Town and Country Planning Act 1990

Planning Appeal

By

Fairfax Acquisitions Ltd

Council Ref: 22/1539/OUT

PINS Ref: APP/N1920/W/23/3320599

Proposals

Erection of up to 195 new homes (45% affordable), safeguarded land for the expansion of Newberries Primary School and provision of a new medical centre, along with associated access, landscaping and parking. Outline application to include the matter of access (with the following matters reserved: appearance, landscaping, layout and scale)

Land South of Shenley Hill, Radlett

Proof of Evidence (Planning)

of

Philip Allin BA (Hons) DipTP MRTPI

July 2023

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APPENDIX

1. SUMMARY

1.1 This appeal has been submitted against the refusal of Hertsmere Borough Council (HBC) to grant outline planning permission for the development of the site to deliver up to 195 new homes, safeguarded land for the expansion of Newberries Primary School and provision of a new medical centre along with associated access (ref: 22/1539/OUT).

1.2 The Site is located to the east of Radlett, immediately adjacent to the settlement boundary. It totals 11.45 ha and comprises a field which slopes gently downwards from north-west to south-east and an area of woodland. Radlett is a key settlement within the Borough with a range of services and facilities that would meet the day to day needs of residents whilst there are excellent public transport services that provide connections further afield. The site is well located in respect to the existing settlement and it is common ground with HBC that it would comprise a sustainable location for new development.

1.3 The proposed development will comprise of the following elements:

- The delivery of up to 195 new homes, in a range of house sizes, which will make a significant and valuable contribution to the supply of housing in the borough;
- The delivery of up to 88 affordable homes in a mix of tenures (45%);
- The provision of expansion land (0.7Ha) for Newberries Primary School, adjacent to the site, to allow for the future growth of the school.
- The delivery of a new medical centre, to be managed and operated by the Red House Surgery (replacing their existing outdated surgery in Radlett which is at capacity) which will meet the growing health needs of the local community;
- Enhancements and securing the long-term management of Radlett Plantation Regionally Important Geological Site (RIGS), located immediately adjacent to the site; and
- Biodiversity enhancements resulting in a net gain of 26.99%

1.4 Section 38(6) of the Planning and Compulsory Purchase Act requires that planning applications are determined in accordance with the Development Plan unless material considerations indicate otherwise. The Statutory Development Plan for HBC comprises the Core Strategy (2013), Site Allocation and Development Management Policies Plan (2016) and Radlett Neighbourhood Plan (2021).

1.5 The application, subject to this appeal, was refused for three reasons. The first reason was in respect to impact on the Green Belt, namely that the proposals were considered by the Council to represent inappropriate development not outweighed by very special circumstances and would harm the openness of the Green Belt. The second reason related to the risk to potential archaeological artefacts whilst the third reason related to insufficient information to demonstrate that an appropriate sustainable drainage strategy can be delivered.

1.6 As confirmed within the Council's Statement of Case (para 1.4, CD/7.2) the archaeological issues have now been overcome and so this reason for refusal falls away whilst ongoing discussions are taking place with the LLFA with it expected that the drainage issues will likewise also be addressed.

1.7 In light of the above, from a planning policy perspective the assessment of the acceptability of the proposals rests on whether the scheme accords with Green Belt policy at both the local and national level which is reaffirmed by the Council's Statement of Case which only alleges any policy breach in respect to Green Belt matters (paras 4.15-.23). This is reiterated by the Council stating that *"the development is not considered to conflict with any relevant aspects of the NPPF beyond those relating to Green Belt issues"* (para 4.13, CD/7.2).

1.8 As such Policies CS13 and SADM26 are the most important in the determination of the appeal. Policy CS13 is clear in stating that *'There is a general presumption against inappropriate development within the Green Belt, as defined on the Policies Map and as such development will not be permitted unless very special circumstances exist".*

1.9 In light of Policy CS13 it is necessary to understand the policy direction set out within the NPPF. Guidance within paragraph 147 is reflected within this Policy whilst paragraph 148 is clear that substantial weight is given to any harm to the Green Belt and that 'Very Special Circumstances' will not exist unless the potential harm to the Green Belt by reason of inappropriateness, and any other harm resulting from the proposal, is clearly outweighed by other considerations. On this basis, for the proposals to be considered acceptable it is therefore necessary for it to be demonstrated that 'Very Special Circumstances' exist.

1.10 There is no clear guidance on what constitutes 'very special circumstances' however case law is clear that a number of factors, which may not be "very special" when considered in isolation, may when combined together amount to very special circumstances and so there is no reason why a number or factors that are ordinary/or special in themselves cannot combine to clearly outweigh the totality of the harm.

1.11 I consider that it is also relevant to note that the site was proposed for allocation with the Council's emerging Local Plan which had reached Regulation 18 stage (site R3) however in April 2022 the Council decided to 'set aside' this Plan (there is not yet any clarity on timescales for any future Local Plan). I accept that given that the Local Plan has been set aside the policies contained within it carry no weight in the decision making process. Notwithstanding this, the emerging Plan was underpinned by an extensive evidence base which in my view should carry significant weight.

1.12 The evidence base includes a number of assessments including a Green Belt Assessment, undertaken by Arup, and Landscape Sensitivity Assessment & Outline Landscape Appraisals, both undertaken by LUC.

1.13 The Arup assessment concludes that the site makes a moderate contribution towards the purposes of including land within the Green Belt. Based on the Arup conclusions at Stage 1 & 2 I consider this to be at the lower end of moderate especially in light of the recommendation being that the site be considered for release from the Green Belt. The conclusions I draw from the landscape work by LUC is that the landscape sensitivity of the site is at the lower end of the scale (when assessed against other parts of the Borough) and focuses new development in areas which are visually enclosed which the site is with the acknowledgement that new development would have limited landscape related constraints.

1.14 This evidence base is relevant in understanding the totality of the level of harm to the Green Belt and any other harm caused by the development proposals. To inform this understanding, the impact of the proposals on the openness (spatial and visual) and against the purposes of including land in the Green Belt has been assessed as set out in detail within the proof of Mr Self.

1.15 In the case of the site, aside from the definitional harm caused by development in the Green Belt, given the characteristics of the site, the level of harm to Green Belt openness is limited. The development would result in a limited to moderate harm to the contribution to two purposes of including land within the Green Belt. Notwithstanding this, in accordance of the NPPF, this harm must be given substantial weight.

1.16 I consider that the proposed development would deliver a range of benefits, which I would attach the following weight.

- The delivery of up to 107 new market homes, in light of the current acute housing shortfall, is considered to attract **very substantial weight** given that it is common ground that the Council is unable to demonstrate a 5 year housing land supply shortfall. Indeed, housing delivery in the Borough is woeful with the Council acknowledging that it is only able to demonstrate a 2.25 year housing land supply which represents a shortfall of 2,088 new homes. In reality, housing shortfall is actually considered to be greater as was considered in light of a recent appeal decision in the Borough which indicated that the Council could only demonstrate a 1.58 year housing land supply (resulting in a shortfall on 2,603 homes)(paragraph 43, CD/5.18).

- The delivery of up to 88 new affordable homes, in a variety of tenures and sizes, will make a meaningful contribution towards boosting affordable housing supply in the Borough and so should be afforded **very substantial weight**;

- The delivery of a new medical centre, to be operated and managed by the Red House Surgery, to meet the needs of the local community now and into the future is considered to attract **substantial weight**;

- The associated economic benefits, which are many and varied, is considered to attract **significant weight**;

- The proposed development will deliver a 26.99% biodiversity net gain which is considerably higher than the 10% sought by the Environment Act (which is not yet in force) and which is considered to attract **significant weight**;

- The proposed development will safeguard land to facilitate the future expansion of Newberries Primary School (the only way in which the school could expand) which I consider will be required in the near future. As such I believe that this should attract **moderate weight**;
- As part of the proposed development, a management plan to secure enhancements to the adjacent Radlett Plantation RIGS, the only known Puddingstone exposure in Hertfordshire, will be secured and as such should be afforded **moderate weight**;
- Alongside the proposals measures to improve pedestrian and cycle connectivity to the benefit of both existing and future residents will be secured whilst the development would be capable of achieving a reduction in carbon emissions over and above current building regulations and policy. As such, taken together, I consider that these should be afforded **moderate weight**.

1.17 I consider that the benefits of the development clearly outweigh the totality of the harm and as a result very special circumstances exist to justify the proposed development.

1.18 Overall, I therefore consider that the proposals would be in accordance with the development plan and that there are no material considerations that suggest otherwise. For this reason, I respectfully request that the Inspector allows this Appeal subject to appropriate conditions and legal agreement.

2. INTRODUCTION

Personal Introduction

2.1 My name is Philip Allin and I hold a BA (Hons) and Diploma in Town Planning from Oxford Brookes University. I am also a member of the Royal Town Planning Institute (RTPI) and have been since 2006.

2.2 I am a Director within Boyer's London Office. Boyer is a national town planning consultancy with five offices and forms part of the Leaders Romans Group. Boyer employs around 70 professional staff covering specialisms of town planning, masterplanning and architecture.

2.3 I have over 18 years' professional experience in planning, within Boyer (since 2007) and previously at Nathaniel Lichfield and Partners (now Lichfields).

2.4 Across the whole of my professional career, I have worked for a number of public and private sector clients on a variety of residential based developments across south London and the south-east of England including within Hertsmere Borough Council.

2.5 I am experienced in site appraisal and providing planning advice (and project managing) detailed and outline planning applications (including those that require an ES) on greenfield and Green Belt edge of settlement locations across a number of authorities in the South East. I have participated in Local Plan examinations and have acted as planning witness in planning appeals for new residential development. I am experienced and qualified in advising on the future development of the Site on which I am instructed by the Appellants.

2.6 The evidence which I have prepared and provide for this appeal is true and has been prepared and is given in accordance with the guidance of my professional institution and I confirm that the opinions expressed are my true and professional opinions.

Scope of Evidence

2.7 The evidence prepared within this proof will address:

- Site and Surrounding context;
- Scheme proposals;
- Relevant Policies and their application;
- Planning Assessment; and
- Conclusions.

2.8 My evidence should be read alongside that of Mr Clive Self (Landscape and Green Belt), Dr Andrew Buroni (Health), Mr James Stacey (Affordable Housing), Mr Philip Hamshaw (Highways) and Mr Luke Thurley (Economic/Social).

3. SITES & SURROUNDINGS

3.1 I summarise a description of the site below. Further information on the site and its character is set out within the supporting Planning and Design & Access Statements (CD/1.1 & 1.2).

3.2 The Site is located to the east of Radlett, immediately adjacent to the settlement boundary. It totals 11.45 ha and comprises a field which slopes gently downwards from north-west to south-east and an area of woodland. Access is currently provided via a gateway to the north-west of the Site onto Shenley Hill.

3.3 The Site is bound by Shenley Hill to the north, woodland to the east, Theobald Street to the south, Newberries Primary School to the south-west and existing housing to the west. There are also numerous trees and hedgerows along the boundaries. The adjacent housing is predominantly characterised by detached two storey properties and bungalows on large plots.

3.4 The Site falls within the Metropolitan Green Belt. The Green Belt boundary runs along the western boundary of the Site and surrounds Radlett.

3.5 The Site is also identified by HBC, within the current Local Plan, as a Regionally Important Geological Site (RIGS) due to containing some deposits of Puddingstone. However, the Site is no longer listed as a RIGS by Hertfordshire Geological Society (HGS) due to the condition of the Puddingstone and it is understood that it has been de-listed and de-designated by HGS. To the east of the Site, in the adjacent woodland, is a RIGS (Radlett Plantation RIGS) which continues to be listed by Hertfordshire Geological Society.

3.6 The woodland to the south, adjacent to Theobald Street, is identified as a Local Wildlife Site (LWS), along with the Golf Club to the north of Shenley Hill.

3.7 The Site is not located within a Conservation Area and there are no statutorily listed buildings within the immediate vicinity. To the south-west of the Site is a locally listed property (Buckfield, Theobald Street). The Site is located within Flood Zone 1 (lowest risk).

Radlett

3.8 Radlett is a settlement located within Hertsmere Borough Council and has existed in some form since at least the 15th century. The settlement has undergone growth at various times since then and based on the 2021 Census, the population of Radlett was 8,190 (over 3,145 households). Radlett is now the main settlement within the Parish of Aldenham and is situated between St Albans, to the north, and Elstree and Borehamwood, to the south, and lies to the north west of London, just within the M25 motorway. The settlement also lies close to the M1 and A1(M) motorways.

3.9 There is a frequent commuter train service from Radlett into central London (St Pancras International and other City stations), south London and Gatwick and Luton airports. The frequency and travel times of these services is set out in the following table:

Table 1 – Rail Times[1][2]

Destination	Typical Frequency Peak	Typical Frequency Off Peak	Typical Journey Duration
London	8/9 services per hour	6 services per hour	39 minutes
Luton	8/9 services per hour	5/6 services per hour	24 minutes
Sutton	4 services per hour	4 services per hour	1 hour 32 minutes
St Albans City	4 services per hour	2 services per hour	6 minutes
Rainham	1 service per hour	1 service per hour	2 hour 5 minutes

3.10 In addition, there are a number of bus services that provide local connections. Bus service 602 can be accessed from Shenley Road, approximately 230m from the main site access. This service provides a half hour service to Watford and Hatfield. Bus stops are also located along Theobald Street, approximately 400m from the site served by bus routes 398 and 601. These routes provide an hourly service between Borehamwood and Welwyn Garden City.

3.11 Within the Council's current Local Plan, Radlett is classified as a third-tier settlement (behind only Borehamwood, Potters Bar and Bushey) and is defined as *'Largely residential in character and surrounded by Green Belt with good rail links to London and a popular district centre serving both the local population and an increasing number of visitors from further afield'* (Table 6, CD/3.1). As identified by the supporting Transport Assessment (Table 4.2, CD/1.6) there is a wide range of services and facilities within close walking distance of the site[3]:

Table 2 – Local Services and Facilities

Purpose	Destination	Approx Distance (m) Shenley Hill	Approx Distance (m) Theobald St	Walk Time (mins)	Cycle Time (mins)
Education	Newberries Primary School[4]	1,300	650	8	3
	St Johns Infant School	2,100	1,800	25	8
Health	Boots Pharmacy	1,400	750	9	3
	Red House Surgery	1,400	800	10	3

[1] Based on National Rail
[2] Tables 1 and 2 taken from supporting Transport Assessment
[3] Based on google maps and consultants estimates with times taken from nearest access point.
[4] As part of the development proposals a new pedestrian link will be provided to facilitate direct access to this school.

	The Dental Clinic	1,400	800	10	3
	Manor Pharmacy	1,400	800	10	3
Retail / Employment	Tesco Express	1,250	1,000	12	4
	Radlett Town Centre	1,300	1,000	12	4
	Budgens	1,400	750	9	3
Leisure	Porters Park Golf Club	500	1,100	6	2
	Red Lion Public House	1,200	1,100	13	4
	Radlett Library	1,500	800	10	3
	Radlett Tennis & Squash Club	1,700	800	10	3
	Tabard Rugby Football Club	2,300	1,400	17	5
	Radlett Cricket Club	2,300	1,400	17	5
Transport	Bus Stop	250	290	3	
	Radlett Train Station	1,300	1,200	13	5

3.12 The general accessibility of the site has been assessed by planning officers who conclude that the closest shops of the town centre are within a 12 minute walk of the site with Radlett Station within a 16 minute walk and as such the site is a sustainable location for new housing because it would be within reasonable walking or cycling distance of the shops and services of the town centre, including rail connections to London, meaning that it would not be necessary for anyone living at the site to depend on a car (paragraph 7.7.1, CD/2.2).

3.13 In summary, Radlett is a key settlement within the Borough with a range of services and facilities that would meet the day to day needs of residents whilst there are excellent public transport services that provide connections further afield. The site is well located in respect to the existing settlement and it is common ground that it would comprise a sustainable location for new development.

4. SCHEME PROPOSALS

4.1 The proposed development would comprise of the following elements:

- The delivery of up to 195 new homes, in a range of house sizes, which will make a significant and valuable contribution to the supply of housing in the borough;
- The delivery of up to 88 affordable homes in a mix of tenures (45%);
- The provision of expansion land (0.7Ha) for Newberries Primary School, adjacent to the site, to allow for the future growth of the school.
- The delivery of a new medical centre, to be managed and operated by the Red House Surgery (replacing their existing outdated surgery in Radlett which is at capacity) which will meet the growing health needs of the local community;
- Enhancements and securing the long-term management of Radlett Plantation Regionally Important Geological Site (RIGS), located immediately adjacent to the site; and
- Biodiversity enhancements resulting in a net gain of 26.99%.

4.2 It is also intended that the proposed build standards of the new homes will be significantly greater than that required by current planning policy ensuring that the proposals will minimise carbon emissions whilst a number of enhancements will be delivered as part of the development to improve accessibility to the site by non-car modes of travel to the benefit of both existing and future residents.

4.3 The proposals will be served by a new vehicular access from Shenley Hill together with a further pedestrian and cycle connection onto Theobald Street.

4.4 I set out the weight I consider should be attached to each element of the proposed development later within my planning assessment chapter however in the first instance I briefly describe the main component parts of the proposals.

Medical Centre

4.5 The proposals include the delivery of a medical centre to meet the healthcare needs of the community, representing a new facility for the Red House Surgery which is currently based in Radlett. As is made clear in their comments to the planning application, the Red House Surgery has outgrown their existing premises which has no scope for expansion. The provision of this new facility would therefore facilitate the expansion of the Practice allowing it to meet the needs arising from the proposed development as well as those of the existing community (as had been envisaged by the emerging Local Plan).

Provision of New Housing

4.6 The proposals will deliver new market and affordable housing, as set out below.

Market Housing

4.7 The proposals would deliver up to 107 new market homes with the illustrative layout showing a mix of houses with the majority of new homes being family sized housing. The delivery of new market housing will make a meaningful contribution to remedying the current housing shortfall in the District which is woeful.

4.8 Based on the latest Housing Land Supply Position Statement[5] the District Council is only able to demonstrate a 2.25 housing land supply which represents a shortfall of 2,088 homes in the period 2022-27. In numerical terms this shortfall is significant and has been worsening in respect to expected years supply as is illustrated by previous housing land supply position statements[6]. This downward trend is reiterated by the results of the Housing Delivery Test which currently stands at 88% (based on the latest publicly available information)

Table 3 – Hertsmere 5 Year Housing Land Supply (Standard Methodology [2014 household projections])

2018 23		2019 24		2020 25		2021 26	
Year Supply	Surplus (Homes)	Year Supply	Shortfall (Homes)	Year Supply	Shortfall (Homes)	Year Supply	Shortfall (Homes)
5.1	41	3.24	1,321	2.92	1,566	2.3	2,050

Table 4 – Hertsmere HDT Results

Housing Delivery Test Results Hertsmere			
2018	2019	2020	2021
158%	124%	102%	88%

4.9 Notwithstanding the above, the Council's housing land supply position has been assessed within a recent appeal decision in Shenley (CD/5.18) where it was considered that the housing shortfall was greater, standing at 2,603 homes over the 5 year period (paragraph 45). This only underlines the stark nature of housing supply in the Borough.

Affordable Housing

4.10 The need for new affordable housing is expanded upon by Mr Stacey who sets out in detail this need within his proof. I defer to his analysis but in summary this need is laid bare by a number of different documents including the South West Hertfordshire Local Housing Needs Assessment (LHNA") which was prepared by GLH in 2020.

[5] September 2022
[6] Based on Positions Statements published by HBC for 5 year periods as of 1 April 2018/19/20/21.

4.11 In terms of affordable housing supply, in the 10-year period between 2012/13 and 2021/22, a total of 4,204 net dwellings were delivered across Hertsmere, equivalent to 420 per annum. Of these, 587 dwellings were affordable tenures, equivalent to 59 per annum (net). This equates to 14% affordable housing delivery. (Since the start of the SHMA period in 2013/14 the equivalent net figure is 54 affordable homes per annum). As a result of this poor supply, since the start of the 2016 SHMA period in 2013/14, a shortfall of 3,418 affordable dwellings has arisen in Hertsmere, equivalent to an average annual shortfall of -380 affordable dwellings.

4.12 As a consequence, the Borough is becoming increasingly unaffordable with the ratio of median house prices to median incomes in Hertsmere Borough now standing at 14.39, a 49% increase since the start of the Core Strategy period in 2012 where it stood at 9.63. It is above the national average of 8.28 (+74%) and above the East of England average of 10.08 (+43%).

4.13 It is therefore evident that the provision of 88 affordable homes (45%), which has been increased by 10 since the application was submitted, will make an important contribution to the significant need for affordable housing in the Borough.

Expansion land for Newberries Primary School

4.14 The proposal will safeguard land adjacent to Newberries Primary School to facilitate the future expansion of the school. The additional expansion land adjoins the eastern side of the existing school boundary. The indicative pitch layout has been informed through discussions with Hertfordshire County Council and would meet the expected future requirements of the school. The space requirements are illustrated on the plan attached at Appendix 1 (following discussions with HCC the area sought changed from the blue hatched area to the area edged in red).

4.15 As the only way the school is able to expand is on land within the control of the appellant means that the proposals will ensure that such future expansion can take place to accommodate the increase in school places resulting from the development itself, and other future development in the area, as had been envisaged by the emerging Local Plan.

Radlett Plantation RIGS Enhancements

4.16 The proposal will deliver enhancements to the geo-conservation value of the Radlett Plantation RIGS. This is situated within the plantation to the east of the Site and is within private land. The RIGS Basement Assessment which has been undertaken has determined that the Puddingstone here is in a favourable condition due to the presence of a good exposure of in situ Puddingstone.

4.17 The proposal provides an opportunity to increase the exposure of this Puddingstone and improve its geo-conservation value. An initial strategy to deliver geo-conservation benefit to Radlett Plantation RIGS (off-Site) has been prepared which also proposes a strategy to investigate and implement the potential betterment of geo-conservation features on-Site within the Radlett Field RIGS (CD/1.24). In combination they are considered to deliver a benefit to the current geo-conservation baseline, as well as providing potential scientific insight into the formation and diagenesis of Puddingstone.

Biodiversity Enhancements

4.18 A biodiversity net gain calculation has been undertaken which shows that the proposed new development at the site is capable of achieving a 26.99% net gain.

Sustainability Approach

4.19 The proposals will include multiple access points, new bus stops along Shenley Road and Theobald Street and a range of off-site pedestrian and cycle improvements providing a cohesive package to promote active and sustainable travel to the benefit of both existing and future residents. The proposed new buildings are capable of incorporating a range of Low and Zero Carbon (LZC) technologies including Air Source Heat Pumps and PV panels which are capable of achieving an approximately a 77% reduction in the Part L 2021 CO2 emission performance target for the new homes (see Sustainability Report, CD/1.16). All of this demonstrates that extensive measures are proposed to mitigate the scheme's climate change impact.

5. PLANNING POLICY ASSESSMENT

5.1 Section 38(6) of the Planning and Compulsory Purchase Act requires that planning applications are determined in accordance with the Development Plan unless material considerations indicate otherwise.

5.2 The Statutory Development Plan for Hertsmere Borough Council, relevant to the site, comprises the following documents:

- Core Strategy (2013)
- Site Allocations and Development Management (SADM) Policies Plan (2016)
- Radlett Neighbourhood Plan (2021)

5.3 In addition, there are various Supplementary Planning Documents (SPDs) which are relevant to the consideration of the proposals.

5.4 The Council are in the process of preparing its replacement Local Plan having consulted on an initial Regulation 18 draft in late 2021. This Plan was underpinned by an extensive evidence base and proposed that the site be allocated for development (Site R3). In April 2022, the Council decided to 'set aside' this Plan with the intention of progressing with a revised draft Local Plan however to date no updated LDS has been published setting out the timeline to adoption of the Plan. I consider the implications of the emerging Local Plan and the supporting evidence base later on in my proof.

5.5 The relevant key policies of the Statutory Development Plan is set out within Appendix 2 of the Statement of Common Ground (CD/7.4).

5.6 The application was refused for three reasons however two of the reasons relate to technical matters, archaeology (RfR2) and drainage (RfR3). As confirmed within the Council's Statement of Case (para 1.4, CD/7.2) the archaeological issues have now been overcome and so this reason for refusal falls away whilst ongoing discussions are taking place with the LLFA with it expected that the drainage issues will likewise also be addressed. I provide a commentary on the current position later on within my proof.

5.7 In light of the above, from a planning policy perspective the assessment of the acceptability of the proposals rests on whether the scheme accords with Green Belt policy at both the local and national level which is reaffirmed by the Council's Statement of Case which only alleges any policy breach in respect to Green Belt matters (paras 4.15-.23). This is reiterated by the Council stating that *"the development is not considered to conflict with any relevant aspects of the NPPF beyond those relating to Green Belt issues"* (para 4.13, CD/7.2).

5.8 As such Policies CS13 and SADM26 are the most important in the determination of the appeal. Policy CS13 is clear in stating that *'There is a general presumption against inappropriate development within the Green Belt, as defined on the Policies Map and as such development will not be permitted unless very special circumstances exist".* The Policy goes onto to describe circumstances whereby development could be considered appropriate development

within the Green Belt which is not relevant in this case.

5.9 In light of Policy CS13 it is necessary to understand the policy direction set out within the NPPF. Guidance within paragraph 147 is reflected within this Policy whilst paragraph 148 is clear that substantial weight is given to any harm to the Green Belt and that 'Very Special Circumstances' will not exist unless the potential harm to the Green Belt by reason of inappropriateness, and any other harm resulting from the proposal, is clearly outweighed by other considerations. On this basis, for the proposals to be considered acceptable it is therefore necessary for it to be demonstrated that 'Very Special Circumstances' exist.

5.10 The NPPF continues within paragraph 149 by setting out certain exceptions where the construction of new buildings would not be considered inappropriate development which is not applicable in this case.

5.11 There is no clear guidance on what constitutes 'very special circumstances' however case law is clear[7] that a number of factors, which may not be "very special" when considered in isolation, may when combined together amount to very special circumstances and so there is no reason why a number or factors ordinary/or special in themselves cannot combine to create something very special.

5.12 As is clear from Section 4 of my proof the proposed development is considered to deliver a number of benefits, which can be summarised as follows:

- Delivery of a new Doctor's Surgery;
- Delivery of new market and affordable housing;
- Safeguarding of expansion land for Newberries Primary School;
- A number of economic benefits that will be derived with the delivery of the proposed new development;
- Radlett Plantation RIGS enhancements;
- Biodiversity enhancements; and
- Delivery of a package of sustainability benefits.

5.13 I set out the weighting to be attached to these benefits later on in my proof. A key part of the NPPF Green Belt policy test is whether these benefits clearly outweigh harm to the Green Belt (as well as any other harm). Once this level of harm is understood a single exercise of judgement to assess whether there are very special circumstances which justify the grant of permission notwithstanding the particular importance of the Green Belt. Case law[8] is clear that this judgement does not require a particular mathematical exercise, nor do they require substantial weight to be allocated to each element of harm as a mathematical exercise with

[7] Wychavon DC v Secretary of State for Communities and Local Government and Butler [2008] EWCA Civ 692

[8] Sefton Metropolitan Borough Council v Secretary of State for Housing, Communities and Local Government and Doherty [2021] EWHC 1082 (Admin)

each tranche of substantial weight then to be added to a balance.

5.14 In addition to assessing whether sufficient Very Special Circumstances exist it is important to consider other matters that are most important in the determination of the appeals together with other relevant considerations. In undertaking this exercise, it can then be understood on whether there is any other harm caused by the development that need to be weighed in the balance or whether the proposals have a neutral or positive impact or can be considered to be in accordance with the relevant policies.

5.15 Within the Council's Statement of Case it is alleged that the development would result in harm to the character and appearance of the landscape, albeit this harm is not considered 'substantial', but nevertheless would be part of the balancing exercise required to be undertaken by paragraph 148 of the NPPF. I cover this point later on in my proof drawing upon the evidence of Mr Self.

Summary

5.16 In summary, the key policy test is whether the scheme benefits of the proposals clearly outweigh harm to the Green Belt (and any other harm). If this test is satisfied then very special circumstances would exist and the proposals would be consistent with Policy CS13 and paragraphs 147 and 148 of the NPPF.

5.17 As set out later in my proof, it is my firm view that the proposed scheme benefits do indeed clearly outweigh harm to the Green Belt (and any other identified harm).

5.18 As a result of this I therefore find that there is no conflict with the Development Plan taken as a whole. In which case, pursuant to Section 38(6) TCPA 1990 the proposal should be granted planning permission unless material considerations suggest otherwise. I do not consider that other material considerations do indicate otherwise, indeed for the reasons set out in the following chapter I consider that there are other material considerations which weigh in favour of the proposed development.

6. OTHER MATERIAL CONSIDERATIONS

Emerging Planning Policy

6.1 On behalf of the appellant we have been promoting the site for development since 2017 at various stages through the plan making process. Submissions were made to the early stages of the Plan process in September and November 2017 and December 2018.

6.2 In March 2020, a PPA was agreed with Hertsmere Borough Council to assist in the site's promotion and consideration of material. The agreed purpose of the PPA was specified in the document which stated:

"This PPA is an agreement between HBC and the Promoter to provide a project management tool for handling the assessment of the Site promoted through the emerging Local Plan. This includes early liaison on technical studies and the preparation of any masterplan and/or planning application (subject to securing an allocation) to support this Local Plan process. This PPA is intended to set out an efficient and transparent process for liaising with the Council prepare and establishes an agreed project timeframe (Appendix 2) and responsibilities.

This PPA does not commit HBC to a particular outcome or resolution. It is instead a commitment to a process and timetable for consideration of the Site."

6.3 Subsequent to this, regular discussions took place with HBC Policy Officers over the period up to September 2021 (prior to the publication of the Regulation 18 draft Local Plan). As part of this engagement, assessment work undertaken by appellant was shared with the Council which included a variety of technical assessments included RIGS assessment, arboriculture, ecology, noise, flood risk, LVIA, Green Belt, transport and access assessments. This work was then assessed by officers who provided feedback to ensure that a robust assessment of the emerging scheme proposals, which were illustrated within a concept vision document, could be undertaken. The work undertaken at this stage is set out within CD/8.1.

6.4 In addition, there were ongoing dialogue with other parties either led or facilitated by HBC officers, including with HCC education officers and the Red House Surgery. Several meetings took place with HCC to inform the extent and design specifications of the safeguarded land for the Newberries School expansion which resulted in an illustrative layout of this land being provided by HCC, as set out in the email from Jamie Anderson (Senior Planning Officer, Growth and Infrastructure Unit) dated 15 April 2021 (enclosed at Appendix 2). This layout was incorporated into the emerging scheme layout.

6.5 At this time, HBC officers met with the partners and practice manager of the Red House surgery where it was acknowledged by the Practice that there was a need to expand the existing surgery which would mean relocating from their current location. This position was made clear in an email from Ann Darnell, Senior Planning Officer at HBC, dated 16 March 2021 (enclosed at Appendix 3).

6.6 Throughout this process, policy officers provided a number of updates on the progress of the emerging Local Plan advising on the likelihood of the site being proposed for allocation within the draft Plan as set out in the email from Ann Darnell, dated 21 April 2021 (enclosed at Appendix 4). In the email it is made clear that any decision would be subject to Member agreement prior to publication of the Regulation 18 version of the Plan. Indeed the extent of Member engagement undertaken by officers prior to publication is made clear within the officers report to the 30th September 2021 Full Council Committee (paragraph 2.8, CD/4.23).

6.7 In light of this engagement with planning officers over an extended period of time, it is evident that the appellant was committed to promoting the site through the Plan making process with the inclusion of the non-residential uses being informed by feedback from the appropriate stakeholders. I consider that this collaborative approach with planning officers assisted the Council in preparing its draft Local Plan such that the delivery of new development in the Borough would be genuinely plan-led in accordance with the objectives of paragraph 15 of the NPPF.

Hertsmere Local Plan (Regulation 18) – September 2021

6.8 In September 2021, the Council published its Local Plan (Regulation 18) for public consultation. Draft Policy H1 identified an overall housing target of 12,160 homes over the Plan period (2022-38) which translated into an annual housing requirement of a minimum of 760 homes which would ensure that the Council met the housing need derived by the Government's standard methodology.

6.9 The supporting text to draft Policy H1 stated that *"Directing new residential development to urban and brownfield sites and optimising the density of development remain local priorities but the extent of housing need identified still requires a number of sites and/or locations within the boundary of the green belt, as defined on the 2016 Policies Map, to be allocated for residential use"* (page 59, CD/3.4). To put this into context, I note that the draft Plan acknowledges that only 2,765 new homes will be delivered from urban brownfield sites (Table 2, page 16, CD/3.4) whilst the latest HELAA (2019) identifies that based on the current policy context it is envisaged that the Borough only has capacity to deliver a maximum of 3,770 new homes for the 15 year period between 2019-34 (Table 1, page 7, CD/4.10). Whichever figure is used it is abundantly clear that to come anywhere near meeting the Borough's housing requirement there needs to be some Green Belt release. As a result of this and in accordance with guidance contained within paragraphs 140 and 141 of the NPPF, the Council concluded that exceptional circumstances exist which justify changes to the Green Belt boundaries in a limited number of areas (page 139, CD/3.4).

6.10 I note that within the FAQs published by the Council that accompanied the consultation it is stated *"We will be re-designating around 8 per cent of the borough which is currently green belt which is the equivalent of around 1,200 football pitches. However, only half of this area would be required for new homes with a further 7 per cent identified for new employment development. One third of the area to be de-designated would be made available for new open space, sports pitches, community facilities and the other services and infrastructure*

required to support growth. The remaining land to be re-designated primarily relates to parts of the built up areas of Shenley and Elstree, which are currently covered by green belt policies". On this basis, only 4% of the proposed Green Belt release is required to meet the housing requirement whilst the Council, within the FAQs, make the observation that not all the Green Belt is high quality, unspoilt countryside with much of it being largely closed off to the general public. The quality of the site and the contribution it makes to the purposes of including land within the Green Belt is a matter that I return to later in my proof.

6.11 As part of the proposed spatial strategy for the Borough, the appellants site was proposed for removal from the Green Belt and allocation for new development (Site R3). A full copy of the site allocation is set out within page 100/101 of the Draft Plan (CD/3.4) but in summary it stated that new development at the site will:

- Provide for around 195 new homes (including 40% affordable)
- Provide land to facilitate any required future expansion of Newberries Primary School to 2 forms of entry;
- Reserve land for any required future relocation of the Red House Surgery;
- Create attractive areas of public open space;
- Provide attractive, clear and safe walking and cycling routes from the site into the surrounding area;
- Secure off-site improvements to public transport to enhance existing services;
- Provide vehicular access into the development site from Shenley Hill and Theobald Street incorporating a through route prioritised for sustainable modes of transport;

6.12 In addition the site allocation sought environmental and compensatory green belt improvements as well as measures to achieve a high quality design. The draft Plan was supported by an extensive evidence base which I consider further below.

6.13 At HBC's Full Council Committee held on 27 April 2022 there was much debate around the fact that there were 18,000 responses to the draft Local Plan however I consider that this figure should be treated with a high degree of caution given that as pointed out by officers in their report to this Committee almost two-thirds of the responses were submitted via a campaign website which generated an email containing a standardised template response (para 5.5, CD/4.24).

6.14 Notwithstanding this, a decision was made by the Council to 'set aside' the emerging Local Plan but carry on with further background information. To date, no updated LDS has been published by the Council and so there is no clarity on when the Council expect to have a new Plan in place however suffice to say it is reasonable to assume that it will not be in place for a number of years meaning that there is no short or medium term solution to readdressing the chronic housing shortfall in the Borough.

6.15 In preparing the spatial strategy contained within the draft Local Plan, the Council grappled with the competing objectives of national planning policy arriving at a strategy that met the identified future development needs for the Borough whilst minimising the impact of doing so. Such an approach would be fully aligned with the NPPF however the decision was made not to proceed with this option creating considerable uncertainty in respective to whether and/or when a new Local Plan will be adopted. The result was that this left the proposed allocated sites, including the appellants, in a state of limbo whilst in the meantime, the development needs of the Borough continue not to be met.

6.16 Whilst this is the case I accept that given that the Local Plan has been set aside the policies contained within it carry no weight in the decision making process. Notwithstanding this, the emerging Plan was underpinned by an extensive evidence base which in my view should carry significant weight which was the conclusion reached by the Inspector in the case of the Little Bushey Lane appeal (see paragraph 37, CD/5.23). As such, I consider that there are a number of reports/assessments that form part of the evidence base that are relevant to the site which I set out below.

Green Belt Assessment

6.17 HBC commissioned Arup to produce an independent assessment of all Green Belt land across Hertsmere and to identify how it meets national Green Belt purposes. Stage 1, 2, 3 and 4 Green Belt reports have been prepared. The Stage 1 and 2 reports are relevant in considering the Site. The Stage 3 and 4 reports focus on smaller washed over settlements and so are not applicable.

- Stage 1 Green Belt Assessment (2017) – this study was carried out to assess how different areas of Green Belt across the Borough perform against the Green Belt purposes.
- Stage 2 Green Belt Assessment (2019) – builds on the Stage 1 assessment with a more refined and focussed assessment and the further sub-division of the parcels considered at Stage 1.
- Stage 2 Green Belt Assessment Additional Sites (2020) – this study considered three additional sites in Bushey.

6.18 The Stage 1 Green Belt Assessment identifies the Site as forming part of Green Belt Parcel 30, which encompasses a large area of land bound by Radlett to the west, Shenley to the northeast and Borehamwood to the south, which is generally considered to score strongly against the purposes of including land within the Green Belt. However, the assessment also recognises that there is scope for sub-division of Parcel 30 in the north-west adjoining Radlett, which is the area covering the Site. The following is stated at page 75 of the report:

"This area, bounded by dense wooded [sic] to the east and south, the edge of Radlett to the west and Shenley Road to the north, is relatively small in scale and makes only a limited contribution to the gap between Radlett and Shenley (Purpose 2). Furthermore, it is visually more connected to the settlement edge and has a limited relationship with the wider

countryside to the east."

6.19 The Stage 1 report recommends that the north-west part of Parcel 30 should be considered further.

6.20 Building on the Stage 1 Green Belt Assessment, the Stage 2 report was published in March 2019. The Stage 2 Green Belt Assessment further sub-divides the Stage 1 Parcels. Parcel 30 is sub-divided into two sub-areas. The Site falls within sub-area SA-75, which also encompasses Newberries Primary School and the woodland belt adjacent to Theobald Street.

6.21 SA-75 is assessed in the Stage 2 study against the first four NPPF Green Belt purposes. At Page 67 of the Stage 2 Assessment, it is concluded that SA-75 performs moderately overall against the NPPF Green Belt purposes and plays a limited role in respect to the wider strategic Green Belt. It is stated that the release of the sub-area would result in the designation of a similarly performing Green Belt boundary when compared with the existing boundary. The report states that the removal of the sub-area is unlikely to impact the performance of the wider strategic Green Belt and overall the report recommends that SA-75 is considered further for release from the Green Belt.

6.22 The following table sets out the conclusions of the Arup assessment of the site and its contribution to the purposes of including land within the Green Belt:

Table 5 – Arup Assessment Conclusions

NPPF Green Belt Purposes	Arup HBC Green Belt Assessment Stage 2 (March 2019)
1) Unrestricted sprawl of large built-up areas	Does not meet Purpose 1 as not at the edge of a distinct large built-up area.
2) Prevent neighbouring towns merging into one another	Performs moderately against Purpose 2, forming a small part of the gap between Radlett and Borehamwood, and preventing ribbon development from Radlett. The Gorse Woodland to the south-east also provides an additional buffer to the physical or perceptual coalescence of settlements. *NB: I note that this is a different conclusion to the Stage 1 assessment which concluded that the site only made a 'limited' contribution to this purpose (pages 75/76, CD/4.26).*
3) Assist in safeguarding the countryside from encroachment	Performs moderately against Purpose 3 as it is formed of open fields with limited built form, contributing to a largely rural character. The sub-area does, however, have a strong sense of enclosure with limited links to the wider countryside.

4) Preserve the setting and special character of historic towns	Does not meet Purpose 4.
5) Assist in urban regeneration, by encouraging recycling of derelict and other urban land	Purpose 5 not considered.

6.23 Overall, the Arup assessment concludes that the site makes a moderate contribution towards the purposes of including land within the Green Belt. Based on the Arup conclusions at Stage 1 & 2 I consider this to be at the lower end of moderate especially in light of the recommendation being that it be considered for release from the Green Belt.

Landscape Sensitivity Assessment

6.24 LUC were commissioned by HBC to prepare a Landscape Sensitivity Assessment to residential and employment development in order to increase the understanding of the local landscape and settlement pattern, inform decisions on the allocation of sites in the new Local Plan and guide consideration of individual planning applications in and around those areas assessed. The subsequent study was published in September 2020.

6.25 The site is identified as being within the Radlett Fringe (ref: 21B). This area is described as being *"…a combination of agricultural fields, deciduous woodland copses, Porter's Park Golf Course and a coniferous plantation……The presence of some elevated ridges (and the setting these provide to Radlett), mature trees and deciduous woodland, Kitwells Brook, and public rights of way increase sensitivity to development, although the area's sensitivity is reduced by its location on the urban edge of Radlett and the enclosure provided by existing woodland"* (page A-61, CD/4.25).

6.26 The assessment considers that medium density development (i.e. houses and flats) at the site would have a 'moderate' sensitivity which is defined as *"landscape and visual characteristics/values of the assessment unit are susceptible to change. It may have some potential to accommodate the relevant type of development if sited and designed sensitively. Thresholds for significant change are intermediate*". As a result the guidance of the assessment states that *"Any development should be located in visually enclosed areas, avoiding open/visible ridge tops that provide a setting to Radlett. Retain all deciduous woodland (which is a priority habitat) as well as hedgerows/ hedgerow trees where possible and use vegetation that is in character with the locality to integrate any new development into the landscape so that the rural character of the wider landscape character area is retained".*

6.27 The conclusions I draw from this assessment is that the landscape sensitivity of the site is at the lower end of the scale (when assessed against other parts of the Borough) and focuses new development in areas which are visually enclosed which the site is. On this basis, I consider that there is scope to deliver new development that minimises any landscape harm.

Outline Landscape Appraisals (OLA) Report

6.28 Following on from the Landscape Sensitivity Assessment LUC were also commissioned by HBC to consider each of the potential development sites in terms of their potential landscape and visual effects, constraints to development and opportunities for mitigation. This report was published in October 2020.

6.29 In respect to the site conditions the site assessment identifies that *"Except for a small area of deciduous woodland (Theobald Street Wood Local Wildlife Site), this site does not contain any of the key sensitivity indicators – it lies on the edge of Radlett and is well enclosed by woodland, meaning it generally has a lower sensitivity than some parts of the assessment unit".* This reaffirms that the site's overall landscape sensitivity is at the lower end of the scale.

6.30 The assessment provides a favourable assessment of the site's development potential in that it acknowledges that *"Development on this site would not affect the settlement pattern within Hertsmere as the area is on the urban fringe of Radlett village and is naturally enclosed by Shenley Road and surrounding woodland".* In summary it concludes that the *"…site has the potential to accommodate residential housing and smaller flats as long as the Theobald Street Wood Local Wildlife Site is protected"* and that in terms of sensitivity/developability the site has *"Low sensitivity: site could be developed for mixed residential use – few constraints".*

6.31 In my view it is clear that the landscape evidence prepared to support the emerging Local Plan identified the development potential of the site, identifying that new development would have limited landscape related constraints.

Recent Appeal Decisions in Hertsmere

6.32 I am aware that there have been two recent appeal decisions in Hertsmere in Shenley (CD/5.18) and Bushey (CD/5.23). Clearly each proposal needs to be assessed on its own merits however where matters relevant to this appeal have been discussed in these decisions I have made reference in my proof (citing the relevant paragraph number). As a general comment, however, there are key matters that mean that both decisions stand apart from the proposals subject to this appeal.

6.33 In the case of the Shenley appeal the proposals were for a much smaller quantum of development with very limited non-residential benefits whilst in the case of the Bushey appeal, the Inspector concluded that the proposals had failed the Sequential Test finding that some 13 sites (including this appeal site) were reasonably available. As a consequence the Inspector attached very substantial weight to this harm (paragraphs 99-100, CD/5.23). Based on guidance set out within paragraph 162 of the NPPF I consider that this would have formed a strong reason against allowing the development even if the site had not been in the Green Belt.

7. POLICY ASSESSMENT

7.1 Within this section I assess the proposals against the relevant policies and guidance.

Green Belt – Reason For Refusal 1

7.2 As has been stated the site lies within the Green Belt where inappropriate development is, by definition, harmful and should not be approved except in very special circumstances. As is made clear by the NPPF when considering any planning application, local planning authorities should ensure that substantial weight is given to any harm to the Green Belt. 'Very special circumstances' will not exist unless the potential harm to the Green Belt by reason of inappropriateness, and any other harm resulting from the proposal, is clearly outweighed by other considerations. Policy CS13 is consistent with this.

7.3 Before I consider whether very special circumstances exist, it is important to understand the level of harm to the Green Belt caused by the development proposals. As I have set out already, the Council has undertaken this exercise as part of the emerging Local Plan process with the Arup assessment concluding that the site only makes a moderate contribution towards two of the purposes of including land within the Green Belt. To inform the planning application, CSA also undertook a Green Belt assessment, detail of which is set out within the proof of Mr Self, the conclusions of which I summarise below. For the purposes of clarity, given the significant housing need and limited supply of previously developed land in the District, I do not consider that the fifth purpose (assisting in urban regeneration) is applicable in this instance.

7.4 I also consider it relevant that when assessing the proposals impact on safeguarding the countryside from encroachment a clear distinction is made between the contribution the site makes at a site specific level compared to the contribution made by the wider land parcel the site sits within as has been undertaken by the Council. A similar issue was considered by the Inspector in the case of proposals at Colney Heath where in this case, the Inspector acknowledged that given the characteristics of the site the proposals would only result in a localised impact on the Green Belt and the broad thrust of, function and purpose of the Green Belt in the location would remain and that there would be no significant encroachment into the countryside. The Inspector concluded that the appeal proposals *"…would not result in harm in terms of the encroachment of the Green Belt in this location. This is a neutral factor which weighed neither in favour nor against the appeal proposals."* (para 26, CD/5.1). Like the current appeal proposals, the scheme at Colney Heath involved residential development on currently open land and so this decision highlights that whilst there may be an impact on openness this does not mean that there is harm to the purposes of including land within the Green Belt.

Green Belt Impact

7.5 In terms of impact on the purposes of including land within the Green Belt, it is common ground that the proposals would not impact upon purpose 5 and it is our view that the proposals would

also not affect Purpose 1 (to check the unrestricted sprawl of built up areas) and Purpose 4 (to preserve the setting and special character of historic towns). This position is supported by the Arup work (undertaken on behalf of the Council – see table 5 above) and is reflected in the officer's report to Committee (paragraph 7.2.4, CD/2.2). There is no indication in the officers report that planning officers reach a different conclusion.

7.6 In respect to purpose 2 (Prevent neighbouring towns merging into one another), Radlett is variously described as a town and a village. It is relatively large with over 8,000 residents; it has a range of services and facilities and is served by the regular mainline railway services.

7.7 As noted by Mr Self the nearest settlements to Radlett are Borehamwood and Shenley with the land that separates these settlements from Radlett falling within the Green Belt. While the proposed development would result in a minor reduction in the gap between Radlett and Shenley, the containment provided by the woodland that borders the Site, would prevent intervisibility between the two settlements. When traveling from Radlett to Shenley on Shenley Hill/Shenley Road, the development on the Appeal Site frontage would only be visible for a very short distance and there would continue to be a significant area of woodland and open countryside separating the two settlements.

7.8 This very minor reduction in the gap between Radlett and Shenley would only be experienced from the Shenley Hill frontage, and its immediate environs, on account of the alignment of the road and the extensive area of woodland that contains the Site. Once past the woodland one would pass through an area of open countryside and experience a clear break between the settlements with no intervisibility between them.

7.9 In respect to purpose 3 (to assist in safeguarding the countryside from encroachment) any development on a greenfield site will result in an element of encroachment. However, as set out by Mr Self, the Site's visual relationship with the neighbouring residential area of Radlett and the enclosure provided by the adjacent dense woodland means that the development will not visually encroach into the wider countryside.

7.10 In addition to the purposes of including land within the Green Belt Paragraph 137 of the NPPF defines the essential characteristics of Green Belts are their openness and their permanence. Assessing the impact of a proposal on the openness of the Green Belt, where it is relevant to do so, requires a judgement based on the circumstances of the case which is undertaken by Mr Self.

7.11 In terms of the visual aspects of openness Mr Self concludes that there will be very few opportunities to view the proposed development from the public domain. The main public viewpoint will be from the entrance to the Site, and its immediate environs, on Shenley Hill. From here there will be views into the Site, along the access road, and of the houses which front onto the road. The view of the frontage housing will be softened by existing and new planting but will not be screened as the development has been planned to read as a natural extension to Radlett and to complement the nature of the existing frontage development immediately to the west of the Site access.

7.12 The pedestrian and cycle access from Theobold Street will be visible from the roadside but the alignment of this access and the extent of intervening woodland will mean that development within the Site will not be visible. From Newberries Avenue and Faggots Close there will be glimpsed views, between existing properties, of the new homes. There will similarly be some opportunities for views from the neighbouring properties and from Newberries School. There will also be a framed view from the proposed pedestrian access to Willian Way.

7.13 Openness has both a spatial as well as a visual component. In terms of the spatial impact, development on the Site would inevitably result in a reduction in the physical openness of part of the Green Belt that the Appeal Site occupies. Effects on the openness of the wider Green Belt would be minimal due to the visual containment of the Site and its relationship to the edge of Radlett.

7.14 I consider that overall, aside from the definitional harm caused by development in the Green Belt, given the characteristics of the site, the level of harm to Green Belt openness is limited to the immediate site. Overall I consider that as established by the Council's evidence the site makes no more than a moderate contribution towards two purposes of including land within the Green Belt. Based on the assessment undertaken by Mr Self and inconsistencies between the Stage 1 and 2 Arup assessments I consider that the impact on the Green Belt is more limited.

7.15 In addition, I acknowledge that the proposed development would lead to a substantial change to the sites character which is an inevitable result of developing any greenfield site. Notwithstanding this I concur with the conclusions of Mr Self who finds that the landscape/townscape effects on the wider area will be extremely limited on account of the scale of the proposed development and the enclosure provided by the neighbouring woodland. Therefore I consider that the proposals would also lead to landscape harm, albeit this would be limited and so far less than was considered to be the case by the Inspector in the Little Bushey Lane appeal (paragraph 66, CD/5.23).

Scheme Benefits

7.16 I set out my view on the weight that should be attached to each of the scheme benefits. For the purposes of clarity the weighting scale I adopt is **Very Substantial, Substantial, Significant, Moderate, Limited.**

Delivery of New Market Housing

7.17 The delivery of up to 107 market homes. As is evident the Council has a woeful housing land supply which has existed for a considerable period of time (see table 3) resulting in a Borough housing shortfall of 2,088 new homes in the current 5 year housing land supply (although in a recent appeal decision the Inspector alluded to a greater shortfall of 2,603 new homes (which would represent a 1.58 year housing land supply). In a recent appeal an Inspector considered a similar shortfall constituted an "acute deficiency" and that in this case the delivery of 100 homes was found to "contribute significantly" to the extremely serious housing shortfall (para

67, CD/5.19). In this case, a greater quantum of development is proposed which will make a more meaningful contribution. In addition, the emerging Local Plan is still years away whilst the Neighbourhood Plan does not allocate any housing sites meaning that there is no solution in either the short or medium term to remedying this persistent shortfall. On this basis I consider that **very substantial weight** should be afforded to this benefit which is the level of weight attached to this benefit by the Inspectors in respect to Little Bushey Lane, (paragraph 110, CD/5.23), Little Chalfont (paragraph 129, CD/5.14) and Colney Heath (paragraph 49, CD/5.1) where there was a similar level of housing shortfall.

Delivery of New Affordable Homes

7.18 The delivery of up to 88 affordable homes. The accompanying legal agreement requires the preparation and submission of an Affordable Housing Scheme to detail the number, type and tenure mix of the affordable housing which will be made up of a mix of social/affordable rented, shared ownership including First Homes which are specifically tailored to first time buyers.

7.19 This new housing, which exceeds that required by Policy, will make a significant contribution to meeting the significant need for this type of housing. Mr Stacey, within his proof of evidence, sets out in detail the significant need for new affordable housing and the woeful supply of such housing.

7.20 Policy CS4 of the Core Strategy (2013) states that "The policy equates to an affordable housing target of 1,140 from 2012 to 2027", equating to 76 per annum. However, the 2016 SHMA identifies a need for 434 affordable dwellings per annum between 2013 and 2036, equivalent to 9,982 affordable dwellings over the 23-year period. Furthermore, the most recent assessment of affordable housing is contained within the 2020 LHNA which identifies a higher need of 503 affordable dwellings per annum between 2020 and 2036, equivalent to 8,048 affordable dwellings over the 16-year period.

7.21 In respect to supply, as Mr Stacey highlights since the start of the 2016 SHMA period in 2013/14, affordable housing completions have averaged just 54 net affordable dwellings per annum, resulting in an accumulated shortfall of -3,418 affordable dwellings between 2013/14 and 2021/22. This is equivalent to an annual average shortfall of -380 affordable dwellings. Against the most recent assessment of affordable housing need (2020 LHNA), a significant shortfall has arisen in just two years. The shortfall equates to -874 affordable dwellings.

7.22 As a consequence of this position there are a number of affordability indicators, detailed by Mr Stacey that demonstrate an ongoing deteriorating situation in Hertsmere Borough for those households seeking an affordable home. Again, there is no imminent Plan led solution to addressing this significant need and so for all these reasons, and the fact that the Council's Homelessness and Rough Sleeping Strategy 2019-2023 identifies the delivery of affordable housing as a key priority, I consider that **very substantial weight** should be afforded to this benefit which is consistent with the findings of the Inspector at Little Bushey Lane (paragraph 113, CD/5.23), Little Chalfont (paragraph 129, CD/5.14) and a host of other Inspectors as set out in Mr Stacey's proof.

Delivery of a New Medical Centre

7.23 The delivery of a new medical centre, the rationale of which is set out within the proof of evidence by Dr Buroni. The associated legal agreement requires that a healthcare facility specification be agreed with the Council. Notwithstanding this, ongoing discussions have taken place with the Red House Surgery which has informed the preparation of draft proposals for the medical centre (see plans contained at Appendix 3 of the Statement of Case CD/7.1).

7.24 It is anticipated that the new centre will be significantly larger than the internal clinical space of the current facility and would therefore represent a significant benefit to Radlett. As explained by Dr Buroni this additional space will provide staff amenities and improve working conditions, of which is critical to retaining and enticing staff, but also improves patient experience, while building in spare capacity to accommodate the future needs of Radlett. This space coupled with adaptable multifunctional rooms means additional health care and health promotions services can be provided over and above that currently.

7.25 The external parking space is again considerably greater than the current facility, and given proximity, is not for the new residents associated with the application, but reflective of the wider area the Red House GP Surgery already serves. However, it also serves as additional clinical space, where external electrical and utility points can accommodate mobile health screening units, and if necessary, accommodate test and vaccination facilities, while still retaining more parking than the current facility.

7.26 It is the view of Dr Buroni that such features not only greatly improve capacity, but significantly enhances and expands current health promotion and health care services, through what is effectively a community health hub.

7.27 The proposed building also improves energy efficiency and thermal comfort over and above what can be achieved at the current facility, which aids in maximising the NHS budget allocation to health care (as opposed to responding to inflated energy bills), while improving working conditions and patient experience. Provision of the building directly to the GP surgery itself, also means greater financial resilience and security to the surgery, removing any rental overhead, but also acquiring a building with a warranty, removing unexpected maintenance costs. This again means more of the NHS budget allocation can be spent on care and staff, securing greater provision, capacity and service to Radlett.

7.28 I note that Policy RV2 of the Neighbourhood Plan supports the enhancement of the range of medical services in Radlett. It continues by stating that such use should be located in the Village Centre unless it can be demonstrated that there are no viable and deliverable sites, in which case provision elsewhere in the settlement will be supported.

7.29 The supporting text to this policy (para 3.66, CD/3.9) states that the Red House Surgery recognise that the building will be at capacity in less than 10 years time as the population grows in Radlett and further demands are put on the already overstretched GP surgery (indeed the existing building is at capacity now). The text continues by stating that the Neighbourhood Plan Steering Group believes a building such as the Post Office or the Village Institute could

be converted into a medical hub for the future health of the population of Radlett. The appendix to the Neighbourhood Plan seemingly identifies 4 potential available locations within the centre of Radlett.

7.30 In light of comments made within the Statement of Case of Aldenham Parish Council, I consider the suitability of each of these from a planning perspective.

Location A - Radlett Service Station/Regency House, Former Radlett Fire Station, and Burrell & Co.

7.31 This site has been the subject of various permissions which have been built out or are now under construction (TP/12/1194 & 21/0778/FUL relating to the former fire station & 18/0479/FUL in respect to Regency House). On this basis, this site is no longer available which has presumably been accepted by Aldenham Parish Council as this is not referred to within their Statement of Case.

Location B – Newberries Car Park

7.32 The site was assessed by the Council's latest HELAA (site ref: HEL403, extract attached at Appendix 5) for potential residential redevelopment, subject to the existing public car park being retained. It is stated that there is developer interest. The site is owned by the Borough Council however its availability is unclear in that HELAA stating that it will only be available for development in 16+ years (if at all). Also, the site is identified as partly within Flood Zone 3. In light of this the site is not currently available and is being considered for alternative uses. Notwithstanding this, the need to retain the existing car park use means that there is considerable doubt on the viability of providing a medical centre in this location. As such, I conclude that this is not a realistic location for a new medical centre.

Location C – Radlett Village Institute

7.33 This is the village hall in Radlett which is used for a variety of uses and which can also be hired for events and functions. Given the wider community use of this building means that it could not realistically house a new medical centre without significant disruption to existing users and groups. As such it would presumably be necessary to erect a new building on site with associated parking whilst also retaining the existing building (and associated parking). In light of this and the existing mature trees along the site boundary which would be retained, I do not consider that there is sufficient space at the site to accommodate all of these buildings and uses. As a consequence I do not consider that this site represents a realistic option to accommodate a new medical centre.

Location D – Post Office

7.34 I note that the site has a planning history with a planning application for change of use to a children's nursery in 2012 was refused (ref: TP/12/1521) due to concerns from highway officers about insufficient space to accommodate the potential increase in vehicle numbers and associated vehicular movements. There were also concerns raised that parents dropping

off and collecting children from the site will cause a backlog of traffic onto Watling Street to the detriment of both pedestrian and vehicle safety. I consider that any expanded / new medical centre at the would face similar issues. Furthermore, the existing building is locally listed and is immediately adjacent to a Conservation Area meaning that there is heritage issues that would need to be addressed. This would therefore point to a conversion scheme which is likely to compromise the quality of the accommodation and place limitations on the type of medical services that could be provided. In light of these issues I do not consider that this is a realistic location for a new medical centre.

7.35 In addition to the above and common to all options is the ability of the Practice to adequately fund the delivery of a new medical centre which is highlighted as an issue by the Red House Surgery in their initial response to the planning application. This is also a fundamental point made by Dr Buroni.

7.36 As set out in my proof the site is readily accessible by public transport and is within a short walking distance of the Village Centre and therefore would be in a location that is accessible by all which is the overriding objective of the Neighbourhood Plan (which was presumably the reason why the proposed allocation within the Plan included provision of a new medical centre). On this basis I consider that this benefit should be afforded **substantial weight**.

Economic Benefits

7.37 The proposed development will deliver a number of economic benefits, namely the provision of construction related jobs, increased spend by new residents and increased tax receipt for the Council as set out in the proof of Mr Thurley. These economic benefits would accord with paragraph 81 of the NPPF which states that significant weight should be placed on the need to support economic growth and productivity. As a result of this I consider that this benefit should be afforded **significant weight** which is consistent with the conclusions of the Inspectors in respect to Little Bushey Lane (paragraph 117, CD/5.23), Yatton (paragraph 149, CD/5.16) and Clappers Lane (paragraph 95, CD/5.17).

Biodiversity Net Gain

7.38 The proposals will deliver a biodiversity net gain of 26.99% (in habitat units) and 76.59% (in hedgerow units) which is significantly above that sought or required by national or local policy, SPD guidance or the Environment Act (10%)(although it should be noted that this has not yet come into force).

7.39 This level of biodiversity net gain has been achieved by delivering a larger area of off-site land which will be secured by the associated legal agreement. This arable field, situated approximately 870m to the southeast of the appeal site at its closest point represents an appropriate local biodiversity offset location, which is situated adjacent to a pond and native broadleaf woodland, providing good links between these habitats through the strategic positioning on the proposed new scrub. As set out in the ecology note, enclosed at Appendix 6, this larger area of land can accommodate a mixture of other neutral grassland and mixed scrub habitat totalling 4.44ha in area.

7.40 0.8ha of mixed scrub habitat would be fenced and planted with a mixture of species types. This slightly lower density planting will encourage the establishment of bramble scrub within this habitat and provide space for some natural colonisation by other trees and shrubs. Small glades would also be incorporated within this habitat as this is a valuable feature within scrub. All whips would be protected with guards to prevent damage by rabbits and deer and planted as bare root stock between November and February.

7.41 3.64ha of modified grassland habitat would be sown with a mixture that is more tolerant of higher nutrient levels. The recommended mixture in this instance would contain a mixture of wildflowers commonly found in arable margins, which would be partnered with a suitable grass seed mix to create a total of not less than 19 native species sown. Sowing would take place between September and October or March and April when there is sufficient ground moisture and a careful prescription of more regular cutting of this sward in the first year to encourage good establishment, followed by annual or bi-annual cutting in the late summer and very early spring would be followed as necessary.

7.42 The creation of these habitats has led to a forecast moderate condition score for both the mixed scrub habitat and the other neutral grassland, creating a yield of 29.73 medium distinctiveness habitat units. This uplift in off-site biodiversity units has led to an overall increase of 20.97 habitat units for this scheme, representing 26.99% net gain. In the case of other appeal decisions, the weight attached to BNG significantly above 10% varies from moderate (see paragraph 92, Clappers Lane (CD/5.17) and paragraph 44, Warlingham (CD/5.19) up to substantial (see paragraph 161, Little Chalfont (CD/5.14). On the basis of the level of biodiversity net gain achieved in this case I attach **significant weight** to this benefit.

Newberries Primary School Safeguarded Land

7.43 The proposals include the transfer of land (0.7Ha) to Hertfordshire County Council to safeguard for the future expansion of Newberries Primary School, the specification of which has been the subject of ongoing dialogue with the County. These discussions were held primarily in the context of the emerging Local Plan allocation and I note the County in their response to the Regulation 18 consultation state:

"The Radlett settlement strategy identifies the need to allocate land for a new, 2fe primary school within Site R1: Land north of Watford Road, Radlett, as well as land allocated within Site R3: Land south of Shenley Road, Radlett to facilitate a 1fe expansion of Newberries Primary School. The primary education provision offered in the plan for Radlett would meet the potential demand expected from the housing proposed."

7.44 In the case of the emerging Local Plan it is evident that the land at the appellant's site would be required to enable Newberries Primary School to expand. Whilst it is appreciated that the current emerging Local Plan has been set aside it will nevertheless be the case that, at some point, the Borough Council will bring forward a new Local Plan which will set out how the development needs of the Borough will be met. It is also evident that Radlett is a relatively high order settlement with excellent transport links with a wide range of services and facilities and so it is reasonable to expect that there will be future growth directed to the settlement. It

is also clear that the only way for Newberries Primary School to expand is on land within the control of the appellant.

7.45 Notwithstanding the above, I accept that there is currently space within Newberries Primary School to accommodate additional children which the County estimate at approximately 0.5Fe. In their response to the application, the County estimate that the proposed development will generate a need of approximately 0.5Fe and with the stated requirement to maintain a buffer of 5-10% in schools capacity means that the need generated by development alone will require the future expansion of this school in the medium term. This position is reaffirmed by the County Council's CIL Compliance Statement (CD/4.36) which identifies that it is necessary to provide a reserve site to facilitate the expansion of this school. As is clear from this Compliance Statement the proposals will generate a need for up to 13 school places however the proposed safeguarded land would enable a 1Fe expansion (providing up to 210 additional spaces). On this basis, it is clear that the provision of this land would not only mitigate the impact of the school but would also represent a benefit.

7.46 The proposed development will therefore 'future proof' the expansion of this school which whilst not necessarily needed now will be in the future. On this basis I consider that this benefit should be afforded **moderate weight** which is consistent with the weight attached to a similar benefit by the Inspector in the case of Little Bushey Lane (paragraph 119, CD/5.23).

Radlett Plantation RIGS Enhancements

7.47 The delivery of enhancements to the Radlett Plantation RIGS as set out in the submitted Geo-conservation Enhancement and Management Plan. The Radlett Plantation RIGS was designated for its in-situ Puddingstone exposure, the only known such exposure in Hertfordshire. It is considered important for the depositional and structural features it shows and for its possible indication of the materials origin.

7.48 Enhancements to the Radlett Plantation RIGS offers the potential to increase the size and quality of the Puddingstone exposure. This work would also improve the exposure of the boundary between the Puddingstone and its surrounding geological sequence, thus helping to advance scientific understanding of the stratum's formation and diagenesis. In order to achieve this betterment (and other benefits) the Management Plan sets out a range of measures, that will be secured by way of legal agreement, for example appropriate excavation work and ensuring secured means of access. I consider that this will secure geological benefits that do not currently exist and whilst specialist in nature it is a benefit nonetheless which I believe should be afforded **moderate weight**.

Sustainability and Transport Initiatives

7.49 The proposals will deliver a number of individual sustainability and transport initiatives. As set out in the proof of evidence of Mr Hamshaw the site is located on the southern edge of the existing Radlett settlement, within easy walking and cycling distance where a range of services and facilities are available including Radlett rail station. The development proposal includes multiple access points, new bus stops along Shenley Road and Theobald Street and a range

of off-site pedestrian and cycle improvements providing a cohesive package to promote active and sustainable travel to the benefit of both existing and future residents. In addition, the proposals would deliver new pedestrian/cycle connections between Theobald Street, Shenley Hill and Williams Way as sought by the Neighbourhood Plan.

7.50 As set out within the Energy & Sustainability Statement which accompanied the planning application (CD/1.16) a range of Low and Zero Carbon (LZC) technologies are considered appropriate including Air Source Heat Pumps and PV panels which are capable of achieving an approximately a 77% reduction in the Part L 2021 CO2 emission performance target for the new homes. In addition this statement includes a water efficiency strategy in order to reduce the demand for potable water from the proposed development together with a strategy to maximise the efficient use of resources, both through the construction process and during future occupation. All of this demonstrates that extensive measures are proposed to mitigate the scheme's climate change impact.

7.51 I note that the Council, in its statement of case (CD/7.2) refer to its Interim Planning Policy Position Statement on Climate Change and Sustainability which sets out the Council's aspirations to achieve zero carbon emissions from new developments. The fact that this is an interim position statement means that it has not been the subject of the usual rigour associated with a statutory development plan which means that it can only carry limited weight. Policy CS16 (Environmental Impact of Development) of the Core Strategy seeks to achieve reduced levels of energy consumption and the use of renewable resources without specifying targets. As stated by the submitted Energy & Sustainability Statement the proposals are capable of achieving a significant measurable carbon reduction over building regulations meaning that the proposals would go over and above the bare minimum sought by Policy CS16 and so accordingly should be seen as a benefit.

7.52 Taken together I consider that these should be afforded **moderate weight**.

Summary

7.53 In summary, the weight I attach to each of the scheme benefits is set out below:

- The delivery of up to 107 new market homes, in light of the current acute housing shortfall, is considered to attract **very substantial weight**;
- The delivery of up to 88 new affordable homes, in a variety of tenures and sizes, will make a meaningful contribution towards boosting affordable housing supply in the Borough and so should be afforded **very substantial weight**;
- The delivery of a new medical centre, to be operated and managed by the Red House Surgery, to meet the needs of the local community now and into the future is considered to attract **substantial weight**;
- The associated economic benefits, which are many and varied, is considered to attract **significant weight**;
- The proposed development will deliver a 26.99% biodiversity net gain which is considerably

higher than the 10% sought by the Environment Act (which has not yet been introduced) and which is considered to attact **significant weight**;

- The proposed development will safeguard land to facilitate the future expansion of Newberries Primary School (the only way in which the school could expand) which we consider will be required in the near future. As such I believe that this should attract **moderate weight**;
- As part of the proposed development, a management plan to secure enhancements to the adjacent Radlett Plantation RIGS, the only known Puddingstone exposure in Hertfordshire, will be secured and as such should be afforded **moderate weight**;
- Alongside the proposals measures to improve pedestrian and cycle connectivity to the benefit of both existing and future residents will be secured whilst the development would be capable of achieving a reduction in carbon emissions over and above current building regulations and policy. As such, taken together, I consider that these should be afforded **moderate weight**.

7.54 In conclusion, I consider that these benefits would outweigh the totality of the harm and as such 'very special circumstances' exist. Accordingly the proposed development would be in accordance with Policy CP13 and paragraph 148 of the NPPF.

Other Reason for Refusal Matters

7.55 In addition to the reason for refusal relating to Green Belt matters, the Council's decision notice included reasons for refusal relating to archaeology (RfR 2) and drainage (RfR 3). Since the issuing of the decision notice, further work has been undertaken with outstanding matters relating archaeology which have now been resolved as set out in the Statement of Common Ground (paragraph 4.10, CD/7.4).

7.56 In respect to drainage matters (RfR 3), there has been ongoing discussions with the LLFA (and WSP acting as their consultants) with the only outstanding matter being that it hasn't been proven to the satisfaction of WSP (and the LLFA) that the proposed surface drainage scheme would not have an adverse impact on Groundwater source protection zone 1 (SPZ1) (which covers part of the site). Further testing has been undertaken to demonstrate that there is an alternative method of drainage that avoids SPZ1, evidence of which has been shared with the LLFA and WSP (enclosed at Appendix 7). It is expected that this additional information will overcome existing outstanding issues allowing for an agreed position to be reached prior to the start of the Public Inquiry (which can be secured by an addendum to the Statement of Common Ground or a similar mechanism).

7.57 On this basis these reasons are no longer being contested by the Council and as such I consider that the proposals are fully in accordance with Policies CS14 of the Core Strategy and SADM14 and SADM15 of the Site Allocations and Development Management Plan. As such, these two matters do not raise any additional harm that needs to be weighed in the Green Belt balance.

8. OTHER MATTERS

8.1 A number of other matters have been raised by HBC and Aldenham Parish Council. I respond to each below.

Hertsmere Borough Council

8.2 The Council, at paragraph 4.1, state that the proposals conflict with criterion v and vii of Policy SP1 which relate to harm to the natural environment / Green Belt, matters that I have already addressed in the preceding chapter. Notwithstanding this Policy SP1 is a framework to deliver the Core Strategy Vision, which as far as housing growth is concerned, is out of date. The Council have failed to review their plan in a timely manner and as a consequence there has been a failure to deliver sufficient market and affordable housing as evidenced by the Council's inability to demonstrate a 5 year supply of housing land and the evidence of Mr Stacey on affordable housing need. I therefore attribute only limited weight to this Policy.

8.3 At paragraph 4.18, the Council state that the site comprises a vacant area of pasture grass-land, with no existing built-form, of some 11.45 hectares. As a point of clarity the site includes an area of woodland (of approx. 3Ha) which save for a new pedestrian/cycle connection would remain as is and so as currently worded this paragraph gives a false impression of the size of the field.

Aldenham Parish Council

8.4 Aldenham Parish Council have been granted Rule 6(6) status in respect of this appeal and as such have submitted their own Statement of Case which raises various matters (CD/7.3). I provide comment on a number of matters raised by the Parish Council.

8.5 It is noted that at paragraphs 6.6 and 6.7 there is reference to the vision and objectives set out within the Radlett Neighbourhood Plan (RNP). I would note that there are further objectives that are considered relevant, namely objective 2 which seeks that RNP policies meet new housing demand in a manner that is sensitive to the character of the village, objective 3 which seeks to support the development and/or retention of smaller homes available to young people and older downsizers and objective 8 which is to seek to encourage and facilitate the development of buildings and sites in the village in order to improve the vitality of the high street and provide better facilities and amenities for the community and visitors. I consider therefore that the proposed development would contribute to meeting a number of the objectives of the RNP.

8.6 As is referred to in paragraph 6.8, the proposals would deliver a cycle and pedestrian connection between Shenley Hill and Theobald Street (and Williams Way) as sought by the RNP. This connection would be made up of an appropriate surface treatment that would allow it to be used by all whilst also being suitable for cyclists. On this basis I consider that this proposed connection would therefore fully accord with the objectives of Policy GA1 of the RNP as it would constitute a well maintained, safe and attractive route.

8.7 The proposed development is in outline with all matters reserved, save for access. The application is accompanied by a parameters plan to guide future development at the site (whilst an illustrative layout has been prepared to show how the development could be developed). It is inferred within paragraph 6.13 that by reference to proposed density alone the development would not be in accordance with the character of Radlett. Density is a crude metric and through detailed design it is entirely possible to arrive at an appropriate and high quality scheme, which is the overriding objective of Local Plan and RNP design policy. In my view, based on the information which accompany this application the proposals are capable of constituting a form of development that accords with the aims and objectives of the relevant design policies.

8.8 In respect to the provision of the new medical centre and as noted at paragraph 6.19 Policy RV2 of the RNP supports provision in the settlement (subject to demonstrating that there are no viable or deliverable sites within the village centre). As set out in paragraphs 7.30-.35 of my proof I do not consider that any potentially alternative site (as identified by the RNP) within the village centre are viable or deliverable which is also supported by the reasoning of Dr Buroni. As highlighted by the planning assessment undertaken by HBC officers the site is approximately 15 minutes walk from the village centre and is identified by officers as a sustainable location for new development. In addition, dedicated car parking will be provided (which is limited at the current practice) which will assist those that need to travel by car (which is likely to be the case for many patients). For these reasons, I consider the location of the new medical centre to be entirely appropriate and which should be supported by Policy RV2 of the RNP.

8.9 It is alleged within paragraph 6.24 that the proposed development would undermine the site's contribution to the Watling Chase Community Forest although it is not stated how. There is no planning policy that specifically relates to the Watling Chase Community Forest (whilst there is a guide for landowners, developers and users (2003) there is a non-statutory document (para 4.3)). There are, though, references within the Core Strategy which states that almost the entire Borough lies within the boundary of Watling Chase Community Forest (para 7.25, CD/3.1) whilst in the glossary it is described as *"an initiative by the Countryside Agency and the Forestry Commission in the 1990s to establish a number of community forests around the Country. It aims to assist planting, woodland management, habitat maintenance and creation, and access"* (page 100). The proposed development will create new pedestrian and cycle connections that enhance access to the wider countryside (and adjacent woodland) and so, insofar as it is relevant, I consider that the proposals would support the Watling Chase Community Forest initiative.

8.10 As stated at paragraph 6.28 it is accepted that the proposals are likely to result in the loss of 23 trees or groups however as is set out in the arboricultural assessment which accompanied the planning application (CD/1.15) of those proposed to be removed only 1 is identified as category B with the remainder being either category C or U. As set out within the accompanying landscape strategy (CD/1.3) the proposals provide ample opportunity for additional tree planting across the site that would result in the significant net gain in trees across the site.

8.11 It is stated that the safeguarded school land will result in the removal of a significant number of mature trees and dense hedgerow however this simply cannot be known. It is accepted that there is likely to be some removal however I consider that the extent of removal is likely to be restricted to the removal of the G59 grouping of Cypress's which are identified as category C. If need be, I consider that an appropriately worded planning condition can be attached to secure the protection of other trees along this boundary.

8.12 As has been clarified by Mr Hamshaw the proposed pedestrian connection onto Williams Way is deliverable and as is shown by the tree report this can be achieved whilst retaining the existing Oak tree.

9. CONCLUSIONS

9.1 Applications for planning permission must be determined in accordance with the Development Plan unless material considerations indicate otherwise, in accordance with Section 38(6) of the Planning and Compulsory Purchase Act (2004).

9.2 The Site is located to the east of Radlett, immediately adjacent to the settlement boundary. It totals 11.45 ha and comprises a field which slopes gently downwards from north-west to south-east and an area of woodland. Radlett is a key settlement within the Borough with a range of services and facilities that would meet the day to day needs of residents whilst there are excellent public transport services that provide connections further afield. The site is well located in respect to the existing settlement and it is common ground with HBC that it would comprise a sustainable location for new development.

9.3 The proposal will deliver up to 195 new homes (40%), safeguarded land for the expansion of Newberries Primary School and provision of a new medical centre along with associated access (ref: 22/1539/OUT).

9.4 From a planning policy perspective the assessment of the acceptability of the proposals rests on whether the scheme accords with Green Belt policy at both the local and national level. As such Policies CS13 and SADM26 are the most important in the determination of the appeal. Policy CS13 is clear in stating that *'There is a general presumption against inappropriate development within the Green Belt, as defined on the Policies Map and as such development will not be permitted unless very special circumstances exist".*

9.5 There is no clear guidance on what constitutes 'very special circumstances' however case law is clear that a number of factors, which may not be "very special" when considered in isolation, may when combined together amount to very special circumstances and so there is no reason why a number or factors ordinary/or special in themselves cannot combine to create something very special.

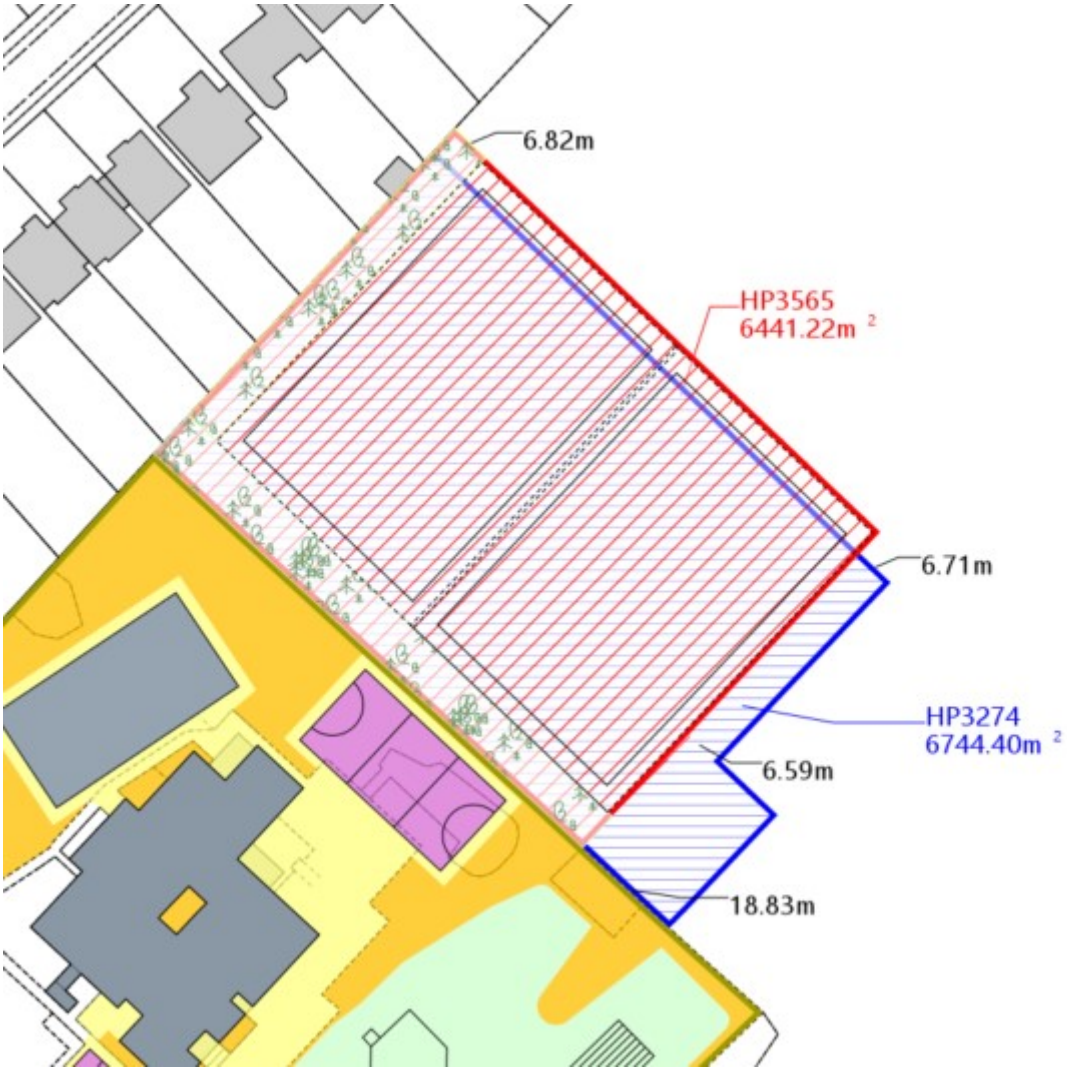
9.6 In the case of the site, aside from the definitional harm caused by development in the Green Belt, given the characteristics of the site, the level of harm to Green Belt openness is limited. The development would result in a limited to moderate contribution to two purposes of including land within the Green Belt. Notwithstanding this, in accordance of the NPPF, this harm must be given substantial weight. In addition there is limited landscape harm that needs to be added.

9.7 Weighed against this is a range of benefits that would be delivered as a result of the proposed development which include the delivery of up to 107 new market homes (very substantial weight), the delivery of up to 88 new affordable homes (very substantial weight), the delivery of a new medical centre (substantial weight), the associated economic benefits (significant weight), delivery of a 26.99% biodiversity net gain (significant weight), the safeguarding of land to facilitate the future expansion of Newberries Primary School (moderate weight), enhancements to the adjacent Radlett Plantation RIGS (moderate weight) and a range of transport/sustainability benefits (moderate weight).

9.8 I consider that the benefits of the development clearly outweigh the totality of the harm and as a result very special circumstances exist to justify the proposed development.

9.9 Overall, I therefore consider that the proposals would be in accordance with the development plan and that there are no material considerations that suggest otherwise. For this reason, I respectfully request that the Inspector allows this Appeal subject to appropriate conditions and legal agreement.

APPENDIX ONE – SCHOOL EXPANSION LAND INITIAL LAYOUT


6.82m
HP3565
6441.22m 2
6.71m
HP3274
6744.40m 2
6.59m
18.83m

APPENDIX TWO – HCC OFFICER CORRESPONDENCE – SCHOOL EXPANSION

Philip Allin

From: Jamie Alderson <Jamie.Alderson@hertfordshire.gov.uk>
Sent: 15 April 2021 12:10
To: Philip Allin
Subject: RE: Land south of Shenley Road, Radlett
Attachments: HP3274.pdf

Hi Phil,

It was nice to meet you (and your colleagues) and chat earlier. Please find attached the plan that I shared on the screen during the meeting to show a possible configuration of the school facilities required to facilitate an expansion of Newberries Primary by 1FE.

I have also included a link to the draft Developer Contribuitions Guidance document that we consulted on earlier this year and expect to adopt this summer (17 Item 8 Appendix 1 The Guide.pdf (hertfordshire.gov.uk)). Note that our starting point for securing school sites is the standard specification set out in this document – sites that are non standard (e.g. sloping topography) often result in abnormally large build costs for HCC that make the delivery of school places unviable.

Happy to remain in communication on this, along with any other HCC matters that relate to the site.

Best,

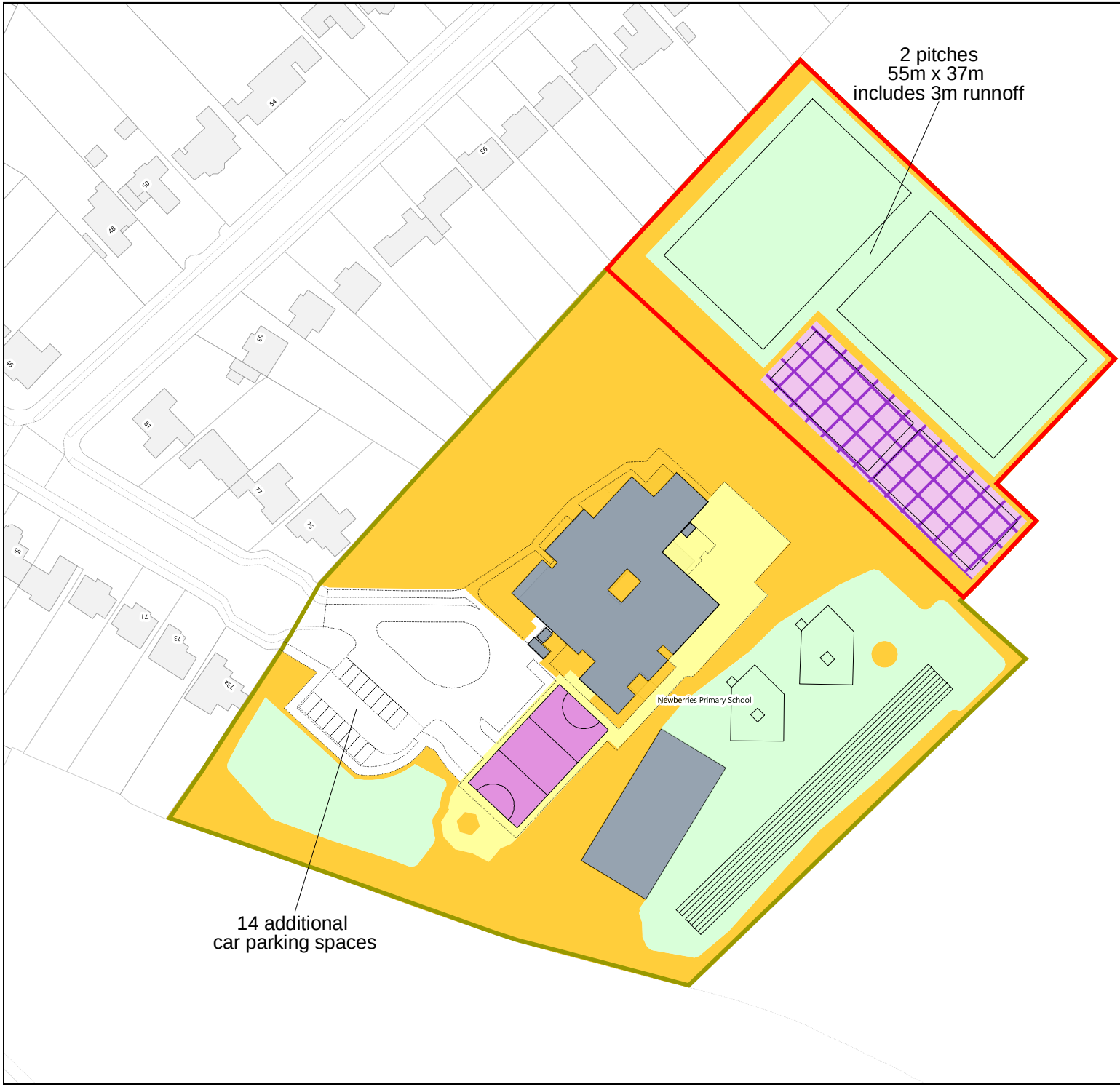
Jamie

Jamie Alderson Msci MA
Senior Planning Officer (South West) Growth and Infrastructure Unit | Growth and Place Services |Hertfordshire County Council
County Hall, Pegs Lane, Hertford, SG13 8DE, Postal Point: CHN114
T: 01992 556711 (**Internal:** 26711) **M:** 07812 323319
E: jamie.alderson@hertfordshire.gov.uk

From: Philip Allin <PhilipAllin@boyerplanning.co.uk>
Sent: 30 March 2021 13:25
To: Jamie Alderson <Jamie.Alderson@hertfordshire.gov.uk>
Cc: Philip Brunt <Philip.Brunt@hertfordshire.gov.uk>; Russell Monck <Russell.Monck@hertfordshire.gov.uk>; Paul Hewett <hewett439@btinternet.com>; 'willadams@fairfaxproperties.co.uk' <willadams@fairfaxproperties.co.uk>; Martin Wilkes <martinwilkes@fairfaxproperties.co.uk>
Subject: RE: Land south of Shenley Road, Radlett

Hi Jamie,

Thanks for your email – any information relating to the feasibility work that you can forward on to us would be much appreciated.



Total site area	**23704m ²**
Net area	**21039m ²**
Soft outdoor PE - total	8242m ²
All weather pitch	
Hard outdoor PE - total	463m ²
MUGA	1205m ²
Hard informal& social	961m ²
Soft informal& social	8964m ²
Non net area	**3869m ²**
Buildings	1923m ²
Access	1947m ²
Additional Land	**6744m ²**

Hertfordshire

Resources
Hertfordshire County Council
County Hall
Hertford SG13 8DQ

PROJECT

Newberries Primary School
Newberries Avenue
Radlett

DRAWING TITLE

Potential Expansion Plan
from 1FE to 2FE

DRAWN	J McNicholas
CHECKED	
DATE	06/04/2020
SCALE	1:1250
PLAN NO.	REVISION

HP 3274

OS Tile Ref: 07:04:20

APPENDIX THREE – HBC OFFICER CORRESPONDENCE – RED HOUSE SURGERY

Philip Allin

From: Ann Darnell <Ann.Darnell@hertsmere.gov.uk>
Sent: 16 March 2021 09:47
To: Philip Allin
Cc: 'willadams@fairfaxproperties.co.uk'; Martin Wilkes (martinwilkes@fairfaxproperties.co.uk); Mark Silverman
Subject: RE: HEL358 land south of Shenley Road CONFIDENTIAL

Dear Philip

Thanks for your email. We met with the partners and practice manage at Red House GP practice yesterday. They are in principle interested in a dialogue and recognise the need to expand (which would mean relocating from their current location) but first want to have a discussion with the CCG about the process and funding arrangements that would apply.

I am now requesting a meeting with relevant people from the CCG so will let you know how things progress.

Kind regards

Ann

Ann Darnell (Mrs) (part time)
Senior Planning Officer
Hertsmere Borough Council | Civic Offices | Elstree Way | Borehamwood | Herts | WD6 1WA
t: 020 8207 2277 ex 5800
email: ann.darnell@hertsmere.gov.uk

My usual working hours are 8.30am – 1:30pm Monday to Friday.

We are working from home following Government guidance.

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HertsmereBC Hertsmere HertsmereBC

APPENDIX FOUR – HBC OFFICER CORRESPONDENCE – LOCAL PLAN PROGRESS

Philip Allin

From: Ann Darnell <Ann.Darnell@hertsmere.gov.uk>
Sent: 21 April 2021 09:20
To: Philip Allin
Subject: Local Plan timescale

Dear Philip

We are writing to you and to the promoters of other strategic sites to provide an update on the preparation of the new Local Plan.

You will be aware that the Council recently ran a call for employment sites, as we were aware of a number of new sites being promoted for economic development which had not been previously submitted for assessment. This Call for Sites resulted in a number of both strategic and smaller employment sites being submitted, details of which can be viewed on our website at Call for Sites and HELAA - Hertsmere Borough Council

Details of these sites were presented to our Member Planning Panel on 30 March and following further consultation with the Panel, it has been agreed with the Portfolio Holder for Planning, to update our Local Plan programme. Our intention is to publish a full draft Local Plan, at Regulation 18 stage, in early autumn this year which will provide an opportunity for statutory consultees, developers and other stakeholders, as well as the local community, to view the plan. Publication of the Regulation 19 Plan and submission for public examination would then follow next year. An updated Local Development Scheme will be published shortly on our website reflecting these changes.

At this stage and based on the information before us, I can advise that officers are likely to recommend the inclusion of your site (HEL358, land south of Shenley Road Radlett) in the draft Local Plan for Members' consideration and thereafter for Regulation 18 consultation. Although this position could potentially change should further information come to light, I hope that this update enables you to commit to undertaking any further technical work, as required.

If you have any questions in relation to the above, please do not hesitate to ask.

Kind regards

Ann

Ann Darnell (Mrs) (part time)
Senior Planning Officer
Hertsmere Borough Council | Civic Offices | Elstree Way | Borehamwood | Herts | WD6 1WA
t: 020 8207 2277 ex 5800
email: ann.darnell@hertsmere.gov.uk

My usual working hours are 8.30am – 1:30pm Monday to Friday.

We are working from home following Government guidance.

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HertsmereBC Hertsmere HertsmereBC

APPENDIX FIVE – HELAA ASSESSMENT EXTRACT

HELAA 2018 **SITE ASSESSMENT FORM**	**Site reference**	**HEL403**
	Site source	

Site location / address:

Site Name	Newberries car park		
Address	Watling Street, Radlett		
Postcode		**Parish**	Aldenham
Ward	Aldenham East	**Town/ Village**	Radlett
Owner	Asset Management, Hertsmere Borough Council		

Site size / use:

Size (ha) Gross	0.97	**Current use(s)**	Car park

Surrounding area:

Neighbouring land uses	Railway to east, Theobald Street to south, residential and town centre commercial to west, garages and station to north
Character of surrounding area – landscape, townscape	The area is at the edge of Radlett district centre, between the rear of shops and other commercial premises on Watling Street and the railway line to the east.
Could this site be joined to another to form a larger site?	no
If yes, give details of adjoining site including site reference if applicable	n/a

Planning history:

Relevant Planning history (include unimplemented permissions, non-confidential enforcement issues)	none

Use(s) proposed by owner/developer (tick and complete relevant box):

Residential		**Employment (B class)**		**Mixed use (specify below)**		**Other (specify below)**	
☐		☐	Choose an item.	☐		☒	Retention of surface parking with development above. Type of development sought yet to be determined by the Council.

Location type (tick relevant box):

Urban settlement [1] PDL	**Urban settlement [1] non-PDL**	**Green Belt settlement [2] PDL**	**Green Belt settlement [2] non-PDL**	**Green Belt other[3] PDL**	**Green Belt other[3] non-PDL**

☒	☐	☐	☐	☐	☐
[1] outside the Green Belt	[2] washed over by the Green Belt	[3] isolated sites and open countryside			

Green Belt purposes:

Stage 1				
Parcel number	**1 Prevent sprawl score**	**2 Prevent coalescence score**	**3 Protect countryside score**	**4 Historic towns score**
N/A	N/A	N/A	N/A	N/A
Stage 1 Comment	N/A			
Stage 2				
Sub-area number	**1 Prevent sprawl score**	**2 Prevent coalescence score**	**3 Protect countryside score**	**4 Historic towns score**
N/A	N/A	N/A	N/A	N/A
Stage 2 Comment	N/A			

Site Suitability:

Conflict with existing policy.	No
Flood Zone 2 or 3?	Part of the site is within FZ3 and part within FZ2. Development will adopt a sequential approach
Any heritage designations within or adjoining the site.	No. Radlett North and Radlett South Conservation Areas are both on the opposite site of Watling Street in this part of the district centre.
Site promoter indicated evidence of land contamination, pollution, poor ground conditions or hazards.	There is an underground water storage facility
Any access difficulties.	Access is from Watling Street but is down a steep ramp currently giving access to the car park.
Any existing 'bad neighbours' which would be unsuitable in relation to the proposed use.	The railway line runs the length of the eastern boundary of the site. Noise and vibration mitigation may be required.
Any other environmental constraints?	No
Is the Site suitable for the proposed use?	Yes, depending on the use proposed and subject to complying with flood risk Sequential and Exception tests

Site Availability:

Has the owner said the site is available	yes	**Is there developer interest**	yes
Ownership constraints / indications that the site may not actually be available	no		

Is the Site available	yes

Site Achievability:

Is the Site achievable	yes

Estimated development potential - residential

(a) Density multiplier (baseline 30dph):

Area type	Prevailing density	Accessibility	Likely type
Central	medium	very high	Urban brownfield mixed

(b) Net capacity

Density dph	Net Ha	Net capacity: (no. units)
126	0.82	104*

Deliverability / Developability:

What is the likely timescale within which the site is capable of being developed taking into account suitability, availability, achievability and constraints, plus anticipated lead in times and build out rates							
☐	Deliverable **1-5 years**	☐	Developable **6-10 years**	☐	Developable **11-15 years**	☒	Developable **16 years + or unknown**

Brownfield Register:

Should the site be considered for inclusion on the Brownfield Site Register?	yes
Reason	Brownfield land which meets criteria for inclusion on register

Conclusion:

The site is located within Radlett District centre where the neighbouring uses are commercial and residential. The site is accessed via a steeply sloping ramp down from Watling Street. This is a relatively accessible location, being approximately 0.09 miles from Watling Street in the centre of Radlett and on bus routes 398 (Watford – Potters Bar) and 601 (Welwyn Garden City – Borehamwood). The site is close to but does not adjoin the Radlett Conservation Areas. Part of the site is within Flood Zone 3, and a smaller part within the functional flood plain FZ3b. This will constrain both the proposed uses and layout, which will need to pass the sequential and potentially exception tests in order to be acceptable. The relationship to adjoining uses and the need to retain public parking provision will also need to be taken into account in considering the quantum and design of any development proposed.

Whilst a decision on the likely future use of the site (in addition to retention of parking) has not yet been made, the site is within the urban area, in an accessible location and if brought forward for residential use could potentially be suitable, available and achievable for approximately 104 dwellings.

Capacity under current policy framework: 104* homes timescale unknown

*** Capacity figure is based on a standard calculation and is an indication only. It does not mean that this number of homes would be built were the site to be taken forward for development.**

APPENDIX SIX - BIODIVESITY NET GAIN CALCULATIONS

The Ecology Co-op
ENVIRONMENTAL CONSULTANTS
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Technical Note

Introduction

1. This Technical Note has been produced to support the Proof of Evidence being provided by Philip Allin of Boyer Planning for the residential development of Land South of Shenley Hill, Radlett, WD7 7BD, under PINS Ref: APP/N1920/w/23/3320599. This note provides information about Biodiversity Net Gain (BNG) matters only, noting that there were no reasons for refusal on grounds of ecology for application reference 22/1539/OUT by Hertsmere Borough Council.
2. At the request of the appellant, The Ecology Co-op has assessed opportunities to find significant additional Biodiversity Net Gain value from the development proposal, which has been set out below.

Biodiversity Net Gain Calculations

3. The Application for Land South of Shenley Road (22/1539/OUT) was supported by a Biodiversity Impact Calculation (BIC) report further to the completion of detailed site surveys. The Metric used to inform this report and supplied separately to Hertsmere Borough Council was the Defra Metric 3.1, the most recent biodiversity Metric available at the time.

4. The BIC considered a combination of on-site impacts, including the loss of modified grassland habitat (7.82ha), bramble scrub (0.1ha) and lowland mixed deciduous woodland (0.29ha), the latter of which was concluded to be an unavoidable impact in order to create necessary emergency vehicle access to the site. Post-development a number of on-site enhancements to habitats were proposed, including the creation of 'other neutral grassland' (0.72ha), sustainable urban drainage features (0.4ha), mixed scrub habitat (0.05ha) and 190 urban trees. As it was not feasible to achieve BNG within the red line boundary of the application, off-site enhancement of a woodland called 'The Gorse' was proposed, in addition to the reversion of 2.1 hectares of arable land to create other neutral grassland habitat. Both parcels of land form part of the same land ownership as the appeal site and are therefore considered a secure resource for biodiversity offsetting.

5. This combination of on-site and off-site proposals led to a calculated gain of 9.7 habitat units (an increase of 12.49%) and 1.88 hedgerow units (an increase of 76.59%).

Revised Net Gain Proposal

6. As a revision to the proposals for BNG to support this appeal, a larger area of off-site land has been identified, as illustrated in Figure 1. This arable field, situated approximately 870m to the

southeast of the appeal site at its closest point represents an appropriate local biodiversity offset location, which is situated adjacent to a pond and native broadleaf woodland, providing good links between these habitats through the strategic positioning on the proposed new scrub (see Figure 2). This larger area of land can accommodate a mixture of other neutral grassland and mixed scrub habitat totalling 4.44ha in area.

Figure 1. The application site (red outline) and the two proposed off-site biodiversity offset areas forming The Gorse woodland area to the east and an arable field parcel to the southeast.

Figure 2. An illustration of proposals for 0.8ha of scrub habitat (blue shading) and 3.68ha of modified grassland (green shading). The positioning of the scrub habitat will improve habitat links between the pond and woodlands to the northeast and west.

7. 0.8ha of mixed scrub habitat would be fenced and planted with a mixture of hawthorn *Crataegus monogyna,* spindle *Euonymus europaeus*, dogwood *Cornus sanguinea*, wild privet *Ligustrum vulgare*, blackthorn *Prunus spinosa* and guelder rose *Viburnum opulus* at a density of 3000 whips per hectare. This slightly lower density planting will encourage the establishment of bramble scrub within this habitat and provide space for some natural colonisation by other trees and shrubs. Small glades would also be incorporated within this habitat as this is a valuable feature within scrub. All whips would be protected with guards to prevent damage by rabbits and deer and planted as bare root stock between November and February. A detailed habitat creation and management would be set out and form a requirement of any future Section 106 agreement or condition.

8. 3.64ha of modified grassland habitat would be sown with a mixture that is more tolerant of higher nutrient levels. The recommended mixture in this instance would contain a mixture of wildflowers commonly found in arable margins, with the MM9(F) mixture from Wildflowers UK, with Agrimony *Agrimonia eupatorium,* wild carrot *Daucus carota*, oxeye daisy *Leucantemum vulgare* and common vetch *Vicia sativa* all found within this mixture, which would be partnered with a suitable grass seed mix to create a total of not less than 19 native species sown. Sowing would take place between September and October or March and April when there is sufficient ground moisture and a careful prescription of more regular cutting of this sward in the first year to encourage good establishment, followed by annual or bi-annual cutting in the late summer and very early spring would be followed as necessary.

9. The creation of these habitats according to the above prescriptions has led to a forecast moderate condition score for both the mixed scrub habitat and the other neutral grassland, creating a yield of 29.73 medium distinctiveness habitat units. This uplift in off-site biodiversity units has led to an overall increase of 20.97 habitat units for this scheme, representing 26.99% net gain (see figure 3).

On-site baseline	*Habitat units*	77.68
	Hedgerow units	2.45
	River units	0.00
On-site post-intervention (Including habitat retention, creation & enhancement)	*Habitat units*	69.34
	Hedgerow units	4.33
	River units	0.00
On-site net % change (Including habitat retention, creation & enhancement)	*Habitat units*	-10.74%
	Hedgerow units	76.59%
	River units	0.00%
Off-site baseline	*Habitat units*	113.48
	Hedgerow units	0.00
	River units	0.00
Off-site post-intervention (Including habitat retention, creation & enhancement)	*Habitat units*	142.79
	Hedgerow units	0.00
	River units	0.00
Total net unit change (including all on-site & off-site habitat retention, creation & enhancement)	*Habitat units*	20.97
	Hedgerow units	1.88
	River units	0.00
Total on-site net % change plus off-site surplus (including all on-site & off-site habitat retention, creation & enhancement)	*Habitat units*	26.99%
	Hedgerow units	76.59%
	River units	0.00%
Trading rules Satisfied?	Yes ✓	

Figure 3. The Headline results from the revised Defra Metric 3.1.

10. Mandatory biodiversity net gain of 10% is not a requirement under the Environment Act until November 2023 and would be highly unlikely to apply to applications that have been submitted before secondary legislation comes into force. Under the National Planning Policy Framework (NPPF) paragraph 179 b) developers should 'identify and pursue opportunities for securing measurable net gains for biodiversity'. This forms the only active policy under which biodiversity net gain is applied as a requirement of planning at a national level. Hertsmere Borough Council policy SP1 – Creating sustainable development states that 'All development across the Borough should:

    ii) conserve and enhance biodiversity, protected trees, and sites of ecological value in the Borough and provide opportunities for habitat creation and enhancement throughout the life of a development.

    Policy SP1 does not make any specific targets for the enhancement of biodiversity and therefore any measurable biodiversity net gain should be considered as policy compliant. The biodiversity net gain offering to support this development far exceeds the requirements to support both local and national policy and should therefore be considered to give **significant weight** in favour of approving the appeal. This would be consistent with the ruling under Appeal Ref: APP/D0121/W/21/3286677 for Rectory Farm, Cheescombe Road, Bristol. This appeal confirmed that the provided measurable significant biodiversity net gains in habitat units and hedgerow units provided were a 'significant enhancement in terms of biodiversity value achieving NPPF standard of delivering measurable net gain'.

APPENDIX SEVEN – FRA & OUTLINE DRAINAGE STRATEGY (REV 3)

Report

12 July2023

Report for: Fairfax Acquisitions Limited
Radlett Field Site
Flood Risk Assessment & Outline Drainage Strategy
P17014_R3_Rev 3
Final

Document version control

Version	Date	Author	Reviewed by	Reviewed and approved by
Draft	27/10/2020	E. Brown	H. Kelly	J. Mortimer
Draft	28/07/2022	H. Kelly	J. Mortimer	J. Mortimer
Draft	15/02/2023	H. Kelly	J. Mortimer	J. Mortimer
Final	12/07/2023	H. Kelly	J. Mortimer	J. Mortimer

Report for:	**Fairfax Acquisitions Limited** Buncton Barn, Buncton Lane, Bolney West Sussex RH17 5RE
Main contributors:	**Henry Kelly (Director)** **James Mortimer (Director)**
Copy to:	

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Executive Summary

The Site extends to approximately 11 ha and comprises (pastoral) agricultural land and woodland. It is proposed to develop a residential led scheme at the Site.

This FRA investigates flood risk at the Site and outlines suitable mitigation measures proposed to ensure the sustainable and safe development of the Site in line with the requirements of the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG).

The Site is located in Flood Zone 1 and therefore has a Low Probability of flooding from rivers and the sea. A wooded depression (former quarry), as well as an additional area in the south of the Site are shown to be at a low to high risk of pluvial flooding. Similarly, small areas in the eastern area of the Site are shown to be at a low risk of pluvial flooding, which is connected to an area of high-risk pluvial flooding (a surface water flowpath) adjacent to the eastern Site boundary. Areas of elevated surface water flood risk within the Site boundary would be addressed with the implementation of the future drainage scheme which would intercept overland flow and direct it to the SuDS features proposed.

Two potential Sustainable Drainage Systems (SuDS) Strategies have been developed for the Site and are included within this report. The principal components of the primary scheme are a detention basin, swales, bioretention area and the infiltration basin within the wooded depression which is a former chalk quarry. The scheme would result in a significant reduction in off-Site runoff rates and volumes post-development. As the wooded depression is within Zone 1 of a Source Protection Zone (SPZ1), a discharge permit application would need to be supported by a hydrogeological Risk Assessment (HRA). There is sufficient space around the Site to include a SuDS train to mitigate the potential risk of pollution from the residential development (as demonstrated within this report) but a second SuDS strategy has been included to give confidence that a viable method is available for water disposal is available ahead of the completion of an HRA and dialogue with the Environment Agency on the matter.

In summary, this report demonstrates that the Proposed Development is appropriate for its location, will remain safe in times of flooding, and will not result in an increase in off-Site flood risk.

1.0 Introduction

1.1.1 Yellow Sub Geo Ltd (Yellow Sub) was instructed by Temple Group Ltd (Temple) on behalf of Fairfax Acquisitions Ltd (Fairfax; the Developer) to carry out a Flood Risk Assessment (FRA) and outline drainage strategy (SuDS) for a parcel of land known as Land South of Shenley Road, Radlett (the Site). The Proposed Development is residential in nature and the Site is located to the southeast of the town of Radlett, Hertfordshire.

1.1.2 This report builds on a previous report produced by Stantec UK Ltd where both the author and reviewer previously worked and as such have first-hand knowledge of the Site. This 2023 revision of the report includes site-specific infiltration rates for the underlying White Chalk at the proposed site of infiltration of on-site runoff water (the wooded depression) as well as deeper borehole soakaway tests located further north (outside of the Source Protection Zone 1 (SPZ1) area).

1.1.3 Additional information and data has also been included in this revised report following a meeting between Yellow Sub, Hertsmere Borough Council (HBC), Hertfordshire County Council (HCC; LLFA), Boyer Planning and WSP on the 23rd June 2023. The meeting followed feedback on the previously submitted FRA and ODS (dated 15th February 2023) and the purpose was to define the additional work required to ensure that flood risk had been adequately assessed and that a viable SuDS strategy has been demonstrated for the Site. The principle point discussed was the presence of a SPZ1 within the southern part of the Site (which includes the wooded depression) and the requirement of a second, back-up SuDS strategy. This has been included in this report along the additional material submitted in response to the LLFA feedback.

1.1.4 This report has been produced in accordance with the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance (PPG). The NPPF and PPG require that flood risk is taken into account at all stages of the planning process to ensure that new development is appropriate for its location, will remain safe, and will not increase flood risk elsewhere.

1.2 Report objectives

1.2.1 This report presents the findings of a FRA for the Site that demonstrates that the proposed residential development meets the above requirements of the NPPF and PPG as well as local and national guidance on sustainable drainage design.

1.3 Available information

1.3.1 This report is based on the following available information:

- Proposed development plans;
- Environment Agency (EA) flood data;
- Hertsmere Borough Council (HBC) Strategic Flood Risk Assessment (SFRA - AECOM 2018).
- Ordnance Survey mapping;
- Open-source LiDAR Digital Terrain Model (DTM) data;

- British Geological Survey mapping;
- Information collected during a site walkover in July 2020; and
- Site specific soakaway test data (Appendix B) and deep borehole soakaway test locations and logs (Appendix C).

1.4 Report limitations

1.4.1 The findings presented in this report are primarily based on information supplied by third parties. Whilst Yellow Sub assumes that all information is representative of past and present conditions, neither Temple nor Yellow Sub cannot guarantee its validity.

1.4.2 This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

1.4.3 The information contained in this report is intended for the use of Fairfax Acquisitions Ltd and no responsibility can be taken by either Temple or Yellow Sub for the use of this information by any third party or for uses other than that described in this report or detailed within the terms of engagement.

2.0 Site setting

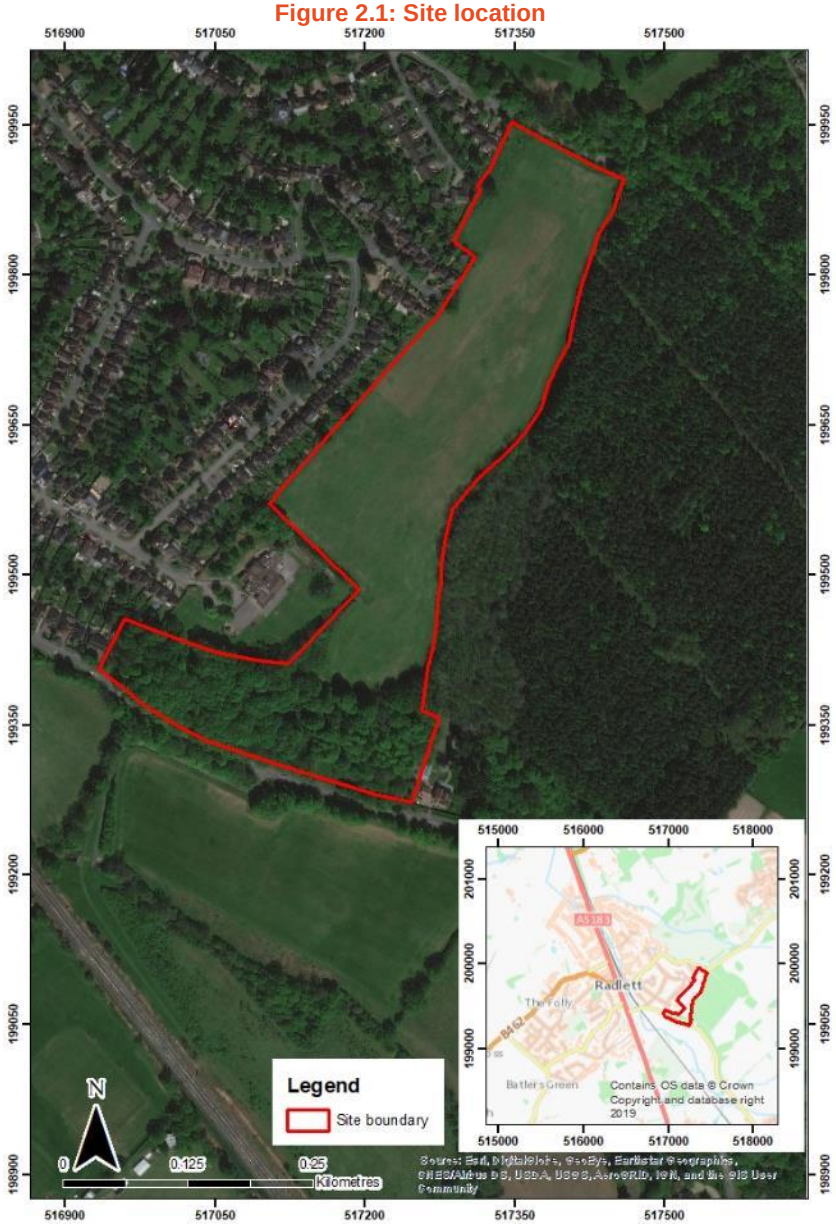
2.1 Description of the existing Site

2.1.1 The Site is located to the east of the village of Radlett in Hertfordshire, to the west of and adjacent to Newberries Avenue and Newberries Primary School. It is centred on National Grid reference TQ 17278 99674 (see Figure 2.1).

2.1.2 The Site comprises a grassed field and wooded area in the south which includes the site of a former chalk quarry and currently includes a large depression. The total Site area is approximately 11 ha.

2.1.3 To the east of the Site is an area of woodland known as “The Gorse”. To the South of the Site is Theobald Street and a watercourse known as “Tykes Water”.

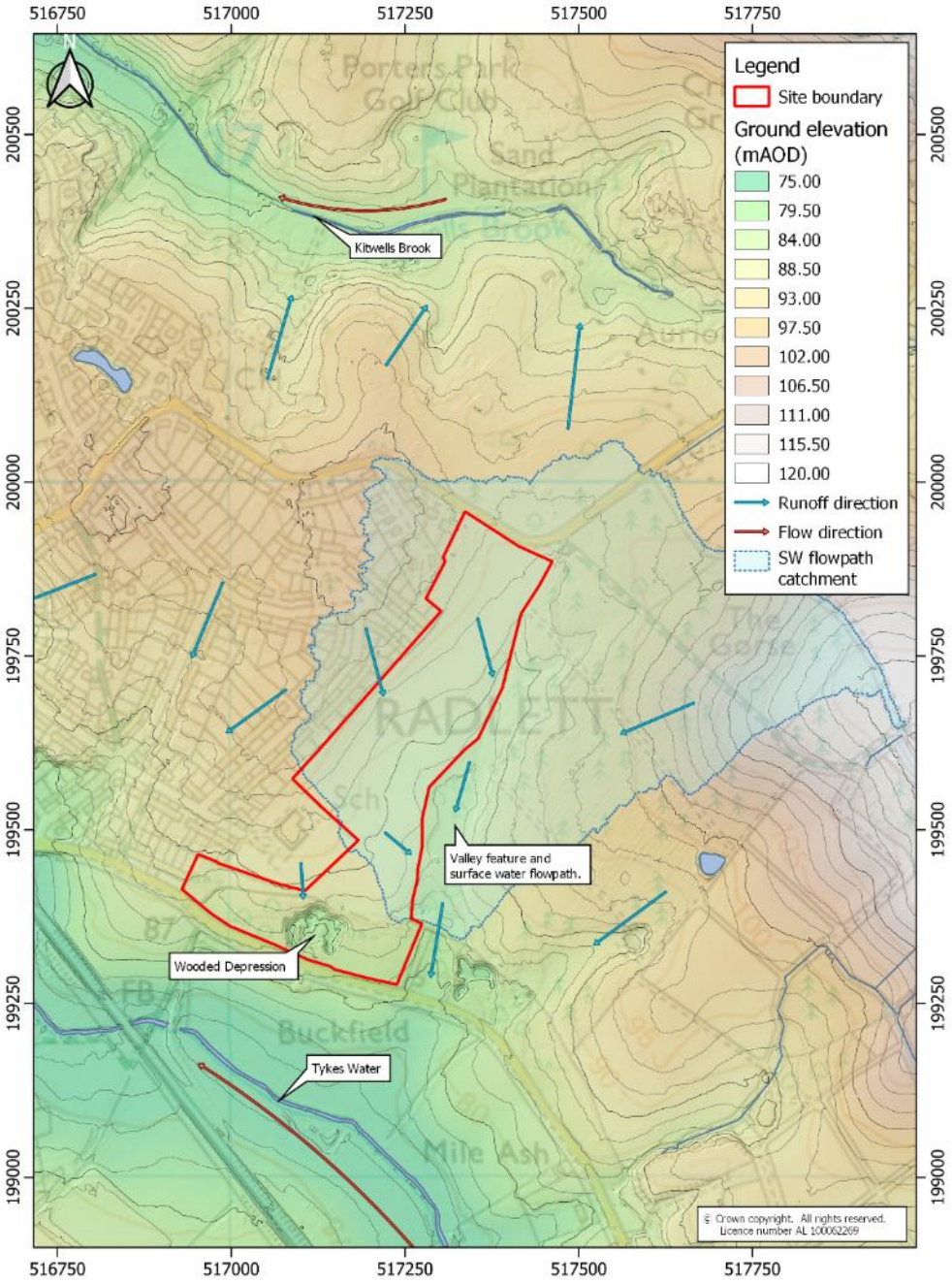
Figure 2.1: Site location



2.2 Topography

2.2.1 The topography of the Site slopes from approximately 97m above Ordnance Datum (m aOD) along its northern boundary to approximately 82m aOD along its southern boundary (see Figure 2.2). These gradients will dictate the flow pathways and discharge location point for surface water runoff that the Site currently generates, which will gravitate towards a natural discharge point in the eastern and southern parts of the Site.

Figure 2.2: Site topography, runoff directions and surface water features



2.2.2 To the east of the Site is a valley feature. This is thought to constitutes an overland flowpath, with surface water flood risk discussed in Section 4.3 of this report. The feature drains a relatively small catchment area of 0.349km2; this was defined using Surfer 2D and 3D surface modelling and analysis software and is presented in Figure 2.2. The catchment area commences just to the north of the Site, and includes a the heavily wooded area to the east. Much of the Site runoff drains to this feature currently (this runoff would be managed by the proposed SuDS scheme post-development).

2.2.3 The wooded depression in the south, created from former quarrying in the area is around 4m to 5m below the surrounding ground elevation.

2.3 Geology, hydrogeology and soils

2.3.1 The Soilscapes library indicates that the Site is covered with slightly acid loamy and clayey soils with slightly impeded drainage. Trial pits excavated for permeability testing (see Section 2.4) validate this description (see Appendix B).

2.3.2 According to British Geological Survey (BGS) mapping data and data collected during on-site intrusive investigation works (see Appendix B and Appendix C), there are no superficial deposits present on Site and it is underlain by the Lambeth Group (Clay, Silt and Sand) overlying the White Chalk. The White Chalk is defined by the EA as a Principal Aquifer and the Lambeth Group a Secondary Aquifer.

2.3.3 The Lambeth Group comprises a low permeability material (see Section 2.4) and this formation overlies the White chalk across the northern part of the Site. The presence of the Lambeth Group is thought to be of sufficiently low permeability as to act as a barrier to flow of groundwater from the underlying White Chalk (as well as infiltrating water from above). The presence of this strata was proven to a depth of 2.4m bgl in a previous trial pitting exercise in the main field (Appendix B). No groundwater was recorded (within the Lambeth Group) during this investigation.

2.3.4 More recent trial pitting exercise (Yellow Sub, 2023) was commenced at a lower elevation within the target infiltration feature which is a former chalk quarry in the south of the Site. This recorded Lambeth Group to between 1.4m bgl and 1.9m bgl followed by the White Chalk proven to a maximum depth of 2.7m bgl. No groundwater was recorded during the investigation/ soakaway testing. Upon the cessation of the works, one trial pit (the lowest) was converted into a groundwater monitoring well (2m below the base of the former quarry) which has not recorded groundwater since the testing was undertaken in February 2023.

2.3.5 The base of the former quarry is at approximately 80m aOD. The closest previous trial pit (TP101; Stantec, 2020) was undertaken along the tree line within the main field which has an approximate surface elevation of 88m aOD. TP03 (Yellow Sub, 2023) was in the base of the former quarry and recorded 1.5m of Lambeth Group over the White Chalk. TP101 recorded Lambeth Group to 2.4m depth. Therefore, it may be estimated that there is 3.9m to 4m of Lambeth Group overlying the White Chalk across the main field and development area. All investigation locations were and, in respect to the Yellow Sub data, have remained dry.

2.3.6 This is confirmed further by the recent deep borehole soakaway testing which recorded between 5.8m and 7.5m of Lambeth Group which demonstrates a thickening sequence across the field from south to north.

2.3.7 The elevation of the water table in the underlying White Chalk is considered to be well below the surface at the Site indicating a thick unsaturated sone below the surface. BGS borehole TL10SE76, located near the north of the Site, notes a rest water level of 38.8m below ground level (m bgl; i.e. well below the surface). The BGS extreme high groundwater elevation data set (which presents an interpolated surface of the peak 1 in 100 year groundwater elevation) has a mean depth to ground water across the Site of >6m.

2.3.8 Given the information reviewed, there seems to be limited prospect of groundwater/ surface water interactions at the Site.

2.3.9 The Site is located within a groundwater Source Protection Zone (SPZ). The Southern part of the Site is within Zone 1 (Inner Protection Zone), the centre of the Site is within Zone 2 (outer protection zone) and the north of the Site is within Zone 3 (total catchment area). This is illustrated in Figure 2.3.

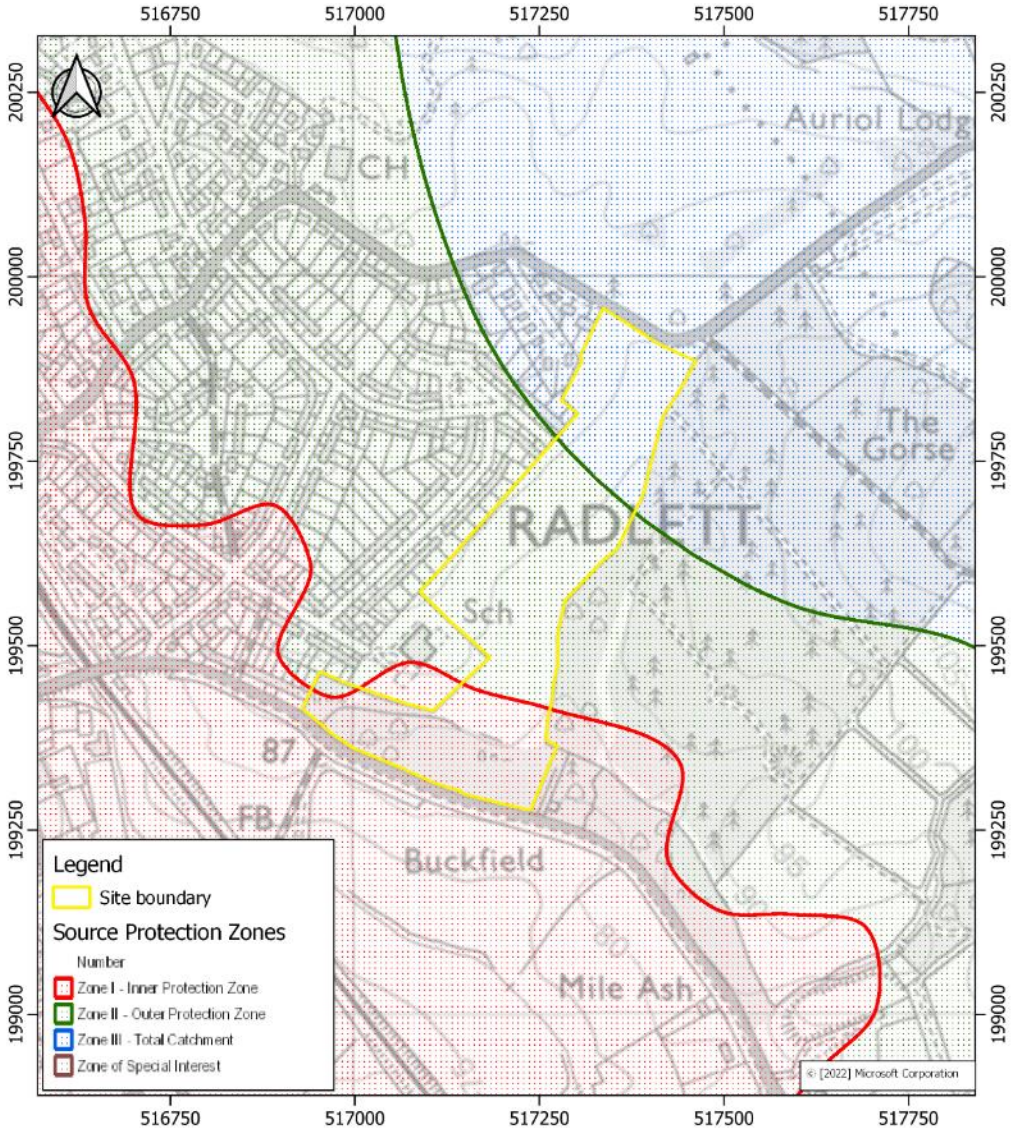


Figure 2.3 EA Source Protection Zones (SPZs)

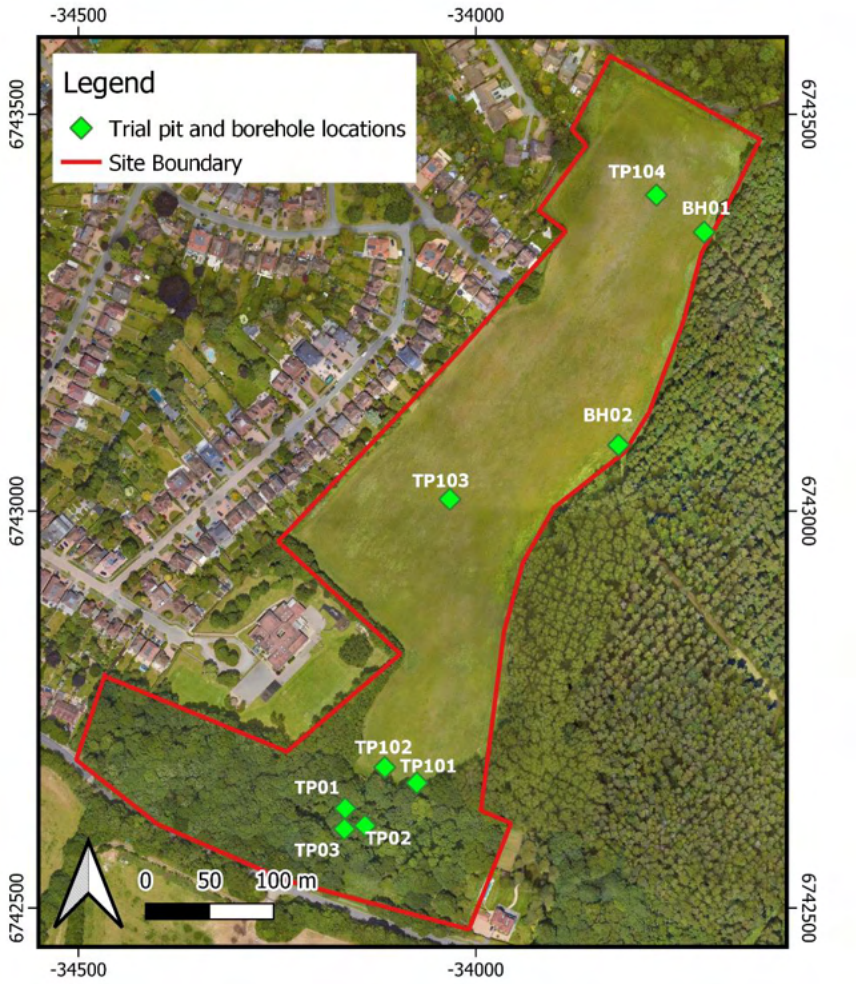
2.4 Permeability testing

2.4.1 Permeability tests were undertaken during a site investigation (Stantec, 2020) with investigation locations presented in Figure 2.4. The permeability tests were conducted at various depths between 2.2m and 2.4m below ground level (bgl) at four locations; two along the wooded area to the south and two in the centre and north of the Site. The testing failed in all four locations, indicating that there was little opportunity for disposal of water to ground within the Lambeth Group deposits.

2.4.2 Soakaway testing within the exposed White Chalk, in the former quarry, was undertaken in early 2023 during one of the site investigation visits. Three pits were excavated into the chalk, with three tests undertaken in each (apart from one pit which only underwent two tests owing to failing light). The tests yielded results ranging from 0.04m/hr and 0.06 m/hr and further details are included in Appendix B.

2.4.3 Additionally, infiltration testing was undertaken within boreholes installed into the White Chalk below the Lambeth Group at the locations shown in Figure 2.4. This was to inform the back-up SuDS Strategy presented in this report, which does not rely on infiltration within Zone 1 of the SPZ.

Figure 2.4: Soakaway test location plan



2.5 Water features

2.5.1 To the South of the Site is a watercourse known as “Tykes Water”, located 180m from the Site boundary. The watercourse flows westwards at this location and is classified as a Main River.

2.5.2 To the north of the Site is Kitwells Brook, a smaller watercourse but also a statutory Main River. The catchment divide between the two watercourses is located just to the north of the northern Site boundary.

2.5.3 A surface water flowpath is located to the east of the Site as stated in Section 2.2. The feature drains a relatively small catchment area of 0.349 km^2 and is presented in Figure 2.2. The length of the feature was walked by Yellow Sub staff in July 2023. On the ground within the afforested area there was no evidence of a channel or depression leading south towards the property ’Buckfield’ on Theobald Street. The area was heavily vegetated but based on local topography, it was considered that surface water was more likely to follow the forestry tracks or edge of the wooded area/ eastern Site boundary. No evidence of a culvert was noted on either side of Theobald Street however private land was not entered.

2.6 Site drainage

2.6.1 There is no formal drainage scheme in place at the Site. Rainfall runoff flows eastwards and southwards ultimately discharging to Tykes Water or infiltrating to ground via the Wooded Depression in the south of the Site.

2.7 Proposed development details

2.7.1 The illustrative masterplan for the Site is provided in Appendix A. The proposal is for a residential development with access roads and parking facilities. The development will contain 195 separate dwellings of varying sizes with gardens and areas of public open space.

2.7.2 In addition, areas for future expansion of the existing Newberries Primary School and a new medical centre are also shown in the south of the Site.

3.0 Potential sources of flood risk

3.1 Flood zones

3.1.1 The PPG defines three flood zones as shown in Table 3.1.

Table 3.1: PPG flood zones

Flood Zone	Return Period (Annual Exceedance Probability)
1	Low probability - less than 1 in 1,000 year (<0.1%) for river or sea flooding.
2	Medium probability - between 1 in 1,000 year (0.1%) and 1 in 100 year (1%) for river flooding or between 1 in 1,000 year (0.1%) and 1 in 200 year (0.5%) for sea flooding.
3a	High probability - 1 in 100 year (1%) or greater for river flooding or 1 in 200 year (0.5%) or greater for sea flooding.
3b	The Functional Floodplain - land where water has to flow or be stored in times of flood. There is not a strict definition of the annual probability of flooding in this zone, but the 1 in 20 year (5%) or greater return period should provide a starting point for consideration.

3.2 Sources of flooding

3.2.1 Flooding can occur from a number of sources as shown in Table 3.2.

Table 3.2: Possible Sources of Flooding Identified in the PPG

Source	Description
Flooding from rivers	River flows which exceed the flow capacity of the river channel (or culverts) can cause flooding from rivers.
Flooding from the sea	High tides and/or storm surges can cause flooding from the sea.
Flooding from land	Intense rainfall that cannot soak into the ground or enter drainage systems can quickly run off the land and result in local flooding.
Flooding from groundwater	Groundwater flooding occurs when water levels in the ground rise above surface elevations.
Flooding from sewers	Sewer flooding can occur when piped systems are overwhelmed by heavy rainfall, when sewers become blocked or when sewers are of inadequate capacity.
Flooding from reservoirs, canals and other artificial sources	Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level.

4.0 Flood risk to the Site

4.1 Flooding from rivers and the sea

4.1.1 The EA's Flood Map for Planning (see Figure 4.1) indicates that the Site is located in Flood Zone 1. As such, the Site has a very low probability of flooding from rivers and the sea.

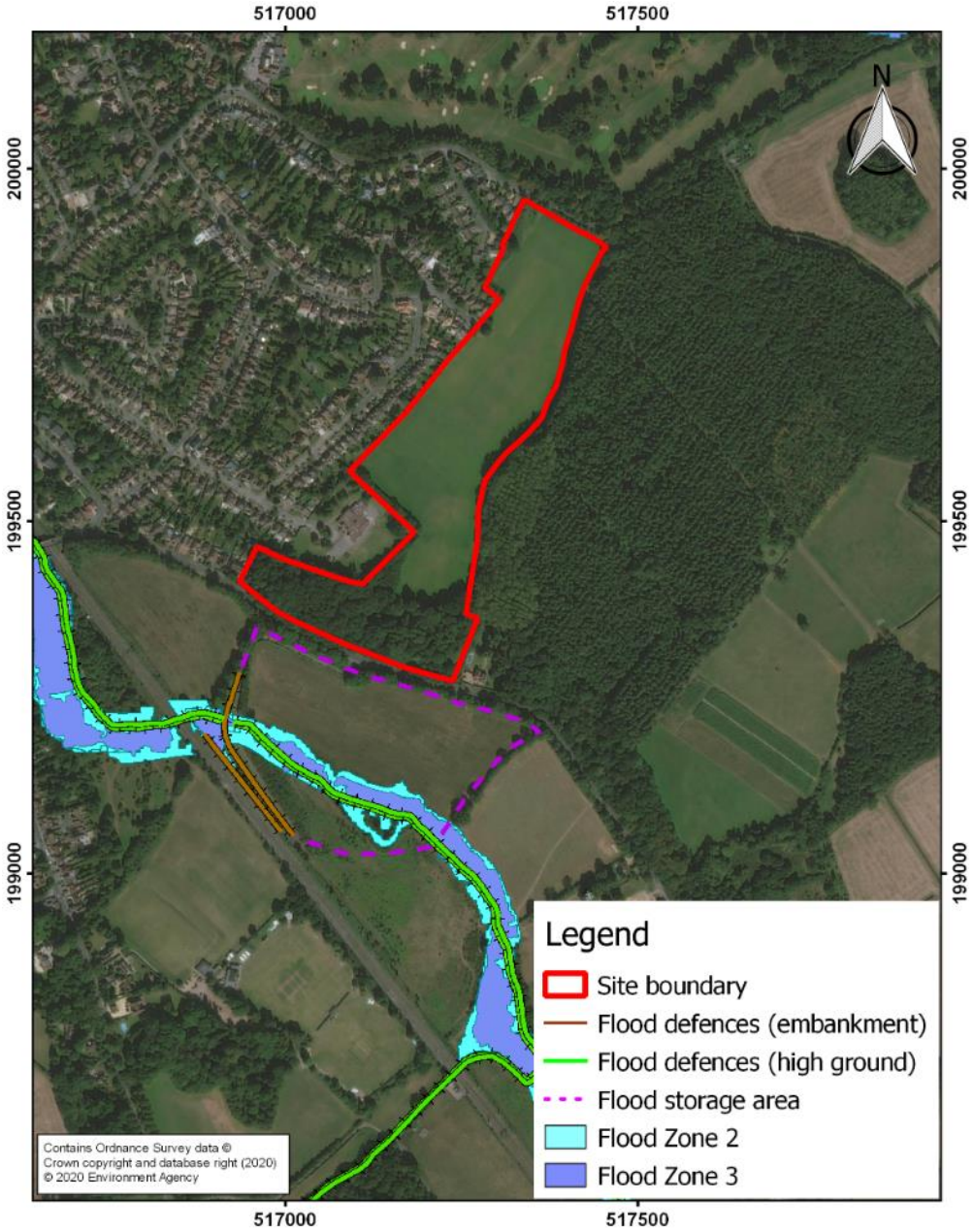


Figure 4.1 EA fluvial and coastal flood risk map

4.1.2 The Site lies approximately 150m to the northeast of the nearest land located within Flood Zones 2 and 3 (180m southwest of the Site at its closest point and associated with Tykes Water). A review of available LiDAR ground elevation data puts the flood elevation of the

1 in 1,000 year event to be approximately 73.2m aOD, considerably lower than the Site elevation at the southern boundary of approximately 82m aOD.

4.1.3 Directly south of the Site, on the opposite side of Theobald Street, is designated flood storage area (see Figure 4.1) (AECOM, 2018 Map G, Existing and Future Flood Alleviation Schemes), which is related to an area of residual risk associated with the Tykes Water (HBC SFRA, 2018 Map I Residual Risk). Flood defences are in place along the banks of the watercourse (see Figure 4.1) including embankments and high ground.

4.2 Climate change

4.2.1 Hertsmere Borough Council SFRA (AECOM, 2018, Map F, Flood Map 2025-2115) indicates that when considering possible increases in Flood Zones as a result of factors including climate change the Site will remain outside of Flood Zone 2 and 3 in future. Accordingly, these sources of flood risk are not considered further.

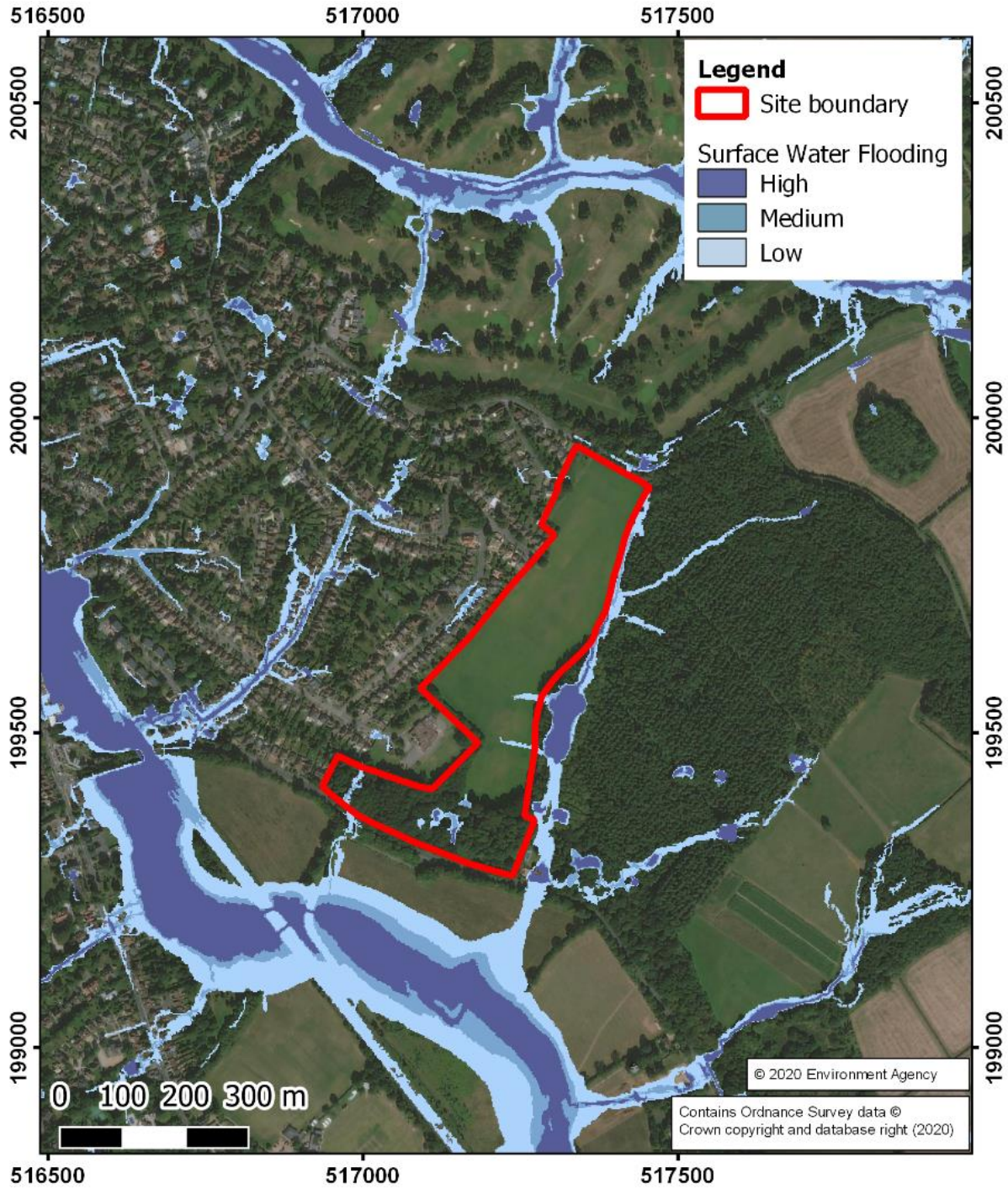
4.3 Flooding from surface water

4.3.1 According to the EA's Flood Map for Surface Water (pluvial) (see Figure 4.2) the majority of the Site is at a very low risk of pluvial flooding. However, mapping indicates that there are areas at a low to high risk in the former quarry in the southern area of the Site, as well as an area of low to medium risk running parallel to the Site boundary in the southwest. Along the eastern Site boundary are two areas of low risk, which are linked to areas of high flooding risk (3.3% annual probability of greater) adjacent to the Site boundary in an area of previously infilled land, where there is an overland flow route.

4.3.2 The flow path to the east of the Site is located off-Site (to the east). The maximum modelled flooding extent does not overlap with /influence the proposed SuDS scheme or development areas (see Figure 4.3). The development area and SuDS are outside of the 1 in 1,000 peak extent envelope (which is a reasonable proxy for the 1 in 100 year event with a significant allowance for climate change).

4.3.3 Two lateral overland flowpaths are noted on-Site (which currently drain eastwards to the main overland flowpath mentioned above). These are derived from on-Site runoff (the residential area to the west will have its own surface water management infrastructure). Site derived runoff will be managed by the SuDS scheme which has been presented in outline form at this stage (see Section 7.0). As an additional note on this topic, the inputs to the surface water flow path in the east will be reduced (betterment) owing to the interception of runoff from the Site by the SuDS scheme. Therefore, the potential surface water flood risk to downstream receptors will, in effect, reduce (for example to residential dwellings on Theobald Street and Theobald Street itself).

Figure 4.2: EA Risk of Flooding from Surface Water Map



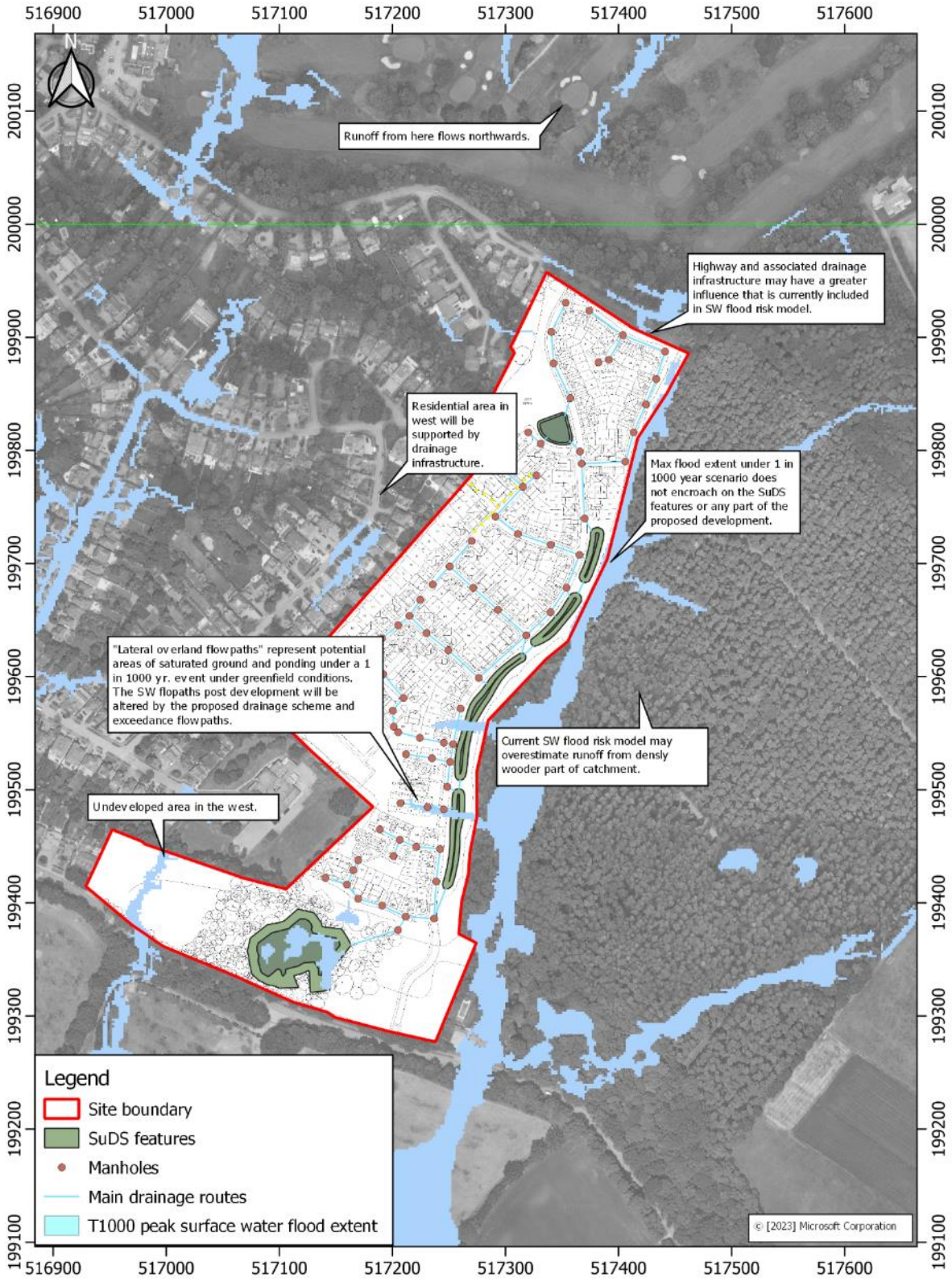


Figure 4.3 Peak SW flood risk extents in relation to proposed development and drainage plans

4.3.4 The maximum modelled extent of the surface water flood risk under the 1 in 1,000 year may be considered to be a conservative estimation in this area for the following reasons.

- Runoff from the land to the east would not generate a significant volume of water to this feature as the residential development will be supported by its own water management infrastructure (likely to manage flows up at the 1 in 30 year event at least).
- The road to the north (and the drainage infrastructure included) will have some influence on the overland flow route from the north (small catchment), perhaps intercepting and diverting some of this flow.
- Much of the catchment area to the east is heavily wooded and would generate relatively little runoff. This will be represented in the surface water flood risk model in terms of roughness, but it is quite possible that the quantity of runoff simulated from this area is an overestimation.

4.3.5 According to Map B of the HBC SFRA, incidents of surface water flooding are not reported to have occurred at the Site. The SFRA does indicate a reported incidence of surface water flooding (land drainage) within 100m of the Site, at the intersection between the surface water flowpath and Theobald Street (Map B- AECOM, 2018).

4.3.6 As the flow path is off-Site (although it is acknowledged that the peak flood envelope encroaches into the eastern boundary) and will not be influenced by the proposed development other than to limit inflows from the Site area (a result of the introduction of the proposed SuDS scheme).

4.4 Flooding from groundwater

4.4.1 According to the HBC SFRA (2018), groundwater flooding in the borough is possible due to the underlying White Chalk bedrock. However, The Site is overlain with the lower permeability Lambeth Group and the likelihood of groundwater emerging at the ground surface on Site is considered to be negligible, based on a conceptual model approach to assessing groundwater flood risk.

4.4.2 Commercial groundwater flood risk data (GeoSmart Groundwater Flood Risk Data v2.4) has been obtained for the Site area (Figure 4.4). This classifies the Site and surrounding area as being at a negligible risk of groundwater flooding (see definitions of groundwater flood risk zones included in Table 4.1).

4.4.3 The elevation of the water table in the underlying chalk is thought to be well below the surface at this location. BGS borehole TL10SE76, located near the north of the Site, notes a rest water level of 38.8 meters below ground level (m bgl - i.e. well below the surface). The BGS extreme high groundwater elevation data set (which presents an interpolated surface of the peak 1 in 100 year groundwater elevation) has a mean depth to ground water across the Site of >6 m. On-site groundwater monitoring in shallow (c. 2 m) wells retained after the soakaway testing have been dry on each visit – this includes a monitoring well installed in the base of the wooded depression and both deeper boreholes (10m).

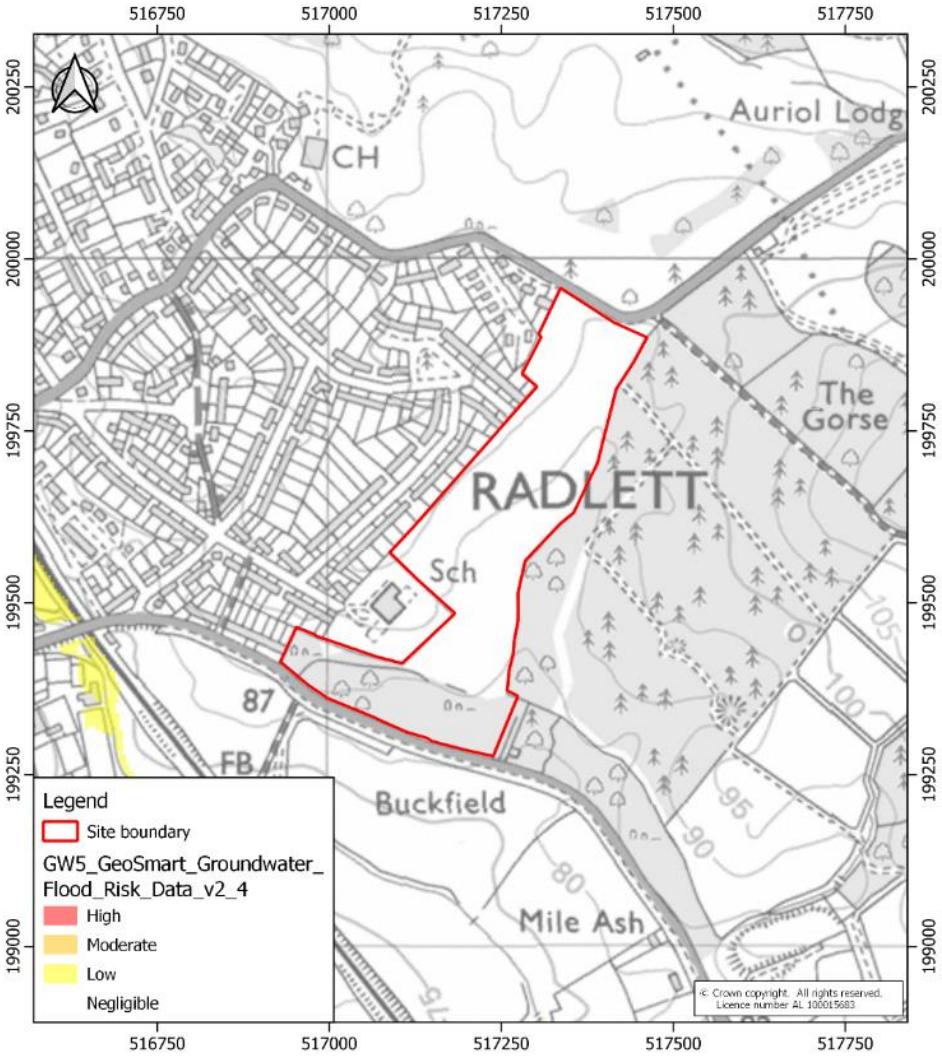


Figure 4.4 Groundwater flood risk (Geosmart Information, 2023)

Table 4.1 Groundwater flood risk zone descriptions (Geosmart Information, 2023)

Risk Level	Description
1	There is a negligible risk of groundwater flooding in this area and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
2	There is a low risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.
3	There is a moderate risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.
4	There is a low risk of groundwater flooding in this area with a chance of greater than 1% annual probability of occurrence.

4.4.4 Overall, the risk of groundwater flooding at the Site is considered to be low/negligible.

4.4.5 Given the absence of groundwater expected in proximity to the surface and the presence of the lower permeability Lambeth Group over much of the Site, the prospect of groundwater/surface water interactions at this locations would seem to be unlikely.

4.5 Flooding from sewers

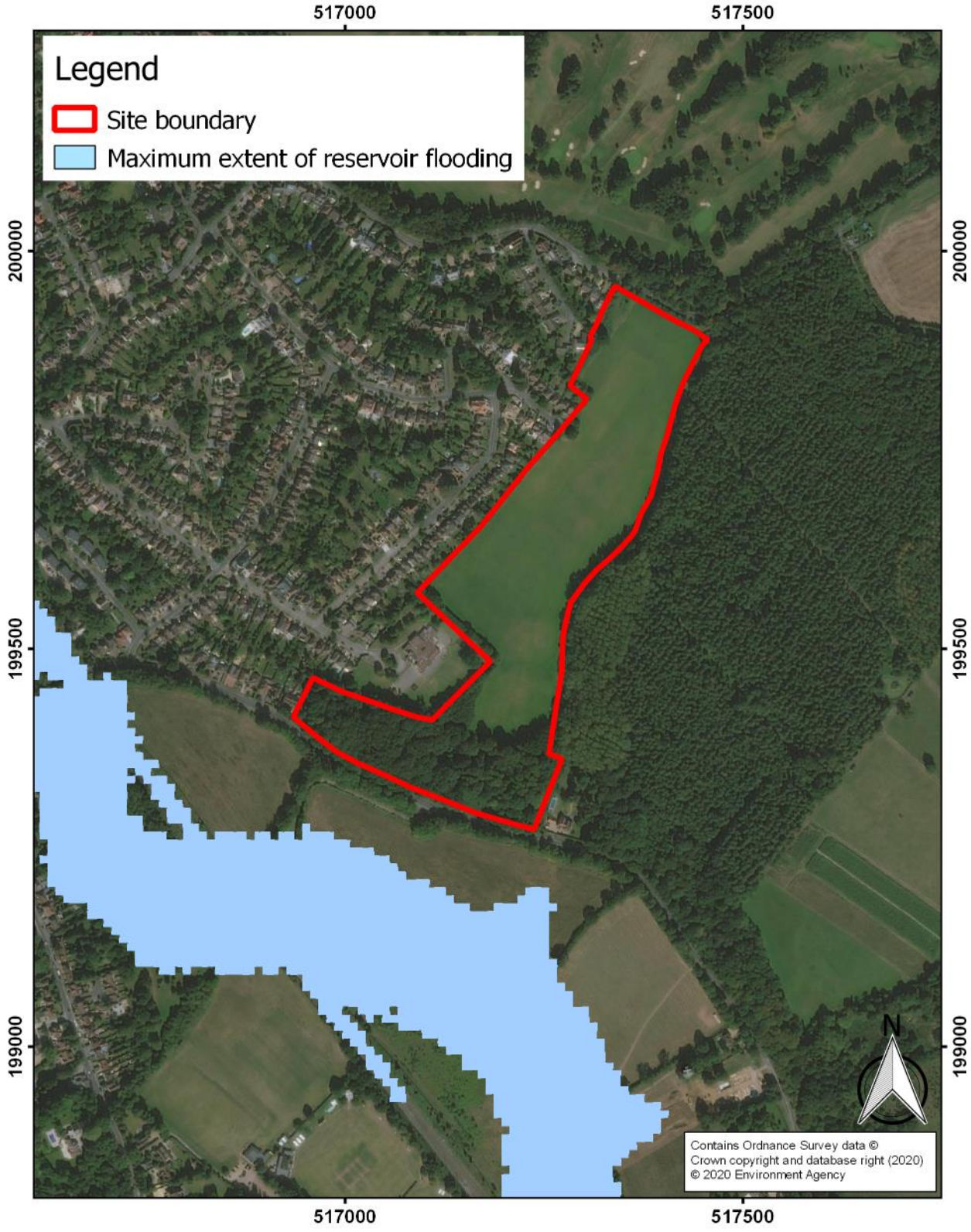
4.5.1 The Site currently comprises a predominantly greenfield plot of land with the exception of the former quarry in the south of the Site. The risk of flooding from sewers is therefore currently considered to be negligible to very low. Map K of the SFRA confirms the Site is in an area at low risk of sewer flooding (AECOM, 2018).

4.6 Flooding from reservoirs, canals and other artificial sources

4.6.1 According to the EA's Risk of Flooding from Reservoir mapping the Site is not at risk of flooding from reservoirs, see Figure 4.5 (EA, 2020).

4.6.2 Culverts and bridges have been identified within 1km of the Site. However, these structures are at a significant distance from the Site and are unlikely to represent a flood risk to the Site in the event of a blockage. Map B of the SFRA has not identified any historical drainage issues within the Site area (AECOM, 2018).

Figure 4.5: EA data maximu extent of reservoir flooding



5.0 Planning practice guidance

5.1 Proposed land use classification

5.1.1 The proposed residential development is classified as a 'More Vulnerable' land use, which is defined under the PPG as: "Buildings used for dwelling houses..." According to the PPG, this would mean that the proposed development is considered appropriate for location within Flood Zone 1.

5.2 Sequential test

5.2.1 The sequential test aims to steer new development to areas that have the lowest probability of flooding. Given that the Proposed Development is located within Flood Zone 1 (low probability), the sequential test is considered to be passed.

5.3 Exception test

5.3.1 In some cases this may need to be applied once the sequential test has been considered. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. Given that the proposed development is located within Flood Zone 1 (low probability), and the development would be classed as 'More Vulnerable' (residential) this is classed as acceptable according to National Policy.

6.0 Flood risk considerations

6.1 Key considerations

6.1.1 To meet (or exceed) the PPG requirements, 'More Vulnerable' residential land use such as that proposed at the Site will be considered suitable for locations within Flood Zone 1 provided it:

- Remains safe in times of flooding whilst taking climate change into account;
- Results in no net loss of floodplain storage;
- Does not impede flood water flows; and
- Does not increase the volume and rate of surface water runoff leaving the Site over its intended design lifetime.

6.1.2 Each of these requirements is discussed in relation to the proposed development in Sections 6.2 to 6.5 below.

6.2 Remain safe in times of flooding

6.2.1 EA flood risk mapping (see Figure 4.1) indicates that the Site is located within Flood Zone 1, meaning that the Site is unlikely to be affected by fluvial or tidal sources.

6.2.2 On-Site surface water flow paths are only evident in the extreme, 1 in 1,000 year event flood risk data, but not for the lesser events (defined as being a low risk zone of surface water flooding). The following points are noted on the subject of surface water flood risk:

- The principal surface water flowpath is located off-Site to the east and does not affect the development area or SuDS features (see Figure 4.3).
- The 1 in 1,000-year event data represents a very extreme storm scenario and may be considered an appropriate proxy for a 1 in 100-year storm event with an uplift allowance for climate change induced increases in rainfall intensity.
- The lateral flowpaths noted on-Site (under the 1 in 1,000-year event) are derived principally from on-Site runoff. The development to the west will have its own water management infrastructure.
- On-Site runoff will be managed by the SuDS strategy post-development (resulting in a reduced input to the eastern surface water flowpath (betterment)).

6.2.3 Surface water flooding is not thought to present a risk to life at the Site post-development based upon the information reviewed.

6.2.4 The Site is not at risk of any other sources of flood risk based on the information reviewed.

6.3 No net loss of floodplain storage

6.3.1 As the Site is not located within a floodplain there will be no loss in floodplain storage.

6.4 No impediment to flood water flows

6.4.1 The Site is not within a floodplain and will not impede fluvial flood flows

6.4.2 The proposed development layout has be designed to ensure that the development does not interfere with the surface water flow pathways, particularly the area identified in Section 4.3.6, that is shown to run parallel to the eastern Site boundary.

6.5 Surface water runoff management

6.5.1 The proposed residential development will be located on previously undeveloped, greenfield land. A significant proportion of the Site will comprise impermeable surfaces following its development (for example roofs and larger access roads) which will result in greater runoff rates and volumes without the implementation of appropriate mitigation measures. A sustainable urban drainage strategy (SuDS) for the Proposed Development is presented in Section 7.0.

6.5.2 The proposed development should be steered away from the eastern Site boundary, or if development is to occur on these areas, consideration should be given to placing areas adjacent to the eastern boundary as garden areas, amenity areas or preferably SuDS features, so as not to impede surface water flows.

7.0 Outline Sustainable Drainage (SuDS) Strategy

7.1 Introduction

7.1.1 The following sections describe the outline SuDS Strategy for the Proposed Development with due regard to DEFRA's Non-Statutory Technical Standards for SuDS (DEFRA, 2015), the CIRIA SuDS manual (CIRIA, 2015) and the PPG for Flood Risk and Coastal Change, which recommends the following hierarchy for the disposal of surface water from new developments:

1 Discharge to ground via infiltration techniques (most preferred)[1];

2 Discharge to a surface water body;

3 Discharge to a surface water sewer, highway drain, or another drainage system and,

4 Discharge to a combined sewer (least preferred).

7.1.2 The proposed residential development will be located on previously undeveloped, largely 'greenfield' land. A significant proportion of the Site will comprise impermeable area following its development (for example roofs and main access roads). Without appropriate management, this would result in a significant increase in both the volume and rate of surface runoff generated by the Proposed Development, which could lead to an increase in surface water flood risk elsewhere (i.e. downstream). Surface runoff from the developed Site will, however, be sustainably managed using SuDS, as described in the following sections.

7.1.3 SuDS aim to mimic the natural drainage characteristics of a site prior to its development by controlling surface water runoff as close to where the rain falls as possible e.g. through interception and re-use, evaporation and infiltration into the ground. Furthermore, SuDS provide opportunities to remove pollutants from runoff and also provide amenity and biodiversity benefits.

7.2 Runoff destination

7.2.1 The White Chalk underlying the Lambeth Group is generally known to be a permeable medium and suitable receptor for runoff. Literature values of infiltration rates range from 0.001 to 100m/hr (Innovyze, 2020). Soakaway testing within the exposed White Chalk, in the former quarry, was undertaken in early 2023 during one of the site investigation visits. Three pits were excavated into the chalk, with three tests undertaken in each (apart from one pit which only underwent two tests owing to failing light). The tests yielded results ranging from 0.04m/hr and 0.06 m/hr and further details are included in Appendix B.

7.2.2 Observations made while exploring the depression on foot noted it to be around 4m to 5m deep, well drained (with no evidence of standing water of boggy conditions) and with some humus rich soil in the area. Mature trees were noted (sycamore, ash, sweet

[1] On-site water reuse is now also considered to be a preferred method for surface water disposal.

chestnut and hazel) but there was little in the way of ground covering vegetation. Photos of the feature are included in Appendix C.

7.2.3 The White Chalk underlying the Site has been demonstrated as being sufficiently permeable to allow surface water from the Proposed Development to be discharged to ground using infiltration techniques. However, the White Chalk is overlain across the majority of the Site by the less permeable Lambeth Group as demonstrated by the infiltration testing (see Section 2.4 and Appendix B). As a result, the intention is to discharge surface water runoff to the White Chalk in the former quarry (entitled “wooded depression” in this report) in the south following a SuDS train through the Site. The other features included in the drainage scheme are permeable paving, a detention basin (“Detention Basin”), along swale sequence in the east (“Eastern Swale”), a long swale in the south (“Southern Swale") and a bioretention basin (“Bioretention Area”) upgradient of the Wooded Depression. Further attenuation and water quality treatment (as well as biodiversity and amenity value) will be provided by these features.

7.2.4 The Proposed Development layout has been divided into three sub-catchments (titled Northern, Central, Central-southern and Southern respectively) that drain into each feature (see Figure 7.2). These sub-catchments have been delineated based on the indicative layout plan included in Appendix A and LiDAR Digital Terrain Model (DTM) data.

7.2.5 The features described above operate as a SuDS management train, with water being discharged from each feature, at a limited rate, to the downgradient catchment. A schematic of this arrangement is presented below.

Figure 7.1: Sequence of flow in the SuDS train.

7.2.6 An initial drainage network has been drafted based upon the outline development plan and the current Site topography (see Figure 7.3). Indicative key pipeline routes and manhole locations are also included in Figure 7.3.

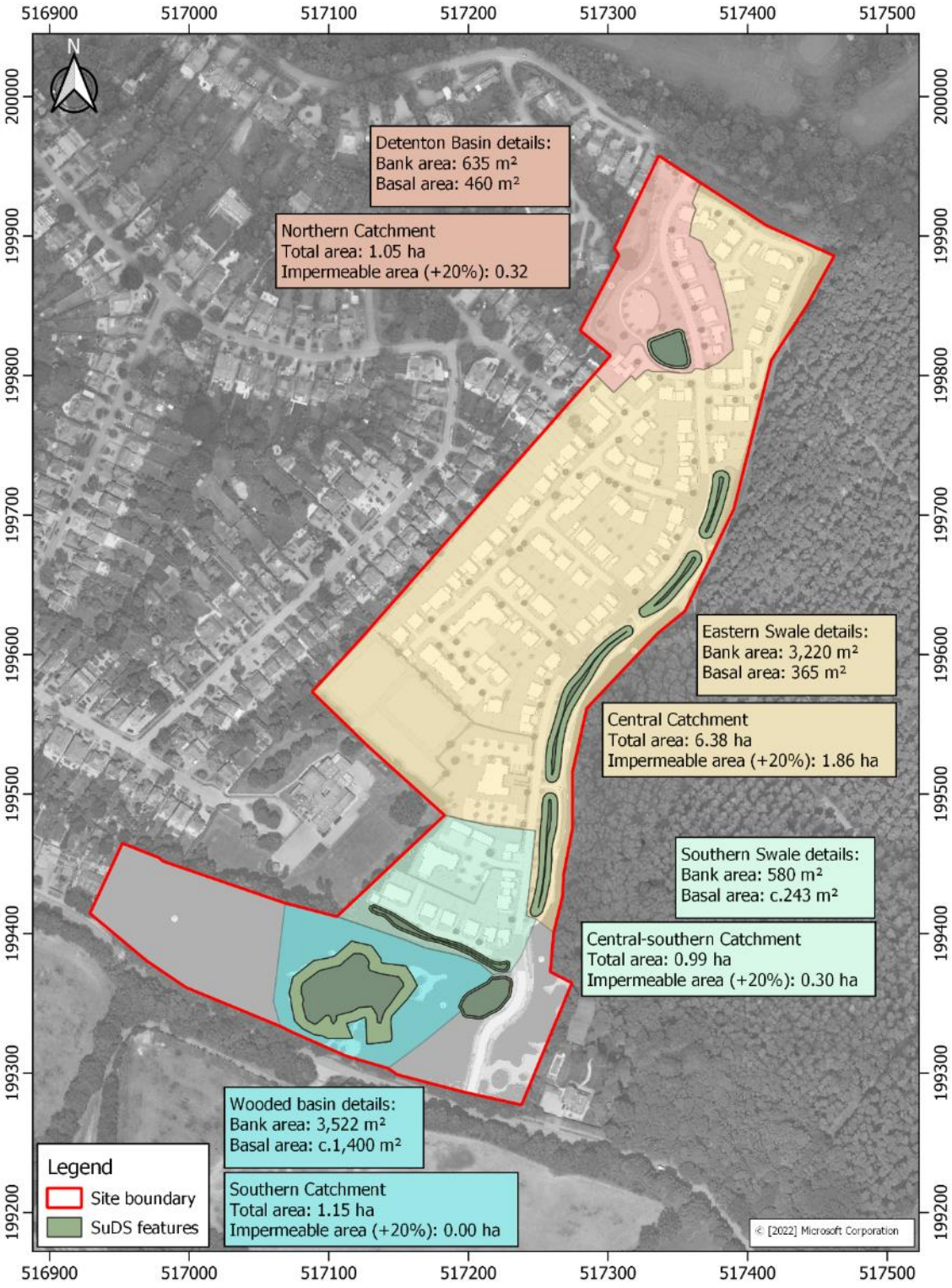


Figure 7.2: Catchment areas serving the proposed SuDS features

Figure 7.3 Outline drainage strategy

7.3 Greenfield runoff and permissible discharge rates

7.3.1 The Institute of Hydrology Report 124 (IH124) method in the 'Rural Runoff' calculator within MicroDrainage was utilised to estimate the greenfield runoff rates for the existing Site (see Appendix D). The calculation was carried out for an assumed Site area of 50 ha, with the rate then pro-rated per unit area (as recommended in the Interim Code of Practice for SuDS Design and Environment Agency/DEFRA Report: Preliminary Rainfall-Runoff Management for Developments (DEFRA, 2015)). The 'QBAR' (i.e. 1 in 2.3 year return period) greenfield runoff rate for the existing Site was thus determined along with runoff rates for other return period storm using the regional growth curve (see Table 7.1).

Table 7.1: Greenfield runoff

Return period (yrs)	Runoff rate (l/s)
1	41..0
2.3 (Qbar)	48.2
30	109.2
100	153.7

7.3.2 The QBAR greenfield runoff rate was used to define the 'permissible discharge' rate for the Site. As such, a 48.2 l/s 'permissible discharge' rate has been assumed, although this is largely academic given that the majority of Site runoff will be discharged to ground post-development.

7.4 SuDS features design

7.4.1 The initial design of the SuDS features has been undertaken using the MicroDrainage software. Simulations were run for the 1 in 100-year event plus a 40% allowance for climate change (i.e. the upper end allowance for the 2070's epoch in the Colne Management Catchment).

7.4.2 Hydrological descriptors for the Site were obtained from the Flood Estimation Handbook (FEH) website (CEH, 2020). These are shown in Table 7.2 below.

Table 7.2: FEH Catchment Descriptors

Catchment Descriptor	Abbreviation	Value
Base Flow Index associated with each HOST soil class	BFIHOST19	0.427
Proportion of time when soil moisture deficit was equal to, or below, 6mm during 1961-90	PROPWET	0.293 (i.e. 29% of the time)
Average Annual Rainfall (1961 – 1990)	SAAR	677 mm

7.4.3 GIS software was used to calculate the total area within the sub-catchment draining to each SuDS feature (see Table 7.3 below) and the impermeable area within each catchment. Permeable paving areas have not been included in total impermeable areas.

The impermeable areas have been increased by 10% to allow for urban creep over time and an additional 10% to allow for runoff from residual permeable surface areas.

Table 7.3: Catchment areas draining to each SuDS feature

Catchment	Total area (ha)	Impermeable runoff (ha)	Impermeable runoff +20% (ha)
Detention Basin (Northern Catchment)	1.05	0.27	0.32
Eastern Swale (Central Catchment)	6.38	1.55	1.86
Southern Swale (Central-Southern Catchment)	0.99	0.25	0.30
Bioretention Area (no catchment)	n/a	n/a	n/a
Wooded Depression	1.15	0.00	0.00

7.4.4 The infiltration rate for the Wooded Depression was calculated at between 0.04 m/hr and 0.06 m/hr during on-site testing. A value of 0.044 m/hr was used in these calculations - the lowest value obtained during the testing. A value of zero was used for the main swale and northern detention basin based on the Site specific test results (see Appendix B). A safety factor of 2 (MicroDrainage default setting) was also maintained for the calculations (note infiltration losses have been applied to the Wooded Depression only).

7.4.5 The Winter volumetric runoff coefficient for impermeable areas was set to 1.00 as agreed during the discussions between Yellow Sub and WSP on 23rd June 2023.

7.4.6 Orifice flow controls have been implemented in the model for now, but these may be substituted for alternative features at the detailed design phase.

7.4.7 The MicroDrainage Cascade function was used to input the outflow from upgradient catchments as per the arrangements shown in Figure 7.1. In this way the performance of the scheme as a whole can be assessed as well as the individual features themselves.

7.4.8 The dimensions/ details of each SuDS feature are presented below. Note that the Site has a fairly steep gradient and therefore some check dams within the Eastern Swale sequence will be required over its length. This will maximise the storage capacity available and increase residency time within the feature. This fine tuning of the scheme can be achieved during the detailed design phase and for now, this has been modelled as a single feature with a single invert/ bank levels to demonstrate the broad general feasibility of the scheme.

7.4.9 The permeable paving areas have not been modelled individually but their surface area was removed from the overall impermeable areas used in the calculations for each of the main SuDS features.

Table 7.4: Details of SuDS features

Feature	Feature invert level (m AOD)	Bank elevation (m AOD)	Feature Depth (m)	Side slopes	Area of base (m^2)	Surface area at bank (m^2)	Total volume (m^3)	Outfall	Outfall elevation
Detention Basin	93.5	94	0.5	1:3	460	635	273	0.15 m orifice	93.5
Eastern Swale	91.5	93	1.5	1:3	365	3,220	c. 2000 depending on check dam arrangements	0.6 m orifice	91.5
Southern Swale	90.50	91.5	1.0	1:3	243	580	206	0.80 m orifice	90.5
Bioretention Area	84.35	85.10	0.75	1:3	658	818	343.5	Filtration	84.35
Wooded Depression	77.67	82.07	4.40*	As per current state	c. 1400	3,522	5,972**	None	N/A

** Maximum depth according to 1 m LiDAR data*

*** Calculated using 1 m LiDAR data*

7.4.10 Appendix E contains the output from the MicroDrainage simulations. This confirms that, based on the parameters described above, the proposed drainage scheme will be able to attenuate and infiltrate all runoff generated during the 1 in 100 year storm event with a 40% allowance for climate change. A summary of the performance of each feature is included in Table 7.5 which includes remaining freeboard depths under the 1 in 100 year +40% storm event.

Table 7.5: Performance of the SuDS features under a 1 in 100 year + 40% storm event.

Feature	Critical duration (mins)	Max. water level (m AOD)	Min. freeboard remaining (m)
Detention Basin	180	93.83	0.16
Eastern Swale	15	92.76	0.22
Southern Swale	30	91.41	0.10
Bioretention Area	30	85.07	0.03
Wooded Depression	600	80.67	1.40

7.4.11 The half drain time for the Wooded Depression is 878 minutes (c. 14.75 hrs) for the 1 in 100 year event + 40% climate change allowance. This is for a very extreme event and assumes a relatively low (0.04 m/hr) infiltration coefficient (and a safety factor of 2). Day to day, we expect the feature to drain well and waterlogging not to occur such that root damage to the existing trees does not occur. However, as part of the landscaping strategy planting of more water tolerant species in this area (such as alder and willow) to increase the diversity and resilience of the woodland will be undertaken.

7.4.12 It should be noted that the MicroDrainage calculations for the SuDS features are conservative, as they assume that these are the only SuDS features that will serve the Proposed Development. As the detailed layout plan evolves, it will be possible to include further SuDS techniques within the development layout in order to enhance the 'SuDS Management Train'. Techniques such as rainwater capture and re-use, linear conveyance swales, green corridors, and bio-retention areas will be considered during the development of the detailed layout to maximise water efficiency, water quality, biodiversity, health and wellbeing, and amenity benefits.

7.5 Exceedance routes

7.5.1 The available freeboard within each feature will ensure that their respective capacity will in reality be somewhat greater than the 1 in 100-year (plus 40% for climate change) event. Due consideration, however, also needs to be given to the exceedance routes that could occur during events above the design standard of the various components of the proposed SuDS Strategy (i.e. surface water sewers and the infiltration basins).

7.5.2 Figure 7.4 shows exceedance routes for two scenarios:

Surcharging water from the proposed surface water sewers under storm conditions ranging from the 1 in 30-year event to the 1 in 100-year event plus climate change.

7.5.3 Under this scenario, water would surcharge from manholes and be safely conveyed along the road surfaces to the respective downgradient SuDS features. These exceedance flows would be shallow and contained within road kerbing. These exceedance routes have been calculated using the proposed stormwater drainage routes (Figure 7.3) and the existing LiDAR DTM data.

Over-topping of the SuDS features under events in excess of the 1 in 100 year plus 40% return period which has been used for the feature design in this instance.

7.5.4 Under these extreme events, exceedance flows from the SuDS features will be designed to follow the existing preferential surface water flow pathway through the Site (i.e. to the southeast) and away from proposed nearby dwellings. Note that overflow features are proposed in the eastern and southern extents of the Southern Swale and Bioretention Area to divert exceedance flows away from the Wooded Depression (site of infiltration).

7.5.5 We believe that the eastern swale sequence is located in an appropriate location, downgradient of the development areas (allowing for a gravity driven SuDS scheme and removing the development areas from the exceedance flowpaths.

7.6 Water quality

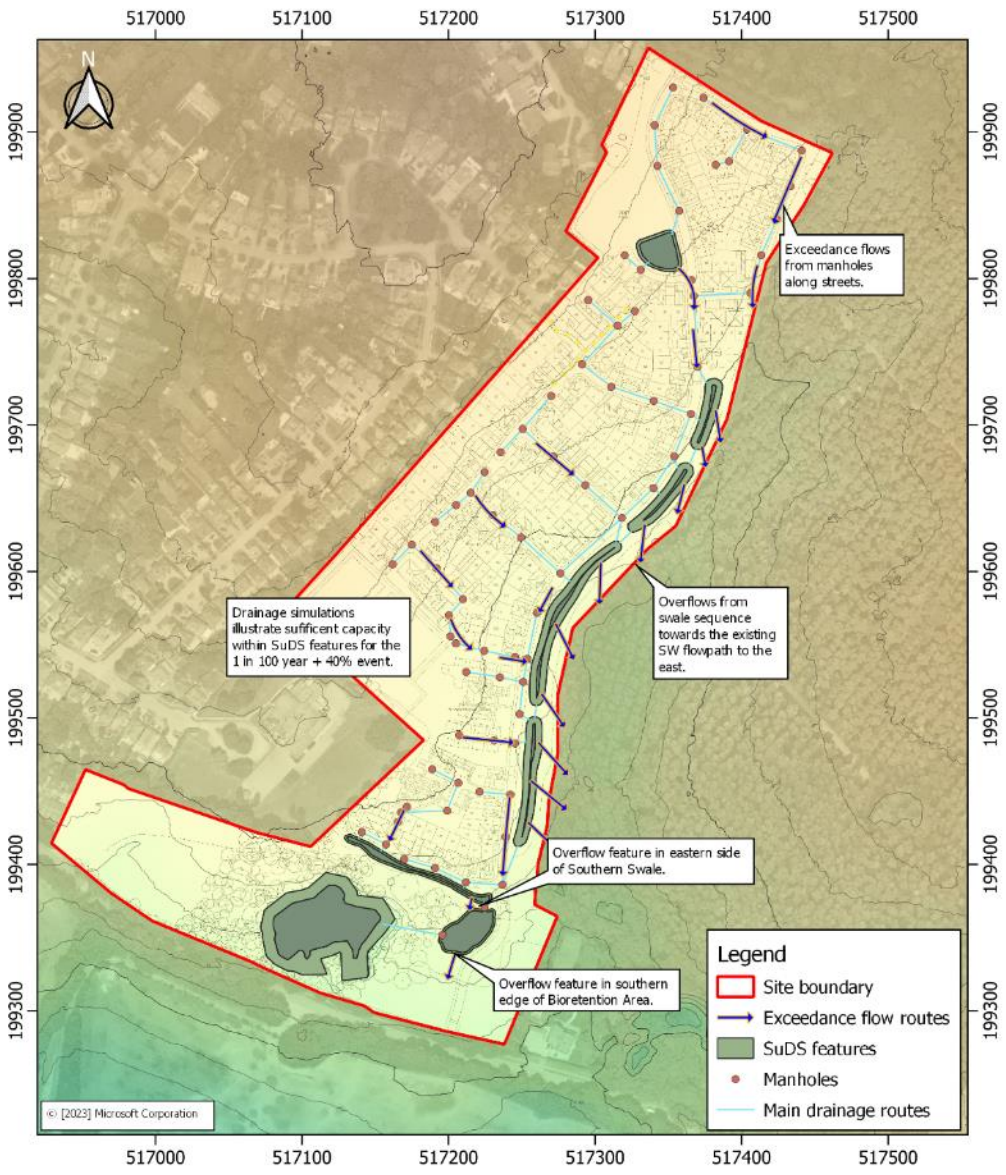
7.6.1 SuDS techniques can be used to effectively manage the quality of surface water flowing across a site. Different methods can be used to intercept pollutants and allow them to degrade or be stored in situ without impacting the quality of water further downstream. Frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5mm to 10 mm of rainfall (i.e. the 'first flush') should be adequately treated using SuDS.

7.6.2 The proposed development will include residential dwellings, low traffic roads and driveways. The CIRIA SuDS manual categorises runoff from residential dwellings as presenting a very low water quality hazard and runoff from low usage roads and residential driveways as presenting a low hazard rating.

Table 7.6: Water quality hazard ratings (CIRIA, 2015)

Land use	Hazard level
Residential Roof drainage	Very Low
Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.	Low
Commercial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).	Medium
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemical and fuels (other than domestic fuel oil) are delivered, handled, stored used or manufactured, industrial sites.	High
Trunk roads and motorways	High

Figure 7.4: Exceedance flow routes



7.6.3 The CIRIA SuDS manual (CIRIA, 2015) advocates a qualitative approach to designing a SuDS scheme for a site with a low hazard rating. This should provide adequate controls on pollutants contained in runoff water.

7.6.4 As the Proposed Development is residential in nature with a low hazard rating, hazard indices of 0.5 for Total Suspended Solids (TSS), 0.4 for Metals and 0.4 for Hydrocarbons are considered applicable.

7.6.5 The CIRIA SuDS Manual (Section 26.3) states that where a discharge is proposed to protected groundwater (i.e. SPZ1), an additional treatment component (i.e. over and above that required for standard discharges) or other equivalent protection is required that provides environmental protection in the event of an unexpected pollution event or poor system performance.

7.6.6 Additional water quality treatment measures (beyond the SuDS features already included) and safeguards have been incorporated into the SuDS scheme upgradient of the Wooded Depression within this revised SuDS Strategy.

7.6.7 The following measures are examples which are suitable for inclusion in a drainage strategy for a residential development to mitigate a potential increase in sediment loads within on-Site and off-Site runoff. Removal indices are included for each feature type relative to the specific pollutant.

Table 7.7: Mitigation indices for SuDS components

Component Type	TSS	Metals	Hydrocarbons
Filter drain	0.4	0.4	0.4
Swale	**0.5**	**0.6**	**0.6**
Permeable paving	**0.7**	**0.6**	**0.7**
Detention basin (also used for infiltration basin in this assessment)	**0.5**	**0.5**	**0.6**
Bioretention area	**0.8**	**0.8**	**0.8**
Pond	0.7	0.7	0.5

7.6.8 Table 7.8 provides a more detailed view of the pollution removal potential of bioretention systems as taken from the CIRIA SuDS manual (CIRIA, 2015)

Table 7.8 Pollution removal potential of bioretention systems (CIRIA, 2015)

Pollutant	Typical removal efficiency
TSS	> 90%
Total phosphorous	> 80%
Nitrogen	50% on average
Metals (zinc, lead, cadmium)	> 90%
Metals (copper)	up to 60%

7.6.9 The sequence of permeable paving, a detention basin, swales, bioretention area and infiltration basin included within the SuDS Strategy for the proposed development will provide adequate treatment to mitigate the low hazard associated with runoff from the development prior to infiltration.

7.6.10 The U.K. government's Groundwater Protection Policy 13 states that where SuDS are proposed for anything other than roof drainage in SPZ1, a Hydrogeological Risk Assessment (HRA) should be undertaken. We propose to undertake and HRA to demonstrate the acceptability of the proposed discharge.

7.6.11 An appropriate Hydrogeological Risk Assessment will be undertaken to assess the post-development risks to groundwater. This will support a future discharge permit application. At this stage, given the low starting risk value and the mitigation measures proposed, the source term in the calculations will be very low and ensuring compliance on this issue (i.e.

demonstrating a viable discharge point) should not be an issue. Note that a back-up SuDS strategy has been presented below which does not rely on infiltrating runoff to ground within Zone 1 of the SPZ.

7.6.12 Sediment traps (i.e. sumps within the inspection chambers of the final manhole upstream of each feature) will be used to facilitate the maintenance of these basins and reduce the build-up of potentially polluted material stored within.

7.7 SuDS maintenance

7.7.1 Inspection and long-term maintenance of SuDS components ensures efficient operation and prevents failure. Surface SuDS components can be managed using landscape maintenance techniques. Table 7.9 describes the management and maintenance requirements for the SuDS features included. These requirements will be implemented following the completion of the proposed development, and will be undertaken either by the Lead Local Flood Authority, a private management company or by the local water company, subject to ongoing discussions regarding this responsibility.

Table 7.9: Management and maintenance requirements for SuDS features

SuDS Device	Maintenance requirements	Maintenance frequency
Permeable paving	• Initial inspection • Inspect for evidence of poor operation and/or weed growth – if required, take remedial action. • Inspect silt accumulation rates and establish appropriate brushing frequencies. • Monitor inspection chambers	• Monthly for three months after installation. • Three-monthly, 48 hours after large storms in first six months. • Annually. • Annually.
Detention basin	• Litter/trash removal • Cut grass • Inlet/outlet cleaning • Sediment monitoring and silt removal. • Reseed areas of poor vegetation coverage	• Monthly • Monthly in summer • Quarterly • Annually or every three years • Annually or every three years
Swale	• Litter/trash removal • Cut grass • Inlet/outlet cleaning • Sediment monitoring and silt removal.	• Monthly • Monthly in summer • Quarterly • Annually or every three years
Bio-retention area	• Litter/trash removal • Replace plans to maintain density • Infill any holes or scour in porous medium • Sediment monitoring and silt removal.	• Monthly • As required • As required (check after storms) • Annually or every three years

SuDS Device	Maintenance requirements	Maintenance frequency
	• Remove and replace filter medium and vegetation	• As required, but likely c. 20 years
Infiltration basin (i.e. the Wooded Depression)	• Litter/trash removal • Inlet/outlet cleaning • Vegetation management • Sediment monitoring and silt removal.	• Monthly • Quarterly • Quarterly • Annually or every 3 yrs

7.8 Source control measures and SuDS train

7.8.1 Permeable paving is included in the proposed SuDS Scheme. As the detailed layout plan evolves, it will be possible to include further SuDS techniques within the development layout in order to improve the 'SuDS Management Train'. Techniques such as rainwater capture and re-use, linear conveyance swales, green corridors, and bio-retention areas will be considered during the development of the detailed layout plan to maximise water efficiency, water quality, biodiversity, health and wellbeing, and amenity benefits.

7.9 Biodiversity and amenity

7.9.1 SuDS schemes present opportunities to enhance habitat for wildlife on-Site and this often improves the biodiversity of the surrounding areas. Ponds, constructed wetlands and other surface water features are landscape assets that have amenity value and improve the aesthetics of a site more than conventional drainage systems. The use of a grassed Detention Basin, large swales (with larger, more mature vegetation along the tops of the banks), the Bioretention Area and the Wooded Depression (within Theobald Wood) has the potential to enhance the biodiversity and amenity value of the Site post-development. Ecological diversity should be enhanced by the use of native planting within each feature.

7.10 Back-up SuDS strategy

7.10.1 As discussed above, the preferred proposals for water disposal at the Site are to include a high level of water treatment prior to infiltration via the wooded depression, with additional measures to mitigate the risk of leaks, spillages etc. We also note that residential developments are not generally high risk in terms of water quality to begin with compared with other development types.

7.10.2 At present, as the proposed development is in outline, it does not have a permit for discharging treated runoff to ground within SPZ Zone 1. Therefore, following consultation with the LLFA, we have presented a back-up option for surface water disposal outside of SPZ1.

7.10.3 Infiltration testing within the White Chalk within boreholes located in the positions shown in Figure 2.4 was undertaken in July 2023. The tests yielded results ranging from 0.0374m/hr and 0.0421m/hr (see Section 2.4).

7.10.4 An alternative drainage strategy is presented in Appendix G. This includes deep borehole soakaways within both the northern detention basin and the sequence of swales in the east of the Site (i.e. outside of the SPZ1 area). Boreholes within the swale sequence would be spaced at between 10-15m distances. These will be located at least 15m from the proposed dwellings to mitigate the potential risk of dissolution/ subsidence of the receiving White Chalk.

7.10.5 A lined basin is included in the south of the Site to attenuate runoff from the southern area. A pumped system (rising main) is then included within the feature to move water up to the eastern swale sequence.

7.10.6 The grassed swale would include a porous medium at the base which would provide both water quality treatment and a pathway to the underlying sequence of deep borehole soakaways. An example diagram of a grassed swale with an underlying soakaway in included in Figure 7.5.

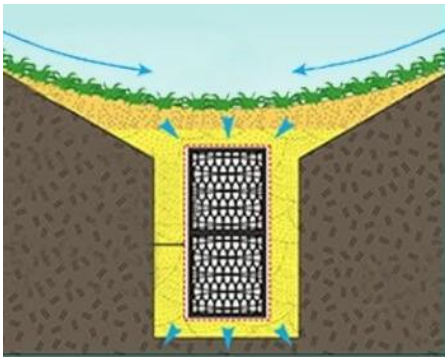


Figure 7.5 Example schematic of Swale with underlying infiltration feature

7.10.7 The back-up scheme has also been modelled in MicroDrainage software as per the configurations set out in Section 7.4.

7.10.8 The catchment areas (and impermeable areas) draining to each feature in the back-up scheme are the same as was set out in Figure 7.2.

7.10.9 The sequence of the features has been changed such that the Central Catchment no longer drains to the Central-southern Catchment, and the Central Southern Catchment no longer drains to the Southern Catchment (the wooded depression).

7.10.10 An infiltration rate value of 0.0374m/hr was used in these calculations - the lowest value obtained during the testing. A value of zero was used for the Southern Swale and Attenuation Basin as these features will be lined to prevent infiltration within SPZ1. A safety factor of 2 (MicroDrainage default setting) was also maintained for the calculations.

7.10.11 The boreholes in the eastern swale series were lumped together as a single feature to demonstrate the broad feasibility of the scheme at this outline stage. A single borehole has an assumed diameter of 0.50 m (with filter pack), and an assumed depth of 20m. This was scaled up to represent the total borehole sequence included in the eastern swale sequence.

7.10.12 Pumping was applied as a constant rate hydrograph with a rate of -2.5l/s from the Attenuation Basin and a rate of +2.5l/s to the Eastern Swale (illustrated in Appendix G).

7.10.13 The results of the drainage modelling are presented in Table 7.10.

Table 7.10: Performance of the SuDS features under a 1 in 100 year + 40% storm event.

Feature	Critical duration (mins)	Max. water level (m AOD)	Min. freeboard remaining (m)
Detention Basin	180	93.85	0.15
Eastern Swale	2160	92.96	0.04
Southern Swale	15	90.03	0.60
Attenuation Basin	120	81.79	0.27

7.10.14 The exceedance routes for the back-up scenario would be as per the primary SuDS strategy (see Figure 7.4).

8.0 Conclusions and recommendations

8.1.1 The Site is located in Flood Zone 1 and therefore has a low probability of flooding from rivers and the sea.

8.1.2 The Wooded Depression (former quarry), as well as an additional area in the south of the Site are shown to be at a low to high risk of pluvial flooding. Similarly, the eastern area of the Site is shown to be at a potentially low risk of pluvial flooding, which is connected to an area of high-risk pluvial flooding adjacent to the eastern Site boundary. Areas of elevated surface water flood risk on-Site would be addressed with the implementation of the future drainage scheme which would intercept overland flow and direct it to the SuDS features proposed.

8.1.3 Groundwater flood risk at the Site is considered to be low, alongside a negligible risk of flooding from reservoirs or sewers.

8.1.4 This report two Outline SuDS Strategies for the Site. The principal components of the primary scheme are a detention basin, several large swales, a bio-retention area and the Wooded Depression within Theobald Wood (a former chalk quarry). The White Chalk underlying much of the Site is considered an appropriate medium to receive infiltrating surface water run-off, although this is overlain with the less permeable Lambeth Group in this area (with the notable exception of the Wooded Depression in Theobald Wood) . Site -specific infiltration testing has been undertaken within the Wooded Depression to inform the drainage calculations undertaken. A back-up SuDS strategy has been presented in Appendix G which does not rely on the discharge of treated runoff to ground within SPZ1.

8.1.5 The viability of the Outline SuDS Strategies has been proven using the MicroDrainage software. This demonstrates that the scheme is capable of attenuating and infiltrating the Site runoff up to and including the 1 in 100 year event +40% allowance for climate change.

8.1.6 Appropriate management and maintenance arrangements for the proposed SuDS scheme will be in place throughout the lifetime of the proposed development; an outline description of these requirements is presented in this report.

References

British Geological Survey (BGS) (2022). Geoindex – online geological mapping of Britain (http://mapapps.bgs.ac.uk/geologyofbritain3d/),

CIRIA, 2015. The SuDS Manual v2.

Department for Communities and Local Government, 2021. National Planning Policy Framework (NPPF).

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Ordnance Survey Mapping (2020). © Crown copyright. All rights reserved. Licence number AL 100054687.

AECOM Limited (2018). Hertsmere Borough Council, Strategic Flood Risk Assessment, Level 1.

Department for Environment, Food & Rural Affairs (DEFRA)/ Environment Agency (2013). Rainfall runoff management for developments (Report – SC030219)

DEFRA (2015). Sustainable drainage systems: Non-statutory technical standards for sustainable drainage systems.

Appendix A – Proposed Development Site Boundary Plan

N

0 10 20 30 40 50 60 70 80

SCALEBAR 1/1000

Open Space

Footpath link subject to Land Owner approval

Additional Land for Newberries Primary School

Medical Centre

Footpath connection to School

Newberries Primary School

Combined Footpath / Cycleway

Shenley Road

Tagette Close

Williams Way

Newberries Avenue

Theobald Street

Track

Track

El Sub Sta

Buckfield

Breakdown of Accommodation

1-Bed Flats	8
2-Bed Flats	28
2-Bed FOGs	5
2-Bed Houses	62
3-Bed Houses	69
4-Bed Houses	23
TOTAL	**195**

Land Safeguarded for Extension to Newberries Primary School

Land allocated for Medical Centre

Fairfax

Fairfax Aquisitions Ltd

project:

Land:

South of Shenley Road,
Radlett

title:

Illustrative Masterplan

date: Dec'22 **scale:** 1:1000 @ A1

drawing number:	Rev.
2213/PL.04	G

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Chartered Architect

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Appendix B – Infiltration testing

Borehole Log

TP01

Project Name: Radlett Field Project No: P17014

Location: Radlett Co-ords: 517144 - 199366 Level:

Hole Type: TP Logged By: ACW Dates: 09/02/2023 - 09/02/2023

Client: Fairfax Properties Consultant: ACW

Plant Used: Tracked excavator SPT Hammer Serial No:

Well	Water	Samples Depth (m)	Samples Type	Result	Depth	Mechanical Log	Legend	Stratum Description	Stratigraphy	Depth m
					0.30			Soft dark brown slightly sandy organic-rich CLAY. Sand is fine. Abundant rootlets noted (TOPSOIL).	@0-0.1m moss surface covering with abundant rootlets in upper surface.	
								Firm yellowish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse sub-angular to sub-rounded of flint and chalk (LAMBETH GROUP).		0.5
										1.0
										1.5
					1.90			Structureless CHALK composed of silty sub-angular GRAVEL and COBBLES. Clasts are weak medium density off-white with orange banding. (Seaford Chalk Formation and Newhaven Chalk Formation, Grade Dc).	@2-2.7m increasing clast size and strength with depth.	2.0
					2.70					2.5
										3.0
										3.5
										4.0
										4.5

Agreed position on site with contractors. Trial pit cleared with CAT and Genny prior to excavation. Position terminated in natural strata with two soakaway tests undertaken. Position backfilled with arisings.

Borehole Log

TP02

Project Name: Radlett Field Project No: P17014

Location: Radlett Co-ords: 517157 - 199349 Level:

Hole Type: TP Logged By: ACW Dates: 10/02/2023 - 10/02/2023

Client: Fairfax Properties Consultant: ACW

Plant Used: Tracked excavator SPT Hammer Serial No:

Well	Water	Samples Depth (m)	Samples Type	Result	Depth	Mechanical Log	Legend	Stratum Description	Stratigraphy	Depth m
					0.32			Soft dark brown slightly sandy organic-rich CLAY. Sand is fine to medium. Abundant rootlets noted (TOPSOIL).	@0-0.2 abundant coarse rootlets	
								Yellowish/ orange mottled brown slightly sandy gravelly CLAY. Sand is medium to coarse. Gravel is fine to coarse sub-angular of flint and chalk (LAMBETH GROUP).		0.5
					1.40			Structureless CHALK composed of silty sub-angular to sub-rounded GRAVEL. Clasts are weak medium density off-white occasionally cream with occasional black specks (Seaford Chalk Formation and Newhaven Chalk Formation, Grade Dc).		1.0
					2.00					1.5
										2.0
										2.5
										3.0
										3.5
										4.0
										4.5

Agreed position on site with contractors. Trial pit cleared with CAT and Genny prior to excavation. Position terminated in natural strata with three soakaway tests undertaken. Position backfilled with arisings.

Borehole Log

TP03

Project Name: Radlett Field Project No: P17014

Location: Radlett Co-ords: 517136 - 199354 Level:

Hole Type: TP Logged By: ACW Dates: 10/02/2023 - 44967

Client: Fairfax Properties Consultant: ACW

Plant Used: Tracked excavator SPT Hammer Serial No:

Well	Water	Samples Depth (m)	Samples Type	Result	Depth	Mechanical Log	Legend	Stratum Description	Stratigraphy	Depth m
					0.30			Soft dark brown slightly sandy organic-rich CLAY. Sand is fine to medium. Abundant rootlets noted (TOPSOIL).	@0-0.2 abundant coarse rootlets	
								Yellowish brown slightly sandy gravelly CLAY. Sand is medium to coarse. Gravel is fine to coarse sub-angular of flint and chalk (LAMBETH GROUP).		0.5
					1.50					1.0
								Structureless CHALK composed of silty sub-angular to sub-rounded GRAVEL. Clasts are weak medium density off-white occasionally cream with occasional black specks (Seaford Chalk Formation and Newhaven Chalk Formation, Grade Dc).		1.5
					2.05					2.0
										2.5
										3.0
										3.5
										4.0
										4.5

Agreed position on site with contractors. Trial pit cleared with CAT and Genny prior to excavation. Position terminated in natural strata with three soakaway tests undertaken. Position installed at 2m bgl with an inner 50mm well surrounded by 125mm casing backfilled with gravel and bentonite. The rest of the trial pit was backfilled with arisings.

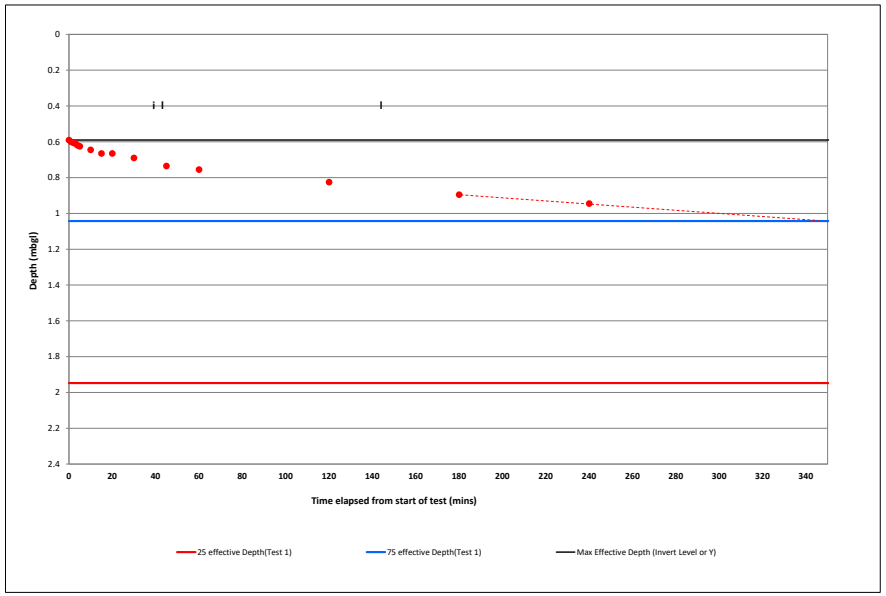
Pit reference:	TP101	**Parameters:**							
Project:	330201438 Radlett EIA	Trial pit length (m):	1.6	*(L)*	Design effective depth (Y)	1.31	*m*	**Completed by:**	ECB
Date of percolation tests:	17/09/2020	Trial pit width (m):	0.35	*(W)*	Gravel porosity:			**Checked by:**	PWH
Method:		Trial pit depth (m):	2.4	*(D)*	Depth to Groundwater:		*mbgl*		
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	1.52	*m3*		

1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)
2) Formation overnight soaking is interpreted only in the absence of a standard test.

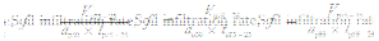
Date:
24/09/2020
Sheet number:
Ver. 1 - Page1

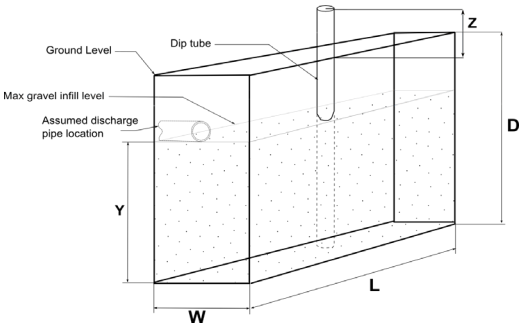
TEST 1

Time	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
9:58	0.0	0.59	1.81
9:59	1.0	0.60	1.80
10:00	2.0	0.605	1.80
10:01	3.0	0.61	1.79
10:02	4.0	0.62	1.78
10:03	5.0	0.625	1.78
10:08	10.0	0.645	1.76
10:13	15.0	0.665	1.74
10:18	20.0	0.665	1.71
10:28	30.0	0.690	1.67
10:43	45.0	0.735	1.65
10:58	60.0	0.755	1.65
11:58	120.0	0.825	1.58
12:58	180.0	0.895	1.51
13:58	240.0	0.945	1.46



Test effective depth		m (Water depth at t=0)	
75% effective depth:		m	
50% effective depth:		m	1.04
25% effective depth:		m	1.50
t75		min	1.95
t50		min	
t25		min	
Vp75-25	-	m3	
Vp75 - Vp25 (corrected)	-	m3	
ap50	-	m2	
tp75-25	-	min	
p			
Soil infiltration rate (f):	-	m/s	Insufficient infiltration to calculate infiltration rate
	-	mm/sec	
	-	m/day	





Soil Log:

From	To	Description
0.00	0.30	Topsoil
0.30	1.15	Firm grey mottled reddish brown gravelly sandy CLAY, with low cobble content (LAMBETH FORMATION).
1.15	1.35	Reddish brown gravelly clayey SAND (LAMBETH FORMATION).
1.35	2.40	Soft grey mottled orangish brown gravelly sandy CLAY, with low cobble content (LAMBETH FORMATION).

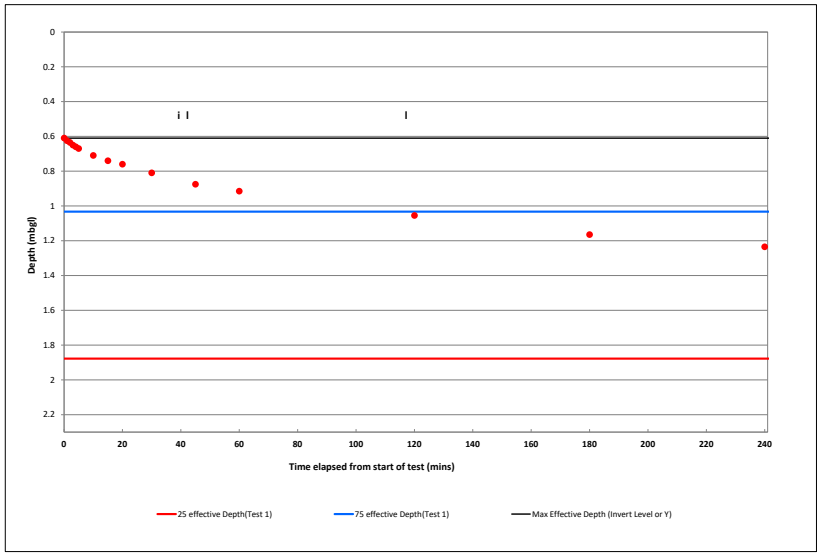
Pit reference:	TP102	**Parameters:**							
Project:	330201438 Radlett EIA	Trial pit length (m):	1.7	*(L)*	Design effective depth (Y)	1.69	*m*	**Completed by:**	ECB
Date of percolation tests	17/09/2020	Trial pit width (m):	0.4	*(W)*	Gravel porosity:			**Checked by:**	PWH
Method:		Trial pit depth (m):	2.3	*(D)*	Depth to Groundwater:		*mbgl*		
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	1.15	*m3*		

1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)
2) Formation overnight soaking is interpreted only in the absence of a standard test.

Date:
24/09/2020
Sheet number:
Ver. 1 - Page1

TEST 1

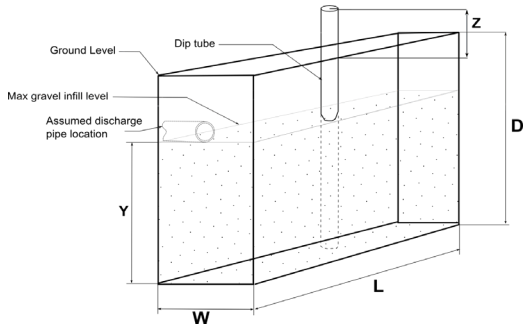
Time	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
10:43	0.0	0.610	1.69
10:44	1.0	0.625	1.68
10:45	2.0	0.635	1.67
10:46	3.0	0.650	1.65
10:47	4.0	0.660	1.64
10:48	5.0	0.670	1.63
10:53	10.0	0.710	1.59
11:58	15.0	0.740	1.56
11:03	20.0	0.760	1.54
11:13	30.0	0.810	1.49
11:28	45.0	0.875	1.43
11:43	60.0	0.915	1.39
12:43	120.0	1.055	1.25
13:43	180.0	1.165	1.14
14:43	240.0	1.235	1.07



Test effective depth	1.69	m (Water depth at t=0)
75% effective depth:	1.27	m
50% effective depth:	0.85	m
25% effective depth:	0.42	m
t75	115.0	min
t50	Insufficient infiltration	min
t25	Insufficient infiltration	min
Vp75-25	-	m3
Vp75 - Vp25 (corrected)	-	m3
ap50	-	m2
tp75-25	-	min
tp75-25	-	min
Soil infiltration rate (f):	-	m/s
	-	mm/sec
	-	m/day

Insufficient infiltration to calculate infiltration rate

[redacted]



Soil Log:

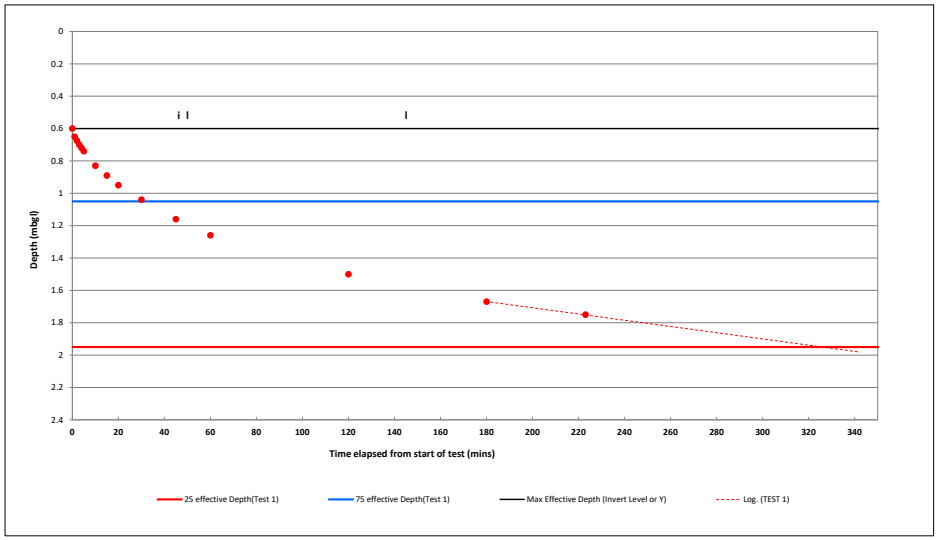
From	To	Description
0.00	0.30	Topsoil.
0.30	1.30	Soft grey mottled orangish browngravelly very sandy CLAY (LAMBETH GROUP).
1.30	2.30	Orangish brown mottled grey very clayey SAND (LAMBETH GROUP).

Pit reference:	TP103	**Parameters:**						1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)	**Date:**
Project:	330201438 Radlett EIA	Trial pit length (m):	1.75	*(L)*	Design effective depth (Y)	1.80	*m*		24/09/2020
Date of percolation tests:	17/09/2020	Trial pit width (m):	0.35	*(W)*	Gravel porosity:			2) Formation overnight soaking is interpreted only	**Sheet number:**
Method:		Trial pit depth (m):	2.4	*(D)*	Depth to Groundwater:		*mbgl*	in the absence of a standard test.	
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	1.10	*m3*		Ver. 1 - Page1

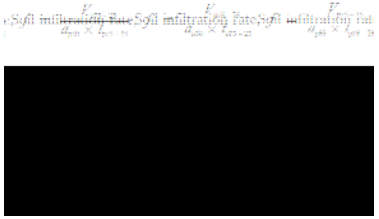
Completed by: ECB
Checked by: PWH

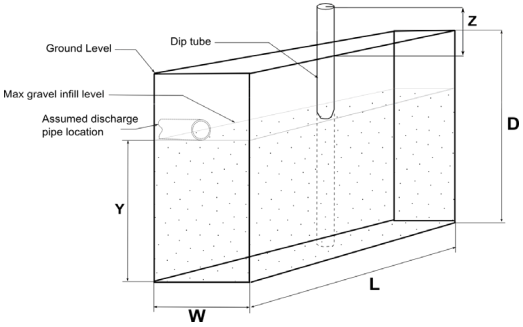
TEST 1

Time	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
11:57	0.0	0.600	1.80
11:58	1.0	0.650	1.75
11:59	2.0	0.675	1.73
12:00	3.0	0.700	1.70
12:01	4.0	0.720	1.68
12:02	5.0	0.740	1.66
12:07	10.0	0.830	1.57
12:12	15.0	0.890	1.51
12:17	20.0	0.950	1.45
12:27	30.0	1.040	1.36
12:42	45.0	1.160	1.24
12:57	60.0	1.260	1.14
13:57	120.0	1.500	0.90
14:57	180.0	1.670	0.73
15:40	223.0	1.750	0.65



Test effective depth	1.80	m (Water depth at t=0)	
75% effective depth:	1.35	m	1.05
50% effective depth:	0.90	m	1.5
25% effective depth:	0.45	m	1.95
t75	35.0	min	
t50	120.0	min	
t25	335.0	min	Extrapolated
Vp75-25	0.55	m3	
Vp75 - Vp25 (corrected)	0.00	m3	
ap50	4.39	m2	
tp75-25	300.0	min	
Soil infiltration rate (f):	6.97E-06	m/s	Infiltration result from extrapolated data
	0.01	mm/sec	
	0.60	m/day	





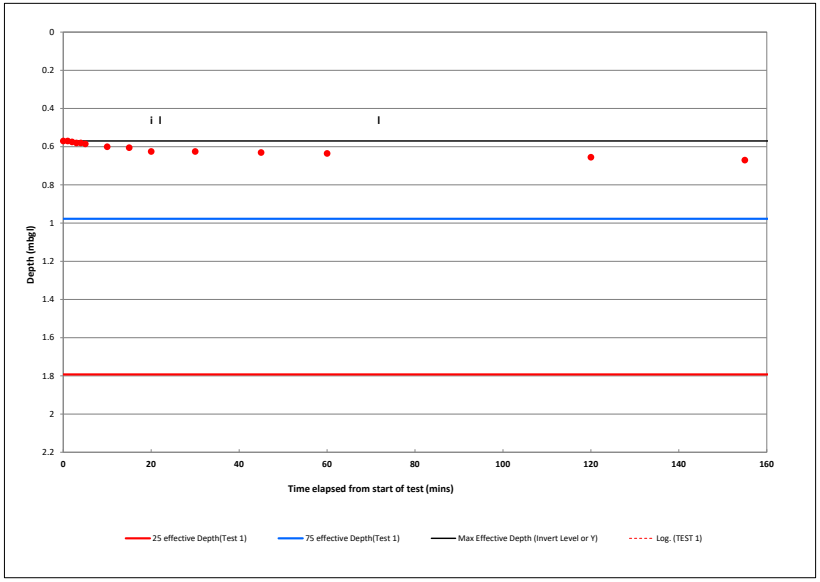
Soil Log:

From	To	Description
0.00	0.30	Topsoil.
0.30	0.75	Firm orangish brown sandy gravelly CLAY, with high cobble content (LAMBETH GROUP).
0.75	1.05	Firm orangish brown slightly gravelly CLAY, with medium cobble content (LAMBETH GROUP).
1.05	2.10	Grey mottled orangish brown gravelly very clayey SAND, with low cobble content (LAMBETH GROUP).
2.10	2.40	Grey slightly clayey SAND (LAMBETH GROUP).

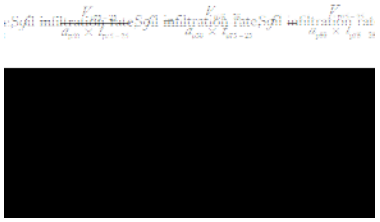
Pit reference:	TP104	**Parameters:**				**Completed by:**	ECB	1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)	**Date:**
Project:	330201438 Radlett EIA	Trial pit length (m):	1.7 (L)	Design effective depth (Y)	1.33 m	**Checked by:**	PWH	2) Formation overnight soaking is interpreted only	24/09/2020
Date of percolation tests	17/09/2020	Trial pit width (m):	0.4 (W)	Gravel porosity:				in the absence of a standard test.	**Sheet number:**
Method:		Trial pit depth (m):	2.2 (D)	Depth to Groundwater:	mbgl				
Datum (mbgl):	0 (Z)			Design effective depth volume:	1.52 m3				Ver. 1 - Page1

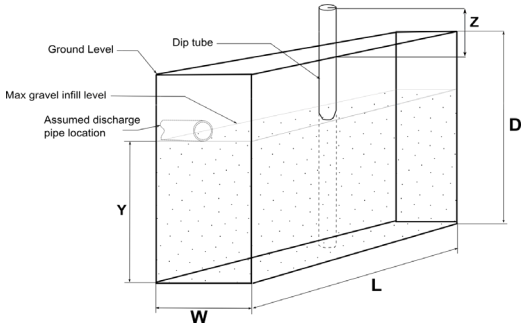
TEST 1

Time	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
13:20	0.0	0.570	1.63
13:21	1.0	0.570	1.63
13:22	2.0	0.575	1.63
13:23	3.0	0.580	1.62
13:24	4.0	0.580	1.62
13:25	5.0	0.585	1.62
13:30	10.0	0.600	1.60
13:35	15.0	0.605	1.60
13:40	20.0	0.625	1.58
13:50	30.0	0.625	1.58
14:05	45.0	0.630	1.57
14:20	60.0	0.635	1.57
15:20	120.0	0.655	1.545
15:55	155.0	0.670	1.53



Test effective depth	1.63	m (Water depth at t=0)	
75% effective depth:	1.22	m	0.98
50% effective depth:	0.82	m	1.39
25% effective depth:	0.41	m	1.79
t75	Insufficient infiltration	min	
t50	Insufficient infiltration	min	
t25	Insufficient infiltration	min	
Vp75-25	-	m3	
Vp75 - Vp25 (corrected)	-	m3	
ap50	-	m2	
tp75-25	-	min	
Soil infiltration rate (f):	-	m/s	Insufficient infiltration to calculate infiltration rate
	-	mm/sec	
	-	m/day	



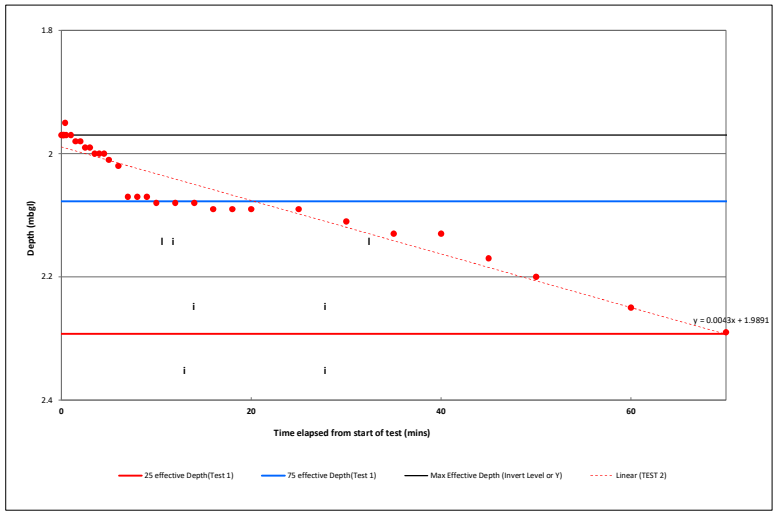


Soil Log:

From	To	Description
0.00	0.30	Topsoil.
0.30	0.75	Firm grey mottled orangish brown sandy gravelly CLAY (LAMBETH GROUP).
0.75	2.00	Soft grey mottled orangish brown sandy gravelyl CLAY, with low cobble content (LAMBETH GROUP).
2.00	2.20	Firm orangish brown mottled grey sandy CLAY (LAMBETH GROUP).

Pit reference:	TP01 Test 2	**Parameters:**							1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)	**Date:**
Project:	P17014 Radlett	Trial pit length (m):	2.3	*(L)*	Design effective depth (Y)	0.43	*m*	**Completed by:**	ACW	2) Formation overnight soaking is interpreted only	16/02/2023
Date of percolation tests	09/02/2023	Trial pit width (m):	1.7	*(W)*	Gravel porosity:	1		**Checked by:**	JEM	in the absence of a standard test.	**Sheet number:**
Method:	BRE365	Trial pit depth (m):	2.4	*(D)*	Depth to Groundwater:		*mbgl*				
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	3.91	*m3*				Ver. 1 - Page1

TEST 2			
	0.0	1.97	0.43
	0.15	1.97	0.43
	0.2	1.970	0.43
	0.3	1.97	0.43
	0.4	1.95	0.45
	0.5	1.970	0.43
	1.0	1.970	0.43
	1.5	1.980	0.42
	2.0	1.980	0.42
	2.5	1.990	0.41
	3.0	1.990	0.41
	3.5	2.000	0.40
	4.0	2.000	0.40
	4.5	2.000	0.40
	5.00	2.010	0.39
	6.00	2.02	0.38
	7.00	2.07	0.33
	8.00	2.07	0.33
	9.00	2.07	0.33
	10.00	2.08	0.32
	12.00	2.08	0.32
	14.00	2.08	0.32
	16.00	2.09	0.31
	18.00	2.09	0.31
	20.00	2.09	0.31
	25.00	2.09	0.31
	30.00	2.11	0.29
	35.00	2.13	0.27
	40.00	2.13	0.27
	45.00	2.17	0.23
	50.00	2.2	0.20
	60.00	2.25	0.15
	70.00	2.29	0.11



Test effective depth		m (Water depth at t=0)	
75% effective depth:		m	
50% effective depth:		m	2.08
25% effective depth:		m	2.19
t75		min	2.29
t50		min	
t25		min	
Vp75-25		m3	
Vp75 - Vp25 (corrected)		m3	
ap50		m2	
tp75-25		min	
tp75-25	143.3	min	
Soil infiltration rate (f):		m/s	
		mm/sec	
		m/day	

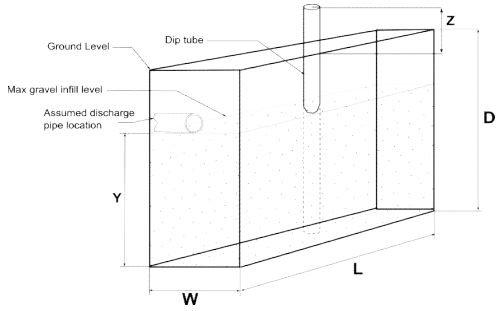
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.



Soil Log:

From	To	Description
0.00	0.30	Topsoil
0.30	1.90	Clay
1.90	2.70	Weathered chalk

Pit reference:	TP01 Test 2	**Parameters:**							
Project:	P17014 Radlett	Trial pit length (m):	2.3	*(L)*	Design effective depth (Y)	0.43	*m*	**Completed by:**	ACW
Date of percolation tests	09/02/2023	Trial pit width (m):	1.7	*(W)*	Gravel porosity:	1		**Checked by:**	JEM
Method:	BRE365	Trial pit depth (m):	2.4	*(D)*	Depth to Groundwater:		*mbgl*		
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	3.91	*m3*		

1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)
2) Formation overnight soaking is interpreted only in the absence of a standard test.

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16/02/2023
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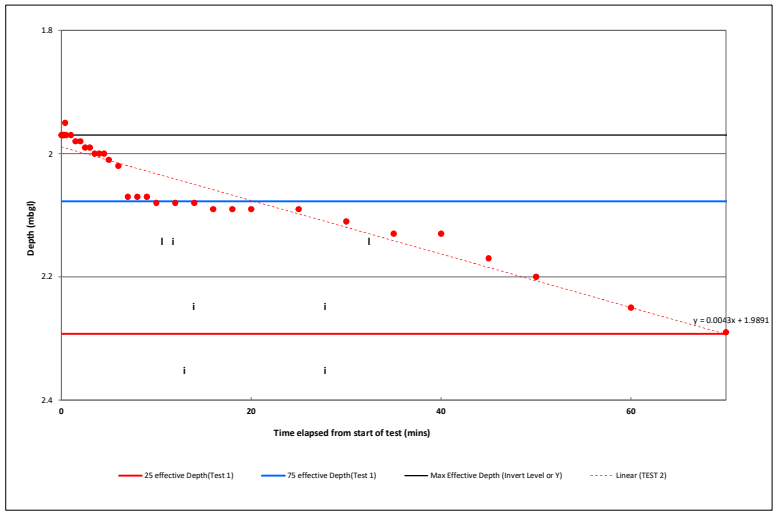
TEST 2			
	Elapsed (min)	**Water dip (mbGL)**	**Depth of water in pit (m)***
	0.0	1.97	0.43
	0.15	1.97	0.43
	0.2	1.970	0.43
	0.3	1.97	0.43
	0.4	1.95	0.45
	0.5	1.970	0.43
	1.0	1.970	0.43
	1.5	1.980	0.42
	2.0	1.980	0.42
	2.5	1.990	0.41
	3.0	1.990	0.41
	3.5	2.000	0.40
	4.0	2.000	0.40
	4.5	2.000	0.40
	5.00	2.010	0.39
	6.00	2.02	0.38
	7.00	2.07	0.33
	8.00	2.07	0.33
	9.00	2.07	0.33
	10.00	2.08	0.32
	12.00	2.08	0.32
	14.00	2.08	0.32
	16.00	2.09	0.31
	18.00	2.09	0.31
	20.00	2.09	0.31
	25.00	2.09	0.31
	30.00	2.11	0.29
	35.00	2.13	0.27
	40.00	2.13	0.27
	45.00	2.17	0.23
	50.00	2.2	0.20
	60.00	2.25	0.15
	70.00	2.29	0.11



Test effective depth	0.43	m (Water depth at t=0)	
75% effective depth:	0.32	m	
50% effective depth:	0.22	m	2.08
25% effective depth:	0.11	m	2.19
t75	968.0	min	2.29
t50	1039.7	min	
t25	1111.3	min	
Vp75-25	0.84	m3	
Vp75 - Vp25 (corrected)	0.84	m3	
ap50	5.63	m2	
tp75-25		min	
tp75-25	143.3	min	
Soil infiltration rate (f):	1.74E-05	m/s	
	0.02	mm/sec	
	1.50	m/day	

Soil Log:

From	**To**	**Description**
0.00	0.30	Topsoil
0.30	1.90	Clay
1.90	2.70	Weathered chalk

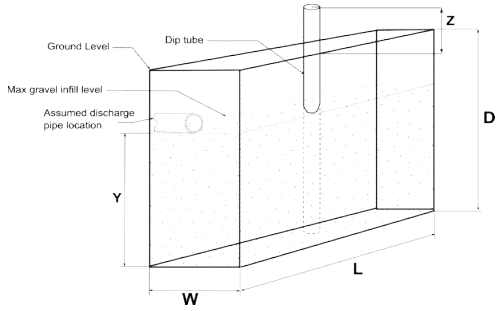
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.



Pit reference:	TP02 Test 1	**Parameters:**							
Project:	P17014 Radlett	Trial pit length (m):	2	*(L)*	Design effective depth (Y)	0.45	*m*	**Completed by:**	ACW
Date of percolation tests	10/02/2023	Trial pit width (m):	1	*(W)*	Gravel porosity:	1		**Checked by:**	JEM
Method:	BRE365	Trial pit depth (m):	1.7	*(D)*	Depth to Groundwater:		*mbgl*		
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	2.00	*m3*		

1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)
2) Formation overnight soaking is interpreted only in the absence of a standard test.

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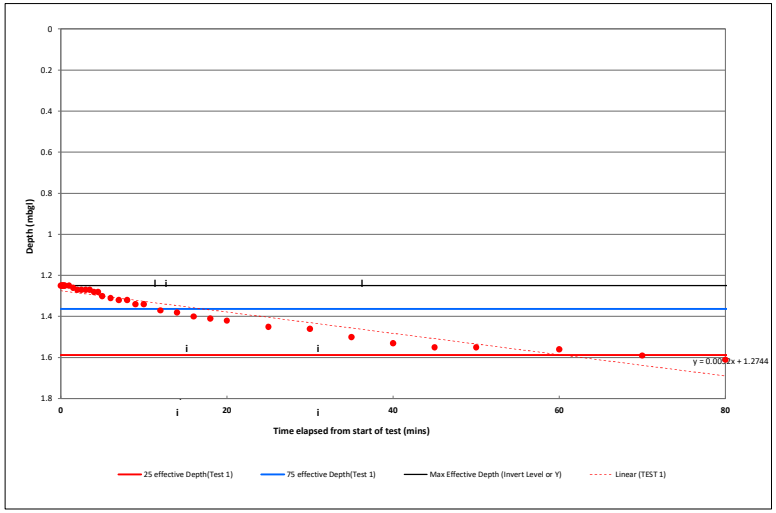
TEST 1

	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
	0.0	1.25	0.45
	0.15	1.25	0.45
	0.2	1.25	0.45
	0.3	1.25	0.45
	0.4	1.25	0.45
	0.5	1.25	0.45
	1.0	1.25	0.45
	1.5	1.260	0.44
	2.0	1.270	0.43
	2.5	1.270	0.43
	3.0	1.270	0.43
	3.5	1.270	0.43
	4.0	1.280	0.42
	4.5	1.280	0.42
	5.00	1.300	0.40
	6.00	1.31	0.39
	7.00	1.32	0.38
	8.00	1.32	0.38
	9.00	1.34	0.36
	10.00	1.34	0.36
	12.00	1.37	0.33
	14.00	1.38	0.32
	16.00	1.4	0.30
	18.00	1.41	0.29
	20.00	1.42	0.28
	25.00	1.45	0.25
	30.00	1.46	0.24
	35.00	1.5	0.20
	40.00	1.53	0.17
	45.00	1.55	0.15
	50.00	1.55	0.15
	60.00	1.56	0.14
	70.00	1.59	0.11
	80.00	1.61	0.09



Test effective depth	0.45	m (Water depth at t=0)	
75% effective depth:	0.34	m	
50% effective depth:	0.23	m	1.36
25% effective depth:	0.11	m	1.48
t75	491.3	min	1.59
t50	566.3	min	
t25	641.3	min	
Vp75-25	0.45	m3	
Vp75 - Vp25 (corrected)	0.45	m3	
ap50	3.35	m2	
tp75-25		min	
tp75-25	150.0	min	
Soil infiltration rate (f):	1.49E-05	m/s	
	0.01	mm/sec	
	1.29	m/day	

Soil Log:

From	To	Description
0.00	0.32	Topsoil
0.32	1.40	Clay
1.40	2.00	Weathered chalk

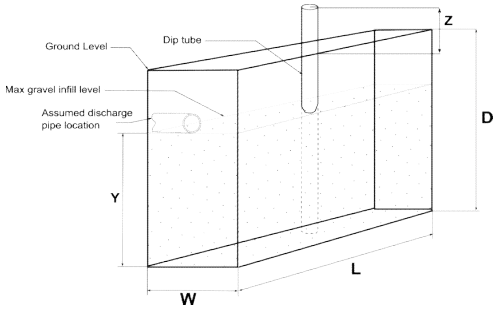
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

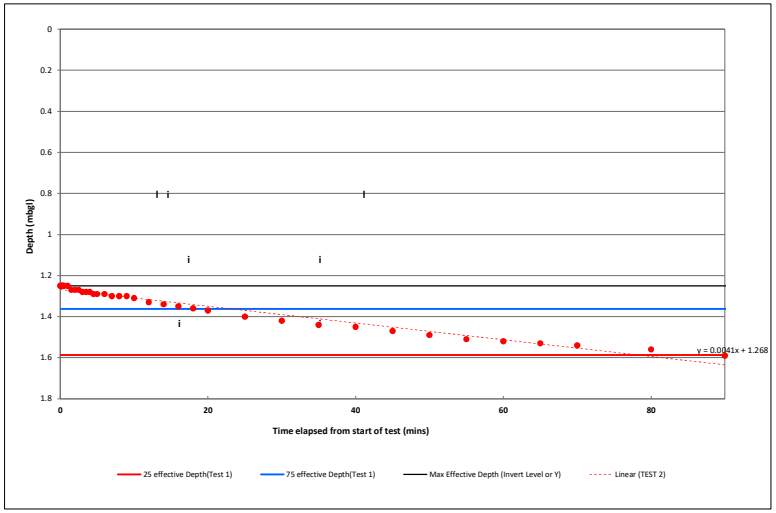
t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.



Pit reference:	TP02 test 2	**Parameters:**							1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)	**Date:**
Project:	P17014 Radlett	Trial pit length (m):	2	*(L)*	Design effective depth (Y)	0.45	*m*	**Completed by:**	ACW	2) Formation overnight soaking is interpreted only	16/02/2023
Date of percolation tests	10/02/2023	Trial pit width (m):	1	*(W)*	Gravel porosity:	1		**Checked by:**	JEM	in the absence of a standard test.	**Sheet number:**
Method:	BRE365	Trial pit depth (m):	1.7	*(D)*	Depth to Groundwater:		*mbgl*				
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	2.00	*m3*				Ver. 1 - Page1

TEST 2

	0.0	1.25	0.45
	0.15	1.25	0.45
	0.2	1.25	0.45
	0.3	1.25	0.45
	0.4	1.25	0.45
	0.5	1.25	0.45
	1.0	1.25	0.45
	1.5	1.270	0.43
	2.0	1.270	0.43
	2.5	1.270	0.43
	3.0	1.280	0.42
	3.5	1.280	0.42
	4.0	1.280	0.42
	4.5	1.290	0.41
	5.00	1.290	0.41
	6.00	1.290	0.41
	7.00	1.3	0.40
	8.00	1.3	0.40
	9.00	1.3	0.40
	10.00	1.31	0.39
	12.00	1.33	0.37
	14.00	1.34	0.36
	16.00	1.35	0.35
	18.00	1.36	0.34
	20.00	1.37	0.33
	25.00	1.4	0.30
	30.00	1.42	0.28
	35.00	1.44	0.26
	40.00	1.45	0.25
	45.00	1.47	0.23
	50.00	1.49	0.21
	55.00	1.51	0.19
	60.00	1.52	0.18
	65.00	1.53	0.17
	70.0	1.54	0.16
	80.00	1.56	0.14
	90.0	1.59	0.11



Test effective depth		m (Water depth at t=0)	
75% effective depth:		m	
50% effective depth:		m	1.36
25% effective depth:		m	1.48
t75	491.3	min	1.59
t50	566.3	min	
t25	641.3	min	
Vp75-25		m3	
Vp75 - Vp25 (corrected)		m3	
ap50		m2	
tp75-25		min	
tp75-25	150.0	min	
Soil infiltration rate (f):	1.49E-05	m/s	
	0.01	mm/sec	
	1.29	m/day	

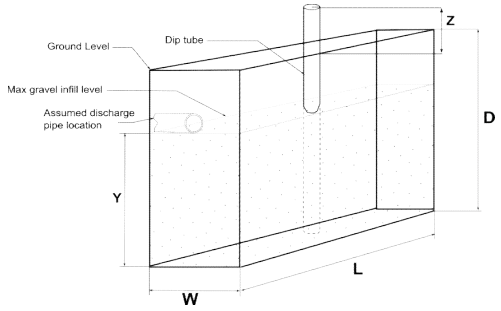
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.



Soil Log:

From	To	Description
0.00	0.32	Topsoil
0.32	1.40	Clay
1.40	2.00	Weathered chalk

Pit reference:	TP02 test 3	**Parameters:**							
Project:	P17014 Radlett	Trial pit length (m):	2	*(L)*	Design effective depth (Y)	0.49	*m*	**Completed by:**	ACW
Date of percolation tests	10/10/2023	Trial pit width (m):	1	*(W)*	Gravel porosity:	1		**Checked by:**	JEM
Method:	BRE365	Trial pit depth (m):	1.7	*(D)*	Depth to Groundwater:		*mbgl*		
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	2.00	*m3*		

1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)
2) Formation overnight soaking is interpreted only in the absence of a standard test.

Date:
24/09/2020
Sheet number:
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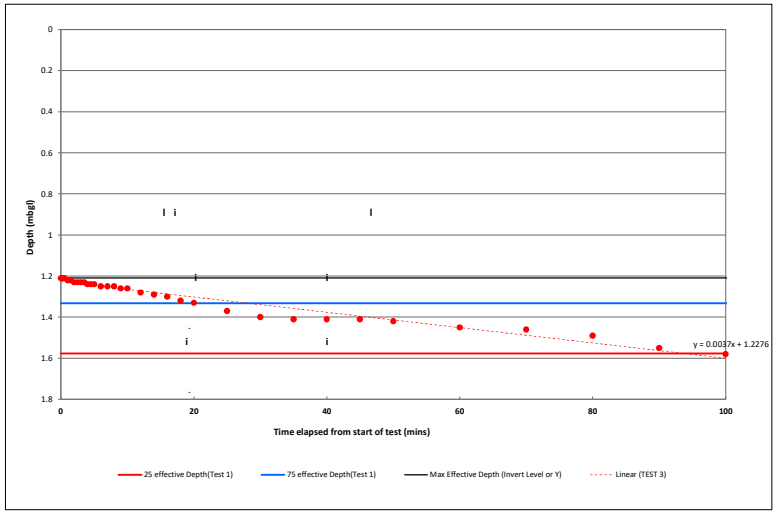
TEST 3			
	Elapsed (min)	**Water dip (mbGL)**	**Depth of water in pit (m)***
	0.0	1.21	0.49
	0.15	1.21	0.49
	0.2	1.21	0.49
	0.3	1.21	0.49
	0.4	1.21	0.49
	0.5	1.21	0.49
	1.0	1.22	0.48
	1.5	1.220	0.48
	2.0	1.230	0.47
	2.5	1.230	0.47
	3.0	1.230	0.47
	3.5	1.230	0.47
	4.0	1.240	0.46
	4.5	1.240	0.46
	5.00	1.240	0.46
	6.00	1.250	0.45
	7.00	1.250	0.45
	8.00	1.25	0.45
	9.00	1.26	0.44
	10.00	1.26	0.44
	12.00	1.28	0.42
	14.00	1.29	0.41
	16.00	1.3	0.40
	18.00	1.32	0.38
	20.00	1.33	0.37
	25.00	1.37	0.33
	30.00	1.4	0.30
	35.00	1.41	0.29
	40.00	1.41	0.29
	45.00	1.41	0.29
	50.00	1.42	0.28
	60.00	1.45	0.25
	70.00	1.46	0.24
	80.00	1.49	0.21
	90.00	1.55	0.15
	100.00	1.58	0.12



Test effective depth	0.49	m (Water depth at t=0)	
75% effective depth:	0.37	m	
50% effective depth:	0.25	m	1.33
25% effective depth:	0.12	m	1.46
t75	471.3	min	1.58
t50	553.0	min	
t25	634.7	min	
Vp75-25	0.49	m3	
Vp75 - Vp25 (corrected)	0.49	m3	
ap50	3.47	m2	
tp75-25	-	min	
tp75-25	163.3	min	
Soil infiltration rate (f):	1.44E-05	m/s	
	0.01	mm/sec	
	1.24	m/day	

Soil Log:

From	**To**	**Description**
0.00	0.32	Topsoil
0.32	1.40	Clay
1.40	2.00	Weathered chalk

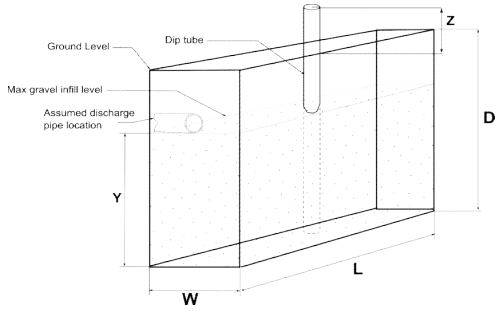
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.

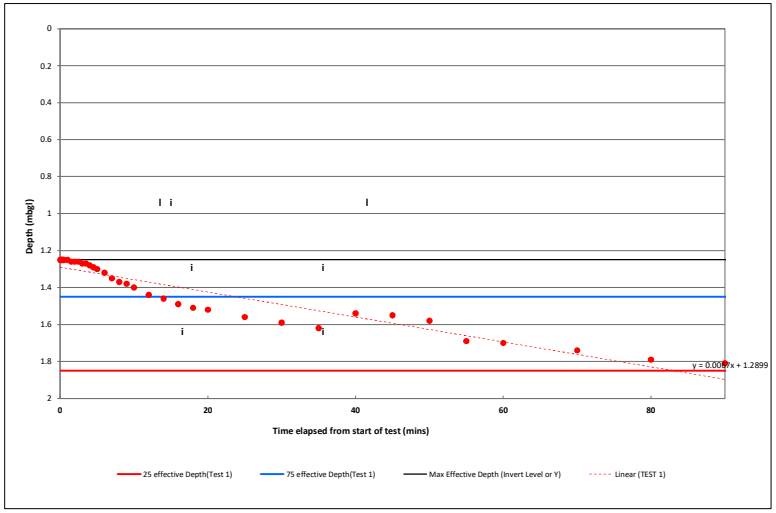


Pit reference:	TP03 test 1	**Parameters:**							
Project:	P17014 Radlett	Trial pit length (m):	2.1	*(L)*	Design effective depth (Y)	0.80	*m*	**Completed by:**	ACW
Date of percolation tests	10/10/2023	Trial pit width (m):	0.92	*(W)*	Gravel porosity:	1		**Checked by:**	JEM
Method:	BRE365	Trial pit depth (m):	2.05	*(D)*	Depth to Groundwater:		*mbgl*		
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	1.93	*m3*		

1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)
2) Formation overnight soaking is interpreted only in the absence of a standard test.

Date:
24/09/2020
Sheet number:
Ver. 1 - Page1

TEST 1	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
	0.0	1.25	0.80
	0.15	1.25	0.80
	0.2	1.25	0.80
	0.3	1.25	0.80
	0.4	1.25	0.80
	0.5	1.25	0.80
	1.0	1.25	0.80
	1.5	1.260	0.79
	2.0	1.260	0.79
	2.5	1.260	0.79
	3.0	1.270	0.78
	3.5	1.270	0.78
	4.0	1.280	0.77
	4.5	1.290	0.76
	5.00	1.300	0.75
	6.00	1.320	0.73
	7.00	1.350	0.70
	8.00	1.370	0.68
	9.00	1.38	0.67
	10.00	1.4	0.65
	12.00	1.44	0.61
	14.00	1.46	0.59
	16.00	1.49	0.56
	18.00	1.51	0.54
	20.00	1.52	0.53
	25.00	1.56	0.49
	30.00	1.59	0.46
	35.00	1.62	0.43
	40.00	1.54	0.51
	45.00	1.55	0.50
	50.00	1.58	0.47
	55.00	1.69	0.36
	60.00	1.7	0.35
	70.00	1.74	0.31
	80.00	1.79	0.26
	90.0	1.81	0.24



Test effective depth	0.80	m (Water depth at t=0)	
75% effective depth:	0.60	m	
50% effective depth:	0.40	m	1.45
25% effective depth:	0.20	m	1.65
t75	549.7	min	1.85
t50	683.0	min	
t25	816.3	min	
Vp75-25	0.77	m3	
Vp75 - Vp25 (corrected)	0.77	m3	
ap50	4.35	m2	
tp75-25	-	min	
tp75-25	266.7	min	
Soil infiltration rate (f):	1.11E-05	m/s	
	0.01	mm/sec	
	0.96	m/day	

Soil Log:

From	To	Description
0.00	0.30	Topsoil
0.30	1.50	Clay
1.50	2.05	Weathered chalk

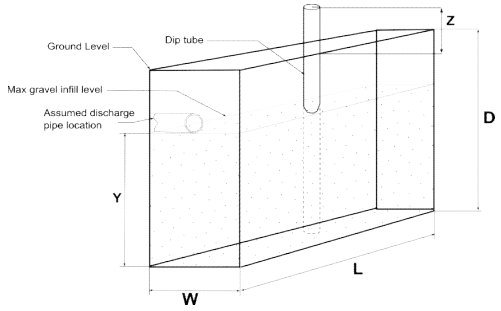
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

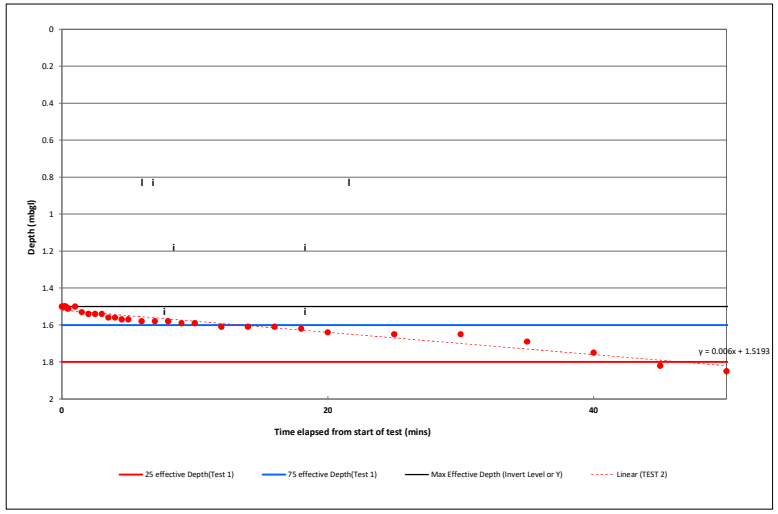
a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.



Pit reference:	TP03 test 2	**Parameters:**						1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)	**Date:**
Project:	P17014 Radlett	Trial pit length (m):	2.1	*(L)*	Design effective depth (Y)	0.40	*m*	**Completed by:** ACW	2) Formation overnight soaking is interpreted only	24/09/2020
Date of percolation tests	10/10/2023	Trial pit width (m):	0.92	*(W)*	Gravel porosity:	1		**Checked by:** JEM	in the absence of a standard test.	**Sheet number:**
Method:	BRE365	Trial pit depth (m):	1.9	*(D)*	Depth to Groundwater:		*mbgl*			
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	1.93	*m3*			Ver. 1 - Page1

TEST 2	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
	0.0	1.50	0.40
	0.15	1.50	0.40
	0.2	1.50	0.40
	0.3	1.50	0.40
	0.4	1.51	0.39
	0.5	1.51	0.39
	1.0	1.50	0.40
	1.5	1.530	0.37
	2.0	1.540	0.36
	2.5	1.540	0.36
	3.0	1.540	0.36
	3.5	1.560	0.34
	4.0	1.560	0.34
	4.5	1.570	0.33
	5.00	1.570	0.33
	6.00	1.580	0.32
	7.00	1.580	0.32
	8.00	1.580	0.32
	9.00	1.59	0.31
	10.00	1.59	0.31
	12.00	1.61	0.29
	14.00	1.61	0.29
	16.00	1.61	0.29
	18.00	1.62	0.28
	20.00	1.64	0.26
	25.00	1.65	0.25
	30.00	1.65	0.25
	35.00	1.69	0.21
	40.00	1.75	0.15
	45.00	1.82	0.08
	50.00	1.85	0.05



Test effective depth	0.40	m (Water depth at t=0)	
75% effective depth:	0.30	m	
50% effective depth:	0.20	m	1.60
25% effective depth:	0.10	m	1.70
t75	649.7	min	1.80
t50	716.3	min	
t25	783.0	min	
Vp75-25		m3	
Vp75 - Vp25 (corrected)		m3	
ap50		m2	
tp75-25		min	
tp75-25	133.3	min	
Soil infiltration rate (f):	1.54E-05	m/s	
	0.02	mm/sec	
	1.33	m/day	

Soil Log:

From	To	Description
0.00	0.30	Topsoil
0.30	1.50	Clay
1.50	2.05	Weathered chalk

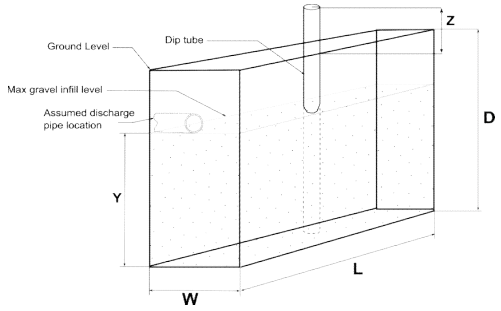
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

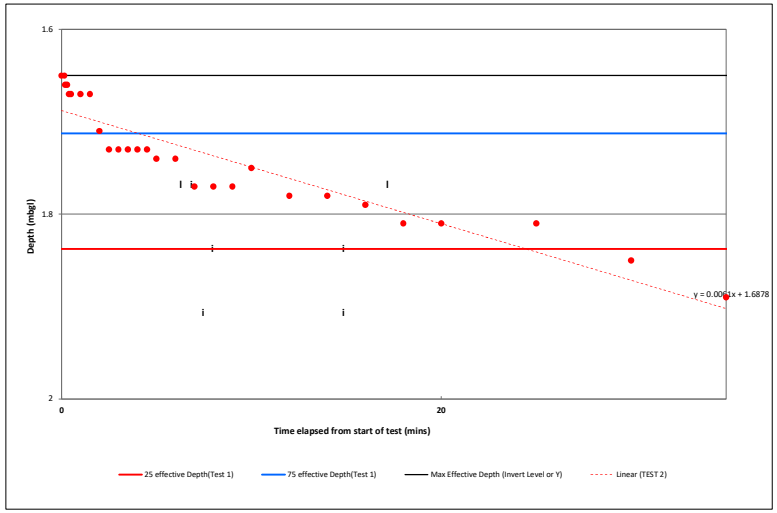
a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.



Pit reference:	TP03 test 3	**Parameters:**						1) *Water depth = Trial pit depth (mbgl) - dip (mbgl)	**Date:**
Project:	P17014 Radlett	Trial pit length (m):	2.1	*(L)*	Design effective depth (Y)	0.25	*m*	**Completed by:** ACW	24/09/2020
Date of percolation tests	10/10/2023	Trial pit width (m):	0.92	*(W)*	Gravel porosity:	1		**Checked by:** JEM	**Sheet number:**
Method:	BRE365	Trial pit depth (m):	1.9	*(D)*	Depth to Groundwater:		*mbgl*	2) Formation overnight soaking is interpreted only in the absence of a standard test.	
Datum (mbgl):	0 *(Z)*				Design effective depth volume:	1.93	*m3*		Ver. 1 - Page1

TEST 2	Elapsed (min)	Water dip (mbGL)	Depth of water in pit (m)*
	0.0	1.65	0.25
	0.15	1.65	0.25
	0.2	1.66	0.24
	0.3	1.66	0.24
	0.4	1.67	0.23
	0.5	1.67	0.23
	1.0	1.67	0.23
	1.5	1.67	0.23
	2.0	1.710	0.19
	2.5	1.730	0.17
	3.0	1.730	0.17
	3.5	1.730	0.17
	4.0	1.730	0.17
	4.5	1.730	0.17
	5.00	1.740	0.16
	6.00	1.740	0.16
	7.00	1.770	0.13
	8.00	1.770	0.13
	9.00	1.770	0.13
	10.00	1.750	0.15
	12.00	1.78	0.12
	14.00	1.78	0.12
	16.00	1.79	0.11
	18.00	1.81	0.09
	20.00	1.81	0.09
	25.00	1.81	0.09
	30.00	1.85	0.05
	35.00	1.89	0.01



Test effective depth	0.25	m (Water depth at t=0)	
75% effective depth:	0.19	m	
50% effective depth:	0.13	m	1.71
25% effective depth:	0.06	m	1.78
t75	724.7	min	1.84
t50	766.3	min	
t25	808.0	min	
Vp75-25	0.24	m3	
Vp75 - Vp25 (corrected)	0.24	m3	
ap50	2.69	m2	
tp75-25	-	min	
tp75-25	83.3	min	
Soil infiltration rate (f):	1.80E-05	m/s	
	0.02	mm/sec	
	1.55	m/day	

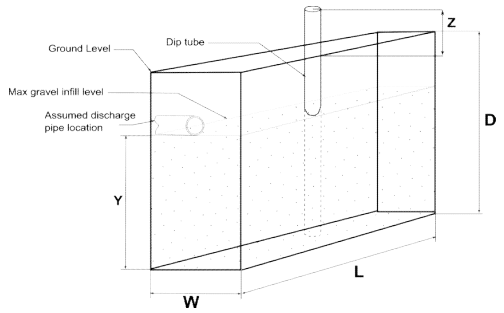
Soil infiltration rate, $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

where:

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area;

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.



Soil Log:

From	To	Description
0.00	0.30	Topsoil
0.30	1.50	Clay
1.50	2.05	Weathered chalk

Appendix C – Deep borehole soakaway test results

Borehole Log

BH01

Project Name: Radlett Field Project No: P17014

Location: Radlett Co-ords: 517419 - 199824 Level:

Hole Type: BH Logged By: RLW Dates: 03/07/2023 - 03/07/2023

Client: Fairfax Properties Consultant: RLW

Plant Used: Dando 2500 SPT Hammer Serial No:

Well	Water	Depth	Legend	Stratum Description	Detailed Description	Depth m
		0.30		Dense dark brown slightly sandy slightly clayey GRAVEL. Sand is fine. Gravel is fine to coarse sub-rounded to sub-angular of flint and sandstone. Rare cobbles of flint (TOPSOIL).	@0-0.2 abundant coarse rootlets	
		0.40		Soft light grey mottled orange slightly gravelly CLAY. Gravel is coarse sub-rounded to rounded of flint (LAMBETH GROUP).		0.5
		0.90		Soft orangeish mottled grey and red slightly sandy CLAY with occasional gravel. Sand is fine to medium. Gravel is coarse rounded of flint (LAMBETH GROUP).		1.0
		1.40		Soft light grey mottled orange sandy silty CLAY. Sand is fine (LAMBETH GROUP).		1.5
		1.90		Soft yellowish brown occasionally mottled greenish sandy CLAY. Sand is fine (LAMBETH GROUP).		2.0
				Medium yellowish brown mottled light grey clayey SAND. Sand is fine to medium becoming more sandy with depth. Rare eounded cobbles of flint (LAMBETH GROUP).	@5-5.5m Fine to medium gravel of light grey chalk. @6m becoming more clay-rich	2.5
						3.0
						3.5
						4.0
						4.5

Agreed position on site with contractors and cleared with CAT and Genny prior to excavation. Position terminated in natural strata with three soakaway tests undertaken. Position installed to 10m.

Borehole Log

BH01

Project Name: Radlett Field Project No: P17014

Location: Radlett Co-ords: 517419 - 199824 Level:

Hole Type: BH Logged By: RLW Dates: 03/07/2023 - 03/07/2023

Client: Fairfax Properties Consultant: RLW

Plant Used: Dando 2500 SPT Hammer Serial No:

Well	Water	Depth	Legend	Stratum Description	Detailed Description	Depth m
				Medium yellowish brown mottled light grey clayey SAND. Sand is fine to medium becoming more sandy with depth. Rare eounded cobbles of flint (LAMBETH GROUP).	@5-5.5m Fine to medium gravel of light grey chalk. @6m becoming more clay-rich	
		6.60		Medium yellowish brown slightly clayey slightly gravelly SAND. Sand is fine to medium. Gravel is fine to coarse sub-angular to angular of flint. Occasional cobbles of flint (LAMBETH GROUP).		
		7.50		Structureless CHALK composed of slightly gravelly SILT. Gravel is fine to coarse sub-rounded of chalk. Clasts are weak low density off-white occasionally cream (Lewis Nodular and Seaford Chalk Formation, Grade Dm).		
		10.00				

5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5

Agreed position on site with contractors and cleared with CAT and Genny prior to excavation. Position terminated in natural strata with three soakaway tests undertaken. Position installed to 10m.

AGS

Borehole Log

BH02

Project Name: Radlett Field Project No: P17014

Location: Radlett Co-ords: 517359 - 199633 Level:

Hole Type: BH Logged By: RLW Dates: 03/07/2023 - 03/07/2023

Client: Fairfax Properties Consultant: RLW

Plant Used: Dando 2500 SPT Hammer Serial No:

Well	Water	Depth	Legend	Stratum Description	Detailed Description	Depth m
		0.40		MADE GROUND: Dark brown clayey gravelly SAND. Sand is fine to medium. Gravel is fine to coarse sub-rounded to rounded of flint. Rare fine brick. Abundant rootlets.		
		1.50		Soft to firm orangeish brown slightly gravelly very sandy CLAY. Sand is fine to medium. Gravel is fine to coarse rounded of flint.		0.5
		1.90		Soft to firm orangish brown mottled grey sandy CLAY. Laminations present. Occasional gravel of fine to coarse sub-rounded flint and fine chalk (LAMBETH GROUP).		1.0
				Soft light orangish/ greyish brown very sandy CLAY (LAMBETH GROUP).	@3m Alternating bands of orange sand and grey clay @4.5m occasionally mottled yellow	1.5
						2.0
						2.5
						3.0
						3.5
						4.0
						4.5

Agreed position on site with contractors and cleared with CAT and Genny prior to excavation. Position terminated in natural strata with one soakaway tests undertaken. Position installed to 10m.

Borehole Log

BH02
Page 2 of 2

Project Name: Radlett Field Project No: P17014

Location: Radlett Co-ords: 517359 - 199633 Level:

Hole Type: BH Logged By: RLW Dates: 03/07/2023 - 03/07/2023

Client: Fairfax Properties Consultant: RLW

Plant Used: Dando 2500 SPT Hammer Serial No:

Well	Water	Depth	Legend	Stratum Description	Detailed Description	Depth m
		5.10		Soft light orangish/ greyish brown very sandy CLAY (LAMBETH GROUP).	@3m Alternating bands of orange sand and grey clay @4.5m occasionally mottled yellow	
				Soft yellowish/ orange mottled brown slightly sandy gravelly CLAY. Sand is medium to coarse. Gravel is fine to coarse sub-angular of flint and chalk (LAMBETH GROUP).		5.5
		5.80		Structureless CHALK composed of slightly gravelly silty CLAY. Gravel is fine to coarse predominantly fine angular of flint chalk. Clasts are weak low density off-white occasionally cream (Lewis Nodular and Seaford Chalk Formation, Grade DC).	@7m flint gravel becoming rare and chalk clasts changing to medium density	6.0
						6.5
						7.0
						7.5
						8.0
						8.5
						9.0
						9.5
		10.00				

Agreed position on site with contractors and cleared with CAT and Genny prior to excavation. Position terminated in natural strata with one soakaway tests undertaken. Position installed to 10m.

FIELD PERMEABILITY - TESTS WITHOUT OBSERVATION WELLS

9-1

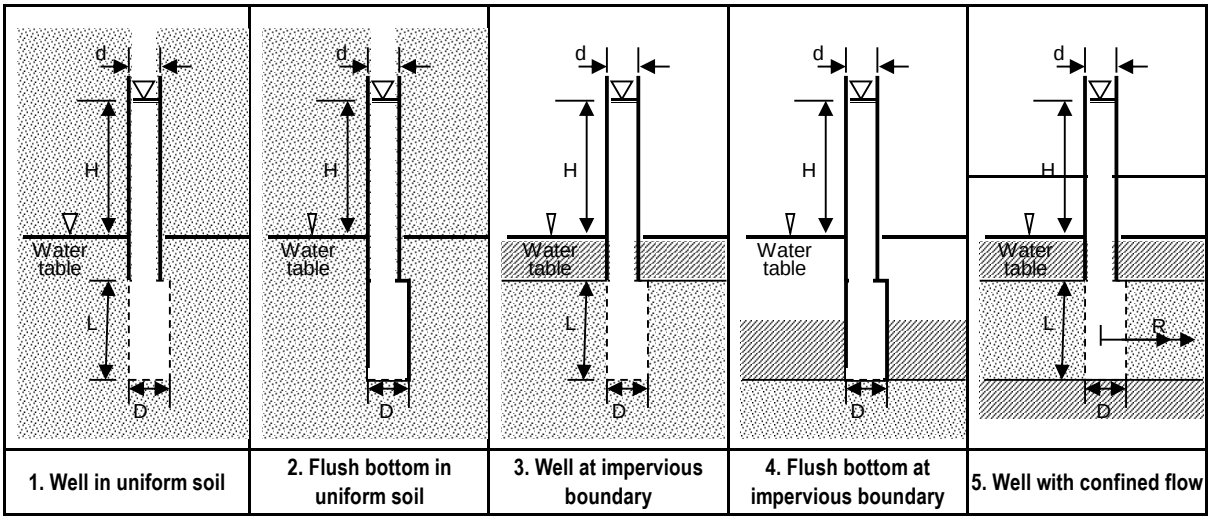
October 2007

APPENDIX TO CHAPTER 3 | Sheet 3 of 4

Project:	Radlett fields			Project no.:	P17014
Borehole:	BH01	Test date:	04-Jul-23	Calc. by:	ACW	Checked by:	

Note: input data only into yellow-highlighted cells: do not amend any other cell, even if it appears blank.

Select test conditions, 1 to 5, from the list below: 3



1. Well in uniform soil	2. Flush bottom in uniform soil	3. Well at impervious boundary	4. Flush bottom at impervious boundary	5. Well with confined flow

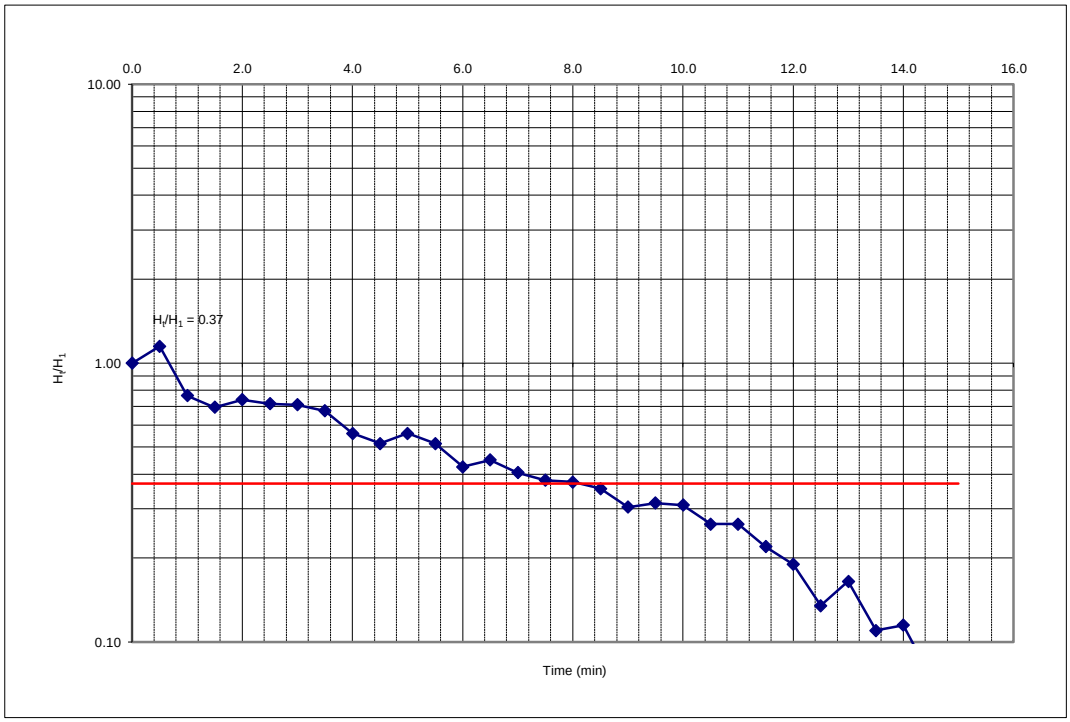
READINGS

Time (minutes)	Water depth (m from top of casing)	Proportional head, H_t/H_0
0.0	8	1.00
0.5	7.7	1.15
1.0	8.47	0.77
1.5	8.61	0.70
2.0	8.52	0.74
2.5	8.57	0.72
3.0	8.580	0.71
3.5	8.650	0.68
4.0	8.88	0.56
4.5	8.97	0.52
5.0	8.88	0.56
5.5	8.97	0.52
6.0	9.15	0.43
6.5	9.1	0.45
7.0	9.19	0.41
7.5	9.24	0.38
8.0	9.25	0.38
8.5	9.29	0.36
9.0	9.39	0.31
9.5	9.37	0.32
10.0	9.38	0.31
10.5	9.47	0.27
11.0	9.47	0.27
11.5	9.56	0.22
12.0	9.62	0.19
12.5	9.73	0.14
13.0	9.67	0.17
13.5	9.78	0.11
14.0	9.77	0.12
14.5	9.85	0.08
15.0	9.85	0.08

RESPONSE ZONE DETAILS

Top of test section (m bgl)	Bottom of test section (m bgl)	Height of casing above ground (m)	Casing or standpipe diameter, d (m)	Test section diameter, D (m)	Depth to water table (m bgl)	Dist. to water source (m) - condition 5 only
8.00	10.00	0.00	0.15	0.150	10.00	

ERROR MESSAGES



TIME LAG VALUE (FROM GRAPH)

BASIC TIME LAG, T (min to reach Ht/H_0=0.37) - from graph	8
BASIC TIME LAG (seconds)	480

CALCULATED VALUES

Length of test section, L	2.00
Initial head of water, H_0	2.00

PERMEABILITY (m/s)	1.17E-05

FIELD PERMEABILITY - TESTS WITHOUT OBSERVATION WELLS

9-1

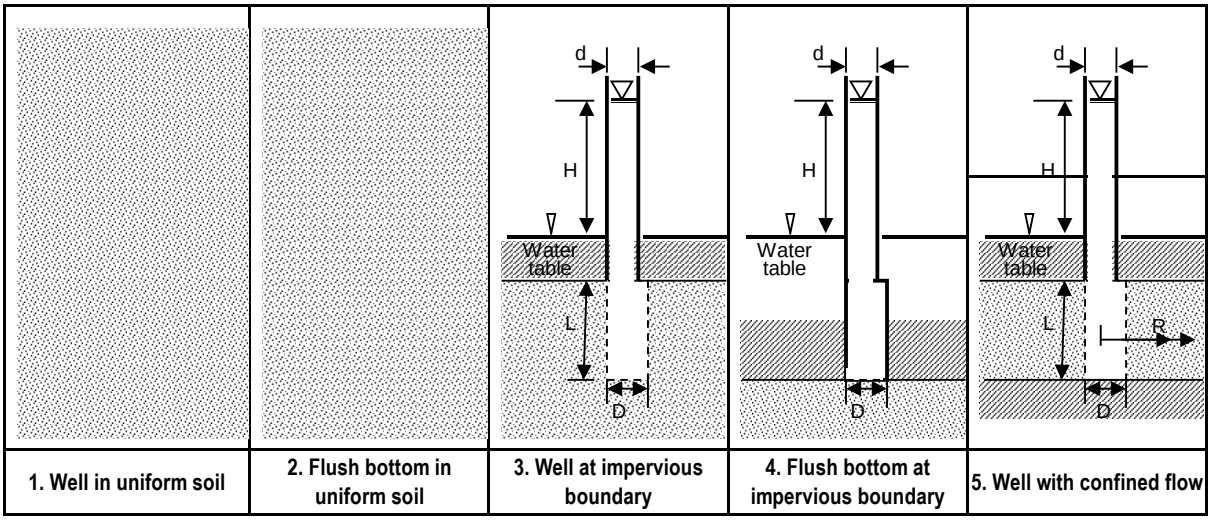
October 2007

APPENDIX TO CHAPTER 3 | **Sheet 3 of 4**

Project:		Project no.:	
Borehole:	Test date:	Calc. by:	Checked by:

Note: input data only into yellow-highlighted cells: do not amend any other cell, even if it appears blank.

Select test conditions, 1 to 5, from the list below: 3



1. Well in uniform soil	2. Flush bottom in uniform soil	3. Well at impervious boundary	4. Flush bottom at impervious boundary	5. Well with confined flow

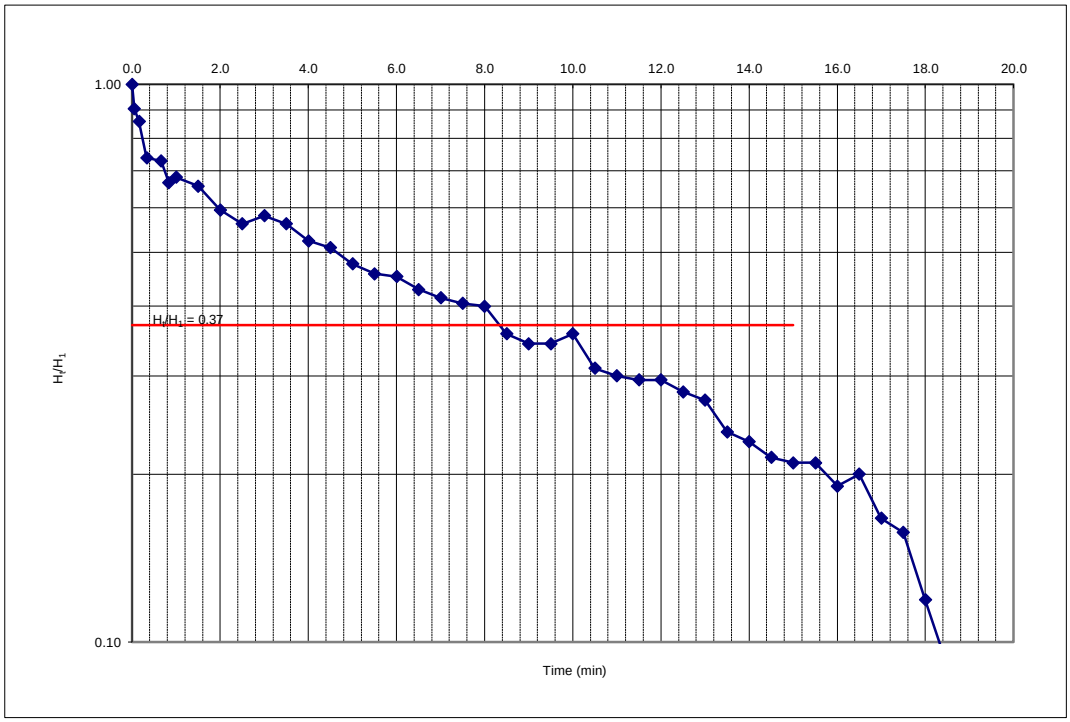
READINGS

Time (minutes)	Water depth (m from top of casing)	Proportional head, H_t/H_0
0.0	7.9	1.00
0.1	8.1	0.90
0.2	8.2	0.86
0.3	8.45	0.74
0.7	8.47	0.73
0.8	8.6	0.67
1.0	8.570	0.68
1.5	8.620	0.66
2.0	8.75	0.60
2.5	8.82	0.56
3.0	8.78	0.58
3.5	8.82	0.56
4.0	8.9	0.52
4.5	8.93	0.51
5.0	9	0.48
5.5	9.04	0.46
6.0	9.05	0.45
6.5	9.1	0.43
7.0	9.13	0.41
7.5	9.15	0.40
8.0	9.16	0.40
8.5	9.25	0.36
9.0	9.28	0.34
9.5	9.28	0.34
10.0	9.25	0.36
10.5	9.35	0.31
11.0	9.37	0.30
11.5	9.38	0.30
12.0	9.38	0.30
12.5	9.41	0.28
13.0	9.43	0.27
		0.24
		0.23
		0.21
		0.21
		0.21

RESPONSE ZONE DETAILS

Top of test section (m bgl)	Bottom of test section (m bgl)	Height of casing above ground (m)	Casing or standpipe diameter, d (m)	Test section diameter, D (m)	Depth to water table (m bgl)	Dist. to water source (m) - condition 5 only
7.90	10.00	0.00	0.15	0.150	10.00	

ERROR MESSAGES



TIME LAG VALUE (FROM GRAPH)

BASIC TIME LAG, T (min to reach Ht/H_0=0.37) - from graph	8.5
BASIC TIME LAG (seconds)	510

CALCULATED VALUES

Length of test section, L	2.10
Initial head of water, H_0	2.10

PERMEABILITY (m/s)	**1.06E-05**

FIELD PERMEABILITY - TESTS WITHOUT OBSERVATION WELLS

9-1

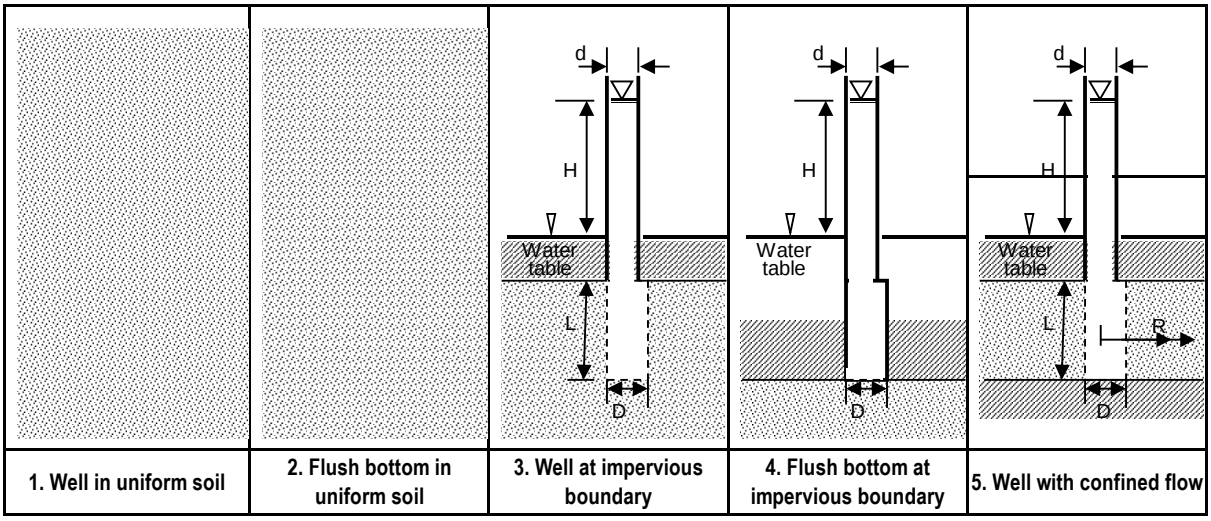
October 2007

APPENDIX TO CHAPTER 3 | **Sheet 3 of 4**

Project:		Project no.:	
Borehole:	Test date:	Calc. by:	Checked by:

Note: input data only into yellow-highlighted cells: do not amend any other cell, even if it appears blank.

Select test conditions, 1 to 5, from the list below: 3



1. Well in uniform soil	2. Flush bottom in uniform soil	3. Well at impervious boundary	4. Flush bottom at impervious boundary	5. Well with confined flow

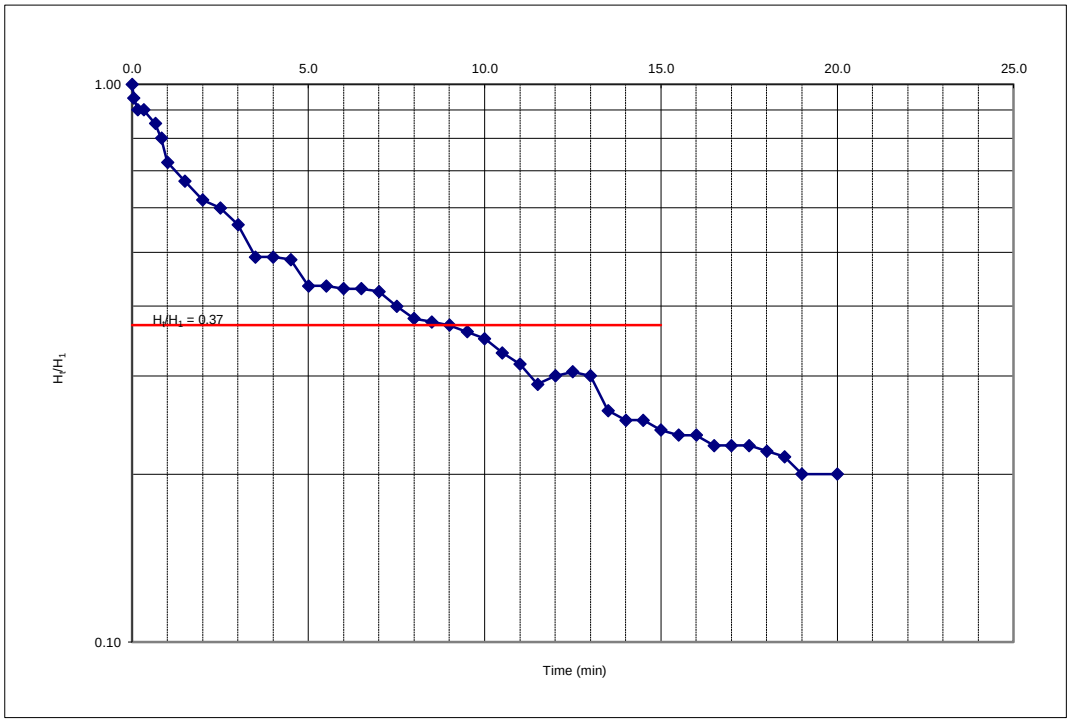
READINGS

Time (minutes)	Water depth (m from top of casing)	Proportional head, H_t/H_0
0.0	8	1.00
0.1	8.11	0.95
0.2	8.2	0.90
0.3	8.2	0.90
0.7	8.3	0.85
0.8	8.4	0.80
1.0	8.550	0.73
1.5	8.660	0.67
2.0	8.76	0.62
2.5	8.8	0.60
3.0	8.88	0.56
3.5	9.02	0.49
4.0	9.02	0.49
4.5	9.03	0.49
5.0	9.13	0.44
5.5	9.13	0.44
6.0	9.14	0.43
6.5	9.14	0.43
7.0	9.15	0.43
7.5	9.2	0.40
8.0	9.24	0.38
8.5	9.25	0.38
9.0	9.26	0.37
9.5	9.28	0.36
10.0	9.3	0.35
10.5	9.34	0.33
11.0	9.37	0.32
11.5	9.42	0.29
12.0	9.4	0.30
12.5	9.39	0.31
13.0	9.4	0.30
13.5	9.48	0.26
14.0	9.5	0.25
14.5	9.5	0.25
15.0	9.52	0.24
15.5	9.53	0.24

RESPONSE ZONE DETAILS

Top of test section (m bgl)	Bottom of test section (m bgl)	Height of casing above ground (m)	Casing or standpipe diameter, d (m)	Test section diameter, D (m)	Depth to water table (m bgl)	Dist. to water source (m) - condition 5 only
8.00	10.00	0.00	0.15	0.150	10.00	

ERROR MESSAGES



TIME LAG VALUE (FROM GRAPH)

BASIC TIME LAG, T (min to reach Ht/H_0=0.37) - from graph	9
BASIC TIME LAG (seconds)	540

CALCULATED VALUES

Length of test section, L	2.00
Initial head of water, H_0	2.00

PERMEABILITY (m/s)	**1.04E-05**

Appendix D - Photos of wooded depression

	Former quarry east of the Plantation RIGS		Former quarry east of the Plantation RIGS
Project	Radlett Fields	Date	12/01/2022
Project No.	P17014	Engineer	ACW
Client	Fairfax Acquisitions Ltd	Comments	

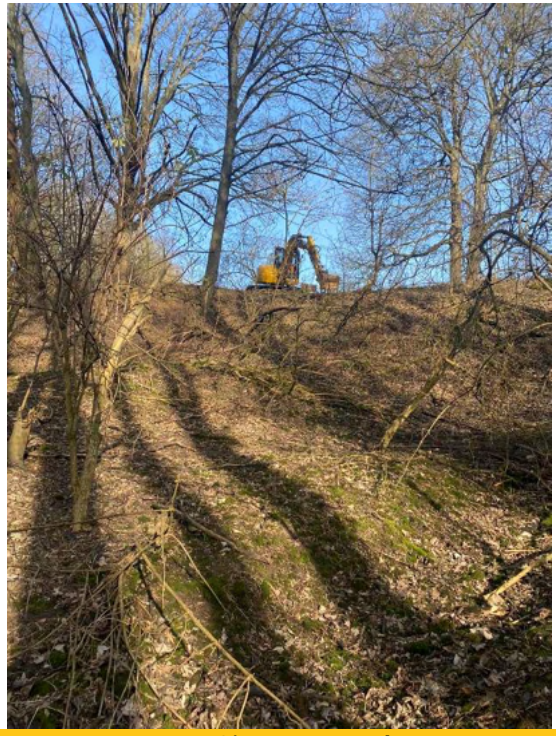
	Plantation RIGS close-up of puddingstone		Plantation RIGS puddingstone in-situ outcrop
Project	Radlett Fields	Date	12/01/2022
Project No.	P17014	Engineer	ACW
Client	Fairfax Acquisitions Ltd	Comments	

	Plantation RIGS puddingstone		Plantation RIGS puddingstone
Project	Radlett Fields	Date	12/01/2022
Project No.	P17014	Engineer	ACW
Client	Fairfax Acquisitions Ltd	Comments	

	Radlett fields looking south		Radlett fields looking north
Project	Radlett Fields	Date	12/01/2022
Project No.	P17014	Engineer	ACW
Client	Fairfax Acquisitions Ltd	Comments	

	Historic chalk pit south of the Site		Historic chalk pit south of the Site
Project	Radlett Fields	Date	12/01/2022
Project No.	P17014	Engineer	ACW
Client	Fairfax Acquisitions Ltd	Comments	

	TP01 pit		TP01 arisings
ProjectA	Radlett FieldA	DateA	09/02/2023
Project No.A	P17014A	Engineer	ACWA
Client	Fairfax PropertiesA	CommentsA	



	TP01 chalk		Site access slope
ProjectA	RadlettAFieldA	DateA	09/02/2023
Project No.A	P17014A	Engineer	ACWA
Client	Fairfax PropertiesA	CommentsA	

	TP02 pit		TP02 arisings
ProjectA	Radlett FieldA	DateA	10/02/2023
Project No.A	P17014A	Engineer	ACWA
Client	Fairfax PropertiesA	CommentsA	

	TP03 pit		TP03 arisings
ProjectA	Radlett FieldA	DateA	10/02/2023
Project No.A	P17014	EngineerA	ACWA
Client	Fairfax PropertiesA	CommentsA	

Appendix E - Greenfield runoff calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	10.970	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results l/s

QBAR Rural	48.2
QBAR Urban	48.2
Q100 years	153.7
Q1 year	41.0
Q30 years	109.2
Q100 years	153.7

Appendix F - MicroDrainage drainage calculation results

F.1 Detention Basin

Cascade Summary of Results for Detention basin.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Eastern Swale.SRCX	Eastern Swale.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	93.680	0.180	13.6	87.9	O K
30 min Summer	93.717	0.217	17.7	107.5	Flood Risk
60 min Summer	93.739	0.239	19.0	119.5	Flood Risk
120 min Summer	93.762	0.262	20.3	132.1	Flood Risk
180 min Summer	93.768	0.268	20.6	134.9	Flood Risk
240 min Summer	93.765	0.265	20.5	133.4	Flood Risk
360 min Summer	93.750	0.250	19.6	125.3	Flood Risk
480 min Summer	93.733	0.233	18.7	116.0	Flood Risk
600 min Summer	93.717	0.217	17.7	107.5	Flood Risk
720 min Summer	93.704	0.204	16.4	100.8	Flood Risk
960 min Summer	93.684	0.184	14.1	90.1	O K
1440 min Summer	93.656	0.156	11.0	75.5	O K
2160 min Summer	93.630	0.130	8.2	62.6	O K
2880 min Summer	93.613	0.113	6.5	54.2	O K
4320 min Summer	93.593	0.093	4.9	44.1	O K
5760 min Summer	93.583	0.083	4.0	39.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	91.7	20
30 min Summer	103.308	0.0	120.0	32
60 min Summer	63.833	0.0	151.3	52
120 min Summer	40.263	0.0	191.3	86
180 min Summer	30.292	0.0	216.1	120
240 min Summer	24.517	0.0	233.3	154
360 min Summer	17.890	0.0	255.5	218
480 min Summer	14.146	0.0	269.4	282
600 min Summer	11.726	0.0	279.1	344
720 min Summer	10.028	0.0	286.4	404
960 min Summer	7.794	0.0	296.7	528
1440 min Summer	5.424	0.0	309.1	770
2160 min Summer	3.765	0.0	324.0	1144
2880 min Summer	2.912	0.0	333.8	1504
4320 min Summer	2.044	0.0	350.3	2212
5760 min Summer	1.604	0.0	369.0	2944

Cascade Summary of Results for Detention basin.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	93.577	0.077	3.4	36.4	O K
8640 min Summer	93.573	0.073	3.0	34.3	O K
10080 min Summer	93.569	0.069	2.6	32.7	O K
15 min Winter	93.734	0.234	18.7	116.5	Flood Risk
30 min Winter	93.784	0.284	21.5	144.1	Flood Risk
60 min Winter	93.814	0.314	23.0	161.1	Flood Risk
120 min Winter	93.839	0.339	24.1	175.1	Flood Risk
180 min Winter	93.839	0.339	24.1	175.3	Flood Risk
240 min Winter	93.830	0.330	23.7	169.8	Flood Risk
360 min Winter	93.800	0.300	22.3	153.1	Flood Risk
480 min Winter	93.770	0.270	20.7	136.2	Flood Risk
600 min Winter	93.743	0.243	19.3	121.7	Flood Risk
720 min Winter	93.721	0.221	18.0	110.0	Flood Risk
960 min Winter	93.693	0.193	15.1	94.9	O K
1440 min Winter	93.658	0.158	11.2	76.6	O K
2160 min Winter	93.629	0.129	8.0	61.9	O K
2880 min Winter	93.610	0.110	6.3	52.4	O K
4320 min Winter	93.588	0.088	4.5	41.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.341	0.0	385.3	3672
8640 min Summer	1.166	0.0	401.3	4408
10080 min Summer	1.041	0.0	417.2	5144
15 min Winter	159.261	0.0	123.5	20
30 min Winter	103.308	0.0	161.3	32
60 min Winter	63.833	0.0	202.3	58
120 min Winter	40.263	0.0	255.7	92
180 min Winter	30.292	0.0	288.8	130
240 min Winter	24.517	0.0	311.7	166
360 min Winter	17.890	0.0	341.3	236
480 min Winter	14.146	0.0	359.9	300
600 min Winter	11.726	0.0	372.9	362
720 min Winter	10.028	0.0	382.7	422
960 min Winter	7.794	0.0	396.4	542
1440 min Winter	5.424	0.0	413.2	786
2160 min Winter	3.765	0.0	432.4	1152
2880 min Winter	2.912	0.0	445.6	1528
4320 min Winter	2.044	0.0	468.1	2212

Cascade Summary of Results for Detention basin.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
5760 min Winter	93.579	0.079	3.6	37.1	O K
7200 min Winter	93.573	0.073	3.0	34.4	O K
8640 min Winter	93.569	0.069	2.6	32.4	O K
10080 min Winter	93.564	0.064	2.3	30.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	1.604	0.0	492.2	2976
7200 min Winter	1.341	0.0	514.0	3672
8640 min Winter	1.166	0.0	535.7	4416
10080 min Winter	1.041	0.0	557.2	5152

Cascade Rainfall Details for Detention basin.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.320

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.200	4	8	0.120

Cascade Model Details for Detention basin.SRCX

Storage is Online Cover Level (m) 94.000

Tank or Pond Structure

Invert Level (m) 93.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	460.0	0.500	635.0

Orifice Outflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 93.500

F.3 Swales

Cascade Summary of Results for Eastern Swale.SRCX

Upstream Structures	Outflow To	Overflow To
Detention basin.SRCX	Southern Swale.SRCX	Southern Swale.SRCX

Half Drain Time : 3 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
15 min Summer	92.563	1.063	0.0	656.5	656.5	137.1	O K
30 min Summer	92.570	1.070	0.0	659.3	659.3	139.6	O K
60 min Summer	92.464	0.964	0.0	612.2	612.2	103.4	O K
120 min Summer	92.309	0.809	0.0	517.5	517.5	62.7	O K
180 min Summer	92.209	0.709	0.0	427.3	427.3	43.1	O K
240 min Summer	92.136	0.636	0.0	362.6	362.6	31.8	O K
360 min Summer	92.041	0.541	0.0	279.0	279.0	20.2	O K
480 min Summer	91.980	0.480	0.0	226.7	226.7	14.5	O K
600 min Summer	91.925	0.425	0.0	191.6	191.6	10.3	O K
720 min Summer	91.883	0.383	0.0	165.5	165.5	7.8	O K
960 min Summer	91.834	0.334	0.0	130.8	130.8	5.4	O K
1440 min Summer	91.788	0.288	0.0	92.6	92.6	3.6	O K
2160 min Summer	91.739	0.239	0.0	65.2	65.2	2.2	O K
2880 min Summer	91.709	0.209	0.0	50.6	50.6	1.6	O K
4320 min Summer	91.677	0.177	0.0	36.0	36.0	1.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	647.1	15
30 min Summer	103.308	0.0	840.6	23
60 min Summer	63.833	0.0	1041.7	38
120 min Summer	40.263	0.0	1314.5	68
180 min Summer	30.292	0.0	1483.7	98
240 min Summer	24.517	0.0	1601.3	128
360 min Summer	17.890	0.0	1752.8	186
480 min Summer	14.146	0.0	1848.0	246
600 min Summer	11.726	0.0	1914.8	306
720 min Summer	10.028	0.0	1965.1	368
960 min Summer	7.794	0.0	2036.3	488
1440 min Summer	5.424	0.0	2125.1	734
2160 min Summer	3.765	0.0	2214.4	1092
2880 min Summer	2.912	0.0	2283.4	1464
4320 min Summer	2.044	0.0	2403.7	2192

Cascade Summary of Results for Eastern Swale.SRCX

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
5760 min Summer	91.655	0.155	0.0	28.5	28.5	0.7	O K
7200 min Summer	91.642	0.142	0.0	24.0	24.0	0.6	O K
8640 min Summer	91.633	0.133	0.0	20.7	20.7	0.5	O K
10080 min Summer	91.626	0.126	0.0	18.6	18.6	0.4	O K
15 min Winter	92.775	1.275	0.0	742.1	742.1	231.6	Flood Risk
30 min Winter	92.756	1.256	0.0	734.6	734.6	221.5	Flood Risk
60 min Winter	92.564	1.064	0.0	656.9	656.9	137.5	O K
120 min Winter	92.307	0.807	0.0	516.1	516.1	62.4	O K
180 min Winter	92.185	0.685	0.0	405.9	405.9	39.1	O K
240 min Winter	92.106	0.606	0.0	335.9	335.9	27.8	O K
360 min Winter	92.009	0.509	0.0	251.6	251.6	17.1	O K
480 min Winter	91.942	0.442	0.0	202.5	202.5	11.6	O K
600 min Winter	91.891	0.391	0.0	170.6	170.6	8.3	O K
720 min Winter	91.854	0.354	0.0	147.4	147.4	6.3	O K
960 min Winter	91.816	0.316	0.0	115.8	115.8	4.6	O K
1440 min Winter	91.773	0.273	0.0	81.6	81.6	3.1	O K
2160 min Winter	91.722	0.222	0.0	56.9	56.9	1.8	O K
2880 min Winter	91.696	0.196	0.0	44.3	44.3	1.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.604	0.0	2517.0	2872
7200 min Summer	1.341	0.0	2629.8	3656
8640 min Summer	1.166	0.0	2742.9	4344
10080 min Summer	1.041	0.0	2857.2	5064
15 min Winter	159.261	0.0	864.1	16
30 min Winter	103.308	0.0	1122.0	24
60 min Winter	63.833	0.0	1389.5	40
120 min Winter	40.263	0.0	1753.4	68
180 min Winter	30.292	0.0	1979.0	98
240 min Winter	24.517	0.0	2135.7	128
360 min Winter	17.890	0.0	2337.8	186
480 min Winter	14.146	0.0	2464.7	248
600 min Winter	11.726	0.0	2553.8	306
720 min Winter	10.028	0.0	2620.9	368
960 min Winter	7.794	0.0	2715.9	492
1440 min Winter	5.424	0.0	2834.5	734
2160 min Winter	3.765	0.0	2953.0	1104
2880 min Winter	2.912	0.0	3045.1	1468

Cascade Summary of Results for Eastern Swale.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
4320 min Winter	91.664	0.164	0.0	31.5	31.5	0.8	O K
5760 min Winter	91.644	0.144	0.0	24.7	24.7	0.6	O K
7200 min Winter	91.632	0.132	0.0	20.6	20.6	0.5	O K
8640 min Winter	91.624	0.124	0.0	18.1	18.1	0.4	O K
10080 min Winter	91.616	0.116	0.0	16.1	16.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
4320 min Winter	2.044	0.0	3206.0	2140
5760 min Winter	1.604	0.0	3356.2	2904
7200 min Winter	1.341	0.0	3506.7	3568
8640 min Winter	1.166	0.0	3657.7	4392
10080 min Winter	1.041	0.0	3810.6	5048

Cascade Rainfall Details for Eastern Swale.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.860

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.800	4	8	0.860	8	12	0.200

Cascade Model Details for Eastern Swale.SRCX

Storage is Online Cover Level (m) 93.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	327.3
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	91.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.3		

Orifice Outflow Control

Diameter (m) 0.600 Discharge Coefficient 0.600 Invert Level (m) 91.500

Cascade Summary of Results for Southern Swale.SRCX

Upstream Structures	Outflow To	Overflow To
Eastern Swale.SRCX Detention basin.SRCX	Bioretention Area.SRCX	Bioretention Area.SRCX

Half Drain Time : 1 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
15 min Summer	91.331	0.831	0.0	721.0	721.0	67.7	Flood Risk
30 min Summer	91.337	0.837	0.0	728.5	728.5	69.1	Flood Risk
60 min Summer	91.303	0.803	0.0	682.5	682.5	61.4	Flood Risk
120 min Summer	91.228	0.728	0.0	581.7	581.7	46.5	Flood Risk
180 min Summer	91.155	0.655	0.0	485.9	485.9	34.5	O K
240 min Summer	91.088	0.588	0.0	413.9	413.9	25.5	O K
360 min Summer	90.990	0.490	0.0	319.8	319.8	15.4	O K
480 min Summer	90.938	0.438	0.0	259.8	259.8	11.3	O K
600 min Summer	90.907	0.407	0.0	219.5	219.5	9.2	O K
720 min Summer	90.883	0.383	0.0	189.5	189.5	7.9	O K
960 min Summer	90.840	0.340	0.0	149.7	149.7	5.6	O K
1440 min Summer	90.781	0.281	0.0	105.7	105.7	3.4	O K
2160 min Summer	90.737	0.237	0.0	74.4	74.4	2.2	O K
2880 min Summer	90.706	0.206	0.0	57.9	57.9	1.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	736.7	16
30 min Summer	103.308	0.0	956.8	24
60 min Summer	63.833	0.0	1185.2	38
120 min Summer	40.263	0.0	1495.7	68
180 min Summer	30.292	0.0	1688.2	98
240 min Summer	24.517	0.0	1821.9	128
360 min Summer	17.890	0.0	1994.3	188
480 min Summer	14.146	0.0	2102.6	248
600 min Summer	11.726	0.0	2178.6	308
720 min Summer	10.028	0.0	2235.8	368
960 min Summer	7.794	0.0	2316.8	490
1440 min Summer	5.424	0.0	2417.9	730
2160 min Summer	3.765	0.0	2519.2	1100
2880 min Summer	2.912	0.0	2597.7	1460

Cascade Summary of Results for Southern Swale.SRCX

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
4320 min Summer	90.674	0.174	0.0	41.1	41.1	1.0	O K
5760 min Summer	90.654	0.154	0.0	32.6	32.6	0.7	O K
7200 min Summer	90.640	0.140	0.0	27.4	27.4	0.6	O K
8640 min Summer	90.631	0.131	0.0	23.8	23.8	0.5	O K
10080 min Summer	90.624	0.124	0.0	21.3	21.3	0.4	O K
15 min Winter	91.405	0.905	0.0	822.6	822.6	86.5	Flood Risk
30 min Winter	91.407	0.907	0.0	824.6	824.6	86.9	Flood Risk
60 min Winter	91.349	0.849	0.0	745.7	745.7	72.1	Flood Risk
120 min Winter	91.234	0.734	0.0	589.6	589.6	47.6	Flood Risk
180 min Winter	91.140	0.640	0.0	465.5	465.5	32.3	O K
240 min Winter	91.058	0.558	0.0	385.4	385.4	22.1	O K
360 min Winter	90.961	0.461	0.0	289.2	289.2	13.0	O K
480 min Winter	90.917	0.417	0.0	232.3	232.3	9.8	O K
600 min Winter	90.888	0.388	0.0	195.9	195.9	8.1	O K
720 min Winter	90.865	0.365	0.0	168.4	168.4	6.8	O K
960 min Winter	90.816	0.316	0.0	132.2	132.2	4.7	O K
1440 min Winter	90.764	0.264	0.0	93.0	93.0	2.9	O K
2160 min Winter	90.719	0.219	0.0	65.1	65.1	1.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
4320 min Summer	2.044	0.0	2734.9	2176
5760 min Summer	1.604	0.0	2863.3	2928
7200 min Summer	1.341	0.0	2991.7	3648
8640 min Summer	1.166	0.0	3120.5	4384
10080 min Summer	1.041	0.0	3250.7	5128
15 min Winter	159.261	0.0	983.5	16
30 min Winter	103.308	0.0	1277.0	24
60 min Winter	63.833	0.0	1581.0	40
120 min Winter	40.263	0.0	1994.9	70
180 min Winter	30.292	0.0	2251.6	100
240 min Winter	24.517	0.0	2429.9	128
360 min Winter	17.890	0.0	2659.7	188
480 min Winter	14.146	0.0	2804.2	246
600 min Winter	11.726	0.0	2905.5	306
720 min Winter	10.028	0.0	2981.8	370
960 min Winter	7.794	0.0	3089.9	486
1440 min Winter	5.424	0.0	3225.0	732
2160 min Winter	3.765	0.0	3359.5	1096

Cascade Summary of Results for Southern Swale.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
2880 min Winter	90.692	0.192	0.0	50.4	50.4	1.3	O K
4320 min Winter	90.662	0.162	0.0	35.8	35.8	0.8	O K
5760 min Winter	90.642	0.142	0.0	28.2	28.2	0.6	O K
7200 min Winter	90.631	0.131	0.0	23.8	23.8	0.5	O K
8640 min Winter	90.622	0.122	0.0	20.5	20.5	0.4	O K
10080 min Winter	90.614	0.114	0.0	18.3	18.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
2880 min Winter	2.912	0.0	3464.2	1468
4320 min Winter	2.044	0.0	3647.5	2192
5760 min Winter	1.604	0.0	3818.0	2816
7200 min Winter	1.341	0.0	3989.3	3664
8640 min Winter	1.166	0.0	4161.1	4360
10080 min Winter	1.041	0.0	4335.2	4992

Cascade Rainfall Details for Southern Swale.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.300

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.200	4	8	0.100

Cascade Model Details for Southern Swale.SRCX

Storage is Online Cover Level (m) 91.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	107.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	90.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.3		

Orifice Outflow Control

Diameter (m) 0.800 Discharge Coefficient 0.600 Invert Level (m) 90.500

F.4 Bioretention Area

Cascade Summary of Results for Bioretention Area.SRCX

Upstream Structures	Outflow To	Overflow To
Southern Swale.SRCX Eastern Swale.SRCX Detention basin.SRCX	Wooded depression.SRCX	Wooded depression.SRCX

Half Drain Time : 15 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
15 min Summer	84.760	0.460	196.6	123.4	320.0	324.7	O K
30 min Summer	84.840	0.540	199.1	134.2	333.3	385.5	Flood Risk
60 min Summer	84.818	0.518	198.4	131.3	329.7	369.0	Flood Risk
120 min Summer	84.754	0.454	196.4	122.6	319.0	320.1	O K
180 min Summer	84.662	0.362	193.5	110.0	303.5	251.5	O K
240 min Summer	84.571	0.271	190.7	97.8	288.5	186.1	O K
360 min Summer	84.429	0.129	186.5	78.5	264.9	86.5	O K
480 min Summer	84.353	0.053	184.3	68.2	252.4	35.1	O K
600 min Summer	84.341	0.041	152.0	66.6	218.6	27.2	O K
720 min Summer	84.334	0.034	124.3	65.6	189.9	22.2	O K
960 min Summer	84.323	0.023	85.7	64.2	149.8	15.3	O K
1440 min Summer	84.312	0.012	43.3	62.6	105.9	7.6	O K
2160 min Summer	84.304	0.004	13.8	61.6	75.3	2.3	O K
2880 min Summer	84.300	0.000	0.0	57.9	57.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	736.8	24
30 min Summer	103.308	0.0	955.5	34
60 min Summer	63.833	0.0	1187.2	50
120 min Summer	40.263	0.0	1496.4	80
180 min Summer	30.292	0.0	1687.7	112
240 min Summer	24.517	0.0	1821.6	142
360 min Summer	17.890	0.0	1994.0	198
480 min Summer	14.146	0.0	2102.2	252
600 min Summer	11.726	0.0	2178.2	310
720 min Summer	10.028	0.0	2235.4	370
960 min Summer	7.794	0.0	2316.4	490
1440 min Summer	5.424	0.0	2417.5	730
2160 min Summer	3.765	0.0	2519.2	1096
2880 min Summer	2.912	0.0	2597.7	0

Cascade Summary of Results for Bioretention Area.SRCX

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
4320 min Summer	84.300	0.000	0.0	41.1	41.1	0.0	O K
5760 min Summer	84.300	0.000	0.0	32.6	32.6	0.0	O K
7200 min Summer	84.300	0.000	0.0	27.4	27.4	0.0	O K
8640 min Summer	84.300	0.000	0.0	23.8	23.8	0.0	O K
10080 min Summer	84.300	0.000	0.0	21.3	21.3	0.0	O K
15 min Winter	84.943	0.643	202.5	148.2	350.7	466.5	Flood Risk
30 min Winter	85.072	0.772	205.7	165.7	371.4	570.7	Flood Risk
60 min Winter	85.056	0.756	205.9	163.5	368.8	557.8	Flood Risk
120 min Winter	84.935	0.635	202.2	147.1	349.3	460.2	Flood Risk
180 min Winter	84.782	0.482	197.3	126.3	323.6	341.0	O K
240 min Winter	84.639	0.339	192.8	107.0	299.8	235.0	O K
360 min Winter	84.418	0.118	186.2	77.0	263.1	78.9	O K
480 min Winter	84.345	0.045	164.9	67.1	231.9	29.6	O K
600 min Winter	84.335	0.035	129.9	65.8	195.6	23.2	O K
720 min Winter	84.328	0.028	104.1	64.8	168.9	18.5	O K
960 min Winter	84.319	0.019	69.1	63.5	132.6	12.3	O K
1440 min Winter	84.309	0.009	32.2	62.2	94.4	5.6	O K
2160 min Winter	84.301	0.001	4.6	61.9	65.8	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
4320 min Summer	2.044	0.0	2734.9	0
5760 min Summer	1.604	0.0	2863.3	0
7200 min Summer	1.341	0.0	2991.7	0
8640 min Summer	1.166	0.0	3120.5	0
10080 min Summer	1.041	0.0	3250.7	0
15 min Winter	159.261	0.0	981.8	27
30 min Winter	103.308	0.0	1277.8	37
60 min Winter	63.833	0.0	1580.5	54
120 min Winter	40.263	0.0	1995.7	86
180 min Winter	30.292	0.0	2251.3	120
240 min Winter	24.517	0.0	2429.8	150
360 min Winter	17.890	0.0	2659.5	206
480 min Winter	14.146	0.0	2803.9	250
600 min Winter	11.726	0.0	2905.2	310
720 min Winter	10.028	0.0	2981.6	376
960 min Winter	7.794	0.0	3089.7	492
1440 min Winter	5.424	0.0	3224.7	734
2160 min Winter	3.765	0.0	3359.5	1124

Cascade Summary of Results for Bioretention Area.SRCX

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
2880 min Winter	84.300	0.000	0.0	50.4	50.4	0.0	O K
4320 min Winter	84.300	0.000	0.0	35.8	35.8	0.0	O K
5760 min Winter	84.300	0.000	0.0	28.2	28.2	0.0	O K
7200 min Winter	84.300	0.000	0.0	23.8	23.8	0.0	O K
8640 min Winter	84.300	0.000	0.0	20.5	20.5	0.0	O K
10080 min Winter	84.300	0.000	0.0	18.3	18.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
2880 min Winter	2.912	0.0	3464.2	0
4320 min Winter	2.044	0.0	3647.5	0
5760 min Winter	1.604	0.0	3818.0	0
7200 min Winter	1.341	0.0	3989.3	0
8640 min Winter	1.166	0.0	4161.1	0
10080 min Winter	1.041	0.0	4335.2	0

Cascade Rainfall Details for Bioretention Area.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for Bioretention Area.SRCX

Storage is Online Cover Level (m) 85.100

Bio-Retention Area Structure

Invert Level (m) 84.300 Infiltration Coefficient Base (m/hr) 1.00000
Porosity 1.00 Infiltration Coefficient Side (m/hr) 1.00000
Safety Factor 1.0

Depth (m)	Area (m²)	Perimeter (m)	Depth (m)	Area (m²)	Perimeter (m)
0.000	658.0	102.230	0.750	818.3	111.620

Filtration Outflow Control

Permeability Coefficient (m/s) 0.000100 Area (m²) 610.000
Safety Factor 1.000 Invert Level (m) 84.300
Bed Depth (m) 0.450

F.5 Wooded depression

Cascade Summary of Results for Wooded depression.SRCX

Upstream Structures	Outflow To	Overflow To
Bioretention Area.SRCX Southern Swale.SRCX Eastern Swale.SRCX Detention basin.SRCX	(None)	(None)

Half Drain Time : 878 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	78.723	1.053	7.0	233.6	O K
30 min Summer	78.894	1.224	8.2	313.1	O K
60 min Summer	79.052	1.382	9.4	400.3	O K
120 min Summer	79.263	1.593	11.0	538.2	O K
180 min Summer	79.432	1.762	12.3	668.8	O K
240 min Summer	79.550	1.880	13.3	771.6	O K
360 min Summer	79.688	2.018	14.5	903.7	O K
480 min Summer	79.776	2.106	15.2	995.8	O K
600 min Summer	79.842	2.172	15.8	1067.7	O K
720 min Summer	79.885	2.215	16.2	1117.5	O K
960 min Summer	79.941	2.271	16.7	1183.1	O K
1440 min Summer	80.021	2.351	17.4	1281.8	O K
2160 min Summer	80.053	2.383	17.7	1323.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	74
30 min Summer	103.308	0.0	96
60 min Summer	63.833	0.0	124
120 min Summer	40.263	0.0	168
180 min Summer	30.292	0.0	206
240 min Summer	24.517	0.0	250
360 min Summer	17.890	0.0	368
480 min Summer	14.146	0.0	486
600 min Summer	11.726	0.0	604
720 min Summer	10.028	0.0	722
960 min Summer	7.794	0.0	838
1440 min Summer	5.424	0.0	1058
2160 min Summer	3.765	0.0	1436

Cascade Summary of Results for Wooded depression.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
2880 min Summer	79.998	2.328	17.2	1252.4	O K
4320 min Summer	79.847	2.177	15.8	1073.7	O K
5760 min Summer	79.726	2.056	14.8	943.0	O K
7200 min Summer	79.631	1.961	14.0	847.1	O K
8640 min Summer	79.551	1.881	13.3	772.8	O K
10080 min Summer	79.485	1.815	12.8	713.9	O K
15 min Winter	78.918	1.248	8.4	325.4	O K
30 min Winter	79.119	1.449	9.9	441.4	O K
60 min Winter	79.277	1.607	11.1	548.3	O K
120 min Winter	79.455	1.785	12.5	688.7	O K
180 min Winter	79.564	1.894	13.4	784.7	O K
240 min Winter	79.667	1.997	14.3	883.2	O K
360 min Winter	79.825	2.155	15.6	1048.6	O K
480 min Winter	79.958	2.288	16.8	1203.9	O K
600 min Winter	80.057	2.387	17.7	1328.4	O K
720 min Winter	80.133	2.463	18.4	1428.6	O K
960 min Winter	80.238	2.568	19.4	1577.0	O K
1440 min Winter	80.361	2.691	20.5	1762.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
2880 min Summer	2.912	0.0	1844
4320 min Summer	2.044	0.0	2640
5760 min Summer	1.604	0.0	3408
7200 min Summer	1.341	0.0	4184
8640 min Summer	1.166	0.0	4928
10080 min Summer	1.041	0.0	5656
15 min Winter	159.261	0.0	89
30 min Winter	103.308	0.0	112
60 min Winter	63.833	0.0	144
120 min Winter	40.263	0.0	194
180 min Winter	30.292	0.0	236
240 min Winter	24.517	0.0	272
360 min Winter	17.890	0.0	366
480 min Winter	14.146	0.0	480
600 min Winter	11.726	0.0	594
720 min Winter	10.028	0.0	706
960 min Winter	7.794	0.0	918
1440 min Winter	5.424	0.0	1138

Cascade Summary of Results for Wooded depression.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
2160 min Winter	80.423	2.753	21.1	1861.1	O K
2880 min Winter	80.320	2.650	20.1	1698.6	O K
4320 min Winter	80.121	2.451	18.3	1412.9	O K
5760 min Winter	79.957	2.287	16.8	1202.4	O K
7200 min Winter	79.823	2.153	15.6	1047.2	O K
8640 min Winter	79.712	2.042	14.7	927.9	O K
10080 min Winter	79.617	1.947	13.9	834.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
2160 min Winter	3.765	0.0	1564
2880 min Winter	2.912	0.0	1996
4320 min Winter	2.044	0.0	2852
5760 min Winter	1.604	0.0	3640
7200 min Winter	1.341	0.0	4464
8640 min Winter	1.166	0.0	5192
10080 min Winter	1.041	0.0	5952

Cascade Rainfall Details for Wooded depression.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for Wooded depression.SRCX

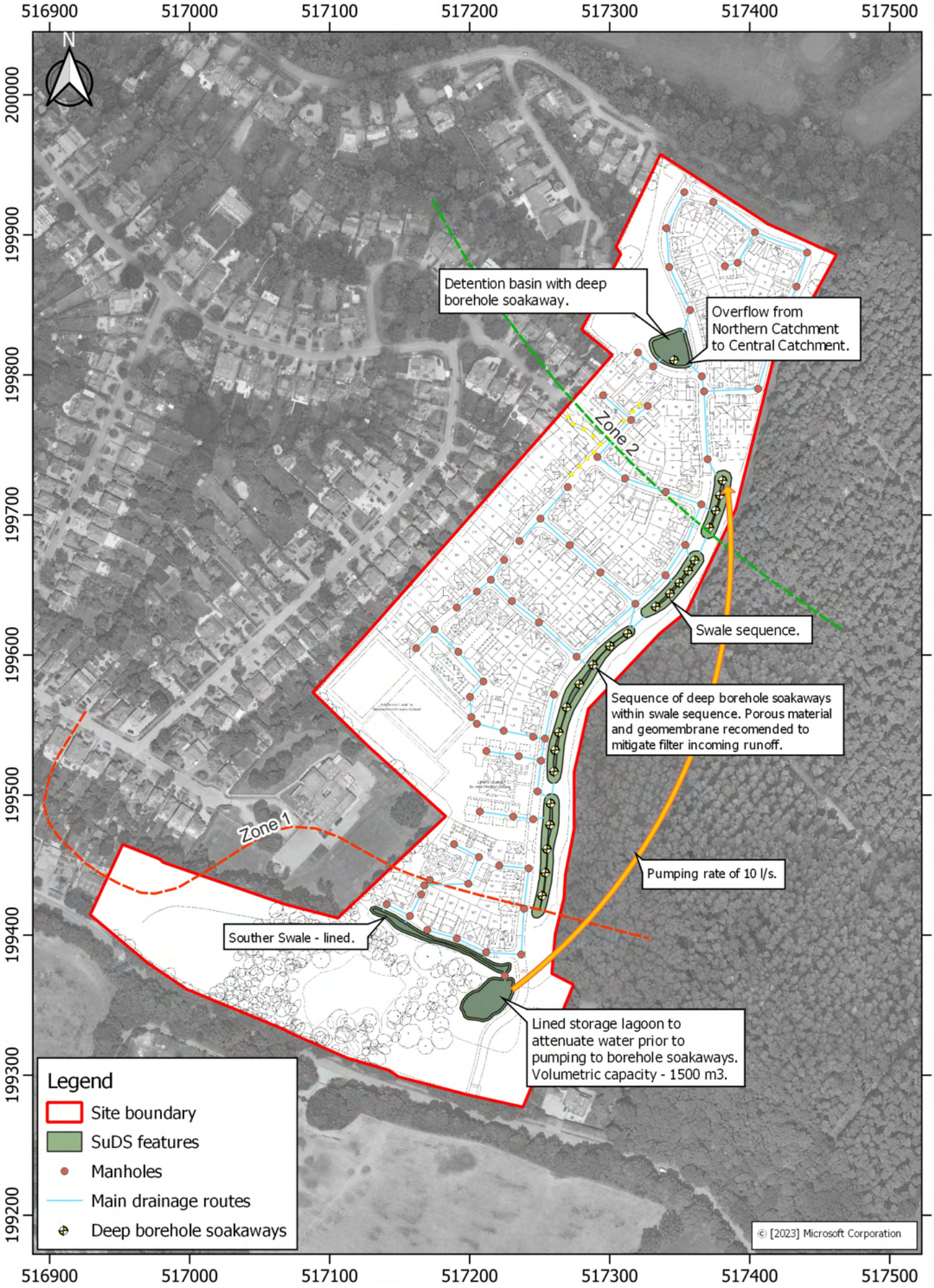
Storage is Online Cover Level (m) 82.070

Infiltration Basin Structure

Invert Level (m) 77.670 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.04000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.04000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	70.0	4.400	3522.0

Appendix G Alternative SuDS strategy details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Detention basin with deep borehole soakaway.
Overflow from Northern Catchment to Central Catchment.
Zone 2
Swale sequence.
Sequence of deep borehole soakaways within swale sequence. Porous material and geomembrane recomended to mitigate filter incoming runoff.
Zone 1
Pumping rate of 10 l/s.
Souther Swale - lined.
Lined storage lagoon to attenuate water prior to pumping to borehole soakaways. Volumetric capacity - 1500 m3.
Legend
Site boundary
SuDS features
Manholes
Main drainage routes
Deep borehole soakaways
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Cascade Summary of Results for Attenuation Basin.SRCX

Upstream Structures	Outflow To	Overflow To
Southern Swale.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	81.684	0.114	86.2	O K
30 min Summer	81.716	0.146	110.7	O K
60 min Summer	81.746	0.176	133.7	O K
120 min Summer	81.782	0.212	162.4	Flood Risk
180 min Summer	81.801	0.231	176.8	Flood Risk
240 min Summer	81.810	0.240	184.0	Flood Risk
360 min Summer	81.814	0.244	187.2	Flood Risk
480 min Summer	81.808	0.238	182.5	Flood Risk
600 min Summer	81.797	0.227	174.1	Flood Risk
720 min Summer	81.787	0.217	166.1	Flood Risk
960 min Summer	81.770	0.200	152.6	O K
1440 min Summer	81.742	0.172	131.3	O K
2160 min Summer	81.709	0.139	105.4	O K
2880 min Summer	81.681	0.111	84.1	O K
4320 min Summer	81.638	0.068	51.1	O K
5760 min Summer	81.607	0.037	28.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	22
30 min Summer	103.308	0.0	37
60 min Summer	63.833	0.0	66
120 min Summer	40.263	0.0	124
180 min Summer	30.292	0.0	184
240 min Summer	24.517	0.0	244
360 min Summer	17.890	0.0	362
480 min Summer	14.146	0.0	480
600 min Summer	11.726	0.0	576
720 min Summer	10.028	0.0	620
960 min Summer	7.794	0.0	734
1440 min Summer	5.424	0.0	984
2160 min Summer	3.765	0.0	1384
2880 min Summer	2.912	0.0	1764
4320 min Summer	2.044	0.0	2512
5760 min Summer	1.604	0.0	3216

Cascade Summary of Results for Attenuation Basin.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
7200 min Summer	81.588	0.018	13.4	O K
8640 min Summer	81.576	0.006	4.8	O K
10080 min Summer	81.571	0.001	0.9	O K
15 min Winter	81.723	0.153	116.1	O K
30 min Winter	81.766	0.196	149.5	O K
60 min Winter	81.807	0.237	181.7	Flood Risk
120 min Winter	81.860	0.290	223.2	Flood Risk
180 min Winter	81.888	0.318	245.6	Flood Risk
240 min Winter	81.905	0.335	258.5	Flood Risk
360 min Winter	81.918	0.348	269.0	Flood Risk
480 min Winter	81.918	0.348	269.3	Flood Risk
600 min Winter	81.912	0.342	264.5	Flood Risk
720 min Winter	81.903	0.333	257.0	Flood Risk
960 min Winter	81.878	0.308	237.5	Flood Risk
1440 min Winter	81.835	0.265	203.3	Flood Risk
2160 min Winter	81.784	0.214	163.9	Flood Risk
2880 min Winter	81.740	0.170	129.7	O K
4320 min Winter	81.669	0.099	74.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
7200 min Summer	1.341	0.0	3888
8640 min Summer	1.166	0.0	4496
10080 min Summer	1.041	0.0	10088
15 min Winter	159.261	0.0	22
30 min Winter	103.308	0.0	37
60 min Winter	63.833	0.0	66
120 min Winter	40.263	0.0	124
180 min Winter	30.292	0.0	182
240 min Winter	24.517	0.0	240
360 min Winter	17.890	0.0	356
480 min Winter	14.146	0.0	472
600 min Winter	11.726	0.0	584
720 min Winter	10.028	0.0	694
960 min Winter	7.794	0.0	904
1440 min Winter	5.424	0.0	1112
2160 min Winter	3.765	0.0	1556
2880 min Winter	2.912	0.0	1980
4320 min Winter	2.044	0.0	2764

Cascade Summary of Results for Attenuation Basin.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
5760 min Winter	81.617	0.047	35.1	O K
7200 min Winter	81.583	0.013	9.6	O K
8640 min Winter	81.570	0.000	0.0	O K
10080 min Winter	81.570	0.000	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
5760 min Winter	1.604	0.0	3456
7200 min Winter	1.341	0.0	4024
8640 min Winter	1.166	0.0	0
10080 min Winter	1.041	0.0	10088

Cascade Rainfall Details for Attenuation Basin.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for Attenuation Basin.SRCX

Storage is Online Cover Level (m) 82.070

Tank or Pond Structure

Invert Level (m) 81.570

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	750.0	0.500	818.0

Cascade Summary of Results for Detention basin - with BH soaks.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Eastern Swale - with BH soaks.SRCX	Eastern Swale - with BH soaks.SRCX

Half Drain Time : 85 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
15 min Summer	93.674	20.174	0.1	13.0	13.1	88.3	O K
30 min Summer	93.713	20.213	0.1	17.4	17.5	108.0	Flood Risk
60 min Summer	93.737	20.237	0.1	18.9	19.0	120.0	Flood Risk
120 min Summer	93.763	20.263	0.1	20.3	20.4	132.8	Flood Risk
180 min Summer	93.769	20.269	0.1	20.7	20.8	135.9	Flood Risk
240 min Summer	93.766	20.266	0.1	20.5	20.6	134.6	Flood Risk
360 min Summer	93.751	20.251	0.1	19.7	19.8	127.0	Flood Risk
480 min Summer	93.733	20.233	0.1	18.7	18.8	118.0	Flood Risk
600 min Summer	93.717	20.217	0.1	17.7	17.8	109.9	Flood Risk
720 min Summer	93.704	20.204	0.1	16.3	16.4	103.4	Flood Risk
960 min Summer	93.683	20.183	0.1	14.0	14.1	92.9	O K
1440 min Summer	93.654	20.154	0.1	10.8	10.9	78.7	O K
2160 min Summer	93.629	20.129	0.1	8.0	8.1	65.8	O K
2880 min Summer	93.612	20.112	0.1	6.4	6.5	57.3	O K
4320 min Summer	93.591	20.091	0.1	4.8	4.9	47.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	93.0	20
30 min Summer	103.308	0.0	121.2	32
60 min Summer	63.833	0.0	153.2	52
120 min Summer	40.263	0.0	193.3	86
180 min Summer	30.292	0.0	218.1	120
240 min Summer	24.517	0.0	235.3	152
360 min Summer	17.890	0.0	257.6	218
480 min Summer	14.146	0.0	271.6	282
600 min Summer	11.726	0.0	281.4	342
720 min Summer	10.028	0.0	288.7	404
960 min Summer	7.794	0.0	299.1	528
1440 min Summer	5.424	0.0	311.3	772
2160 min Summer	3.765	0.0	325.3	1144
2880 min Summer	2.912	0.0	335.4	1504
4320 min Summer	2.044	0.0	352.8	2212

Cascade Summary of Results for Detention basin - with BH soaks.SRCX

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
5760 min Summer	93.582	20.082	0.1	3.9	4.0	42.4	O K
7200 min Summer	93.576	20.076	0.1	3.3	3.4	39.4	O K
8640 min Summer	93.572	20.072	0.1	2.9	3.0	37.2	O K
10080 min Summer	93.568	20.068	0.1	2.5	2.6	35.3	O K
15 min Winter	93.731	20.231	0.1	18.5	18.6	116.8	Flood Risk
30 min Winter	93.786	20.286	0.1	21.6	21.7	144.3	Flood Risk
60 min Winter	93.820	20.320	0.1	23.2	23.3	161.2	Flood Risk
120 min Winter	93.848	20.348	0.1	24.5	24.6	175.4	Flood Risk
180 min Winter	93.849	20.349	0.1	24.6	24.7	175.7	Flood Risk
240 min Winter	93.838	20.338	0.1	24.1	24.2	170.3	Flood Risk
360 min Winter	93.805	20.305	0.1	22.5	22.6	154.1	Flood Risk
480 min Winter	93.773	20.273	0.1	20.9	21.0	137.8	Flood Risk
600 min Winter	93.745	20.245	0.1	19.3	19.4	123.7	Flood Risk
720 min Winter	93.722	20.222	0.1	18.0	18.1	112.3	Flood Risk
960 min Winter	93.693	20.193	0.1	15.1	15.2	97.7	O K
1440 min Winter	93.657	20.157	0.1	11.1	11.2	79.9	O K
2160 min Winter	93.628	20.128	0.1	7.9	8.0	65.2	O K
2880 min Winter	93.608	20.108	0.1	6.1	6.2	55.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.604	0.0	369.6	2944
7200 min Summer	1.341	0.0	386.2	3672
8640 min Summer	1.166	0.0	402.9	4408
10080 min Summer	1.041	0.0	419.7	5144
15 min Winter	159.261	0.0	124.7	20
30 min Winter	103.308	0.0	162.3	32
60 min Winter	63.833	0.0	204.3	58
120 min Winter	40.263	0.0	257.7	92
180 min Winter	30.292	0.0	290.8	130
240 min Winter	24.517	0.0	313.8	166
360 min Winter	17.890	0.0	343.5	234
480 min Winter	14.146	0.0	362.1	300
600 min Winter	11.726	0.0	375.2	362
720 min Winter	10.028	0.0	385.0	420
960 min Winter	7.794	0.0	398.8	542
1440 min Winter	5.424	0.0	415.3	792
2160 min Winter	3.765	0.0	433.7	1152
2880 min Winter	2.912	0.0	447.2	1532

Cascade Summary of Results for Detention basin - with BH soaks.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Outflow (l/s)	Max Volume (m³)	Status
4320 min Winter	93.587	20.087	0.1	4.4	4.5	44.8	O K
5760 min Winter	93.578	20.078	0.1	3.5	3.6	40.2	O K
7200 min Winter	93.572	20.072	0.1	2.9	3.0	37.4	O K
8640 min Winter	93.567	20.067	0.1	2.5	2.6	35.0	O K
10080 min Winter	93.563	20.063	0.1	2.2	2.3	32.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
4320 min Winter	2.044	0.0	470.6	2244
5760 min Winter	1.604	0.0	492.8	2936
7200 min Winter	1.341	0.0	514.9	3672
8640 min Winter	1.166	0.0	537.1	4416
10080 min Winter	1.041	0.0	559.6	5144

Cascade Rainfall Details for Detention basin - with BH soaks.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.320

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.200	4	8	0.120

Cascade Model Details for Detention basin - with BH soaks.SRCX

Storage is Online Cover Level (m) 94.000

Deep Bore Soakaway Structure

Chamber Invert Level (m)	93.500	Borehole Depth (m)	20.000
Chamber Diameter/Length (m)	10.000	Infiltration Coefficient Base (m/hr)	0.03740
Chamber Width (m)	50.000	Safety Factor	2.0
Borehole Diameter (m)	0.300		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.03740	17.500	0.03740	20.000	0.00000

Orifice Outflow Control

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 93.500

Cascade Summary of Results for Eastern Swale - with BH soaks.SRCX

	Upstream Structures	Outflow To	Overflow To
Detention basin - with BH soaks.SRCX		(None)	(None)

Half Drain Time : 4168 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.002	17.002	4.9	0.0	4.9	594.1	O K
30 min Summer	92.032	20.032	5.3	0.0	5.3	778.5	O K
60 min Summer	92.112	20.112	5.3	0.0	5.3	972.9	O K
120 min Summer	92.220	20.220	5.3	0.0	5.3	1239.5	O K
180 min Summer	92.287	20.287	5.3	0.0	5.3	1404.1	O K
240 min Summer	92.334	20.334	5.3	0.0	5.3	1517.7	O K
360 min Summer	92.392	20.392	5.3	0.0	5.3	1661.2	O K
480 min Summer	92.427	20.427	5.3	0.0	5.3	1747.9	O K
600 min Summer	92.451	20.451	5.3	0.0	5.3	1805.5	O K
720 min Summer	92.467	20.467	5.3	0.0	5.3	1845.6	O K
960 min Summer	92.487	20.487	5.3	0.0	5.3	1893.7	O K
1440 min Summer	92.502	20.502	5.3	0.0	5.3	1931.8	O K
2160 min Summer	92.504	20.504	5.3	0.0	5.3	1937.0	O K
2880 min Summer	92.498	20.498	5.3	0.0	5.3	1921.8	O K
4320 min Summer	92.478	20.478	5.3	0.0	5.3	1871.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	159.261	0.0	0.0	169
30 min Summer	103.308	0.0	0.0	185
60 min Summer	63.833	0.0	0.0	224
120 min Summer	40.263	0.0	0.0	280
180 min Summer	30.292	0.0	0.0	328
240 min Summer	24.517	0.0	0.0	370
360 min Summer	17.890	0.0	0.0	456
480 min Summer	14.146	0.0	0.0	542
600 min Summer	11.726	0.0	0.0	634
720 min Summer	10.028	0.0	0.0	732
960 min Summer	7.794	0.0	0.0	970
1440 min Summer	5.424	0.0	0.0	1446
2160 min Summer	3.765	0.0	0.0	2164
2880 min Summer	2.912	0.0	0.0	2884
4320 min Summer	2.044	0.0	0.0	4320

Cascade Summary of Results for Eastern Swale - with BH soaks.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	92.458	20.458	5.3	0.0	5.3	1823.4	O K
7200 min Summer	92.448	20.448	5.3	0.0	5.3	1799.5	O K
8640 min Summer	92.443	20.443	5.3	0.0	5.3	1786.7	O K
10080 min Summer	92.441	20.441	5.3	0.0	5.3	1782.0	O K
15 min Winter	92.042	20.042	5.3	0.0	5.3	801.6	O K
30 min Winter	92.145	20.145	5.3	0.0	5.3	1054.2	O K
60 min Winter	92.251	20.251	5.3	0.0	5.3	1314.5	O K
120 min Winter	92.396	20.396	5.3	0.0	5.3	1671.3	O K
180 min Winter	92.486	20.486	5.3	0.0	5.3	1891.8	O K
240 min Winter	92.548	20.548	5.3	0.0	5.3	2044.2	O K
360 min Winter	92.627	20.627	5.3	0.0	5.3	2238.1	O K
480 min Winter	92.675	20.675	5.3	0.0	5.3	2355.9	O K
600 min Winter	92.707	20.707	5.3	0.0	5.3	2434.8	Flood Risk
720 min Winter	92.730	20.730	5.3	0.0	5.3	2491.0	Flood Risk
960 min Winter	92.759	20.759	5.3	0.0	5.3	2562.1	Flood Risk
1440 min Winter	92.785	20.785	5.3	0.0	5.3	2626.7	Flood Risk
2160 min Winter	92.797	20.797	5.3	0.0	5.3	2656.4	Flood Risk
2880 min Winter	92.799	20.799	5.3	0.0	5.3	2659.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
5760 min Summer	1.604	0.0	0.0	4960
7200 min Summer	1.341	0.0	0.0	5696
8640 min Summer	1.166	0.0	0.0	6480
10080 min Summer	1.041	0.0	0.0	7256
15 min Winter	159.261	0.0	0.0	180
30 min Winter	103.308	0.0	0.0	216
60 min Winter	63.833	0.0	0.0	256
120 min Winter	40.263	0.0	0.0	316
180 min Winter	30.292	0.0	0.0	362
240 min Winter	24.517	0.0	0.0	404
360 min Winter	17.890	0.0	0.0	484
480 min Winter	14.146	0.0	0.0	568
600 min Winter	11.726	0.0	0.0	660
720 min Winter	10.028	0.0	0.0	754
960 min Winter	7.794	0.0	0.0	966
1440 min Winter	5.424	0.0	0.0	1434
2160 min Winter	3.765	0.0	0.0	2144
2880 min Winter	2.912	0.0	0.0	2832

Cascade Summary of Results for Eastern Swale - with BH soaks.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
4320 min Winter	92.791	20.791	5.3	0.0	5.3	2641.2	Flood Risk
5760 min Winter	92.778	20.778	5.3	0.0	5.3	2609.2	Flood Risk
7200 min Winter	92.767	20.767	5.3	0.0	5.3	2581.2	Flood Risk
8640 min Winter	92.757	20.757	5.3	0.0	5.3	2556.0	Flood Risk
10080 min Winter	92.751	20.751	5.3	0.0	5.3	2542.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
4320 min Winter	2.044	0.0	0.0	4200
5760 min Winter	1.604	0.0	0.0	5536
7200 min Winter	1.341	0.0	0.0	6840
8640 min Winter	1.166	0.0	0.0	8032
10080 min Winter	1.041	0.0	0.0	8272

Cascade Rainfall Details for Eastern Swale - with BH soaks.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 517696 199292 TQ 17696 99292
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.860

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.800	4	8	0.860	8	12	0.200

Cascade Model Details for Eastern Swale - with BH soaks.SRCX

Storage is Online Cover Level (m) 93.000

Deep Bore Soakaway Structure

Chamber Invert Level (m)	92.000	Borehole Depth (m)	20.000
Chamber Diameter/Length (m)	7.500	Infiltration Coefficient Base (m/hr)	0.37400
Chamber Width (m)	327.300	Safety Factor	1.5
Borehole Diameter (m)	6.670		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.03740	17.500	0.03740	20.000	0.00000

Weir Overflow Control

Discharge Coef 0.544 Width (m) 30.000 Invert Level (m) 93.000