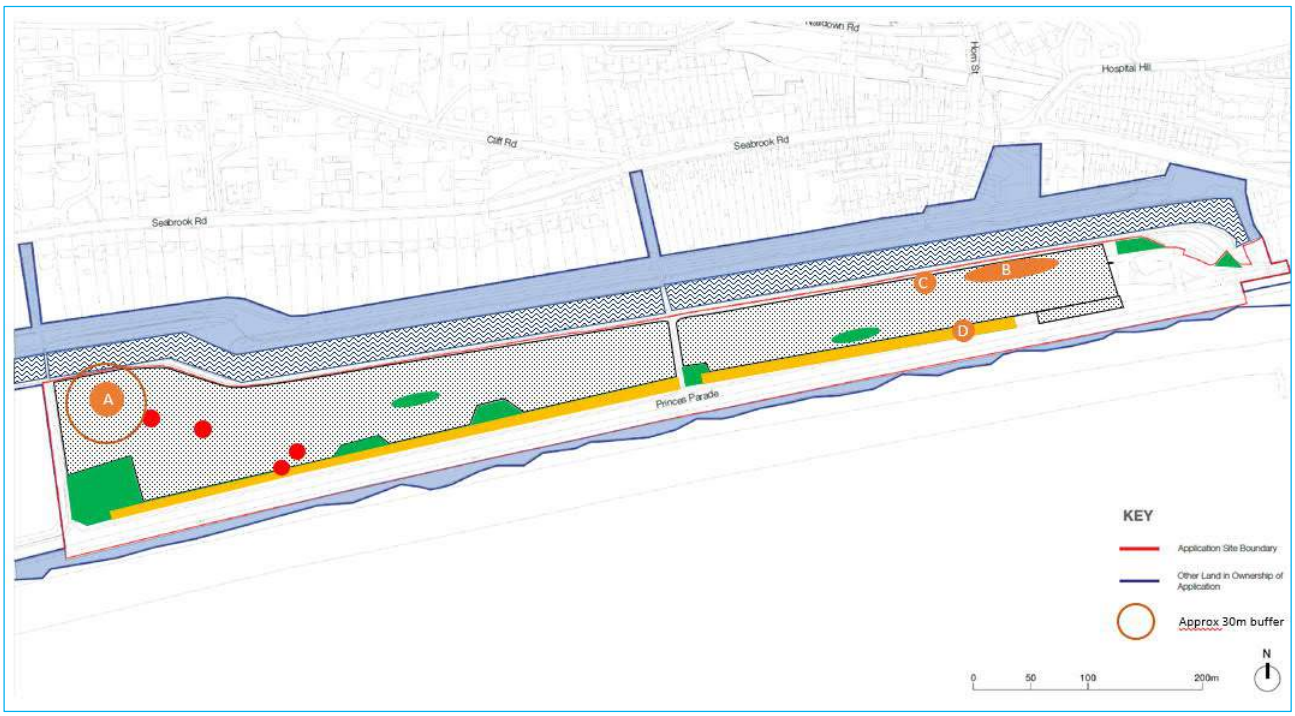

Fig. 1: Ecological constraints plan. (Refer to Appendix 2 for larger version).

Key

- Royal Military Canal (LWS and of County importance for foraging bats)
- Scattered areas of bird nesting habitat
- Other land in ownership of applicant
- Reptile habitat and scattered areas of bird nesting habitat
- Reptile habitat
- Giant hogweed – approximate locations
- Badger sett – approximate locations

4. DEVELOPMENT PLAN

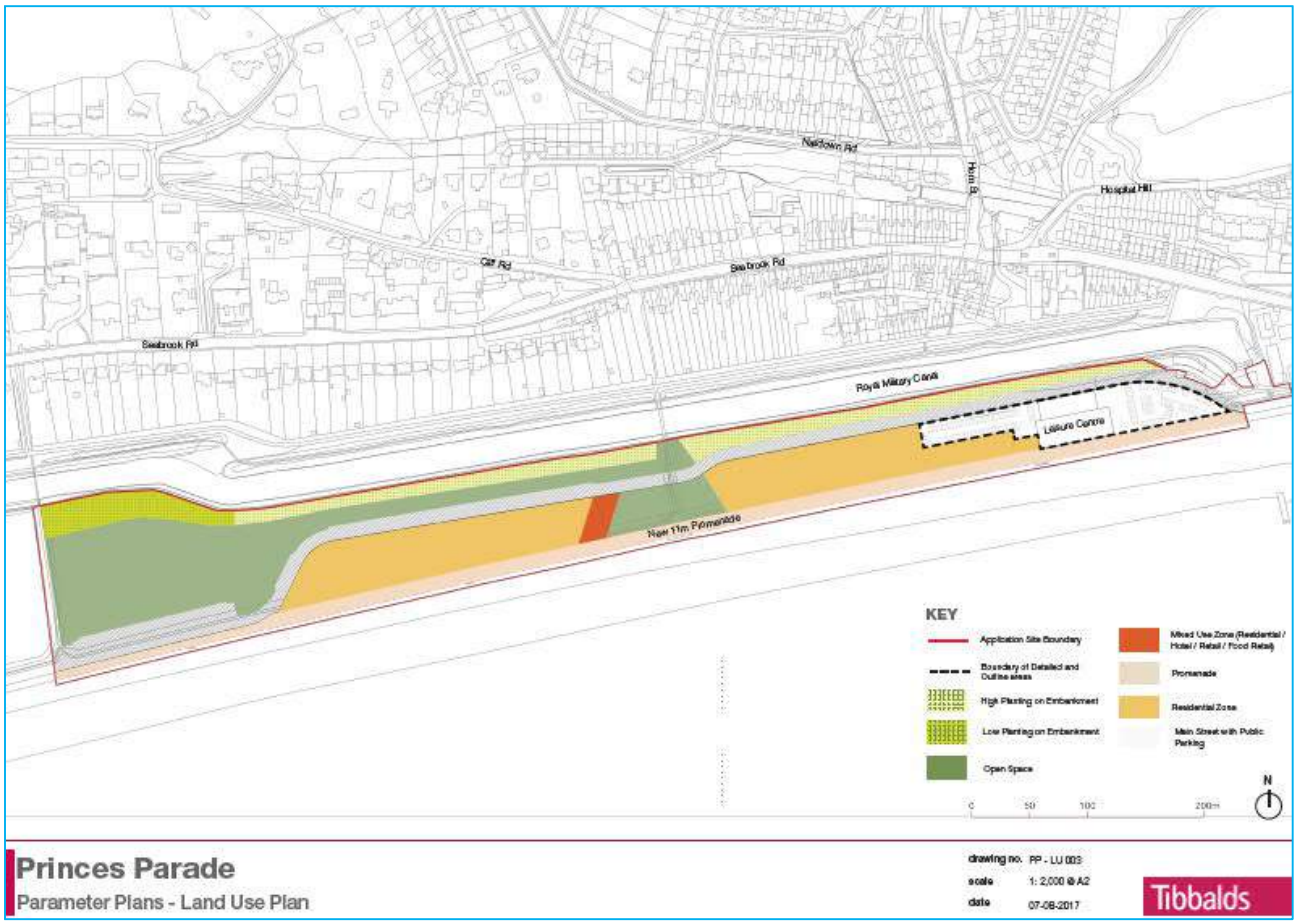

Fig. 2: Parameter plan (Drawing PP - LU 003, Prince's Parade Parameter Plans - Land Use Plan, dated 19.06.2017, Tibbalds), including the red-line boundary of the hybrid planning application and the boundary between the detailed and outline application sites. A larger copy of this plan is provided in Appendix 3 of this document.

5. REPTILE RECEPTOR

Fig. 3: Reptile receptor and area requiring enhancement prior to use as a receptor, north of the RMC. See Appendix 4 for larger version.

Key

Opportunities to create new reptile habitat.

Receptor enhancement works prior to use as a receptor.

6. WORKS PHASING

6.1. The mitigation strategy set out in this document is based on the following sequencing, timescales and phases for the proposed development, as provided in the Programme Plan, dated November 2018.

6.2. The below represents the most up-to-date phasing timeline for the proposed development.

Phase 1: May 2020 to January 2021

- Site remediation works.

Phase 2: May 2020 to November 2021

- Construction of leisure centre;
- Realignment of Princes Parade and construction of western car park;
- Relocation of existing rising main along realigned Princes Parade;
- Provision of new promenade; and
- Construction of a new linear park and installation of planting along the northern embankment.

Phase 3: May 2020 to November 2021

- Construction of character area east (residential) and central open space.

Phase 4: November 2021 to April 2023

- Construction of character area west (residential and commercial) and western open space.

7. MITIGATION METHOD

7.1. The development layout shown on the Land Use Parameter Plan (Figure 2) incorporates ecological avoidance measures. These measures have been informed by the results of ecological survey work conducted in 2015 and 2016, as detailed in Technical Appendices 7.1 to 7.7, inclusive, of the ES (Lloyd Bore 2017a).

7.2. During the master planning process, three main options were considered for the layout of the development.

7.3. The locations of important ecological features in relation to each layout option were considered.

7.4. A comparison of these earlier layout options with the submitted version of the Land Use Parameter Plan provides evidence that the scheme has avoided ecological impacts by design.

7.5. Furthermore, the proposed phasing of Site works will ensure that key green infrastructure is reinstated as soon as possible (in Phase 2 of the construction stage), and that off-site compensation measures are delivered prior to the start of construction.

7.6. This is in accordance with best practice and is particularly important in: -

- Ensuring that, prior to the commencement of reptile translocation works, the reptile receptor site provides suitable habitat that can accommodate translocated animals; and
- Ensuring that habitat connectivity is maintained for foraging bats and common toad adjacent to the Site and is not lost at any point during the construction stage.

7.7. Additionally, a 'buffer' of semi-natural habitats will be built between the development and the RMC.

7.8. A plan showing the widths of the buffer can be found in Appendix 5.

7.9. The width of the buffer should not be the focus of any planning condition relating to the RMC buffer. The ecological functionality and effectiveness of the buffer in protecting the RMC should instead be the focus. The mitigation measures detailed within this document will ensure that the buffer: provides a robust block of appropriate semi-natural habitat; incorporates reasonable measures to avoid pollution of the canal during the construction and operational stages; and that an illuminance level of 1 lux or less is achieved at the southern edge of the buffer.

7.10. The current concept lighting scheme model (Figure 4), does not take into account any planted semi-natural habitat within the 'buffer' and boundary of the application site and therefore, the 1 lux illumination limit (Figure 4, red-line) represents a worst-case scenario.

7.11. Relevant detail of works phasing is provided in this document. Full detail of works phasing is provided within the ES and the PDAS.

7.12. Given that the precise detailed design of the wider Site is not known at this stage, this document will be updated with additional detail of mitigation and enhancement measures as additional design detail emerges.

NON-STATUTORY DESIGNATED SITES

Avoidance

7.13. The eastern development zone (built development) will be located at least *c.*10 to 11m from the northern red line boundary, to allow for a set back from the RMC LWS.

7.14. The western development zone (built development) will be located at least *c.*39m from northern red line boundary and in places up to *c.*100m, to allow for increased set back from the LWS.

7.15. These avoidance measures reduce the risk that the construction and operation of the proposed development would result in pollution and/or damage to habitats within the LWS.

Mitigation

7.16. In the absence of mitigation, Site works could result in contamination of the RMC LWS and damage habitats within the LWS.

7.17. The drainage strategy detailed in Option B incorporates a Sustainable Drainage System (SuDS) which sub-divides the development site into five separate drainage catchments that manage water runoff from impermeable areas (i.e. new trunk road, leisure centre, car parks, play, public highway, private development areas and promenade) before being discharged at a restricted rate to the RMC via three separate outfalls.

7.18. The drainage catchments will use permeable paving to drain water runoff either into lined underground storage tanks or a 1m deep layer of lined open graded sub-base to ensure that there is no interaction between any leachates and surface water.

7.19. Runoff from the new trunk road, public parking areas and the play area will be drained in to a 'natural' swale which will convey surface water runoff and discharge into a lined pond with terraced marginal areas. The terraced areas will manage low volumes of runoff from small storm events.

7.20. The drainage strategy design also incorporates additional storage for water runoff through the delivery of a ground detention basin above one of the storage tanks - to cater for *extreme* rainfall events, with overflows to allow excess water to be directed towards the beach if the detention basin reaches maximum capacity.

7.21. In the event of back to back rainfall events and to ensure that no additional volume of water will be discharged to the RMC, each SuDS will be oversized and incorporate independent overflows which, when activated, will direct the additional surface water onto the beach or be stored safely on-site.

7.22. Runoff from the new promenade will be drained directly to the beach. This will prevent salt water from entering the drainage system and thus reaching the RMC. There will be no public vehicular access along the seafront and therefore, any surface water drainage discharged to the beach from the new promenade is likely to be uncontaminated.

7.23. The proposed surface water drainage outfalls to the RMC will be located to minimise impacts to bankside habitats of the LWS. The specific location for the outfalls will be informed by guidance provided by a suitably experienced ecologist.

7.24. The proposed outfalls are likely to comprise a single pipe connected to a flow device, ensuring the rate of discharge is both restricted and controlled.

7.25. The proposed development (including Option B drainage strategy) has thereby minimised the risk during the occupation-phase of contamination of the LWS through sensitive master planning.

7.26. The pollution prevention guidance for England, which was available on the Environment Agency (GOV.UK) website, has now been withdrawn and archived. However, a replacement set of current pollution prevention guidance can be found on the (GOV.UK) website (Gov.uk, 2016).

7.27. Current guidance on the Gov.uk website, provides working principles for works on or near water, including guidance in relation to: -

- Polluting substances;

- Activities that produce contaminated water;
- Correct use of drains;
- Storing materials, products and waste;
- Unloading and moving potential pollutants;
- Construction inspection and maintenance;
- Set up and environmental management system; and
- Contacting the environment agency.

The above guidance, provided on the Gov.uk website, will be followed to minimise the risk of ecological impacts arising from the storage of chemicals and/or materials on-site, fuel or chemical spillages and the management of Site run-off.

7.28. In addition, rigid site hoarding and/or propped Heras fencing (or similar) fitted with debris netting will be used to minimise the risk of materials, machinery and debris entering the LWS. Wildlife protection signs will be posted to the Heras fencing (Appendix 7).

7.29. These measures will minimise the risk of construction-phase impacts upon the LWS.

7.30. Additional detail of construction-phase habitat protection, and pollution prevention and control measures will be provided in the Construction Environmental Management Plan (CEMP), which will be submitted at the Reserved Matters stage.

7.31. In addition, the new Linear Park - which will be planted during Phase 2 of the construction stage, will provide a habitat buffer between the development areas and the RMC LWS.

7.32. The location of this Linear Park is shown within the PDAS.

HABITATS OF PRINCIPAL IMPORTANCE

Avoidance

7.33. The setting back of the development zones from the RMC, the drainage strategy design and sensitive positioning of surface water drainage outfalls to the RMC will minimise the risk of pollution of and/or damage to the canal HPI during the construction and operational stages.

7.34. In addition, all development will be set back at least 12m from the seawall. This will minimise the risk of operational stage impacts upon the beach.

Mitigation

7.35. In the absence of mitigation, the construction and operation of the proposed development could result in damage and/or pollution of habitats within the RMC HPI.

7.36. The mitigation measures outlined for the LWS will also minimise the risk of damage and/or pollution of the RMC HPI.

7.37. The CEMP, which will be submitted at the Reserved Matters stage, will provide additional detail of measures that will be employed to protect the RMC HPI during the construction stage.

OTHER HABITATS AND FLORA

Avoidance

7.38. Excluding the retained area of vegetation around badger Sett A, it is likely that total clearance of vegetation from the Site will be required to facilitate the capping of contaminated ground.

7.39. For this reason, direct impacts upon the on-site grassland community cannot be avoided.

Mitigation

7.40. The new habitats within the Western Open Space and the Linear Park will include scrub, grass and forb species that are present in the pre-development grassland community. New compensatory scrub and grassland habitats will cover *c.*1.4ha of the proposed new open spaces (within the Western Open Space and Linear Park combined).

7.41. The drainage scheme incorporates a 'natural' swale and lined pond with a terraced marginal area of habitat, the size and location of which will determine the area of the new compensatory grassland habitats within the Western Open Space.

7.42. In addition, a living roof will be installed on the roof of the pool hall, which forms part of the leisure centre. The substrate and seed mix used in this living roof will replicate the substrate and species composition of the existing grassland that is located adjacent to Princes Parade as far as possible.

7.43. The above measures will part-compensate for the loss of the on-site grassland. These measures will not deliver a like-for-like replacement of the grassland community that will be lost to development. However, they will seek to create grassland of comparable conservation importance and will deliver a net gain in the total area of grassland habitat present on the Site.

7.44. The emerging detailed design will include the installation of dog-proof fencing located within the Western Open Space and the Linear Park to protect the pond, swale, areas of grassland / wildflower planting and those areas containing enhancements for reptiles, amphibians, bats and potentially badger sett(s).

7.45. The use of dog exclusion fencing will restrict access by the public with dogs to these areas. However, access for management activities and the public without dogs will be incorporated within the design. The fencing design will also consider access for foraging badgers.

7.46. The location of the Western Open Space is shown within the PDAS.

INVASIVE FLORA

7.47. It is a legal offence to plant or otherwise causes to grow in the wild any plant listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

7.48. Giant hogweed poses a serious threat to human health. During ecological mitigation works, stands of giant hogweed should be fenced off with a 4m buffer zone and warning notices put up.

7.49. The giant hogweed plants, and any soil that may contain the plant material or seeds, will need to be removed from the works footprint and securely disposed of away from works, roads and public access. Composting within a secure area, and treatment of any regrowth with an appropriate herbicide in an environmentally sensitive manner, is one possible disposal option. Additional detail of giant hogweed control measures will be included in the CEMP.

7.50. Japanese knotweed (*Fallopia japonica*) is frequently encountered on development sites.

7.51. For this reason, prior to the commencement of Site works, all Site personnel should be briefed on the identification of Japanese knotweed and giant hogweed. This briefing could be delivered through a Toolbox Talk.

7.52. If Japanese knotweed, giant hogweed or any other plant listed on Schedule 9 of the Wildlife and Countryside Act, is discovered on-site prior to or during works, all works within 7m of the plant(s) should cease immediately and a suitably experienced specialist should be contacted for advice.

INVERTEBRATES

Avoidance

7.53. Excluding the retained area of vegetation around badger Sett A, it is likely that total clearance of vegetation from the Site will be required to facilitate the capping of contaminated ground.

7.54. For this reason, direct impacts upon the on-site grassland adjacent to Princes Parade (which is of Local importance for invertebrates) cannot be avoided.

Mitigation

7.55. The compensation measures detailed for the grassland plant community (see *Other habitats and flora* section) will also provide some level of compensation for invertebrates associated with this grassland. The living roof on the leisure centre will be designed to provide habitat suitable for a diverse range of invertebrate species, including maritime grassland species.

7.56. In addition, areas of gravelly substrate overlain with a thin layer of soil and seeded with a maritime grassland mix will be provided within the Western Open Space - most likely adjacent to the new public parking that will be provided on the main street. The final location of this area will be determined at the detailed design stage. This area will be maintained as a short grass sward.

7.57. The pond, swale and areas of long grass established throughout the Western Open Space and Linear Park will benefit a range of invertebrate species. The areas of long grass will include cut pathways that link to public footpaths and the promenade.

7.58. By splitting the areas of long grass into sections a cutting regime of alternate annual cuts over the winter period will be implemented that will maintain the grass structure and avoid scrub encroachment. The most effective and least damaging cutting period being November to December.

7.59. Grassland plantings within the Western Open Space will include nectar rich wildflowers that are suitable for the soil conditions. The flower mix should include species that flower at different times - providing a nectar source throughout the flowering season.

7.60. A suitable species mix should include native plants from the pea (*Fabaceae*), figwort (*Scrophulariaceae*), broomrape (*Orobanchaceae*) and mint (*Lamiaceae*) plant families. These will provide foraging opportunities for pollinating invertebrates especially *Bombus* sp. including the brown-banded carder (*Bombus humilis*), shrill carder (*Bombus sylvarum*) and short-haired bumble (*Bombus subterraneus*).

7.61. Brown-banded carder, shrill carder and short-haired bumblebee are SPI that occur within the wider local landscape.

7.62. The invertebrate assemblage present within the grassland cannot be replicated or re-created through delivery of new habitats. However, invertebrate assemblages are dynamic, and the

proposed new habitats will provide a range of new opportunities for invertebrates, including maritime grassland species.

7.63. The LEMP, which will be submitted at the Reserved Matters stage, will provide additional detail of the habitat management prescriptions that will be adopted and implemented to benefit invertebrates in the long-term.

COMMON TOAD

7.64. Whilst common toad does not receive specific legal protection, it is listed as an SPI under Section 41 of the Natural Environment and Rural Communities Act 2006 (as amended).

7.65. Under Section 40 of the same Act, it is stated that the local authority must, *'in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity.'* Consideration of impacts upon SPIs is relevant to this requirement.

Avoidance

7.66. Excluding the retained area of vegetation around badger Sett A, total clearance of vegetation from the Site will be required to facilitate the capping of contaminated ground.

7.67. For this reason, direct impacts upon common toad terrestrial habitat cannot be avoided.

Mitigation

7.68. In the absence of mitigation, there is a high risk that works undertaken during the construction stage will result in the killing and injury of individual common toads. Works could also result in the pollution of and/or physical impacts upon the recorded common toad breeding site (the RMC).

7.69. To minimise these risks, mitigation measures will be adopted and implemented.

7.70. On-site habitats will be cleared under ecological supervision, which will help to minimise the killing and/or injury of common toads during the construction stage. Any common toads discovered during clearance (or during the pre-clearance reptile trapping visits) will be translocated to suitable habitat adjacent to the north side of the RMC and the reptile receptor area (as detailed below).

7.71. Prior to the start of construction, herptile (reptile and amphibian) exclusion fencing will be installed along the northern, eastern and western boundaries of the Site. This will help to minimise the risk of common toads entering works areas.

7.72. The CEMP - which will be submitted at the Reserved Matters stage, will provide additional detail of measures designed to minimise the risk of killing and/or injury of individual common toads during the construction stage.

7.73. The risk of impacts upon common toad habitat (terrestrial and aquatic) outside of the Site during the construction stage will be minimised through implementation of the measures outlined in the *Non-Statutory Designated Site* section.

7.74. The pollution prevention and control measures outlined for the LWS will also minimise the risk of damage and/or pollution of off-site common toad terrestrial and aquatic habitats.

7.75. Additional detail of construction-phase habitat protection, and pollution prevention and control measures will be provided in the CEMP, which will be submitted at the Reserved Matters stage.

7.76. The proposed development will deliver an amphibian-friendly road and drainage scheme, through inclusion of features such as wildlife or ACO (ACO is the manufacturer) kerbs and slit drains or other amphibian-friendly drainage solutions.

7.77. This will minimise the risk of killing / injury of common toads during the operational stage. A detailed specification for the amphibian-friendly road design will be confirmed at the Reserved Matters stage.

7.78. With the inclusion of pollution interceptors on drainage outflows, the design of the proposed drainage scheme will minimise the occupation-stage risk of contamination of the canal, which is a common toad breeding site.

7.79. Excluding the retained area of vegetation around badger Sett A, it is likely that Phase 1 of the construction stage will result in a total loss of common toad terrestrial habitats from the Site. New compensatory habitats suitable for common toad will be delivered in Phase 2 of the construction stage - to help compensate for the loss of existing habitats.

7.80. At least 0.6ha of new compensatory habitats suitable for common toad (scrub and tall grassland) will be delivered within the Linear Park as soon as possible after Site clearance. These new habitats will provide foraging and shelter opportunities for common toad close to the recorded breeding site (RMC). This habitat will be created during Phase 2 of the construction stage.

7.81. A pond, 'natural' swale and *c.*0.8ha of new tall grassland and scrub habitats will also be delivered within the Western Open Space. These habitats will provide compensatory terrestrial habitats suitable for common toad. This habitat will be created during Phase 4 of the construction stage.

7.82. Amphibian refugia piles and hibernacula will be installed within the new terrestrial habitats closest to the RMC and pond and furthest from the road. The design of the hibernacula is described within the *Reptiles* section below.

7.83. The above will not fully compensate for the loss of common toad terrestrial habitat from the Site. However, the above will ensure that new terrestrial and aquatic habitat suitable for common toad, and new refuge and hibernation opportunities, are provided close to the recorded breeding site.

7.84. The new habitats will be managed to ensure that they continue to provide foraging and shelter opportunities for common toad post-development. Management operations will be designed to minimise the risk of killing or injury of common toads.

7.85. Management prescriptions will be confirmed in the detailed LEMP, which will be delivered at the Reserved Matters stage.

REPTILES

7.86. The legislation and offences below are relevant to the proposed works.

7.87. All four common reptile species are afforded legal protection from intentional and reckless killing and injury by the Wildlife and Countryside Act 1981 (as amended).

7.88. Actions affecting multiple animals can be construed as separate offences and therefore penalties can be applied per animal impacted.

7.89. All reptiles and amphibians held in captivity are legally protected by the Protection of Animals Act 1911 (as amended) and adder (*Vipera berus*) is listed on the Dangerous Wild Animals Act 1976 (as amended). This may be of relevance during reptile translocation works. However, adder was not recorded during survey work.

7.90. Licences are not required to capture and move the four most common UK reptile species (slow worm, common lizard, grass snake and adder).

7.91. The Wildlife and Countryside Act (1981) includes certain defences that may apply in some specific circumstances.

Reptile habitat

7.92. Approximately 1.4ha of habitat within the Site is suitable for reptiles. Areas of suitable reptile habitat include: -

- The less intensively managed northern edge of the roadside verge adjacent to Princes Parade, which provides some shelter and basking opportunities for reptiles;
- A dry ditch and bund located immediately north of the verge. These features support tall grassland, ruderal vegetation and bramble scrub;
- An area of tall grassland located at the western end of the Site, north of the bund. This area contains scattered concrete blocks, which provide additional shelter, basking and potentially hibernation opportunities for reptiles; and
- Two isolated areas of rough grass within the ruderal habitats described below. One area is present in the eastern half of the Site and one is present in the western half.

7.93. Results from the reptile survey indicate that reptiles occur within the dry ditch and bund and the tall grassland located at the western end of the Site. These comprise *c.*0.68ha of suitable reptile habitat.

7.94. The remainder of the Site is dominated by dense, tall ruderal vegetation and willow (*Salix sp.*) and elder (*Sambucus nigra*) scrub. These habitats are unsuitable for reptiles. However, grass snake has been recorded within the Site and is a transient species and therefore could be found within the areas of unsuitable reptile habitat within the Site.

Avoidance

7.95. Excluding the retained area of vegetation around badger Sett A, it is likely that total clearance of vegetation from the Site will be required to facilitate the capping of contaminated ground.

7.96. For this reason, direct impacts upon reptile habitat cannot be avoided.

Mitigation

7.97. In the absence of mitigation, there is a high risk that works undertaken during the construction stage would result in the killing and injury of individual reptiles.

7.98. To mitigate against the risk of killing and injury of individual reptiles, a programme of reptile trapping, and translocation will be undertaken.

7.99. This will involve the capture of reptiles from the Site by suitably experienced ecologists and the translocation of captured animals to an off-site receptor within the RMC corridor to the east of the Site, on the northern side of the RMC channel (Figure 3).

7.100. Reptile trapping, and translocation will be completed before the commencement of Phase 1 of the construction stage (site clearance). Additional detail is provided below.

Preliminary vegetation clearance works

7.101. During January and February reptiles are likely to be hibernating. The ecological supervision requirements and the timing of the vegetation clearance works in relation to nesting birds (see

Breeding Birds section, below) will reduce the risk of killing and injuring reptiles - by ensuring that works do not break ground or work too closely to the ground where animals could be hibernating.

7.102. Should any vegetation clearance works be required within areas of suitable reptile habitat between March 20198 to September 2019 (inclusive) then vegetation will be cleared under ecological supervision and in stages using a hand-held strimmer and/or brush cutter.

7.103. The first cut will be to a minimum height of 300mm (no less), with a second cut to 100mm (no less) and then a final cut to ground level as advised by an ecologist. This will reduce the risk of killing and injuring reptiles because the works allow animals to move away on their own accord.

7.104. This work must only be conducted in suitable weather conditions (during periods of dry, suitable weather with an ambient air temperature of 12°C or above), as advised by an ecologist.

7.105. Any animals present can be caught be the supervising ecologist and translocated to the off-site receptor.

7.106. Measures relating to breeding birds (below) will also need to be considered during clearance works.

7.107. Most grassland habitats will not be cleared until the completion of the reptile trapping and translocation programme.

Trapping and translocation works

7.108. Prior to trapping works, herptile exclusion fencing fitted with two-way badger gates will be installed along the western, northern and eastern boundaries of the Site. Badger gates will be installed where known badger runs cross the fence line.

7.109. The proposed badger mitigation measures will inform the location of the herptile exclusion fencing when it is close to retained and/or compensatory badger setts.

7.110. The reptile receptor habitat will be located within the RMC corridor, between the Site and Twiss Road (Figure 3).

7.111. It is likely that 60 trapping visits in suitable weather conditions will need to be conducted (HGBI, 1998). However, trapping may extend beyond this if animals continue to be caught.

7.112. Trapping works will not stop until at least 30 trapping visits have been conducted and until there have been at least five clear days of trapping, during suitable weather conditions, when no animals have been caught.

7.113. Trapping visits will only be counted if the weather is suitable. In particular, the weather will need to be dry, and temperatures will be above 12°C, which is the temperature when grass snakes start to bask (Gent and Gibson, 2003).

7.114. In general trapping visits, will not be conducted when the temperature is above 18°C (Froglife, 1999a). However, experience from other projects has shown that trapping can also be effective in temperatures up to 25°C, especially when it is warm and overcast, or during a sunny spell just after a thundery shower. Therefore, trapping works will only cease on-site when temperatures exceed 25°C.

7.115. 'Clear days' will not be counted when trapping works are undertaken at temperatures above 18°C. Therefore, clear days will only be counted when capture works are being conducted in optimal conditions.

7.116. On very hot days trapping may be conducted early and late in the day. However, prolonged hot spells with hot nights are likely to reduce capture efficiency. In these weather conditions, the period of animal free days would not be counted, or the number of free days will be extended to 10 days.

7.117. To ensure the effective capture of reptiles, artificial cover objects (ACOs) will be placed on-site at a high density and well above that recommended for survey work (Froglife, 1999). Areas of the most suitable habitat will be targeted. However, as a precaution, some ACOs will also be placed within areas of less suitable habitat.

7.118. The capture works will only be undertaken during the reptile active season, which is generally between early April and the end of September (inclusive). However, the season may start earlier or extend later because of periods of warm prevailing weather conditions.

Supervised destructive search and site clearance

7.119. Once trapping works have been completed, any areas of reptile habitat within the construction zone will be removed under the supervision of a suitably experienced ecologist and in dry weather when the temperature is above 15°C.

7.120. A toothed bucket will be used to remove vegetation and topsoil - to reduce the risk of killing and injuring any animals that might remain within the Site after the conclusion of trapping work. If any animals are present, this will allow them to be caught and moved to the receptor area.

7.121. If possible, the clearance of suitable bird nesting habitat, such as scrub and hedgerows would have been completed prior to these works being undertaken.

7.122. If this is not possible, prior to commencement of habitat clearance works a check for nesting birds will be undertaken by a suitably experienced ecologist. Any active nests will be retained and protected *in-situ* until the birds have stopped using them.

Compensation

7.123. The construction-stage Site clearance will result in the loss of *c.*1.4ha of suitable reptile habitat from the Site of which *c.*0.68ha was occupied by reptiles as indicated by the results of the reptile survey (Lloyd Bore, 2017a).

7.124. Compensation for the loss of the occupied habitat will be delivered in two ways.

7.125. Firstly, existing habitats suitable for reptiles will be enhanced within the off-site receptor area and new reptile habitat will be created (Figure 3).

7.126. Habitat creation and enhancement measures north of the RMC will be targeted to deliver *c.*0.7ha of new foraging, shelter, basking, refuge and hibernation opportunities for slow worm, common lizard and grass snake.

7.127. These habitats will provide sufficient habitat for the translocated reptile population and the low population of grass snake already present within the receptor area.

7.128. The habitat creation and enhancement measures have been informed by the results of the reptile presence / likely absence survey of the off-site receptor.

7.129. Given the extent of habitats present within the RMC corridor that could be enhanced for reptiles, the above approach is likely to provide sufficient compensation for loss of on-site habitats.

7.130. The creation and enhancement of these off-site habitats will be completed prior to the commencement of translocation of reptiles from the Site.

7.131. Secondly, *c.*0.8ha of new on-site compensatory habitat suitable for reptiles (tall grassland and low scrub) will be delivered within the Western Open Space.

7.132. This will provide long-term compensation for the loss of on-site habitats and will help to account for any adverse effects of translocation upon the local reptile population.

7.133. The exact amount of new on-site compensatory habitat for reptiles that can be delivered will be largely dictated by the extent of the new pond and swale that is incorporated as part of the Option B drainage scheme. Given this and the approximate area of suitable reptile habitat that can be delivered, it is likely that there will be a minor net loss of on-site suitable reptile habitat.

7.134. The new and enhanced reptile habitats within the off-site receptor area and the on-site Western Open Space will connect on to a wider network of suitable reptile habitat within the RMC corridor.

7.135. Detail of the management strategy for receptor habitats and habitats within the Western Open Space will be confirmed in the LEMP, which will be submitted at the Reserved Matters stage.

7.136. The new habitats will be managed to ensure that they continue to provide foraging, shelter, basking and hibernation opportunities for reptiles' post-development.

Reptile presence / likely absence survey of the off-site receptor

7.137. A reptile presence / likely absence survey of suitable reptile habitat within the off-site receptor north of the RMC (Figure 3) (including areas where reptile enhancement works will be undertaken), was conducted by Lloyd Bore between 9th May 2018 and 29th May 2018. Details of the reptile survey can be found in the *Reptile Survey Report* (Lloyd Bore, 2018a).

7.138. Results from the survey recorded an estimated 'low' population (Froglife, 1999) of grass snake. However, the results indicate that the habitat is suitable for reptiles.

7.139. No amphibians were recorded under the deployed Artificial Cover Objects (ACOs).

Hibernacula design

7.140. The design of the hibernacula will broadly follow that depicted in the Great Crested Newt Conservation Handbook (Langton *et al.*, 2001).

7.141. The construction of each hibernaculum will make use of clean rubble, logs, topsoil and a partial covering of turf. Materials used will be not be from a contaminated source. The design will allow some of the rubble and logs to remain exposed providing areas for basking. Gaps within the exposed wood and rubble will provide bolt holes and ingress into the interior for refuge and food.

7.142. The exact positioning of the hibernaculum will be as advised by a suitably experienced ecologist. Proximity to the areas of reptile release, sunny aspects linked to a corridor of suitable reptile habitat and flood risk will be taken into account.

7.143. The hibernacula will each be *c.*500mm high, *c.*2m wide and *c.*2m long.

7.144. The construction of the hibernacula within the Site, will include a section dug to *c.*500mm and the hole lined with gravel to aid drainage.

7.145. The design of the hibernacula located north of the RMC will not break ground to avoid impacts to the scheduled ancient monument site. Instead a deeper topsoil layer will be included within the design to provide an alternative hibernation habitat.

7.146. The hibernacula will be built under ecological supervision. Hibernacula creation in areas where reptiles could be present will be undertaken in suitable hot, sunny weather. Hibernacula will be created during the summer/early autumn months - giving them time to become established and the reptiles the opportunity to locate them before the commencement of hibernation.

7.147. Hibernacula suitable for both reptiles and amphibians will be installed along the northern embankment, within the Western Open Space, Linear Park and within the reptile receptor to the north of the RMC.

Site hibernacula and log piles

7.148. A minimum of nine hibernacula and nine log piles will be installed along the embankment to the west of the central pathway.

7.149. A minimum of four hibernacula and four log piles will be installed within the Western Open Space.

Off-site receptor hibernacula and log piles

7.150. A minimum of nine hibernacula and five log piles will be installed within the reptile receptor area to the north of the RMC prior to the commencement of translocation.

Site monitoring for reptiles

7.151. Three consecutive years of Site and receptor monitoring will occur. The monitoring will focus on the off-site receptor and on-site habitats within the Western Open Space, Linear Open Space and northern embankment.

7.152. Monitoring of the receptor will commence during the first year after the translocation works are complete.

7.153. Monitoring within the Site will commence during the second year after the compensatory habitats have been implemented.

7.154. Monitoring will examine any changes to habitat quality and if necessary, amendments to habitat management will be provided.

7.155. The monitoring work will also look for evidence of breeding by reptiles in each of the three years of monitoring. In the third and final year of monitoring, a population size class estimate assessment will be conducted.

BREEDING BIRDS

7.156. Nesting birds, and their nests, eggs and chicks are afforded legal protection from intentional destruction, killing or injury by the Wildlife and Countryside Act 1981 (as amended).

7.157. In addition, bird species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) are afforded protection from intentional and reckless disturbance whilst breeding.

Avoidance

7.158. Excluding the retained area of vegetation around badger Sett A, it is likely that total clearance of vegetation from the Site will be required to facilitate the capping of contaminated ground.

7.159. For this reason, impacts upon the habitat available to breeding birds cannot be avoided.

Mitigation

7.160. In the absence of mitigation, there is a high risk that works undertaken during the construction stage would result in destruction of active bird nests. To mitigate this risk, the following measures are proposed.

7.161. The vegetation clearance works will be undertaken on suitable areas within the proposed development Site and the proposed reptile receptor location to the north of the RMC (Figure 3).

7.162. Vegetation clearance works (down to *c*.300mm) will be conducted during January and February. This will remove potential bird nesting habitat before the main bird breeding season. This work will be conducted under ecological supervision.

7.163. Wherever possible, clearance of scrub and ruderal vegetation will be undertaken within the period October to February (inclusive) - which is outside of the typical bird nesting period.

7.164. The precise timing and methods of habitat clearance works will also be subject to reptile mitigation requirements.

7.165. Checks should be conducted prior to the clearance of any vegetation during the bird nesting season (March to mid-September). The checks will be undertaken by a suitably experienced ecologist.

7.166. The checks should be performed either on the day of clearance or up to two days in advance of the clearance if deemed appropriate by the ecologist. Any active nests will need to be left *in situ* until birds have stopped using them.

7.167. Given the extent of the vegetation to be cleared, this work will be conducted in sections and at a rate that is sensitive to wildlife. The limit of the checked area will be marked to ensure that vegetation clearance work remains within the extent of the checked area.

7.168. The Wildlife and Countryside Act 1981 (as amended) makes it an offence to intentionally or recklessly disturb those bird species listed on Schedule 1 of the Act whilst they are breeding. This includes adults and their young, at, on or near an 'active' nest.

7.169. During bird surveys and Site visits, kingfisher and Cetti's warbler were recorded. These species are both listed on Schedule 1 of the Act.

7.170. Given the risk of breeding Schedule 1 bird species being present, if these species are observed during pre-clearance checks, further checks prior to vegetation clearance will focus on recording behaviour to establish whether there is evidence of active nests. This will include a check for forms of display, courtship feeding and/or nest building. If there is evidence of nesting, the checks will aim to establish an approximate location, from which an appropriate buffer will be implemented. If any active nests are recorded, to avoid the risk of intentional or reckless disturbance an appropriately sized buffer around the active nest will need to be implemented.

7.171. A buffer of at least 25m around any breeding kingfisher or Cetti's warbler nest sites is considered appropriate and sufficient to minimise the risk of disturbance during Site clearance works.

7.172. Habitats suitable for nesting birds within the adjacent section of the RMC will be protected using rigid Site hoarding and/or propped Heras fencing (or similar) fitted with debris netting. Wildlife protection signs will be posted to the Heras fencing (Appendix 7).

7.173. This protection will be maintained until all construction works that could result in damage of these off-site habitats have been completed.

7.174. Additional detail of mitigation measures relating to nesting birds will be included within the CEMP, which will be submitted at the Reserved Matters stage.

Compensation

7.175. New tall scrub and tree habitat will be provided within the Linear Park and the 'high planting on embankment' areas (as shown on the Land Use Parameter Plan).

7.176. The entire embankment will be planted with dense, tall scrub, with lower scrub present adjacent to the canal towpath. (The existing embankment supports a mixture of low and tall scrub and tall ruderal forbs). These new habitats will be delivered during Phase 2 of the construction stage.

7.177. The embankment planting provides an opportunity to provide native mixed species hedgerows and/or dense native shrub planting along the development boundaries. A species mix could include hawthorn (50%), field maple (*Acer campestre*) (30%), hornbeam (*Carpinus betulus*) (10%), guelder

rose (3%), dogwood (3%), spindle (*Euonymus europaea*) (2%) and dog rose (*Rosa canina*) (2%) (Smith and Day, 2012).

7.178. Tall and low scrub will also be provided within the Western Open Space. Low scrub will be provided within the 'low planting on embankment' areas (as shown on the Land Use Parameter Plan). These habitats will be delivered during Phase 4 of the construction stage.

7.179. These habitats will provide dense cover, foraging and nesting opportunities for song thrush (*Turdus philomelos*), reed bunting (*Emberiza schoeniclus*), linnet (*Linaria cannabina*) and other birds. They will also provide dense cover and foraging opportunities for house sparrow (*Passer domesticus*), starling (*Sturnus vulgaris*) and Cetti's warbler.

7.180. Song thrush, house sparrow, linnet, starling and reed bunting are all SPI and have been recorded within the Site.

7.181. Delivery of these new scrub habitats will effectively compensate for the loss of pre-clearance scrub habitats from the Site during Phase 1 (site clearance).

7.182. Detail of the management of these plantings will be provided in the LEMP, which will be delivered at the Reserved Matters stage.

BADGERS

7.183. Badgers are afforded legal protection by the Protection of Badgers Act 1992 (as amended).

Avoidance, mitigation and compensation

7.184. Badger Setts B, C and D will be lost to facilitate development. Sett A will be retained.

7.185. Based on badger sett survey work undertaken by Lloyd Bore in 2018, Setts B and C are in 'current use' by badgers and Sett D is disused. The survey results show that Sett B is a breeding sett.

7.186. Results from the badger survey conclude that Sett A is not in 'current use' by badger.

7.187. A licence to interfere (destroy) with badger Setts B and C will be secured from Natural England prior to the commencement of any ground clearance works within 30m of the outermost entrances of these two setts. The removal of these setts will be undertaken in strict accordance with the conditions of the granted licence.

7.188. Sett A will be retained and will remain available to badgers.

7.189. Given the distance (c.750m) between Sett B (which will be lost) and Sett A (which will be retained), an artificial sett will need to be constructed under licence from Natural England - to compensate for the loss of the breeding sett. This will need to be constructed prior to the removal of Sett B.

7.190. As a precaution, and to inform the Natural England licence application, a badger walkover survey will be undertaken in March 2019 and an update sett survey of Setts A, B, C and D, and any other setts identified during the update walkover, will be undertaken within the period March to June 2019 (inclusive).

7.191. Vegetation and ground clearance works will not be undertaken within *c.*20m of the outermost sett entrances of Sett A (Figure 1) - to ensure that badgers can maintain access to an existing on-site sett. Therefore, the location and extent of the pond, 'natural' swale and marginal vegetation within the Western Open Space will avoid impacts to this sett.

7.192. Should any works on the pond, 'natural swale' and marginal vegetation be required within *c.*20m of this sett they will be conducted under a precautionary method statement produced by a suitable experienced ecologist.

7.193. Should Sett A show signs indicating that it is in 'current use' by badgers then it will be necessary to determine the type of sett and obtain a licence from Natural England prior to any works within *c.*30m of the sett. This will be done through the 2019 update survey work.

7.194. Additional detail of avoidance, mitigation and compensation measures relating to badgers is provided in the associated *Badger Report* (Lloyd Bore, 2018b)

BATS

7.195. Bats are afforded legal protection by the Conservation of Habitat and Species Regulations 2017 and the Wildlife and Countryside Act 1981 (as amended).

Avoidance

7.196. The arrangement of the proposed development (as per the Land Use Parameter Plan) has been informed by a need to minimise light-related impacts upon foraging bats.

Mitigation (lighting)

7.197. In the absence of mitigation, the proposed development is likely to result in light spill into off-site high-quality bat foraging habitats within the adjacent RMC corridor.

7.198. A conceptual lighting design strategy followed guidance and specification defined within the Lighting Impact Assessment (LIA) (Elementa, 2017). The proposed development was assessed using 2D CAD master planning drawing, 3D computer model and the concept presentation ARC leisure centre documents to fully understand the architectural intent and proposed use for each area, enabling the development of a detailed lighting performance strategy.

7.199. The LIA (Elementa, 2017) was used to inform the mitigation and compensation measures in relation to foraging bats. The project ecologist has since informed the development of a more detailed light modelling exercise, which is shown in the most recent Elementa light modelling plan (which shows the predicted 1 lux illuminance line) – see Figure 4.

7.200. In the absence of mitigation, the construction works, and the operation of the proposed development could also result in contamination of the canal, which is an important bat foraging resource.

Construction stage

7.201. The risks of light-related impacts upon foraging and commuting bats during the construction stage are likely to be low because, in general, construction works during the main period of bat activity are unlikely to occur so late in the day that it coincides with dusk or night. During the winter period, when construction lighting is likely, bats are not active, or their activity levels are low.

7.202. However, the below contents details mitigation measures to minimise the potential risk of impacts on foraging and commuting bats.

7.203. In general, The Institution of Lighting Professionals (ILP) Guidance Notes for the Reduction of Obtrusive Light (GN01:2011) will be adhered to during the construction stage. This will prevent 'sky glow' and will minimise the amount of spill light into off-site bat foraging habitats.

7.204. The type of equipment employed, including lamp type and optics will be carefully selected to limit the luminous intensity of Site lighting to below 10,000 Candelas (cds), as per GN01:2011.

7.205. In general, floodlights required for Site works will be LED units mounted around the perimeter of the works areas and directed inwards - to avoid direct light being projected into off-site habitats.

7.206. The type and positioning of the floodlights will be carefully considered to minimise light spill.

7.207. Any additional Site lighting will be low power, low intensity LED units with zero upward light output ratio (ULOR). This will ensure that light is directed downwards, towards the task plane such as pathways, steps and stairs - resulting in zero upward light ratio (ULR) from the Site.

7.208. In addition to the above, the following principles will be adhered to for construction stage lighting: -

- The Site will be lit using narrow spectrum lighting with no UV content and/or white (preferably 'warm white' LED lighting);
- Timers and motion sensors will be used to minimise the duration of any nocturnal illumination;
- All lighting will be directed to ground and light spill will be minimised through use of optics;
- Use of tall lighting columns will be avoided wherever possible;
- A dusk lighting curfew will be imposed during the period May to September (inclusive) - as this is an important time period for bat foraging; and
- A physical barrier (e.g. Site hoarding) will be maintained between the construction zones and the retained off-site bat foraging habitats. Once the 'tall planting on embankment' has established, this planting will also provide a screen between construction stage lighting and the canal.

7.209. In general, lighting should follow the principles outlined in Section 3 of the Bat Conservation Trust and Institution of Lighting Professionals *Guidance Note 08/18: Bats and artificial lighting in the UK* (BCT and ILP, 2018), and should only be used where necessary.

7.210. No lighting will be installed within or immediately adjacent to the RMC.

Operational stage

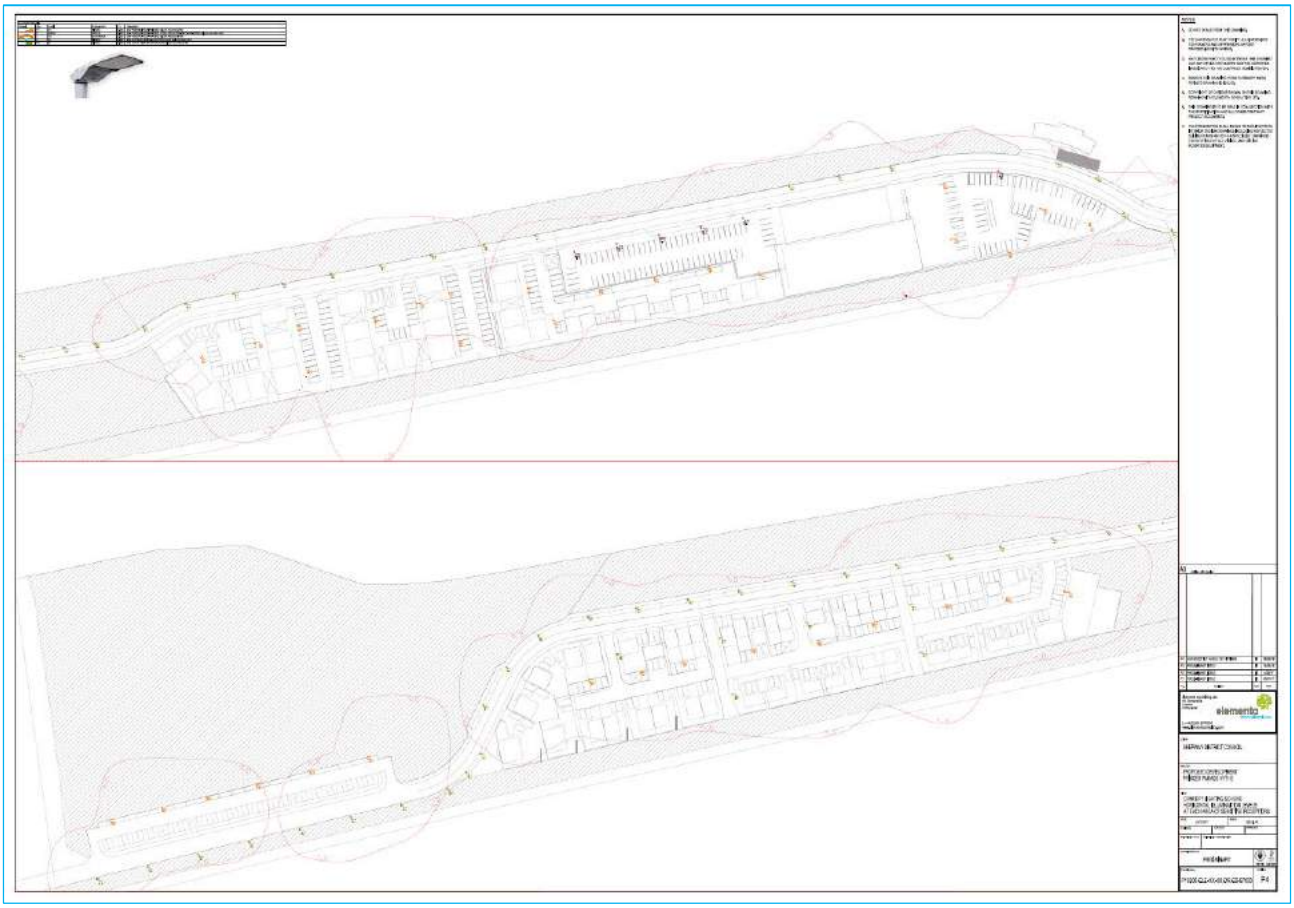

Fig. 4: Concept lighting scheme, horizontal illumination levels at each area of sensitive receptors (Drawing P16206-ELE-XX-XX-DR-ES-97003 REV P4, dated July 2017, Elementa). The red-line indicates the 1 lux illumination limit.

7.211. The LIA (Elementa, 2017) report provides an assessment of the likely impact the artificial lighting of the proposed development will have upon the bat foraging habitats / foraging bats and the local environment. The LIA report assesses the existing baseline conditions and identifies potential sensitive receptors including bat foraging habitats and foraging bats.

7.212. The lighting mitigation measures have been informed using a conceptual lighting design strategy.

7.213. It is important to note that, in the absence of detailed design information, the LIA for the operational stage of the proposed development was based on a 'worst case' scenario (which would result in negligible - minor adverse effect upon off-site habitats during the operational stage).

7.214. The concept lighting scheme (Figure 4), includes the car park lighting, the street lighting and the spill from inside the houses. The scheme modelling does not take into account any vegetation within the boundary of the application site and therefore, the 1 lux illumination limit (Figure 4, red-line) represents a worst-case scenario. As vegetation establishes on the northern embankment, this 1 lux line is likely to retreat towards the built development, because the tall scrub and trees will physically reduce light spill into the canal corridor during the growing season.

7.215. In line with the recommendations of the LIA, mitigation measures will be implemented to reduce the effects of light spill upon foraging bats - by reducing illumination of bat foraging habitat (adjacent canal section and re-vegetated northern embankment) to an average illuminance of below 1 lux.

7.216. These measures include: -

- Building façade lighting or signage will adhere to the CIE 150:2003 (Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations) limits of 0-5 cd/m2 and 50-400 cd/m2 respectively for E1 environmental zone, and any building façade lighting will adhere to the E1 limitations from GN01:2011. Hence, the average surface luminance will not exceed 0 cd/m²;
- The overall upward light ratio for the entire Site lighting should be 0%;
- Luminaires will be carefully positioned to minimise light spill onto boundary habitats;
- External areas will be lit using narrow spectrum lighting with no UV content and/or 'warm white' LED lighting;
- All lighting will be directed to ground and light spill will be minimised through use of optics;
- Use of tall lighting columns will be avoided wherever possible;
- Timers and motion sensors will be used to minimise the duration of any post-curfew illumination;
- The 'tall planting on embankment' (as shown on the Land Use Parameter Plan) will be used to further reduce light spill into the adjacent canal section; and
- Incorporation of a 5-degree back tilt of lights.

7.217. In general, lighting should follow the principles outlined in Section 3 of the Bat Conservation Trust and Institution of Lighting Professionals *Guidance Note 08/18: Bats and artificial lighting in the UK* (BCT and ILP, 2018), and should only be used where necessary.

7.218. No lighting will be installed within or immediately adjacent to the RMC. There will be some level of light trespass from the internal road lighting scheme, but this will be at a level of 1lux or less (Elementa, 2017).

7.219. The detailed lighting strategy for the operational stage of the proposed development will be produced at the detailed design stage, and will adhere to the above principles, whilst also considering all relevant health and safety and security considerations.

7.220. The detailed lighting strategy will be subject to further computer analysis at each stages of design - to ensure that significant adverse effects upon foraging bats can be avoided and minimised by design.

Compensation

7.221. In the absence of compensation, the proposed development will result in direct loss of on-site bat foraging habitat (low, moderate and high-quality).

7.222. The new plantings of tall scrub on the northern embankment and within the Western Open Space will compensate for the loss of high and moderate quality bat foraging habitat.

7.223. The new plantings of tall grassland within the Western Open Space will part-compensate for the loss of low-quality bat foraging habitat from the Site.

7.224. These new plantings will be designed to maximise cover of pollen, nectar and berry producing species. These plantings will attract invertebrates, which in turn provide a foraging resource for bats.

GENERAL MEASURES

7.225. The mitigation measures below are recommended to further reduce the risk of construction works killing and/or injuring reptiles and/or adversely affecting other protected species, habitats and other important ecological features: -

- The project will appoint an Ecological Clerk of Works (ECoW) for the duration of the construction stage. The ECoW will be responsible for ensuring effective and robust implementation of the measures set out in this document and the CEMP.
- All Site workers and contractors are to be made aware of the potential presence of reptiles and toads on-site, and the sensitivity of adjacent off-site habitats as part of the Site induction. A tool-box talk during the induction, prepared by the project ecologist, will be provided to all new workers on-site. This will detail the Site specific ecological constraints and risks.

COMPLETION OF WORKS

7.226. Herptile exclusion fencing with badger gates will be used to prevent reptiles from re-entering the construction zones after Site clearance.

7.227. The exclusion fencing will be retained and maintained in good, functional condition throughout construction. Once construction works are complete the fencing will be removed. Confirmation of fencing removal will be provided to the local planning authority.

8. MITIGATION TIMETABLE

8.1. The timetable of works includes details associated with impact avoidance and mitigation. Collectively referred to as 'mitigation.' Table 1 (below) summaries key details.

Table 1: Approximate timing of works on-site.

Time	Action
Within the period April to July (inclusive)	**Reptile enhancements north of RMC** Vegetation clearance under ecological supervision to enhance and create suitable reptile habitat in areas north of the RMC. Prior to vegetation clearance, a check for nesting birds must be conducted by a suitably experienced ecologist. Log piles and hibernacula will be created under ecological supervision.
Within the period April to July (inclusive)	**Site, preparation for reptile translocation** In suitable weather conditions, installation of herptile exclusion fencing along northern, western and eastern boundaries of the development Site. Prior to any associated vegetation clearance, a check for nesting birds must be conducted by a suitably experienced ecologist. In suitable weather conditions, ACOs will be placed within suitable reptile habitat within the Site boundary. ACOs will be left to bed-down for a minimum of seven days.
Within the period April to September (inclusive)	**Site, reptile trapping and translocation** Reptile trapping and translocation visits in suitable weather conditions. Ecological advice will be provided when opportunities occur to concentrate animals into pockets of suitable habitat through vegetation manipulation. The vegetation manipulation will be conducted under ecological supervision and in suitable weather conditions.
Within the period July to September (inclusive)	**Site, destructive search of reptile habitat** Destructive search works of the Site in suitable weather conditions and under ecological supervision. This work will only be commenced once reptile trapping works have been completed within a given area of the Site and the ECoW confirms that there are no badger setts in 'current use' within the clearance areas or 30m of these areas.

Within the period July to September (inclusive)	**Site, creation of artificial badger sett** Build artificial sett as early as possible and before excluding badgers from Setts B and C - ensure that badgers have found artificial sett before excluding them from these original / natural setts.
Within the period July to November (inclusive)	**Site, destruction of badger Setts B and C** Under NE licence and direct ecological supervision: closure of any badger setts that have shown signs of 'current use' (currently Setts B and C). Once badgers have been successfully excluded in accordance with the licence conditions, these setts should be destroyed (if appropriate) as soon as possible to reduce the chances of badgers re-occupying – and/or ensure these setts are securely proofed against re-entry by badgers by using heavy-gauge chain-link or weldmesh. Additional measures may need to be considered to minimise the risk of badgers recolonising these areas and other areas of the Site.
Within the period September to October (inclusive)	**Site, removal of remaining vegetation and destructive search** Under ecological supervision, any remaining vegetation will be cleared to a minimum height of 200mm and the remaining areas of the site will be subject to a destructive search supervised by the ECoW.
IF REQUIRED: Within the period March to September (inclusive)	**Site, prior to any construction works** During the following vegetation growing season, on-going vegetation management may be required to control regrowth. Any such vegetation management will be as advised by an the ECoW and (if necessary) under ecological supervision Prior to vegetation clearance, a check for nesting birds must be conducted by a suitably experienced ecologist before vegetation clearance commences. Vehicles will avoid tracking within 30m of badger setts and other areas as advised by an ecologist. Vegetation clearance works within 2m of all badger sett entrances will be undertaken manually. Clearance works using a strimmer and/or brush cutter and chainsaw can be conducted up to (but no closer than) 2m from any badger tunnel entrance/sett.

Year 1 following completion of reptile translocation.	**Receptor** <u>1st late summer / early autumn</u> Reptile receptor habitat assessment. Reptile monitoring work of the off-site reptile receptor. If habitat is found to be not in its Target State (to be specified in the LEMP), plan and implement remedial measures and/or changes to habitat management. Information submitted to planning authority.
Year 1 following completion of the implementation of compensatory habitats	**Site** <u>1st late summer / early autumn</u> On-site habitat assessment. Reptile monitoring work of the on-site Western Open Space, Linear Embankment and Northern Embankment. If habitat is found to be not in its Target State (to be specified in the LEMP), plan and implement remedial measures and/or changes to habitat management. Information submitted to planning authority.
Year 2 following completion of reptile translocation.	**Receptor** <u>2nd late summer / early autumn</u> Reptile receptor habitat assessment. Reptile monitoring work of the off-site reptile receptor and Western Open Space. If habitat is found to be not in its Target State (to be specified in the LEMP), plan and implement remedial measures and/or changes to habitat management. Information submitted to planning authority.
Year 2 following completion of the implementation of compensatory habitats	**Site** <u>2nd late summer / early autumn</u> On-site habitat assessment. Reptile monitoring work of the on-site Western Open Space, Linear Embankment and Northern Embankment. If habitat is found to be not in its Target State (to be specified in the LEMP), plan and implement remedial measures and/or changes to habitat management. Information submitted to planning authority.

Year 3 following completion of reptile translocation.	**Receptor** 3rd Autumn On-site and reptile receptor habitat assessment. Reptile monitoring work of the off-site reptile receptor, a population size class estimate assessment will be conducted. If habitat is found to be not in its Target State (to be specified in the LEMP), plan and implement remedial measures and/or changes to habitat management. Information submitted to planning authority.
Year 3 following completion of the implementation of compensatory habitats	3rd Autumn On-site habitat assessment. Reptile monitoring work of the on-site Western Open Space, Linear Embankment and Northern Embankment. A population size class estimate assessment will be conducted. If habitat is found to be not in its Target State (to be specified in the LEMP), plan and implement remedial measures and/or changes to habitat management. Information submitted to planning authority.

9. REFERENCES

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10. APPENDIX 1: SUMMARY OF RELEVANT LEGISLATION

10.1. The level of protection afforded to protected species varies dependent on the associated legislation. A full list of protected species and their specific legal protection is provided within the Schedules and/or Sections of the associated legislation. Case law may further clarify the nature of the legal protection afforded to species.

10.2. The legal protection afforded to protected species overrides all planning decisions.

European Protected Species (EPS) - and the Conservation of Habitats and Species Regulations 2017

10.3. European Protected Species (EPS) are afforded the highest level of protection through the Conservation of Habitats and Species Regulations 2017. EPS are also afforded legal protection by parts of the Wildlife and Countryside Act 1981 (as amended).

10.4. There are a few relatively common and widespread EPS. This includes great crested newts and all species of UK bat.

10.5. In general, any person and/or activity that: -

- Damages or destroys a breeding or resting place of an EPS. (This is sometimes referred to as the strict liability or absolute offence);
- Deliberately captures, injures or kills an EPS (including their eggs);
- Deliberately disturbs an EPS, and in particular disturbance likely to impair animals' ability to survive, breed or nurture young, their ability to hibernate and migrate and disturbance likely to have a significant effect on local distribution and abundance;
- Intentionally or recklessly disturbs an EPS while occupying a structure or place used for shelter and/or protection (Wildlife and Countryside Act 1981 (as amended)); and
- Intentionally or recklessly obstructs access to any structure or place that an EPS uses for shelter or protection (Wildlife and Countryside Act 1981 (as amended)).

…may be guilty of an offence.

10.6. The legislation applies to the egg, larval and adult life stages of great crested newts and to bat roosts even when they are not occupied.

10.7. Actions affecting multiple animals can be construed as separate offences and therefore penalties can be applied per animal impacted.

10.8. Under certain circumstances licences can be granted by the Statutory Nature Conservation Organisation (Natural England in England) to permit actions that would otherwise be unlawful.

10.9. There are some very specific defences associated with the Conservation of Habitats and Species Regulations 2017. However, these are unlikely to apply to construction related projects. The Sections of the Regulations provide further details of these defences.

10.10. The Wildlife and Countryside Act (1981) includes defence for those aspects of the legislation that apply to an EPS. These defences are unlikely to apply to construction related projects and do not apply to those acts included in the Conservation of Habitats and Species Regulations 2017. The Schedules of the Act provide further details of defences.

10.11. Local authorities have obligations under sections 40 and 41 of the Natural Environment and Rural Communities Act (NERC) 2006 to have regard to the purpose of conserving biodiversity in carrying out their duties. Most EPS are listed on Section 41 the NERC Act.

Wildlife and Countryside Act 1981 (as amended)

10.12. The level of protection afforded to species listed on the Wildlife and Countryside Act 1981 (as amended) varies considerably.

10.13. 'Fully protected species', such as water vole, are afforded the highest level of protection. Any person who intentionally kills, injures, or takes 'fully protected species', or who intentionally or recklessly damages or destroys a structure or place used for shelter and/or protection, disturbs the animal whilst occupying a structure and/or place used for shelter and protection, or obstructs access to any structure and/or place used for shelter or protection is likely to have committed an offence.

10.14. Other species, such as common reptiles, are afforded less protection and for these species it may only be an offence to intentionally or recklessly kill or injure animals.

10.15. All active bird nests, eggs and young are protected from intentional destruction. Schedule 1 listed birds are also protected from intentional and reckless disturbance whilst breeding.

10.16. Schedule 9 of The Wildlife and Countryside Act lists plant species for which it is an offence for a person to plant, or otherwise cause to grow in the wild. Schedule 9 also lists animals for which it is an offence to release into the wild.

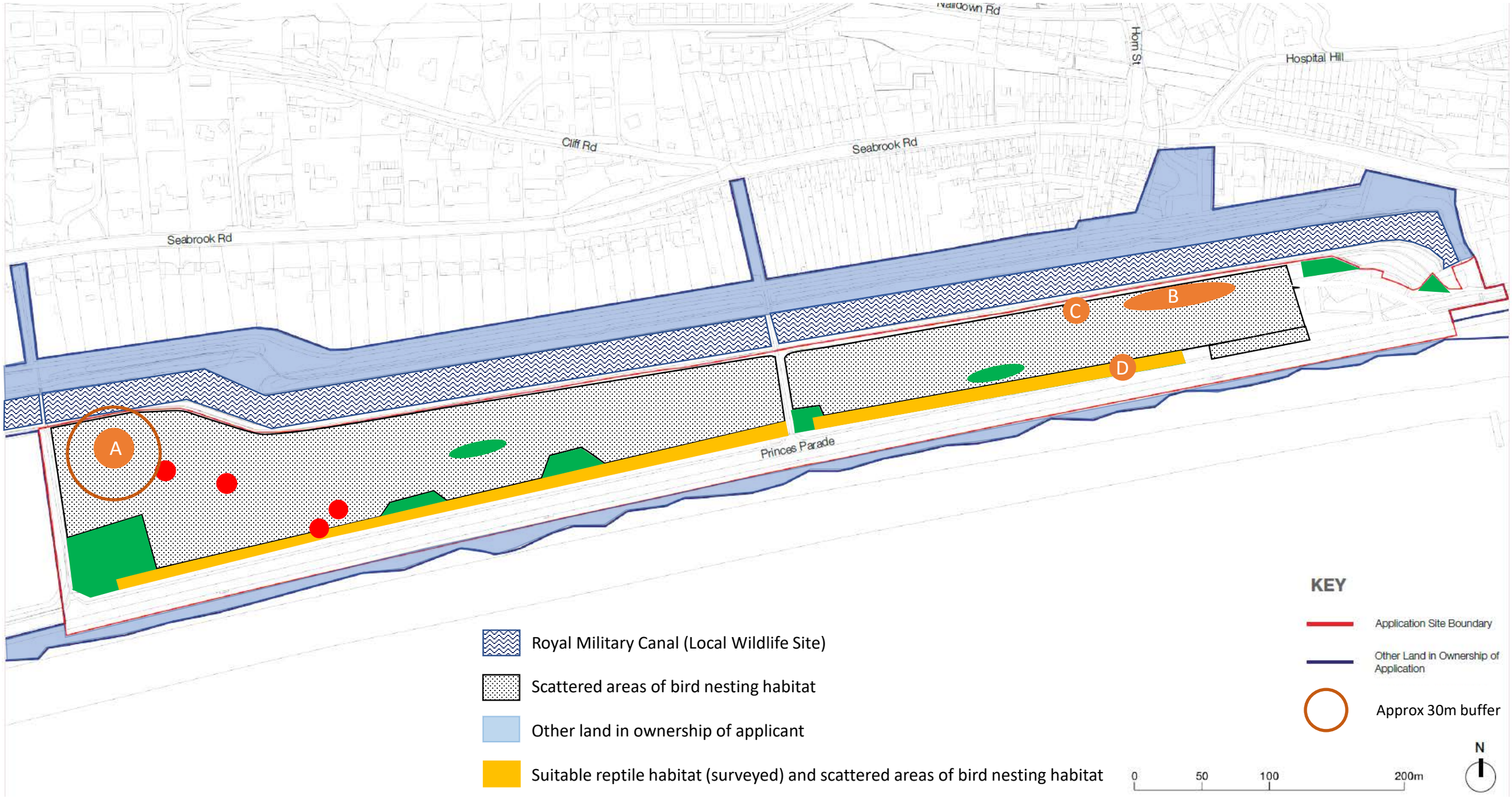
The Protection of Mammals Act 1996 (as amended)

10.17. The Protection of Mammals Act (1996) provides protection for all wild mammals against certain cruel acts with the intention of causing unnecessary suffering, including crushing and asphyxiation.

11. APPENDIX 2: ECOLOGICAL CONSTRAINTS PLAN (LARGE COPY)

(See overleaf)

Constraints Plan



Royal Military Canal (Local Wildlife Site)

Scattered areas of bird nesting habitat

Other land in ownership of applicant

Suitable reptile habitat (surveyed) and scattered areas of bird nesting habitat

Suitable reptile habitat – surveyed

Giant hogweed – approximate locations

Badger sett – approximate locations

Lloyd Bore Ltd.
Date: 13th June 2018
Produced by: John Young

12. APPENDIX 3: DEVELOPMENT PLAN (LARGE COPY)

(See overleaf)

Naildown Rd
Horn St
Hospital Hill
Cliff Rd
Seabrook Rd
Seabrook Rd
Royal Military Canal
Leisure Centre
New 11m Promenade

KEY

- Application Site Boundary
- Boundary of Detailed and Outline areas
- High Planting on Embankment
- Low Planting on Embankment
- Open Space
- Mixed Use Zone (Residential / Hotel / Retail / Food Retail)
- Promenade
- Residential Zone
- Main Street with Public Parking

N

0 50 100 200m

Princes Parade

Parameter Plans - Land Use Plan

drawing no. PP - LU 003

scale 1: 2,000 @ A2

date 07-08-2017

Tibbalds

13. APPENDIX 4: REPTILE MITIGATION AND ENHANCEMENT PLAN (LARGE COPY)

(See overleaf)

Reptile receptor

Key

Opportunities to create new reptile habitat.

Receptor enhancement works prior to use as a receptor.

Lloyd Bore Ltd.
Date: 13th June 2018
Produced by: John Young

Reptile receptor

Key

Opportunities to create new reptile habitat.

Receptor enhancement works prior to use as a receptor.

Lloyd Bore Ltd.
Date: 13th June 2018
Produced by: John Young

14. APPENDIX 5: 'BUFFER' OF SEMI-NATURAL HABITATS

(See overleaf)

Naildown Rd
Horn St
Hospital Hill
Cliff Rd
Seabrook Rd
Seabrook Rd
Royal Military Canal
Proposed road distances from canal
139.1m
116.8m
20m offset from canal
96.8m
41.22m
32.83m
33.16m
32.7m
31.4m
20m
18.03m
16.78m
18.21m
16.23m
16.17m
14.47m
13.32m
20m offset from canal
Leisure Centre
New 11m Promenade

KEY

- Application Site Boundary
- Boundary of Detailed and Outline areas
- High Planting on Embankment
- Low Planting on Embankment
- Open Space
- Mixed Use Zone (Residential / Hotel / Retail / Food Retail)
- Promenade
- Residential Zone
- Main Street with Public Parking
- 20m offset from canal
  Note: Line taken from OS plan NOT full measured survey
- Proposed width of development free buffer zone

N

0 50 100 200m

Princes Parade

Land Use parameter plan showing proposed width of development free buffer zone

drawing no. CA 001 a

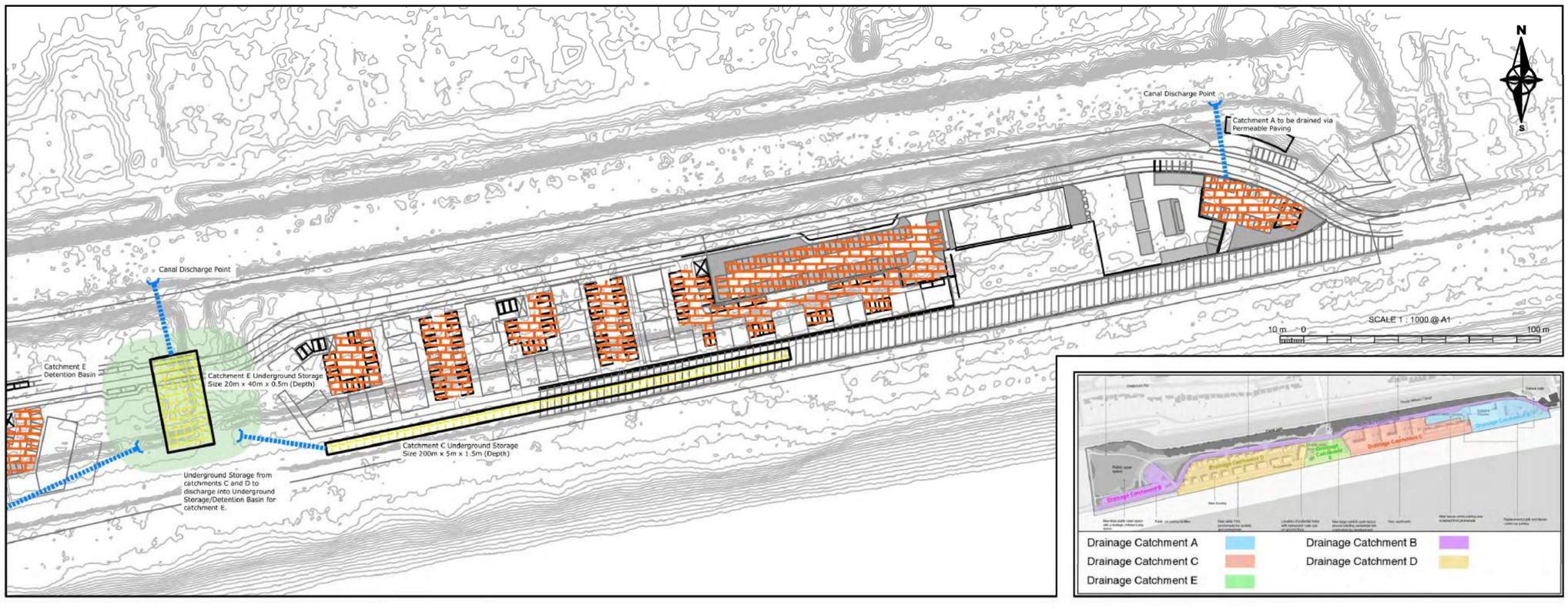
scale 1: 2,000 @ A2

date 17-05-2018

Tibbalds

15. APPENDIX 6: INDICATIVE DRAINAGE LAYOUT

(See overleaf)



PRIVATE DRAINAGE AND LEVELS KEY

- Surface Water Drain
- Underground Storage
- Permanent Wet Area
- Planted Area (1:1 Year use)
- Marginal Area (1:10 Year use)
- Detention Basin
- Permeable Paving
- Headwall

Notes

1. Contains Ordnance Survey data © Crown copyright and database right 2018.
2. All dimensions are in metres unless otherwise stated elsewhere.
3. Proposed drainage positions will be subject to detailed design.
4. The size and extent of the pond will be subject to infiltration testing and trial holes.
5. All drainage systems will need to be installed and designed for suitable loading requirements.

herrington
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CLIENT: Folkestone and Hythe District Council

PROJECT: Princes Parade, Hythe

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:1000	1494	LA	SJB

DWG REF: INDICATIVE DRAINAGE LAYOUT

DWG No.: HC-1494-500

16. APPENDIX 7: WILDLIFE PROTECTION NOTICE