9. Water Resources

Introduction

9.1 This Chapter, which was prepared by Waterman, presents an assessment of the likely significant impacts of the Development on flood risk and water resources. In particular, the management of surface water runoff and foul water drainage are considered. Consideration is also given to the potential impact of the Development on the capacity of potable water supply infrastructure.

9.2 This Chapter presents an overview of relevant legislation and policy, together with a description of baseline conditions, the methods used to assess the impacts and the likely significant impacts of the Development. Mitigation measures are discussed, where appropriate, to prevent, reduce or offset any significant impacts identified.

Legislation and Planning Policy Context

Legislation

9.3 The overall purpose of the Water Framework Directive (2000) is to protect and improve all controlled waters and to promote the sustainable use of water and reduce water pollution, especially by 'priority' and 'priority hazardous' substances. The Water Framework Directive sets a number of different objectives to prevent the deterioration in the quality of water bodies. Under the Directive water bodies should achieve at least a 'good status' by 2015. Where this is not possible, and subject to the criteria set out in the Directive, this target would be delayed until 2021 or 2027.

9.4 The Water Resources Act (1991) (as amended) relates to the control of the water environment. The Act aims to ensure that the polluter pays the cost of any consequences of their discharges. Aspects of the Act which are of particular relevance to the Development include the provisions concerning land drainage and flood mitigation.

9.5 The Land Drainage Act (1991) stipulates that the responsibilities relating to the drainage of land are given to the Environment Agency, Internal Drainage Boards, Local Planning Authorities (LPA), Navigation Authorities and riparian owners. Each has a role in the mitigation of flooding.

9.6 The Water Industry Act (1991) is relevant to a range of activities undertaken by the privatised water companies. The relevant provisions relate to trade effluent discharges to sewers, for which the privatised companies act as the regulatory authorities. The water companies control the nature and composition of the effluent, the maximum daily volume permitted, the maximum flow rate and the treatment works into which the effluent can be discharged.

9.7 The Flood and Water Management Act (2010) removes the automatic right of connection into public water sewers and places the onus on the LPA to adopt Sustainable Drainage Systems (SuDS). This legislation will fully come into force once secondary legislation is published in 2013, although it is currently being taken up by LPA.

National Planning Policy

9.8 Planning Policy Statement 25: '*Development and Flood Risk'* (PPS25) (2010) sets out Government policy on development and flood risk. The objectives of the policy are to ensure that flood risk is taken into account at all stages in the planning process to prevent inappropriate development in areas which are susceptible to flood risk. Where new development is located in areas of high flood risk, PPS25 aims to make such development safe without increasing flood risk elsewhere, and where possible, reduce flood risk overall.

9.9 PPS25 requires developers to provide for, and assess flood risk, including runoff implications appropriate to the nature and scale of the development proposed. PPS25 advocates the use of the risk-based sequential test, in which new development is directed towards areas of lowest probability of flooding, which are identified by Flood Zones. Flood Zone 1 is considered to have the lowest probability of flooding and Flood Zone 3 a high probability of flooding.

9.10 Practice Guidance (2009) which accompanies PPS25 states that annual flow rates up to and including the 1 in 100 year event should be accounted for, including for the effects of climate change.

9.11 Residential development is generally accepted to have a lifespan of 100 years. PPS25 (2010) suggests that for developments of this design life, increasing peak rainfall intensity by 30% may provide an appropriate precautionary response to the uncertainty of climate change impacts.

Local Planning Policy

Strategic Flood Risk Assessment

9.12 CDC and West Oxfordshire District Council Level 1 Strategic Flood Risk Assessment (SFRA) (2009) sets out the requirements for site-specific FRAs dependent upon the location of the Site. Table 13.1 of the SFRA states that with regard to Upper Heyford the porous geology could lead to potential land drainage issues and a site-specific FRA would need to include details of land drainage infrastructure.

Planning Policy

9.13 Although there are no saved policies in the adopted '*Cherwell Local Plan*' (CDC, 1996) relating to water resources, there is one relevant policy in the '*Non-Statutory Cherwell Local Plan 2011'.* Policy EN11 '*Water Resources*' stipulates that '*development would only be permitted where adequate water resources exist, or can be provided without detriment to existing use*'.

9.14 Policy SD6 of the Draft Core Strategy (2010) encourages the use of SuDS to allow for developments to better adapt to the predicted impacts of climate change based on site specific constraints. It is stated that SuDS should aim to mimic surface water flows arising from the site prior to the proposed development. There are no policies contained in the '*Draft Core Strategy*' (CDC, 2010) with respect to potable water supply.

Assessment Methodology and Significance Criteria

Assessment Methodology

9.15 A qualitative desk-based impact assessment was undertaken to ascertain the likely flood risk and drainage issues. The impact assessment was based upon the findings of the Stage 1 Flood Risk Assessment (FRA), which was prepared in accordance with the requirements and principles of PPS25. A copy of the FRA is presented in **Appendix 9.1**.

9.16 The FRA outlines the potential sources and risk of flooding on-Site. As part of the FRA, a preliminary drainage strategy was developed which outlines the principles and feasibility of implementing SuDS as part of the Development, in order to appropriately control and manage surface water runoff.

9.17 The Environment Agency and CDC were consulted to confirm the scope and key issues to be addressed within the FRA and to obtain information relating to historical flooding (see **Appendix 9.1**).

9.18 A Site visit was undertaken on 2 June 2010 to confirm points of discharge and the location of watercourses.

9.19 A qualitative assessment of the potential impact of increased demand on the capacity of potable water supply infrastructure at the Site was undertaken. The assessment was based upon available published information and a Utilities Report (Waterman Building Services, 2010) specific to the Site.

9.20 To facilitate a desk-based qualitative assessment of the potential impacts of the Development on flood risk and drainage, current baseline conditions were established using the following sources of information:

- Environment Agency's indicative flood plain map;
- Environment Agency's source protection zone map;
- Cherwell Catchment Abstraction Management Strategy (CAMS) (Environment Agency, 2005);
- '*The Environment in Oxfordshire*' (Environment Agency, 2009);
- Cherwell District Council and West Oxfordshire District Council Level 1 '*Strategic Flood Risk Assessment'* (April 2009);
- Aspinwall & Company Limited (June 1997) '*RAF Upper Heyford Land Quality Assessment, Phase Two: Intrusive Survey Factual Report*';
- Site sewer records and CCTV survey work;
- '*Revised Draft Water Resources Management Plan*', Thames Water, September 2009; and
- Utilities Report, Waterman Building Services, 2010.

Significance Criteria

9.21 There is no specific methodology or guidance for the assessment of impacts on water resources for the purposes of EIA. Significance criteria were therefore developed based on professional judgement and relevant experience. The significance criteria are set out in **Table 9.1**.

Assumptions and Limitations

9.22 The following assumptions were made in undertaking the assessment:

- areas of the Site which are not intended to be developed will continue to drain as per the existing situation;
- no infiltration discharge currently presumed within redeveloped areas due to lack of on-site soakage tests. Potential to be considered at the detailed design stage subject to confirmation of contamination, remediation and infiltration rates; and
- existing surface water runoff was calculated using the Modified Rational Method for areas of hard-standing, and the IH124 method (Marshell D.C.W & Bayliss A.C., 1994) for areas of soft landscaping.

Table 9.1: Significance Criteria for Water Resources Assessment

Significance Criteria	Description
Adverse Impact of Substantial Significance	Moderate to severe increases in flood risk. Permanent flooding or change to flow characteristics of watercourses. Moderate to severe local scale change in flow of groundwater underneath the site and/or modest changes in off-site groundwater flow. Increase in surface and/or foul water discharge which would require new infrastructure. Increase in water supply which would exceed the water resource capacity of the region and therefore require new sources e.g. application of an abstraction licence. Exceed the capacity of existing infrastructure.
Adverse Impact of Moderate Significance	Minor to moderate local scale increase in flood risk. Severe temporary flooding or change to flow characteristics of watercourses. Minor to moderate local scale change in flow of groundwater. Increase in surface and/or foul water discharge which would place undue pressure on existing infrastructure. Increase in water supply which would place undue pressure on existing local supplies and existing water supply infrastructure.
Adverse Impact of Minor Significance	A slight increase in the risk of flooding and minor and local scale change in groundwater flow. Increase in surface and/or foul water discharge which would require modifications to existing infrastructure. Increase in water supply which would place additional pressure on existing local supplies and existing water supply infrastructure.
Insignificant	No appreciable impact on flood risk. No appreciable impact on surface and/or foul water infrastructure. No appreciable impact on the capacity of water supply and the existing water supply infrastructure.
Beneficial Impact of Minor Significance	Minor local scale reduction in localised flood risk. Minor temporary local scale reduction in demand on surface and/or foul water infrastructure. Temporary local scale reduction in water supply demand and temporary increase in the capacity of existing infrastructure.
Beneficial Impact of Moderate Significance	Moderate scale reduction in localised flood risk. Minor permanent reduction in demand on surface and/or foul water infrastructure. Permanent local scale reduction in water supply demand and permanent increase in the capacity of existing infrastructure.
Beneficial Impact of Substantial Significance	Significant local scale and moderate to significant regional scale reduction in flood risk. Major permanent reduction in demand on surface and /or foul water infrastructure. Permanent regional scale reduction in water supply demand and permanent increase in the capacity of existing infrastructure.

Baseline Conditions

Topography

9.23 Topographically the Site falls in a south-easterly direction away from the 'Flying Field' situated to the north of the Site. Ground levels fall from approximately 127.5m Above Ordnance Datum (AOD) adjacent to the aircraft hangers to 116.7m AOD near to Field Barn Farm.

Geology

9.24 The British Geological Survey (BGS) map (Sheet 218, scale 1:50,000) shows that the solid geology underlying the Site comprises the Great Oolite Limestone, which is part of the Jurassic Great Oolite Series and consists of limestones, marls, sandstones, siltstones and mudstones. The maximum thickness of the Great Oolite Limestone is expected to be approximately 25m. The BGS map shows the Great Oolite Limestone to be underlain by the Inferior Oolite Series, which comprises the Lower Estuarine Series consisting of sandstone and thin mudstone, and the underlying Northampton Sand which consists of the sandy, shelly limestones and sandstones. The Inferior Oolite Series is underlain by the Lias Series comprising mudstones, siltstones and thin limestones.

9.25 The Phase 2 Intrusive Survey Factual Report (Aspinwall, 1997) states that shallow ground conditions at the Site generally comprise layers of silt and clay, often sandy with a significant proportion of cobble sized limestone. This is underlain by weathered limestone bedrock at an average depth of 1.5m (range of 2.6m to 0.9m) to the north of Camp Road and 1.3m (range of 2.7m to 0.8m) to the south of Camp Road.

Hydrogeology

9.26 The Site is not located within a groundwater Source Protection Zone according to the Environment Agency website. However, the Environment Agency classifies the underlying limestone bedrock beneath the Site as a Principal Aquifer. This classification refers to layers of rock or drift deposits that have high fracture permeability, meaning they usually provide a high level of water storage and they may support water supply and/or river base flow on a strategic scale.

9.27 Although there are no boreholes on the Site, seven boreholes have been advanced on the Flying Field area. Boreholes 5 and 6 are the closest to the Site are located to the north-east and south-west of the Site respectively. Borehole 5 shows very steady groundwater levels at an average of 1.2m below ground level (bgl) and a minimum of 1m bgl. Borehole 6 in comparison shows a relatively fluctuating water level located an average of 7m bgl, ranging between 4.72m bgl and 8.93m bgl.

Hydrology and Water Quality

9.28 An unnamed tributary of Gallos Brook is located along the southern boundary of the Site. Another unnamed tributary of Gallos Brook flows through the small parcel of land to the east of the main part of the Site. Gallos Brook enters the River Ray approximately 11km to the south of the Site. The nearest Main River to the Site is the River Cherwell, which is located approximately 1km to the west of the Site.

9.29 According to the '*River Basement Management Plan: Thames River Basin District*' (DEFRA & EA, 2009), the surface water quality across the District is generally good. However, the stretch of Gallos Brook from the source, which appears to be close to the Site, to Bletchingdon Stream to the south of the Site, has currently a poor ecological status. This stretch of Gallos Brook is reported to have a poor invertebrate population (DEFRA & Environment Agency, 2009).

Drainage

9.30 As shown in Figure 3 of the FRA (**Appendix 9.1**), there are four discharge locations adjacent to the Site which enter two tributaries of Gallos Brook: Outfalls 1 and 2 to the south of the Site; and Outfalls 3 and 4 to the east.

9.31 Figure 5 of the FRA shows the existing surface water drainage catchments based on information obtained through the topographic survey, on-Site records and the CCTV survey undertaken at the Site. Outfall 1 (which ultimately joins Outfall 2) drains the western area of the Site. Outfall 2 located to the south of the Site drains the central area to the south of Camp Road. Outfall 3 located beside Camp Road drains the central area to the north of Camp Road and Outfall 4 drains the north-eastern area of the Site.

9.32 There are large areas of existing residential properties in the south of the Site which do not appear to benefit from positive drainage systems. Through discussions with on-Site personnel it is understood that many of these properties are expected to have individual soakaways, although the location, size and design of these features are unknown.

9.33 The existing foul water drainage from the Site discharges to the private Sewage Treatment Works (STW) to the south-east of the Site through both a gravity and pumped foul water based network. Since the closure of the Airbase, the operational capacity of the STW has been reduced.

Flood Risk

Tidal and Fluvial

9.34 The Environment Agency's Flood Zone Map, as seen in Figure 4 of the FRA, shows that the proposed Development is located within Flood Zone 1 and has a low probability of flooding (annual exceedance probability <0.1%).

9.35 Mapping provided by the Environment Agency denotes five secondary and tertiary watercourses adjacent to the southern and eastern boundaries of the Site. The Environment Agency does not hold any records of flooding associated with these features.

9.36 The identified watercourses are located down gradient of the Site, which would not be affected by high water levels associated with extreme rainfall events or flow restrictions caused by debris in the channels. It is therefore concluded that the risk of fluvial flooding is low. Given the elevation of the Site (i.e. greater than 100m AOD) the risk of tidal flooding is effectively nil.

Groundwater

9.37 The Environment Agency and Site management team do not hold any records of groundwater flooding occurring at the Site. Furthermore, throughout the entire 10 year period of groundwater monitoring at the Site, no flooding was recorded. It is therefore considered that the risk of groundwater flooding to the Site is low.

Pluvial

9.38 Pluvial flooding occurs when natural and engineered systems have insufficient capacity to deal with the volume of rainfall. Pluvial flooding can sometimes occur in urban areas during extreme, high intensity, low duration summer rainfall events which overwhelm the local surface water drainage system; or in rural areas during medium intensity, long duration events where saturated ground conditions prevent infiltration into the subsoil. This flood water is then conveyed via overland flow routes dictated by the local topography.

9.39 There are no public sewers located on-site; however there are private sewer systems which connect into watercourses along the Site boundary. On-Site personnel have no recollection of instances of flooding at the Site over the last 40 years.

9.40 The surrounding topography gently falls in a southerly direction towards the adjacent fields. The Site would therefore only be at risk of pluvial flooding from the Site itself or the 'Flying Field'. No flooding has been reported at the Site and it is therefore assumed that the current drainage network is of adequate capacity to collect and dispose of surface water.

Water Resources

9.41 The Site is located within the catchment area of the River Cherwell. According to the '*The Environment in Oxfordshire*' (Environment Agency, 2009), across Oxfordshire the highest licensed volume of surface water and groundwater is abstracted for public water supply, accounting for 58% of the abstracted volume. In the area of the Site, water supply is largely from surface water supplies (Thames Water, 2009).

9.42 The Cherwell CAMS (Environment Agency, 2005) sets out the management of water resources at a local level. The Cherwell CAMS indicates the surface water resource availability for consumptive uses in the Water Resource Management Unit, within which the Site is located, is limited at low flows, although water resources may be available at high flows, with appropriate restrictions. Owing to a lack of large abstractions and the geology of the catchment, an assessment of groundwater resources is not included within the CAMS for this catchment.

Water Supply

9.43 Thames Water is responsible for public water supply in the locality of the Site. The '*Revised Draft Water Resources Management Plan*' (WRMP) published by Thames Water in September 2009, sets out how demand for water is balanced against the available supply over the period from 2010 to 2035. Thames Water forecast a growth in population within the SWOX Water Resource Zone from approximately 0.97 million to 1.1 million.

9.44 The Site is located within Thames Water Swindon, South and North Oxfordshire (SWOX) Water Resource Zone. The Water Resource Zone is defined as an area in which all water resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a water resource shortfall.

9.45 According to the WRMP, the SWOX Water Resource Zone currently has a supply demand deficit of 5% in 2009/2010. The deficit is expected to increase steadily over the planning period, with the deficit of 12% predicted in 2019/2020, which is the first assessment year provided in the WRMP after which the Development would be completed and operational.

9.46 To address the supply demand deficit, the WRMP sets out the preferred programme for reducing the deficit: this includes leakage reduction; metering; and water efficiency measures. The delivery of the programme is expected to be prioritised over other regions to reduce the deficits of the Water Resource Zone as soon as possible. Implementation of the preferred programme is predicted to significantly reduce the demand deficit to 8% in 2010/2011 and in 2019/2020 there is expected to be surplus supply of 2%. This surplus demand balance is expected to be maintained throughout the remainder of the planning period.

9.47 In addition to the above preferred measures, Thames Water is investigating longer term options. The preferred option is to construct a new reservoir near Abingdon, Oxfordshire by 2026 to supply water to Swindon, Oxfordshire and London Thames Water, 2009). Currently, it is anticipated that a reservoir with a capacity of 100 million cubic metres is required. In addition, Thames Water plan to develop new underground water sources to boost supplies in the Swindon and Oxfordshire area by 28 million litres a day. These measures would reduce the predicted gap between supply and demand for water in the SWOX Water Resource Zone.

Potable Water Supply Infrastructure

9.48 The Site has three water connections to the local grid, including: a main entering the Site from the east, terminating near to the main Site entrance on Camp Road; a main extending into the western part of the Site along the southern side of Camp Road; and a main running to the western boundary of the Site along the northern side of Camp Road. The water supply infrastructure across the Site has not been adopted by Thames Water.

Impact Assessment

Demolition and Construction Phase

Increased Flood Risk from Surface Water Runoff

9.49 Existing Site conditions comprise a combination of impermeable and permeable areas. The removal of buildings and hard-standing would temporarily increase the potential for infiltration and allow some attenuation of surface water flows. However, the impact is likely to be negligible since demolition and construction would be undertaken in phases. The main risk is likely to be an increase in runoff as a result of intense rainfall before completion of the drainage system or if ponding of surface water occurs on the Site leading to a surge of runoff into the drainage system. This would result in a temporary **adverse impact** of **minor significance**.

Completed Development

Increased Flood Risk from Surface Water Runoff

9.50 The Site currently has no surface water storage or attenuation infrastructure, and surface water runoff is currently drained into the private network before discharging into the local watercourses.

9.51 There is a downstream balancing pond located to the north of the B4030. However, it has not been possible to confirm the current performance of this feature and therefore the potential benefits of it reducing downstream flows have not been taken into account within this assessment.

9.52 Overall, the proposed Development would slightly decrease the impermeable area of the Site, although this would only give rise to a negligible decrease in the quantity of surface water runoff.

9.53 However, in accordance with national policy and the Environment Agency's aspirations, the impacts of climate change need to be taken into consideration for the lifetime of the Development, ensuring that discharge is not increased over the existing situation and where possible providing a level of betterment.

9.54 A preliminary drainage strategy has been developed and is set out within the FRA (see **Appendix 9.1).** This aims to increase the sustainability of the Site and presents options for SuDS which would be implemented as part of the Development to attenuate surface water runoff. The preferred options, which aim to reduce and attenuate runoff as close to the source as possible, are as follows:

- rainwater harvesting for the direct capture and use for domestic uses and/or irrigation of soft landscaped areas;
- permeable paving within hard-standing areas, car parking and private roads; and
- swales where appropriate within Development plots and alongside highways.

9.55 Balancing ponds are proposed where possible to enhance biodiversity within the Development. Where space constraints mean that ponds would be impracticable, underground storage tanks are proposed to manage surface water at the Site. The existing discharge rates have been calculated for each drainage catchment on-site and are included as Appendix D of the FRA (**Appendix 9.1**).

9.56 A range of storage volume estimates were calculated using WINDES Quick Storage Estimate for each drainage catchment (see Appendix D of **Appendix 9.1**). The estimated storage volumes required are based on a 1 in 100 year (plus 30% allowance for climate change) return period. Discharges from Catchments 1 and 2 have been limited to the existing rate with excess flows attenuated. The allowable discharge rate entering the watercourse from Catchments 3 and 4 would be reduced by 10% to give betterment over the existing situation. The range of the estimated surface water storage would be refined at a detailed design stage.

9.57 As demonstrated in the FRA, the inclusion of SuDS to reduce and attenuate surface water runoff would improve existing Site conditions, in accordance with current policy and guidance. This is assessed as being a local **beneficial impact** of **moderate significance**.

Impact on Capacity of Foul Water Drainage

9.58 As a result of the Development, there would likely be a greater quantity of foul water requiring treatment at the STW in comparison to the existing discharge. However, the volume should be comparable to that which previously discharged to the STW when the existing Site was fully occupied. The Environment Agency's discharge consent for the discharge of treated effluent into the Gallos Brook specifies a limit of 850 cubic metres per day. It is expected that the volume of foul water flow from the proposed residential Development would be 715 cubic metres per day, with 135 cubic metres emanating from the proposed commercial/school Development.

9.59 Since the closure of the Airbase, the operational capacity of the STW has been reduced with parts of the STW becoming redundant. Consequently, the STW would require refurbishment to bring it back into full operation. Following refurbishment, the STW would be able to accommodate the increase in foul water discharge (compared to the existing discharge) expected as a result of the Development.

9.60 Given that the estimated volume of foul water from the Development would accord with the volume specified in the existing discharge consent and would be accommodated by the capacity of the STW, the impact on the capacity of foul water drainage would likely to be **insignificant**.

Impact of Foul Water Drainage on Surface Water Quality

9.61 The effluent from the STW is discharged into a stream which currently has a poor ecological status (DEFRA & Environment Agency, 2009). By 2015, the ecological status of the stream is scheduled to be moderate, with a good ecological status to be achieved by 2027.

9.62 As mentioned above, the predicted foul water discharge is expected to comply with the conditions of the discharge consent, and that the STW would operate within Environment Agency compliance guidelines. Therefore, no further deterioration in the quality of the water in the stream would be expected. This would give rise to an **insignificant** impact on surface water quality.

Increased Demand for Water Supply

9.63 As part of the Development, new supply infrastructure would be provided for the new residential dwellings. For the existing residential dwellings, the existing infrastructure would be maintained or upgraded and replaced, where necessary. Therefore, the capacity of the water supply infrastructure would not be a constraint on the Development.

9.64 With the intensification of the Site following completion of the Development, the demand for water would increase compared to the existing conditions at the Site. Although the '*Revised Draft Water Resources Management Plan*' (Thames Water, 2009) indicates there would be a deficit in water supply and demand in 2019/2020, Thames Water has set out a preferred options programme to address the deficit in the SWOX Water Resource Zone.

9.65 CDC has set a housing target of 13,400 new homes to be built between 2006 and 2026 (CDC, 2010). The Site has been recognised by OCC and CDC as a strategic site for development, which could accommodate approximately 1,000 dwellings. Given that the Site has been identified for development, and that the demand supply forecast provided by Thames Water takes into account an increase in population within the Water Resource Zone, the additional demand on water resources resulting from the Development would be accommodated by existing resources.

9.66 Furthermore, water conservation measures would be employed to ensure that, as a minimum, the mandatory standards in the Code for Sustainable Homes would be achieved. Measures such as water efficient fittings and fixtures and rainwater harvesting for gardens (rainwater butts) would be incorporated into the Development. The incorporation of such measures would reduce water consumption, which is in accordance with local policies. Overall, the Development would likely give rise to an **insignificant** impact on the supply of potable water.

Mitigation Measures and Residual Impacts

Demolition and Construction Phase

Increased Flood Risk from Surface Water Runoff

9.67 All drainage flows and connections should be appropriately maintained throughout the demolition and construction phases. Providing this is implemented, the likely residual impact would be **insignificant**.

Completed Development

Increased Flood Risk from Surface Water Runoff

9.68 Providing the surface water drainage strategy is developed further and implemented, no additional mitigation measures would be necessary. On this basis, the likely residual impact on surface water flooding is assessed as remaining **beneficial** and of **moderate significance**.

Impact of Capacity on Foul Water Drainage

9.69 Following refurbishment of the STW, the capacity of the STW would be expected to accommodate the predicted foul water discharge flows from the completed Development. In addition, the estimated volume of foul water discharge is expected to remain within the limit specified by the discharge consent. For these reasons the likely residual impact on the capacity of foul water drainage would remain as **insignificant.**

Impact of Foul Water Drainage on Surface Water Quality

9.70 Refurbishment of the STW would likely be required as a condition on any planning consent for the Development. No further mitigation of discharge quality would be required, unless operational monitoring of the STW indicated that the required water quality improvements in Gallos Brook were unlikely to be achieved. Therefore, the likely residual impact of foul water drainage from the completed and fully occupied Development on surface water quality would remain as **insignificant**.

Increased Demand for Water Supply

9.71 Since water conservation measures would be employed to ensure that, as a minimum, the mandatory standards in the Code for Sustainable Homes would be achieved, no further measures to reduce water consumption are considered necessary. Therefore the Development's likely residual impact on the supply of potable water would remain as **insignificant**.

Conclusions

9.72 The Site is located in an area which has a very low risk of flooding from fluvial sources and a nil risk of tidal flooding. Ground levels would remain as existing and no basements are proposed. As a result, there would be no flood risk to the Development or increased flood risk off-site.

9.73 A preliminary surface water drainage strategy has been developed which includes SuDS to attenuate rainfall on-site and restrict the rate of surface water runoff into the local watercourses to the existing rate, including allowing for climate change. Furthermore, discharge entering the watercourse to the east of the Site would be reduced by 10%. The proposed Development would therefore not increase flood risk on-Site or elsewhere, which is in line with national and local policy as well as Environment Agency guidance, and would reduce flood risk overall.

9.74 The Development would increase the volume of foul water discharge from the Site to the STW in comparison to the existing Development population. However, this should be comparable to the volume that previously discharged to the STW when the Site was fully occupied and the proposed refurbishment of the STW may lead to an improvement in the quality of the treated effluent. The Development would also result in additional demand for local water supply. However, the implementation of water efficiency measures as part of the Development would minimise the increase in water consumption.

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Upper Heyford

Flood Risk Assessment

October 2010

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Upper Heyford

Flood Risk Assessment

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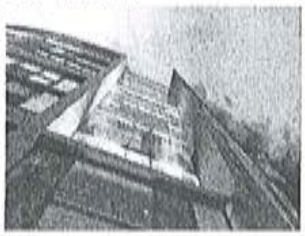
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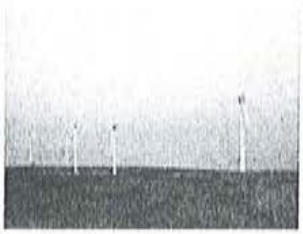
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Executive Summary

Waterman has been commissioned by Dorchester Holdings to undertake a Planning Policy Statement 25 Flood Risk Assessment for the proposed development at Upper Heyford airfield.

The Development proposes the creation of a new settlement, which will include the retention and refurbishment of some existing military housing as well as new build residential development. New social and community infrastructure will be provided as well as landscaping to include formal sports pitches and open space.

The Site is located within Flood Zone 1 and is considered by the Environment Agency to be at a low risk of tidal and fluvial flooding. Furthermore there are no watercourses on-site and no history of fluvial flooding.

The Site is located on top of a plateau, slightly down gradient of the 'flying field'. Overland flows could only emanate from the runway or the Site itself. As there have been no reported instances of flooding to the Site it is assumed that the current on-site drainage network has adequate capacity to deal with surface water runoff. The risk of flooding from pluvial sources is therefore considered low.

Groundwater was located approximately 1.2m below ground level in the northeast of the Site and 7m below ground level in the southwest. Groundwater levels are relatively static and there have been no reported historical instances of flooding on-site. Furthermore, proposed ground levels are to remain as existing so the risk of groundwater flooding to the buildings themselves, or increased flood risk to others caused by displacement of flows would be low.

The on-site surface water drainage network is private, connecting into a number of small watercourses around the southern and eastern boundaries of the Site.

The proposed surface water strategy will mimic the existing situation, restricting flows to the existing rate while taking climate change into account for the lifetime of the Development. Due to anecdotal evidence of flooding off-site, flows entering the watercourse to the east of the Site will be decreased by 10%. This will provide some degree of betterment over the existing situation.

Surface water attenuation will be provided through the use of balancing ponds, permeable paving and attenuation tanks where necessary. Swales will be incorporated within the development parcels and living roofs will be considered where appropriate. The potential for infiltration techniques will also be investigated further at the detailed design stage, to confirm whether soakage rates are favourable.

This report demonstrates that the proposed Development is at a low risk of flooding. It also confirms that surface water runoff from the Development could be drained in such a way as to ensure that flood risk is not increased elsewhere, and where appropriate decreased. It is anticipated that the information provided within this report satisfies the requirements of Planning Policy Statement 25.

1. Introduction and Policy Context

1.1. Waterman was commissioned by Dorchester Holdings to undertake a Flood Risk Assessment in respect to a portion of Upper Heyford airfield (hereafter referred to as 'Upper Heyford'), located in Oxfordshire.

Site Description

1.2. The existing site (hereafter referred to as 'the Site') is approximately 76 hectares in size and is bisected by Camp Road. The north of Camp Road comprises existing residential accommodation in the east and to the west commercial buildings and disused aircraft hangers. To the south of Camp Road commercial buildings are located to the east, with residential bungalows in the central areas. A disused hospital is located in the west of the Site adjacent to the sports fields.

1.3. An unnamed road forms the eastern boundary of the Site and agricultural fields lie beyond the southern boundary. The western boundary comprises the adjacent school and the northern boundary is formed by the 'flying field'. A location plan and application boundary are shown in Figures 1 and 2 respectively.

Topography

1.4. The topographic survey (seen in Appendix A) shows that the Site falls in a south easterly direction away from the 'flying field' situated to the north of the Site. Ground levels fall from approximately 127.5m Above Ordnance Datum (AOD) adjacent to the aircraft hangers to 116.7m AOD near to Field Barn Farm.

Geology

1.5. As taken from the Phase 2 Intrusive Survey Factual Report undertaken by Aspinwall in June 1997 (Ref.1) which covered the entire airfield, shallow ground conditions at the Site generally comprise layers of silt and clay, often sandy with a significant proportion of cobble sized limestone. This is underlain by weathered limestone bedrock at an average depth of 1.5m (range of 2.6m to 0.9m) to the north of Camp Road and 1.3m (range of 2.7m to 0.8m) to the south of Camp Road.

1.6. The solid geology at the Site comprises Middle Jurassic Great Oolite Limestone up to approximately 20m in depth, overlying a thick mudstone sequence with occasional limestone and sandstone bands.

1.7. The underlying Inferior Oolite Group is less than10m thick and includes sand, sandstones and thin mudstone of the Lower Estuarine Series, and sandy limestone, shelly limestones and sandstones of the Northampton Sand.

Hydrology

1.8. Tributaries of the Gallos Brook are located to the south and east of the Site. Surface water runoff from the Site discharges into these watercourses through four outfalls (as seen in Figure 3), two located to the south and two to the east. The Gallos Brook enters the River Ray approximately 11km to the south of the Site.

1.9. The nearest Main River to the Site is the River Cherwell which is located approximately 1.2km to the west of the Site.

Development Proposals

1.10. The development proposals (hereafter referred to as the 'Development') are shown in Appendix B. These illustrate that the development would comprise the creation of a new settlement, which would include up to 1,075 dwellings. Taking a sustainable approach, much of the existing military housing would be retained and refurbished, along with some new build residential development. Some of the residential development would be assisted living accommodation for the elderly and student accommodation involving change of use of existing buildings.

1.11. The proposals also include the provision of new employment uses (Class B1-B8), again comprising the change of use of existing buildings as well as the erection of new buildings.

1.12. New social and community infrastructure will also be created, including a new primary school towards the centre of the settlement area. A range of retail provision, again comprising new build and some change of use would be included, together with a range of Class D1 (non residential institutions) uses.

1.13. The Development would also involve a number of buildings and structures to be removed across the Site, including the boundary fence to the south of Camp Road.

1.14. Requisite infrastructure such as new highways will be provided to serve the settlement. In addition, a range of formal sports pitches and open space would be incorporated within the scheme.

Legislation and National Planning Guidance

Planning Policy Statement 25: Development and Flood Risk (PPS25)

1.15. PPS25 (Ref.2) sets out Government policy on development and flood risk. Its aims are to ensure that flood risk is taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is exceptionally necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere, and where possible reduce flood risk overall.

1.16. PPS25 advocates the use of the risk-based 'Sequential Test', in which new development is steered towards the areas at lowest probability of flooding which are identified by Flood Zones.

1.17. The Site is located within Flood Zone 1, considered to have a low probability of flooding according to the Environment Agency's (EA) internet Flood Zone Map (as shown in Figure 4); therefore the Sequential Test for the Site has been passed.

1.18. PPS25 requires that surface water discharge from any developed site should be no greater than the existing rate, and should be managed in a sustainable manner as far as possible.

1.19. Practice Guidance (Ref.3) which accompanies PPS25 states that annual flow rates up to and including the 1 in 100 year event should be accounted for, including for the impacts of climate change.

1.20. Residential development is generally accepted to have a lifespan of 100 years. As detailed in Table B.2 of PPS25 (Ref.2), it is suggested that for developments of this design life, increasing peak rainfall intensity by 30% may provide an appropriate precautionary response to the uncertainty of climate change impacts.

Local Planning Policy

Strategic Flood Risk Assessment

1.21. The Cherwell District Council and West Oxfordshire District Council Level 1 Strategic Flood Risk Assessment (SFRA) published in April 2009 (Ref.4) sets out the requirements for site specific FRAs dependent upon the location of the Site.

1.22. Table 13.1 states that with regard to Upper Heyford the geology of porous shale could lead to potential land drainage issues and a Level 2 site specific FRA would need to include details of land drainage infrastructure. It concludes that the Level 2 FRA should consider existing available information where possible to further the developer's understanding of flood risk and how this could affect the Development.

Local Development Framework

1.23. The Draft Core Strategy published in February 2010 (Ref.5) forms part of the emerging Local Development Framework and represents Cherwell's policies for development up to the year 2026.

1.24. Policy SD6 encourages the use of Sustainable Drainage Systems (SuDS) to allow for developments to better adapt to the predicted impacts of climate change based on site specific constraints. It states that SuDS should aim to mimic surface water flows arising from the site prior to the proposed development and based on the existing situation.

Scope of Report

1.25. This report assesses the Site in regards to the risk of flooding, taking into consideration tidal, fluvial, groundwater and pluvial sources and the potential effects upon the Development. In line with current policy, the management of surface water will be assessed, and a strategy to effectively manage runoff whilst working within Site specific constraints will be proposed, so as not to increase flood risk elsewhere.

2. Sources of Potential Flooding

Tidal and Fluvial

2.1. The EA's Flood Zone Map, as seen in Figure 4, shows that the proposed Development is located within Flood Zone 1 and has a low probability of flooding (annual exceedance probability <0.1%).

2.2. The nearest Main River to the Site is the River Cherwell situated approximately 1.2km to the west of the Site.

2.3. Mapping provided by the EA (shown in Appendix C) denotes five secondary and tertiary watercourses adjacent to the southern and eastern boundaries of the Site, however the EA do not hold any records of flooding associated with these features.

2.4. Furthermore, the identified watercourses which are tributaries of the Gallos Brook are located down gradient of the development Site. Even in the extremely unlikely event of flooding due to these watercourses, no flooding would occur to the Site. It is therefore concluded that the risk of tidal or fluvial flooding is low.

2.5. Anecdotal evidence provided by the EA (Appendix C) notes that flooding has occurred off-site within Caulcott to the west of the Site and the caravan park to the east.

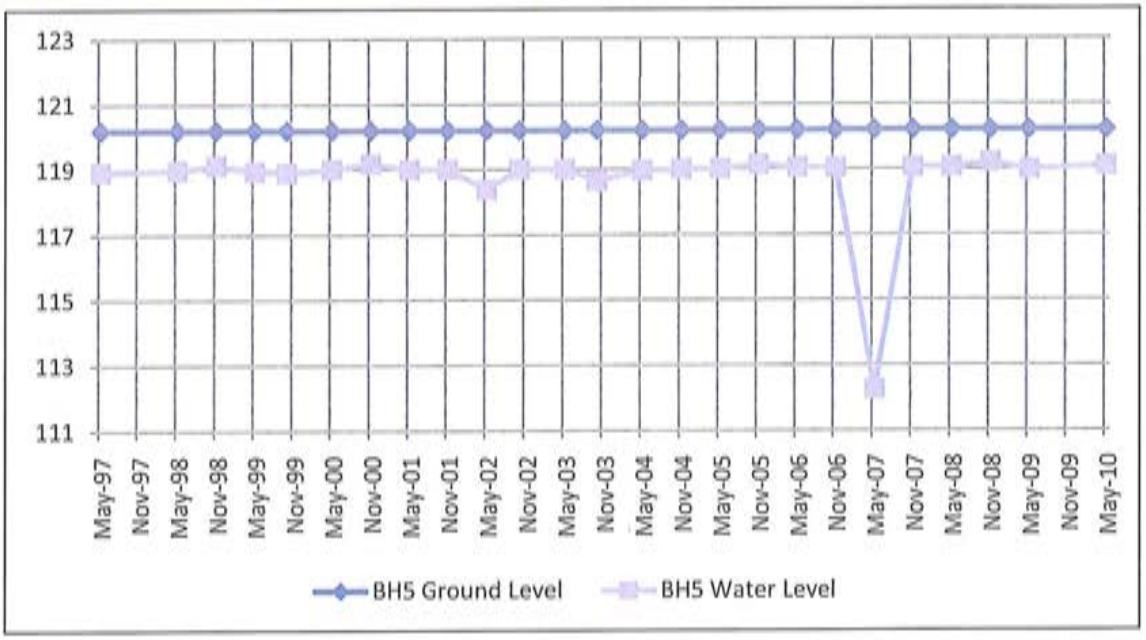
2.6. However, as seen in Figure 1, the Site boundary is such that the proposed development does not drain to the watercourse which flows through Caulcott. Therefore, the development would not affect surface water runoff in this location. Although anecdotal evidence of flooding within the caravan park does not constitute a flood risk to the Site itself, this will be taken into account within the following chapter when considering an appropriate drainage strategy.

Groundwater

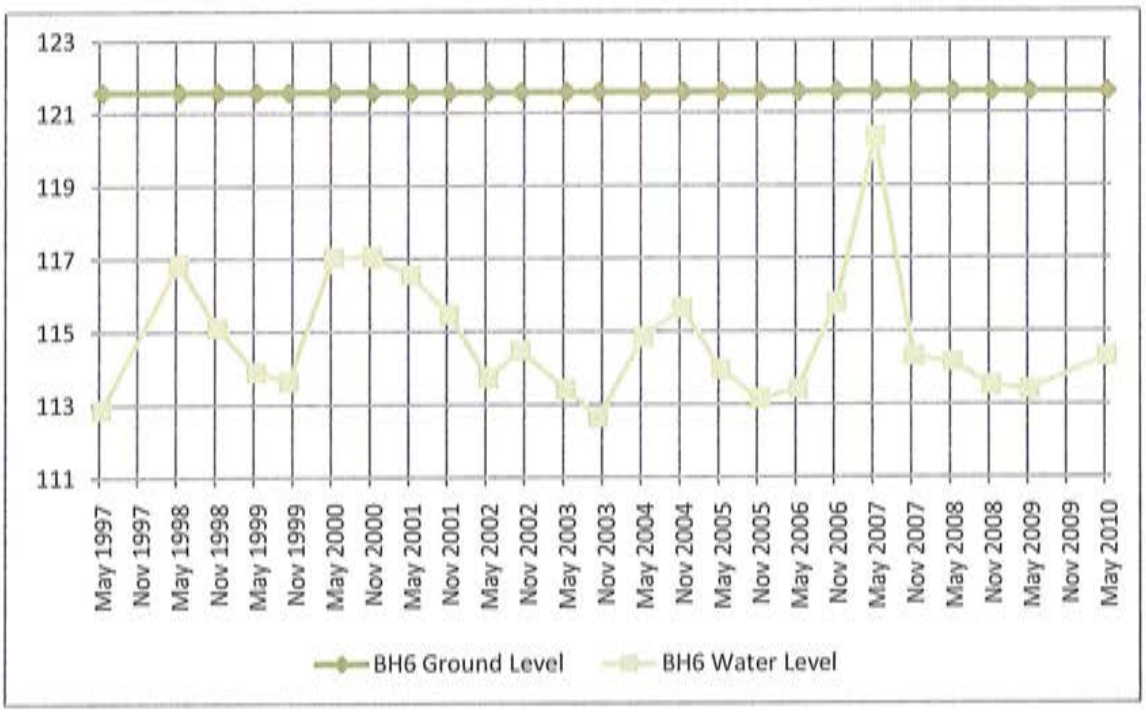
2.7. The Site is not located within a Source Protection Zone according to the EA website. However, the EA classifies the underlying limestone bedrock beneath the Site as a principal aquifer. This classification refers to layers of rock or drift deposits that have high fracture permeability, meaning they usually provide a high level of water storage and they may support water supply and/or river base flow on a strategic scale.

2.8. The Aspinwall report (Ref.1) noted that groundwater was present within a number of horizons dependent upon the lithology present. Boreholes have been monitored on a biannual basis since the report was initially undertaken in 1997. Boreholes 5 and 6 are of significance to the Development and are located to the northeast and southwest of the Site respectively (as seen in Figure 3). The respective relationship between the ground level and water level are shown in the following graphs.

Graph 1: Groundwater Monitoring Borehole 5



Graph 2: Groundwater Monitoring Borehole 6



2.9. As seen in the above graphs, there were two erroneous results taken in May 2007. It appears from viewing the complete set of results that these two readings have been switched between boreholes 5 and 6. These results have therefore been discounted from continued assessment of the potential for groundwater flooding.

2.10. Borehole 5 shows very steady groundwater levels at an average of 1.2m below ground level (bgl) and a minimum of 1m bgl. Borehole 6 in comparison shows a relatively fluctuating water level located an average of 7m bgl, ranging between 4.72m bgl and 8.93m bgl.

2.11. The EA (Appendix C) and on-site management team do not hold any records of groundwater flooding occurring at the Site; furthermore the Development proposes to maintain existing ground levels. It is therefore considered that groundwater flooding would not be an issue either at the Site through ingress of water into newly constructed buildings, or to others caused by displacement of flows.

Pluvial

2.12. Pluvial flooding occurs when natural and engineered systems have insufficient capacity to deal with the volume of rainfall. Pluvial flooding can sometimes occur in urban areas during an extreme, high intensity, low duration summer rainfall event which overwhelms the local surface water drainage systems; or in rural areas during medium intensity, long duration events where saturated ground conditions prevent infiltration into the subsoil. This flood water would then be conveyed via overland flow routes dictated by the local topography.

2.13. There are no public sewers located on-site; however there are private sewer systems which connect into the watercourses along the Site boundary. On-site personnel have no recollection of instances of flooding at the Site (over the last 40 years).

2.14. The surrounding topography of the area gently falls in a southerly direction towards the adjacent fields. The Development would therefore only be at risk of pluvial flooding from the Site itself or the 'flying field'. No flooding has been reported at the Site and it is therefore assumed that the current drainage network is of adequate capacity to collect and dispose of surface water flows. In addition, as part of the Development, surface water runoff would be managed and hence pluvial flooding would not pose a risk to the Development.

Summary

2.15. The Site is considered to be at low risk of flooding from tidal, fluvial, groundwater and pluvial sources. However, it is also necessary to ensure that the Development itself would not increase flood risk elsewhere through increased surface water runoff. This is examined in the following chapter.

3. Surface Water Drainage Strategy

Current Surface Water Regime

3.1. As seen in Figure 3, there are four discharge locations adjacent to the Site which enter two tributaries of the Gallos Brook. These are namely Outfalls 1 and 2 to the south of the Site and Outfalls 3 and 4 to the east. The presence of these watercourses was confirmed through a Site walkover undertaken on 2 June 2010.

3.2. Figure 5 shows the existing surface water drainage catchments based on information obtained through the topographic survey, on-site records and the CCTV survey undertaken at the Site. Outfall 1 (which ultimately joins Outfall 2) drains the western area of the Site. Outfall 2 located to the south of the Site drains central areas to the south of Camp Road. Outfall 3 located beside Camp Road drains the central areas to the north of Camp Road and Outfall 4 drains the north eastern area of the Site.

3.3. There are large areas of existing residential properties in the south of the Site which do not appear to benefit from positive drainage systems. Through discussions with on-site personnel it is understood that these properties are expected to have individual soakaways, however the location, size and design of these features are unknown. There are no reports of any drainage or flooding issues within these areas, and as such the existing provision is considered satisfactory.

3.4. There is an existing balancing pond located to the south of the Site beside the B4030. All four outfalls located on-site drain to this feature, which aids in reducing flows to downstream catchments.

Sustainable Drainage Systems

3.5. The most sustainable way to drain surface water runoff is through the use of SuDS, which need to be considered in relation to site-specific constraints.

3.6. SuDS work by mimicking the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk these features can improve water quality and provide biodiversity and amenity benefits.

3.7. A variety of SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. Table 1 overleaf provides the constraints and opportunities to each of the SuDS devices in accordance with the hierarchical approach outlined in The SuDS Manual CIRIA C697 (Ref.6).

Table 1: Sustainable Drainage Techniques

Device	Description	Constraints / Comments	✓/x
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	Not suitable for individual properties, potential for inclusion within managed areas/buildings.	✓
Infiltration devices Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	Infiltration likely to be feasible, subject to assessment of contamination and soakage rates during detailed design.	✓
Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	Potential for infiltration, soakage rates to be confirmed during detailed design. If sufficient soakage not possible, paving could be lined with an impermeable membrane.	✓
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the Site by reusing water for non-potable uses e.g. toilet flushing.	Rainwater harvesting systems are not considered to provide attenuation for specific storm events.	✓
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	Potential for inclusion within the development plots and alongside the highways. Details to be confirmed at detailed design.	✓
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	See Infiltration Devices above.	✓
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from runoff from adjacent areas.	Could be provided adjacent to ponds or basins.	✓
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	See Infiltration Devices above.	✓
Wet ponds & Constructed Wetlands (end of pipe treatment)	Provide water quality treatment and temporary storage above the permanent water level.	Could be utilised down gradient of the development plots where spatial constraints allow.	✓
Attenuation Tanks (end of pipe treatment)	Used when the SuDS listed above cannot be installed with sufficient volumes to restrict to the required rate.	A gravity connection should be provided for any underground attenuation tank where practical.	✓

Infiltration Techniques

3.8. Although it is expected that drainage by infiltration would be viable at the Site, localised soakage tests have not been undertaken to date. Additionally, confirmation of areas of contamination would be required and the potential for remediation if required assessed. Therefore, the precautionary

principle has been applied to the drainage strategy in order to demonstrate that surface water runoff can be reduced to the required rates without the need for infiltration.

Living Roofs

3.9. Living roofs comprise a vegetative cover over a drainage layer which mimics the natural drainage regime of a Greenfield site, through absorption by the plants and retention of precipitation within the growing medium. This reduces the volume of runoff and attenuates peak flows. Living roofs can also provide ecological benefits through providing replacement and additional habitat within developments. Furthermore living roofs can facilitate in reducing a building's carbon footprint by removing CO_2 and reducing energy demand owing to the thermal benefits.

3.10. In line with the sustainable approach to the Development, a large proportion of the Site is intended to be refurbished and it is not considered feasible to retrofit living roofs to the existing buildings. Living roofs would not be appropriate for new houses, however would be considered during detailed design in areas where there are shared maintenance agreement (e.g. flats and commercial buildings), subject to roof typology and structural stability.

Permeable Paving

3.11. Permeable paving allows infiltration through the surface and filter layers into the sub-base or void structure below. Where soakage rates do not allow for direct infiltration into the underlying subsoil, water would be held within the sub-base and attenuated sufficiently before discharging to the appropriate outfall. Permeable paving would generally be used in non trafficked areas, however could also be utilised on un-adopted highways within the Development subject to appropriate design.

Swales and Filter Drains

3.12. Swales and Filter Drains are designed to convey surface water runoff from adjacent impermeable surfaces, and should ideally infiltrate into the ground.

3.13. Swales could be utilised where topography is favourable within the development plots and alongside the highways to convey runoff to down gradient attenuation features. Where infiltration is not possible, swales would be lined with an impermeable membrane and designed to provide attenuation behind a series of weirs.

Balancing Ponds and Basins

3.14. Balancing ponds collect surface water within the landscape of the Site. Although these require significant land take they can provide ecological enhancement, and improve water quality through the removal of pollutants.

3.15. In line with CIRIA guidance the following assumptions have been taken into account in regards to the design of permanent ponds:

- Side slopes of 4:1, one at 6:1 for safety purposes (dependant on slope stability)
- 1m balancing depth above permanent pool
- Length to width ratio of between 3:1 and 5:1

3.16. These features could be designed as ponds, with a permanent water level in them. Alternatively these could be basins, which would be generally dry during summer months and utilised as amenity and recreation space when not required for attenuation purposes.

3.17. The ponds shown in Figure 6 have been sized assuming that no infiltration is possible; to demonstrate that there is sufficient space available to achieve the required attenuation volume.

Underground Attenuation

3.18. Excess surface water which cannot be controlled through the use of above ground features and permeable paving would be directed to storage tanks and oversized pipes. It is recognised that these measures are considered less sustainable than other methods of attenuation as they provide no water quality, amenity or habitat benefits. However, where surface water runoff cannot be controlled through more sustainable SuDS techniques, the option of attenuation tanks has been considered.

Proposed Surface Water Regime

3.19. The EA have confirmed that in areas identified solely for refurbishment, attenuation would not need to be provided as the buildings, areas of hard standing and drainage networks are to remain as existing. Similarly, no attenuation would be required for areas of the Site which are not intended to be developed. In these areas, the drainage networks would remain as per the existing situation if possible, although minor diversions may be necessary to accommodate the proposed buildings.

3.20. In accordance with PPS25, local policy and EA guidance the rate of surface water runoff from new development would be controlled so that it does not increase over the existing situation for the 1 in 100 year event, while taking climate change into account for the lifetime of the Development.

3.21. In addition, due to anecdotal evidence of flooding to the east of the Site within the caravan park (Appendix C), as agreed with the EA, flows entering the eastern tributary of the Gallos Brook would be reduced by 10% which would provide a degree of betterment over the existing situation.

3.22. Preliminary calculations included within Appendix E show that approximately 1650m^3 of attenuation would be required for Catchment 1, 1903m^3 for Catchment 2, 1986m^3 for Catchment 3 and 511m^3 for Catchment 4. This would mean a total attenuation volume of 6050m^3 would be required across the Site to restrict surface water flows sufficiently.

3.23. As previously noted there is a downstream balancing pond serving the Site. However, due to the existing footprint there is limited scope to increase the volume of this feature. It has therefore been proved that the required attenuation volume can be incorporated on-site.

3.24. Figure 6 shows the associated allowable discharge rates, above ground attenuation features and volumes of below ground storage required per catchment. As agreed with the EA, due to the Masterplan being merely indicative at this stage, the exact location of below ground storage has not been defined. This will allow for some flexibility in the placement of buildings at the detailed design stage, yet ensure that the appropriate level of attenuation will be provided.

3.25. OCC have confirmed that they would adopt SuDS subject to confirmation of design if they serve two or more properties, are located within the most appropriate land topographically and allow access for maintenance purposes. The potential for the adoption of SuDS by OCC will be considered at the detailed design stage subject to confirmation of the Masterplan. If these features were not offered for adoption, these would be maintained through appropriate maintenance companies under a Model Agreement.

3.26. This strategy would provide a robust and sustainable drainage system which would restrict flows sufficiently while providing ecological and amenity benefits. This would ensure that flood risk is not increased to others and where appropriate is decreased.

4. Conclusions

4.1. The Site is located within Flood Zone 1 and is considered by the EA to be at a low risk of tidal and fluvial flooding. Furthermore there are no watercourses on-site and no history of fluvial flooding.

4.2. The Site is located on top of a plateau, slightly down gradient of the 'flying field'. Overland flows could only emanate from the runway or the Site itself. As there have been no reported instances of flooding to the Site it is assumed that the current on-site drainage network has adequate capacity to deal with surface water runoff. The risk of flooding from pluvial sources is therefore considered low.

4.3. Groundwater was located approximately 1.2m bgl in the northeast of the Site and 7m bgl in the southwest. Groundwater levels are relatively static and there have been no reported historical instances of flooding on-site. Furthermore, proposed ground levels are to remain as existing so the risk of groundwater flooding to the buildings themselves, or increased flood risk to others caused by displacement of flows would be low.

4.4. The on-site surface water drainage network is private, connecting into a number of small watercourses around the southern and eastern boundaries of the Site.

4.5. The proposed surface water strategy will mimic the existing situation, restricting flows to the existing rate while taking climate change into account for the lifetime of the Development. Due to anecdotal evidence of flooding off-site, flows entering the watercourse to the east of the Site will be decreased by 10%. This will provide some degree of betterment over the existing situation.

4.6. Surface water attenuation will be provided through the use of balancing ponds, permeable paving and attenuation tanks where necessary. Swales will be incorporated within the development parcels and living roofs will be considered where appropriate. The potential for infiltration techniques will also be investigated further at the detailed design stage, to confirm whether soakage rates are favourable.

4.7. This report demonstrates that the proposed Development is at a low risk of flooding. It also confirms that surface water runoff from the Development could be drained in such a way as to ensure that flood risk is not increased elsewhere, and where appropriate decreased. It is anticipated that the information provided within this report satisfies the requirements of PPS25.

5. References

1. Aspinwall & Company Limited, June 1997. *RAF Upper Heyford Land Quality Assessment Phase Two: Intrusive Survey Factual Report*
2. Communities and Local Government, March 2010. *Planning Policy Statement 25: Development and Flood Risk*
3. Communities and Local Government, 2009. *Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft'*
4. Scott Wilson, April 2009. *Cherwell and West Oxfordshire Level 1 Strategic Flood Risk Assessment*
5. Cherwell District Council, February 2010. *Draft Core Strategy*
6. CIRIA, 2007. *C697 the SUDS Manual*

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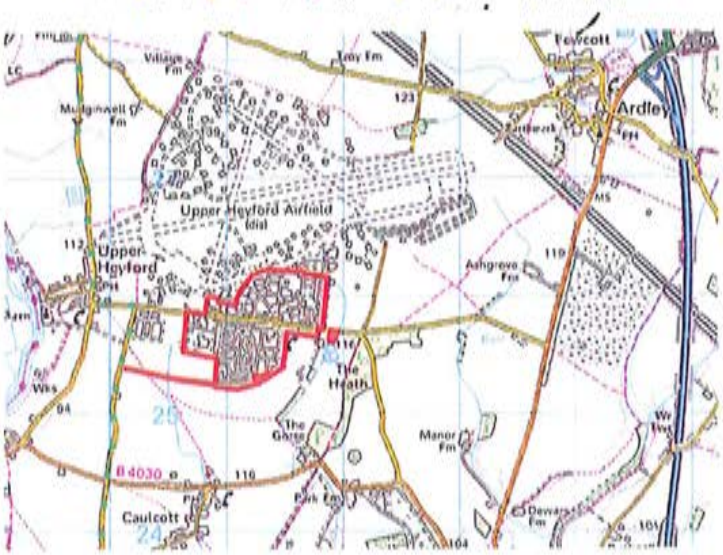
FIGURES

Figure 1: Site Location Plan



Not To Scale

Key

Site Location

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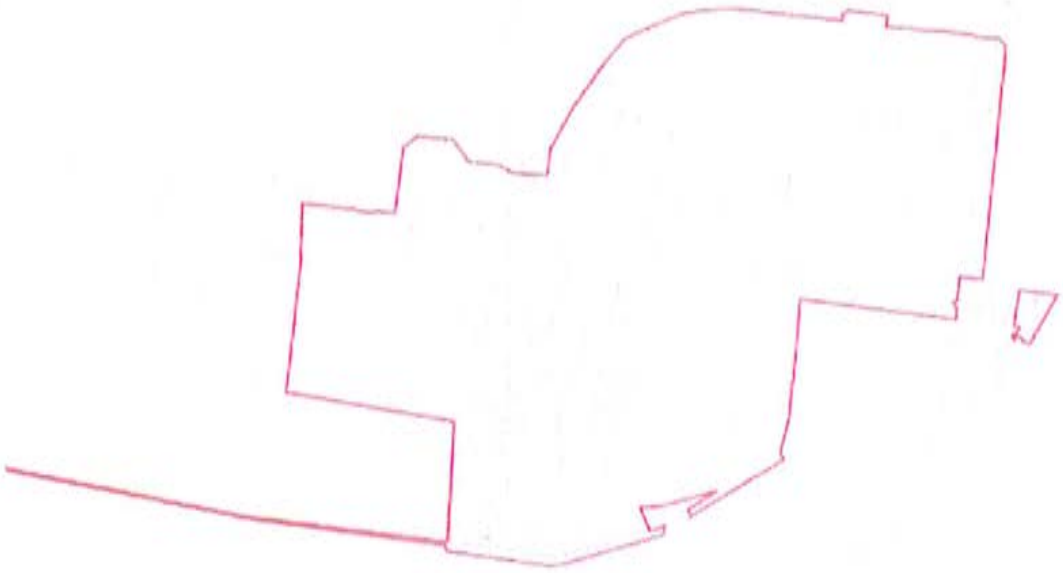
Figure 2: Red Line Boundary



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Key

Application Boundary

Figure 3: Watercourse and Borehole Locations

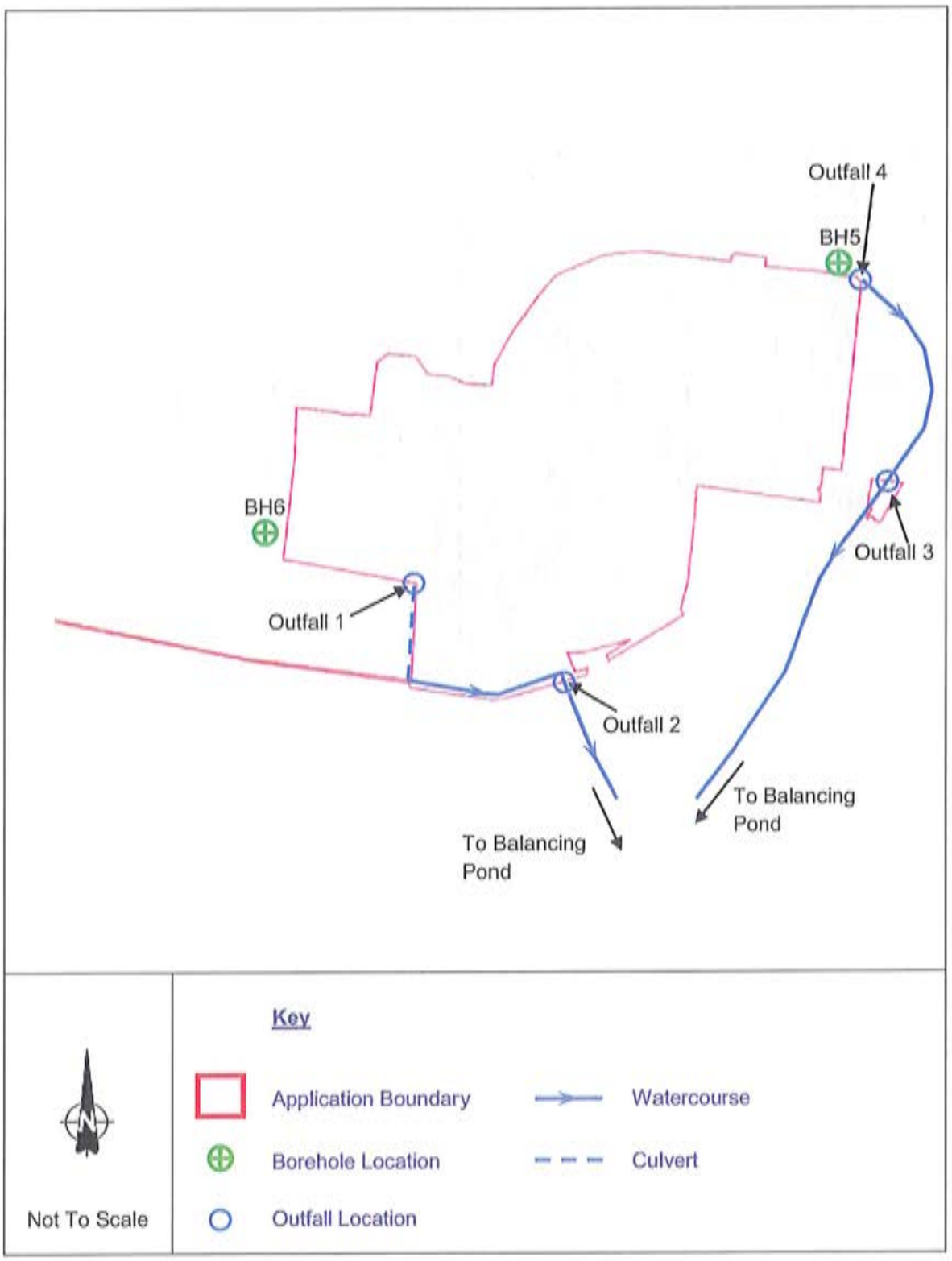
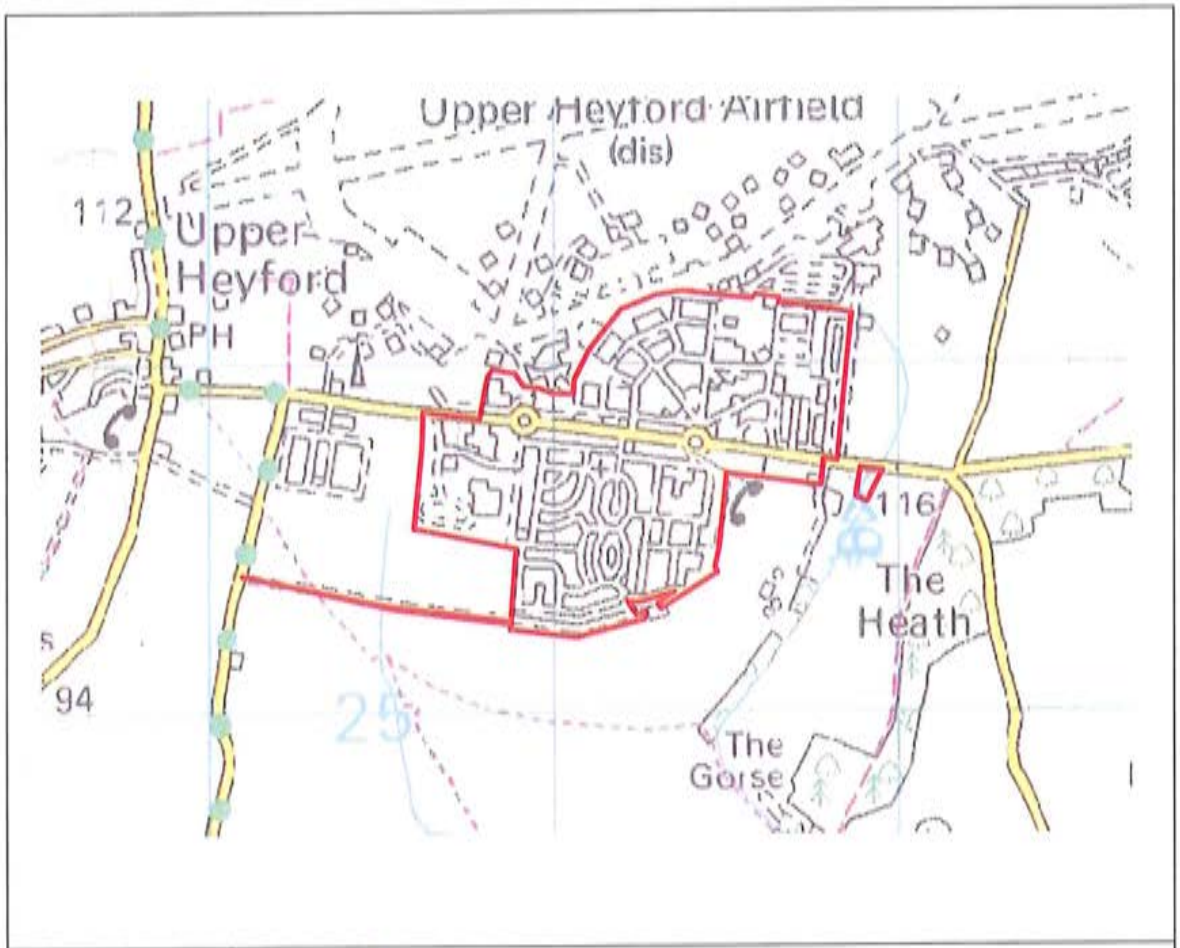


Figure 4: Environment Agency Flood Zone Map



Key

- Site Location
- Flood Zone 3, High Risk, flooding from rivers or sea without defences
- Flood Zone 2, Medium Risk, extent of extreme flood
- Flood Zone 1, Low Risk of flooding from rivers or the sea
- Flood defences
- Areas benefiting from flood defences

Not To Scale

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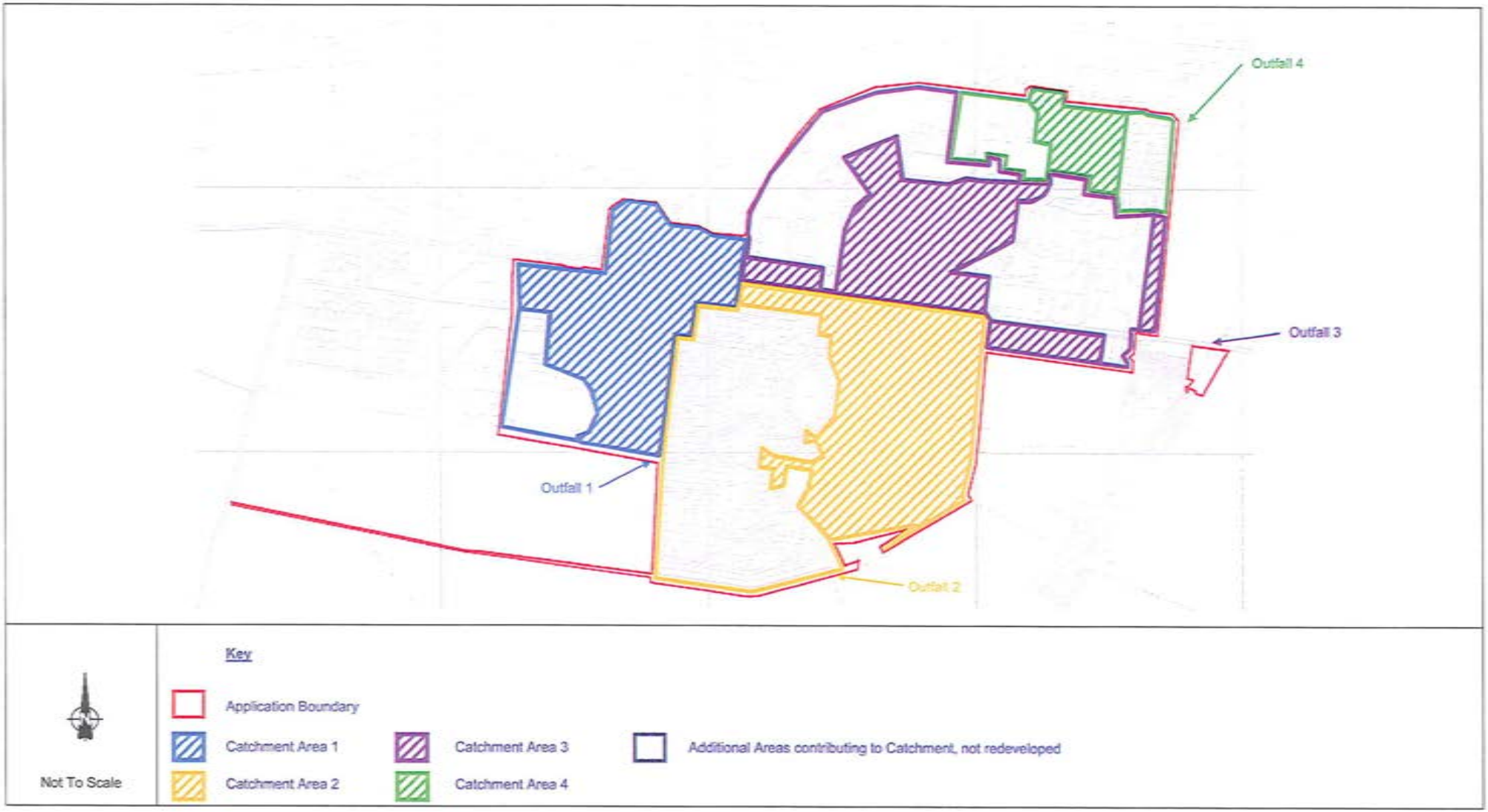
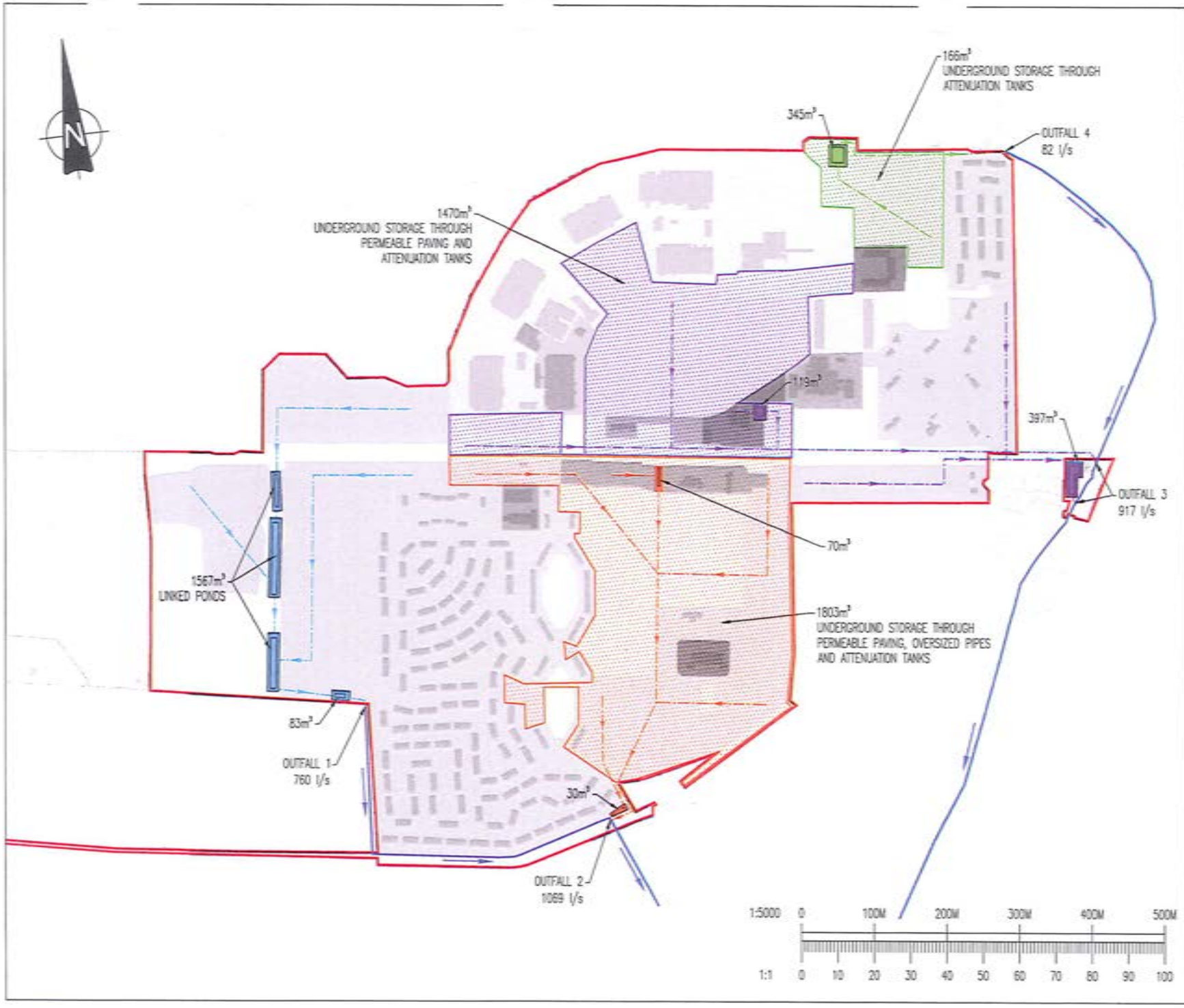
Figure 5: Existing Catchment Boundaries of Developed Site Areas





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GENERAL NOTES

KEY

- RED LINE BOUNDARY
- WATERCOURSE
- AREA 1: ABOVE GROUND STORAGE
- AREA 2: ABOVE GROUND STORAGE
- AREA 3: ABOVE GROUND STORAGE
- AREA 4: ABOVE GROUND STORAGE
- AREA 2: BELOW GROUND STORAGE
- AREA 3: BELOW GROUND STORAGE
- AREA 4: BELOW GROUND STORAGE
- INDICATIVE DRAINAGE NETWORK (COLOUR VARIES BY AREA)

Rev	Date	Description	By
A01	16.09.10	ISSUED	ST

Amendments

Project: UPPER HEYFORD

Title: FIGURE 6: INDICATIVE SURFACE WATER DRAINAGE LAYOUT

Client: DORCHESTER HOLDINGS

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C	SA	04	0001	A01

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APPENDICES

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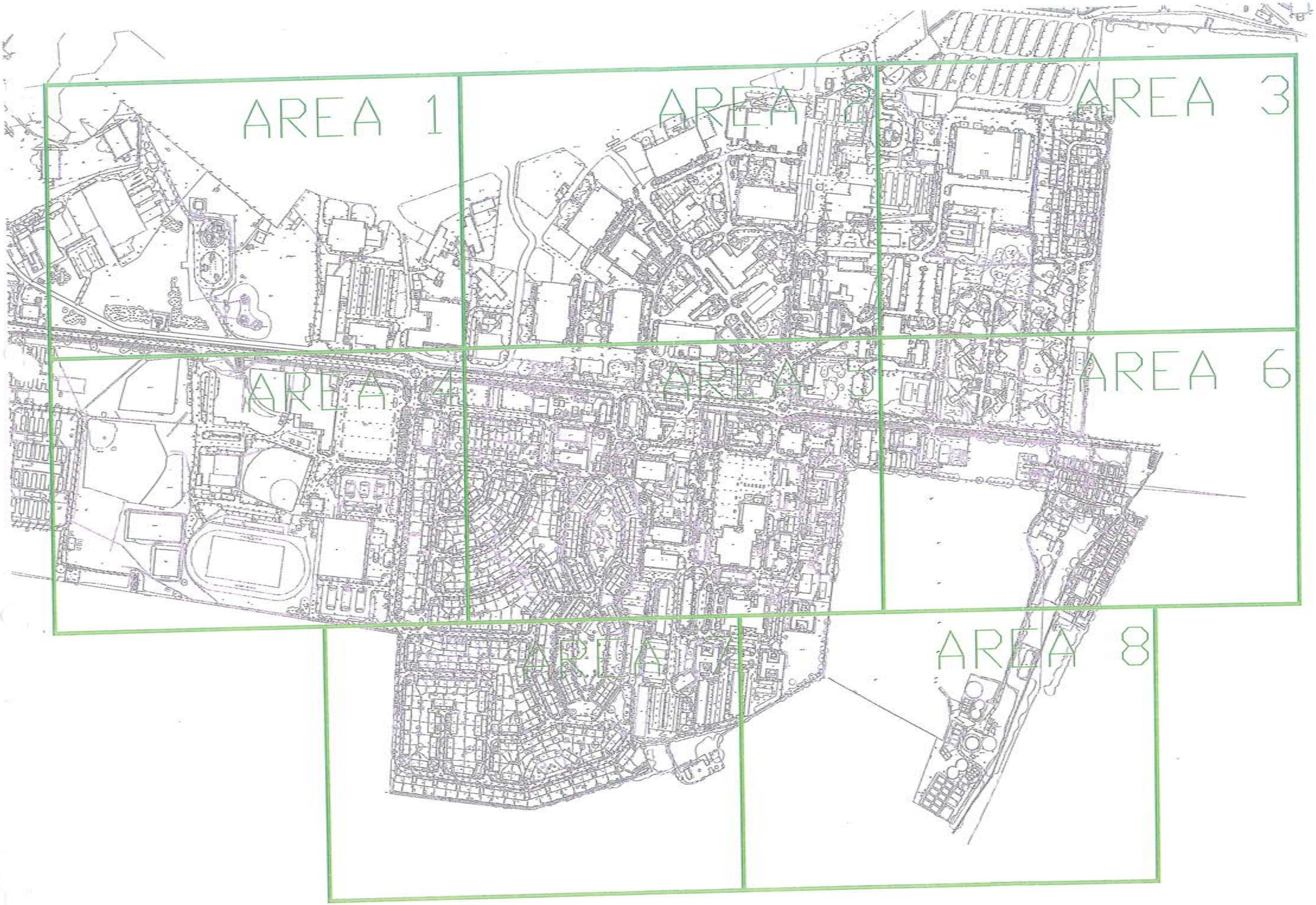
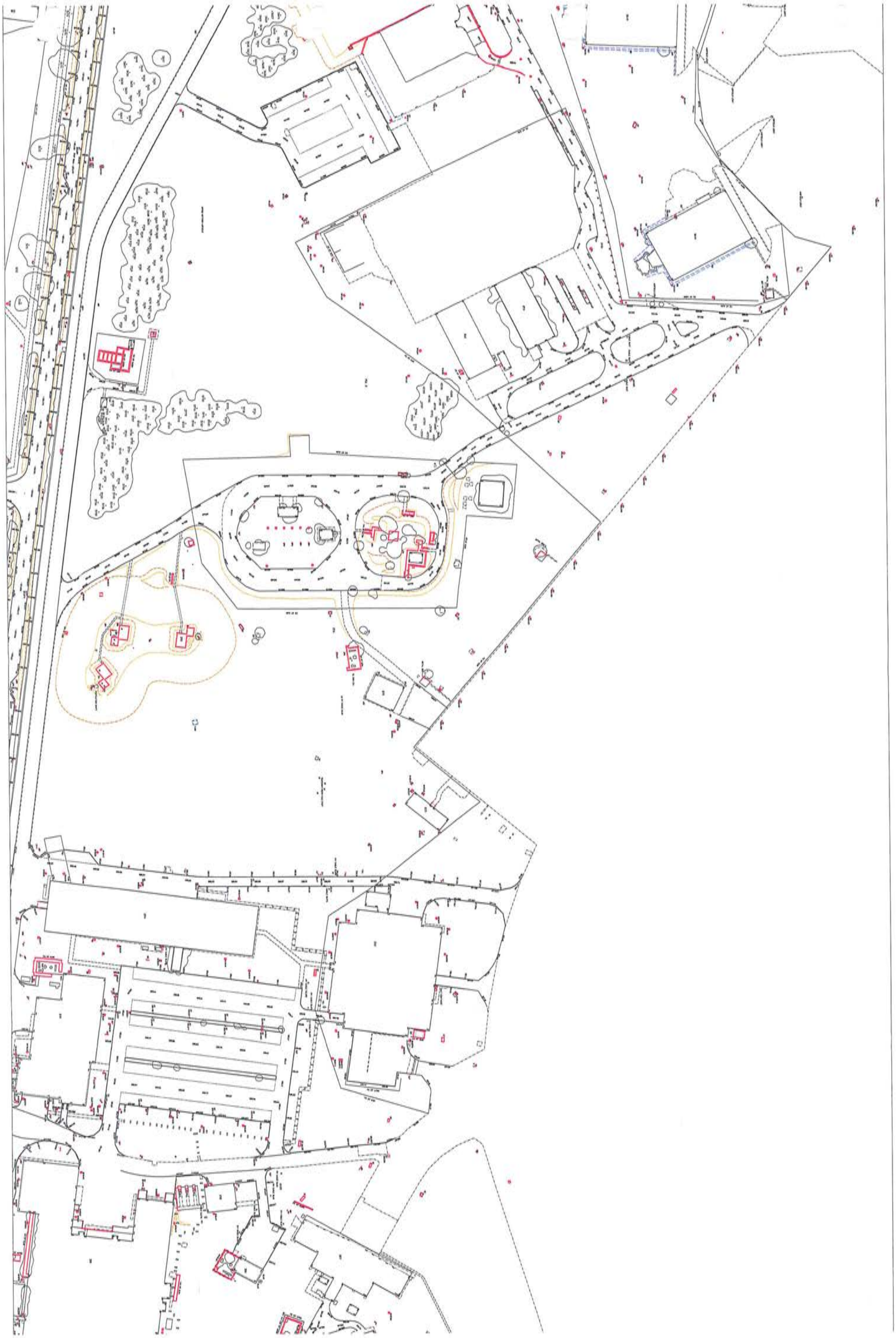
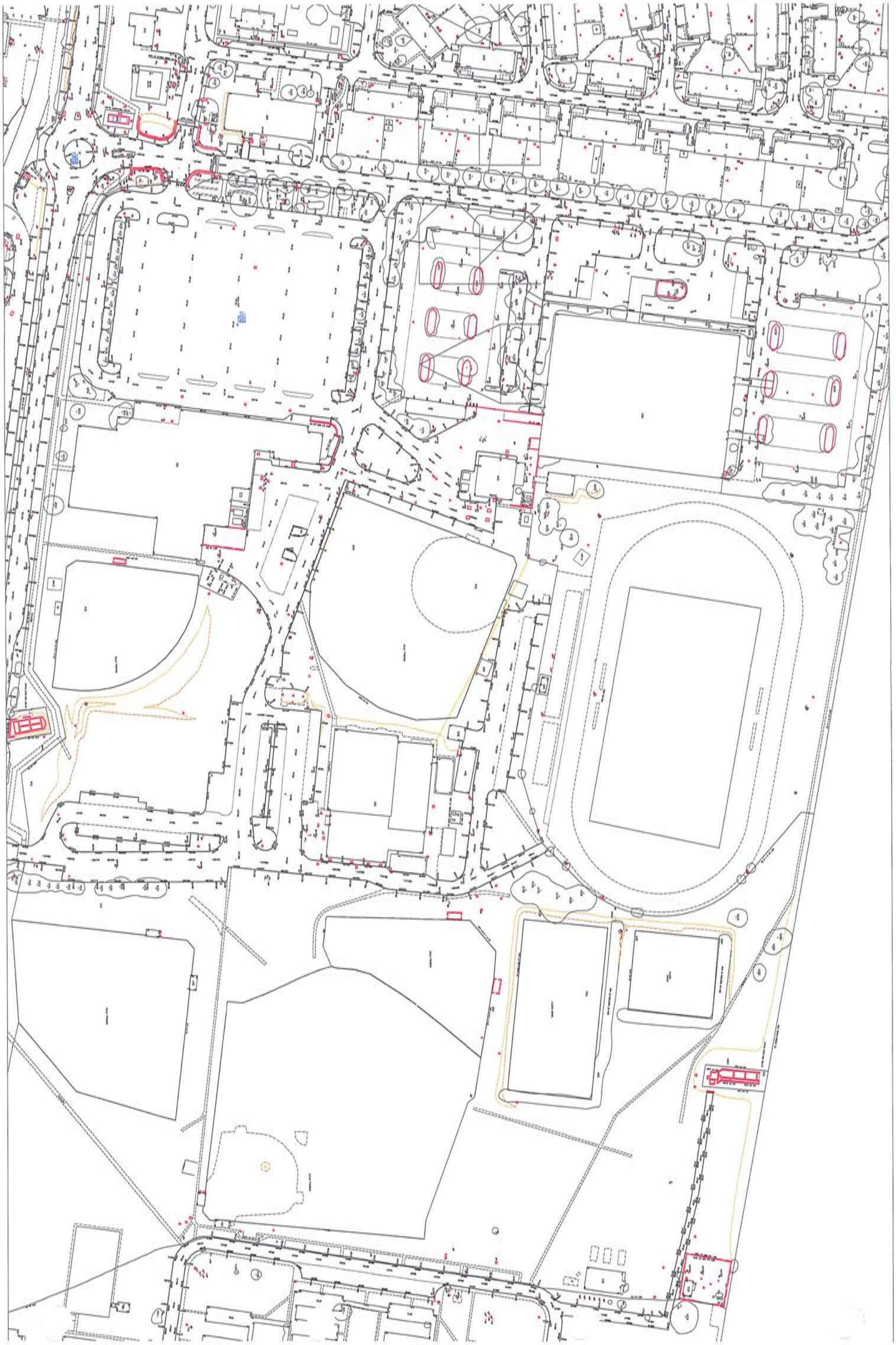
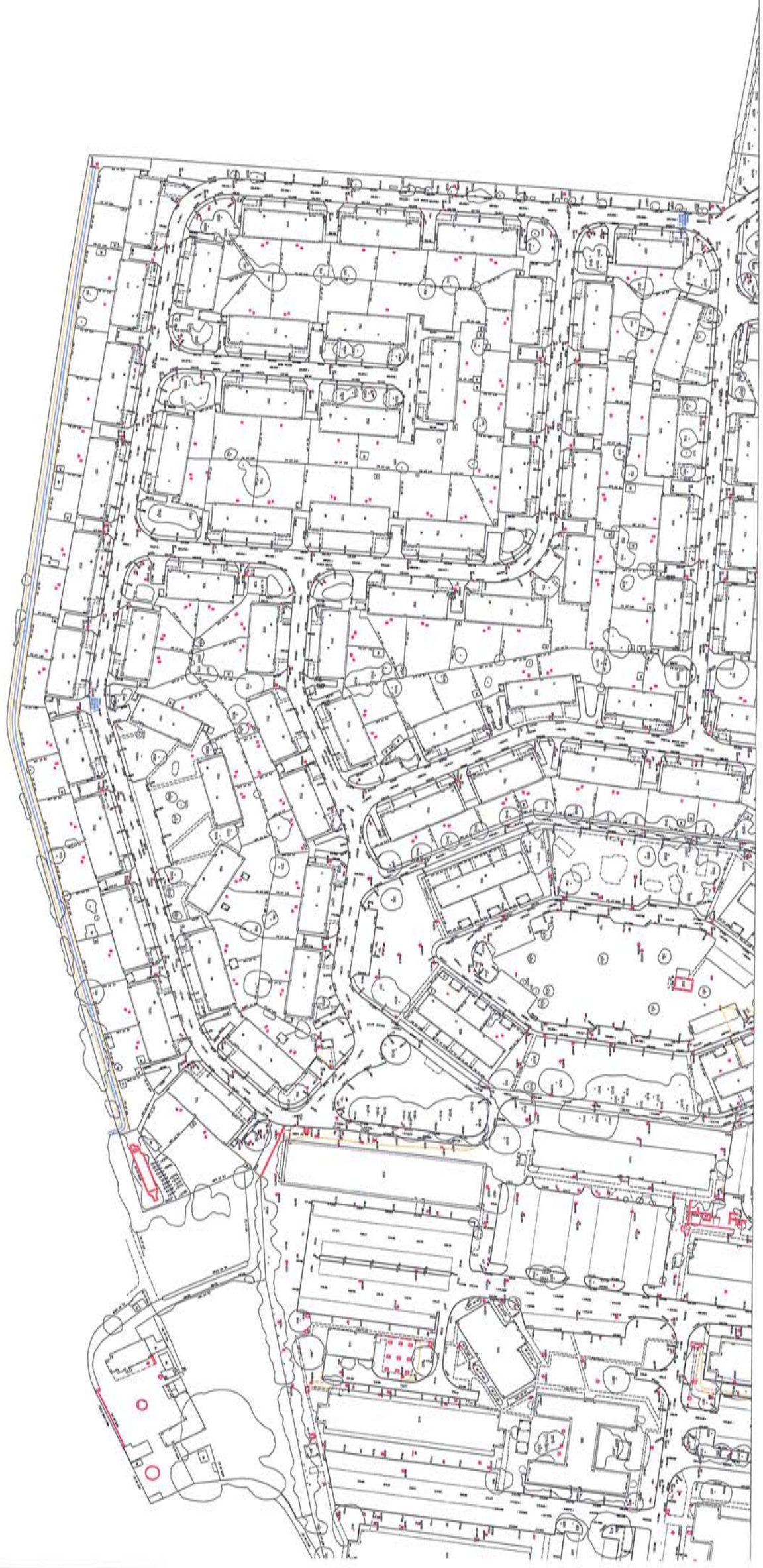
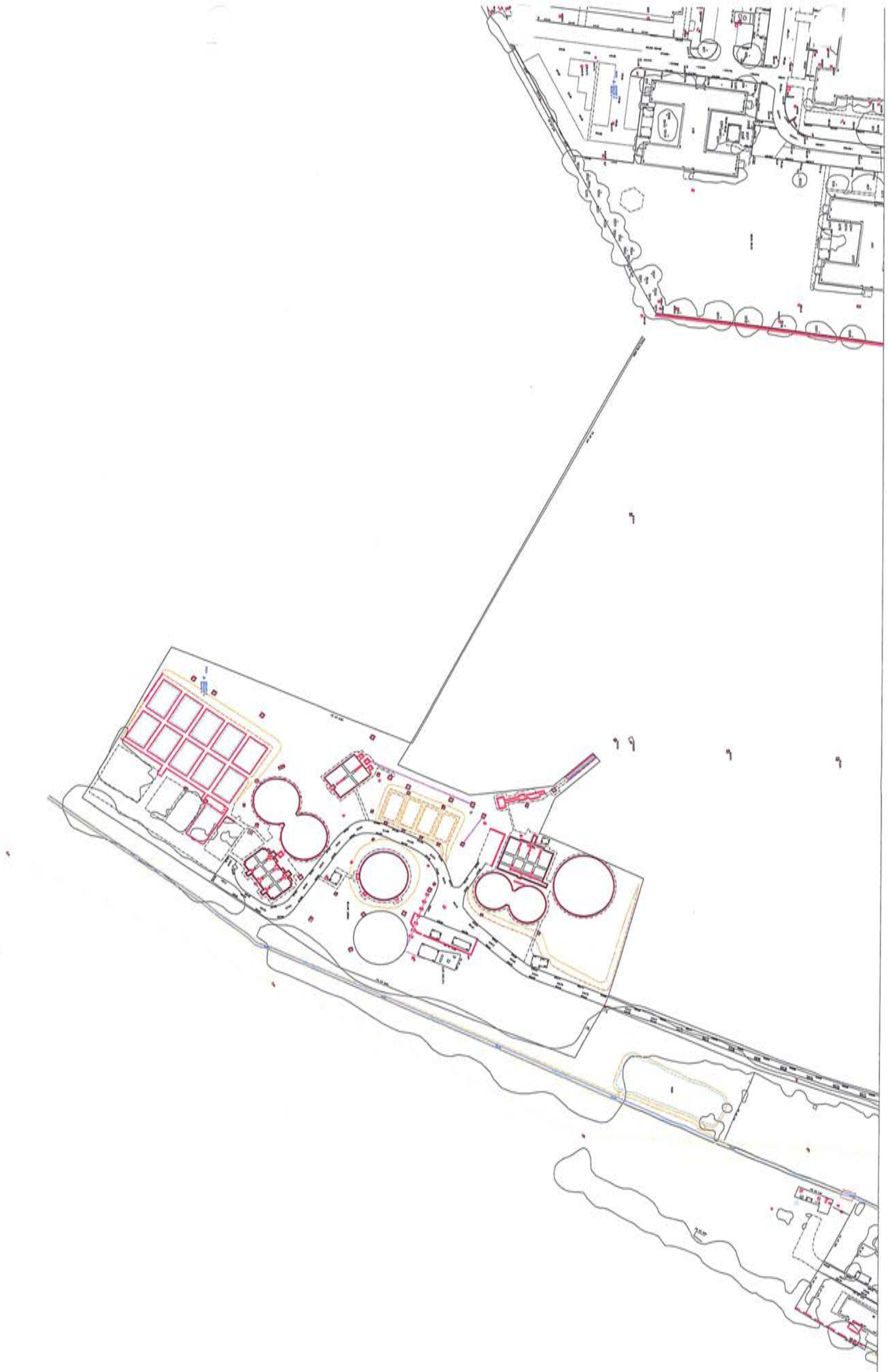
A. Topographic Survey


AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
AREA 7
AREA 8









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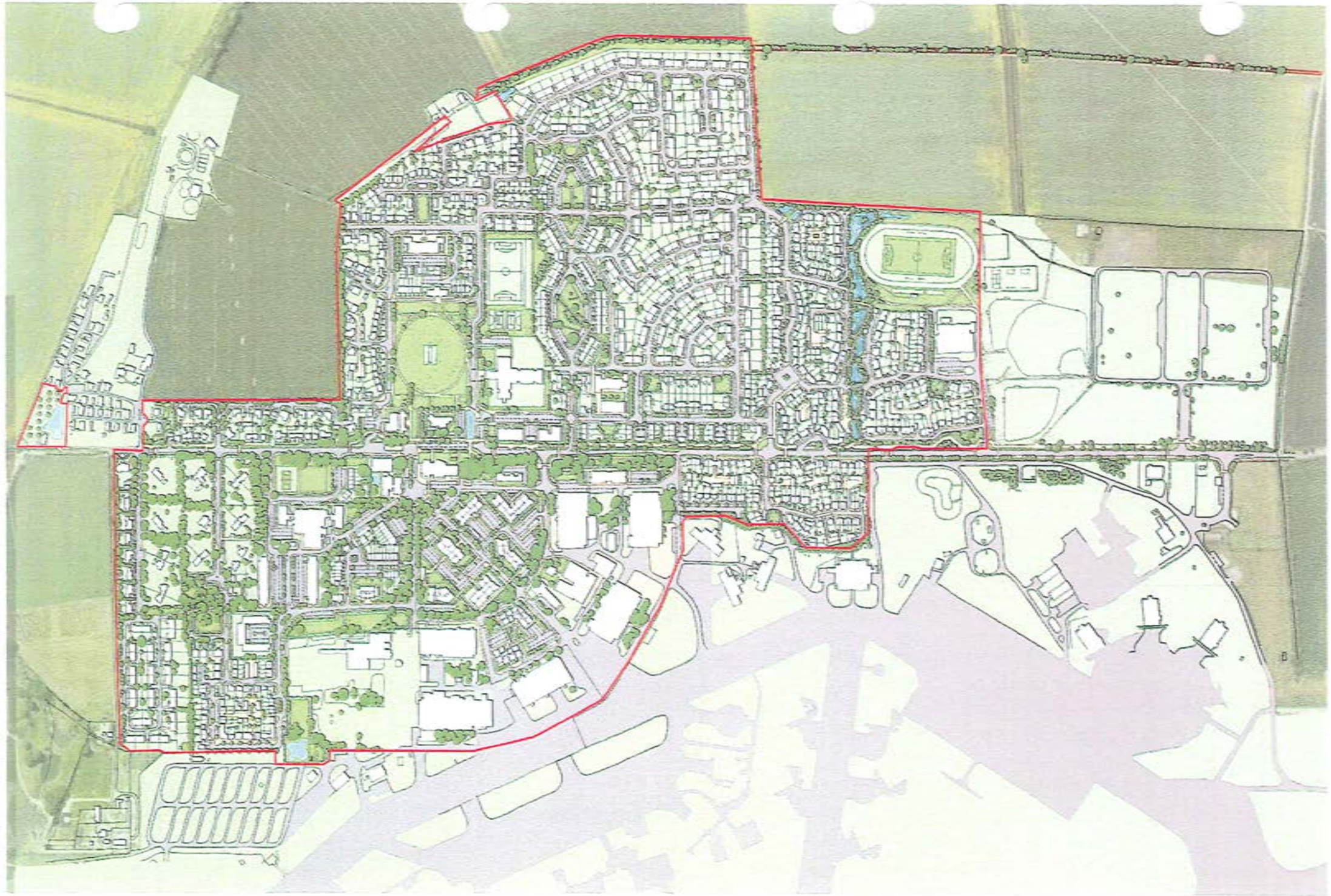
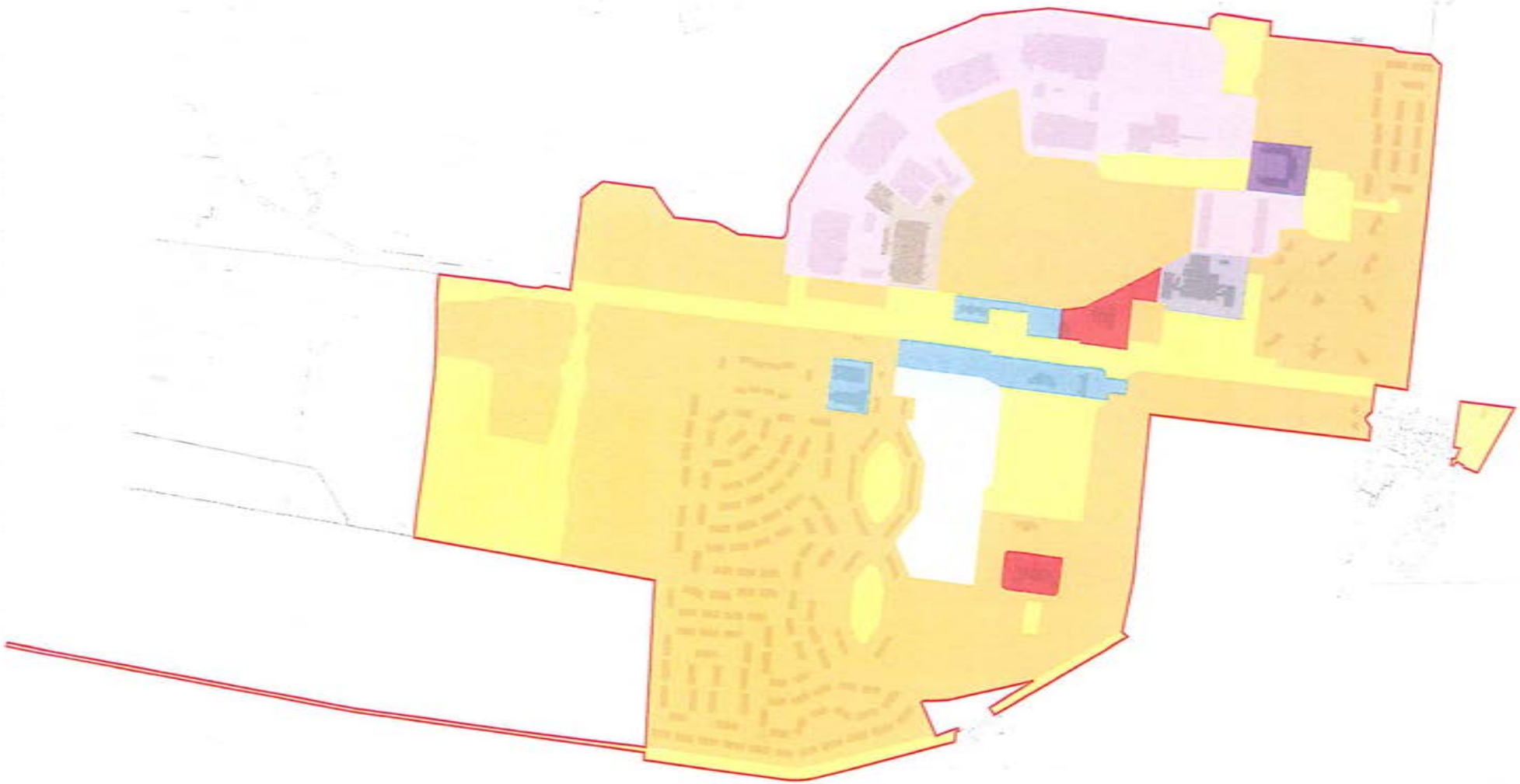
B. Development Proposals



BROWNRIGG



Key: -

- Land required for infrastructure (including green infrastructure)
- Residential Class C3
- Commercial Class B1/B2/B8
- Commercial Class B1
- Local centre Class A1-A5 / D1 and C3 use
- Heritage Class D1
- New Primary School Class D1
- Institutional Residential Class C1
- Hotel/Care home facility Class C1/C2

Development Uses Parameter Plan

Upper Heyford

31 August 2010 14272 - 01 - DW - 411 - 023 D

0 50 100 150 200 250m SCALE 1 : 2500 @ A1

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N

BROWNRIGG

Application Boundary

Open Space

Natural Open Space

Sports ground

Green Routes (see DAS)

Structure Planting (see DAS)

Surface Water Attenuation Feature (precise number, location and dimension to be determined)

Green Infrastructure Parameter Plan

Upper Heyford

02 September 2010 14272 - 01 - DW - 411 - 029 C

0 50 100 150 200 250m SCALE 1 : 2500 @ A1

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N

waterman

C. Correspondence

Tarran, Sophie G

From: Thames West, Customer Contact [thwest@environment-agency.gov.uk]
Sent: 13 May 2010 14:41
To: Tarran, Sophie G
Subject: RE: WIR33071: Upper Heyford Airport Flood Risk Enquiry Letter
Attachments: 33071 flood map.pdf; 33071 receipt.pdf; 33071 watercourse map2.pdf; 33071 watercourse map1.pdf; UpperHeyford PS.xls; EA Standard Notice (Commercial).pdf

Dear Ms Tarran

WIR33071: Upper Heyford Airport Flood Risk Enquiry Letter

Thank you for your data request and payment.

Please now find attached:

Flood Zones Map – confirming that the site lies within flood zone 1, the area with a chance of flooding of less than 1 in 1000 in any year.

Watercourse maps – showing the location of secondary and tertiary watercourses on or near the site. Please note that the closest Main River is the River Cherwell, approximately 1 kilometre west of the site.

History of flooding: the above site is not within the Environment Agency's records of historic flood event from rivers, the sea or groundwater. However, please note that this does not necessarily mean that flooding has not occurred here in the past, as our records are not comprehensive. We would therefore advise that you make further enquiries locally with specific reference to flooding at this location.

Groundwater Information
This is based on a 1km search radius at OX25 5TD (NGR 451202, 225749). Our Groundwater team have included background and any additional information that may be useful:

- **Geology**
  The solid geology beneath the site is the Great Oolite group. This rock formation is classed as a Principal Aquifer. There are no drift deposits within the search radius.

- **Protected Rights and Source Protection Zones**
  There are no groundwater abstractions (licensed or deregulated) or private water supplies within the 1km search radius. There are no Source Protection Zones within the area.

- **Groundwater Levels**
  Groundwater levels at the site are approximately 103.9mAOD - this is a rest water level associated with the drilling of BH SP52/041B which is approximately 700m east from the NGR reference given above. There is an EA closed groundwater monitoring point approximately 1.2km west of the site. I have attached the groundwater level information. Please note that the groundwater levels are only an indication of levels at the site. The elevation of the monitoring BH 10 metres lower than the site.

- **Groundwater Flooding**
  There are no historical flooding events within a 1km radius of the site. Approximately 3.8km west of the site we have a record of a cellar flooded in mid January 2001.Please note that we only hold data on groundwater flooding events from 2000 onwards. There may have been previous groundwater events prior to this date that we do not have records for. We hold groundwater emergence maps (GEM) that show where during exceptionally wet winters, groundwater levels may be close to or at surface. There are no areas of GEM within the search radius.

A VAT receipt and our standard notice for the supply of Environment Agency information are also attached for your reference.

I trust this now completes your enquiry, please don't hesitate to contact us again if we can be of any more assistance.

Regards
Nicola

Nicola Cook
External Relations Officer
Direct Dial: 01491 828 352

External Relations
Planning and Corporate Services
Environment Agency
Thames Region, West Area
Red Kite House, Howbery Park, Wallingford, OX10 8BD

Please be aware that the Environment Agency has updated the way it responds to requests for flood risk information, including Flood Risk/Consequence Assessments (FRA/FCA).

If you are conducting a Flood Risk/Consequence Assessments (FRA/FCA) please check the "New Flood Risk Standing Advice for England – PPS25 National Version 2.0" web pages for the FRA/FCA 'product' you require.

The FRA/FCA 'product' can then be ordered from the External Relations team by emailing us at thwest@environment-agency.gov.uk

---

From: Thames West, Customer Contact
Sent: 06 May 2010 15:43
To: 'Tarran, Sophie G'
Subject: WIR33071: Upper Heyford Airport Flood Risk Enquiry Letter

Dear Ms Tarran

WIR33071: Upper Heyford Airport Flood Risk Enquiry Letter

Thank you for your enquiry (WIR33071). Before we can supply you with information, we require payment. Our charges were revised from 1 July 2009 and those requests including licensing your use of information are calculated as follows:

i) the time spent by our staff in providing you with the information requested, current rates being £25.00 per hour. These charges are not subject to VAT.
ii) a standard charge of £10 for the extra permission to use our information commercially. VAT is applicable to this charge. VAT has reverted to 17.5% from 1 January 2010.

The information you have requested will cost **£41.75** to supply. This charge has been determined as follows:-

Hour(s) of staff time at £25.00 per hour	£25.00
Payment processing cost	£5.00
Commercial re-use charge	£10.00
VAT	£1.75
Total cost	**£41.75**

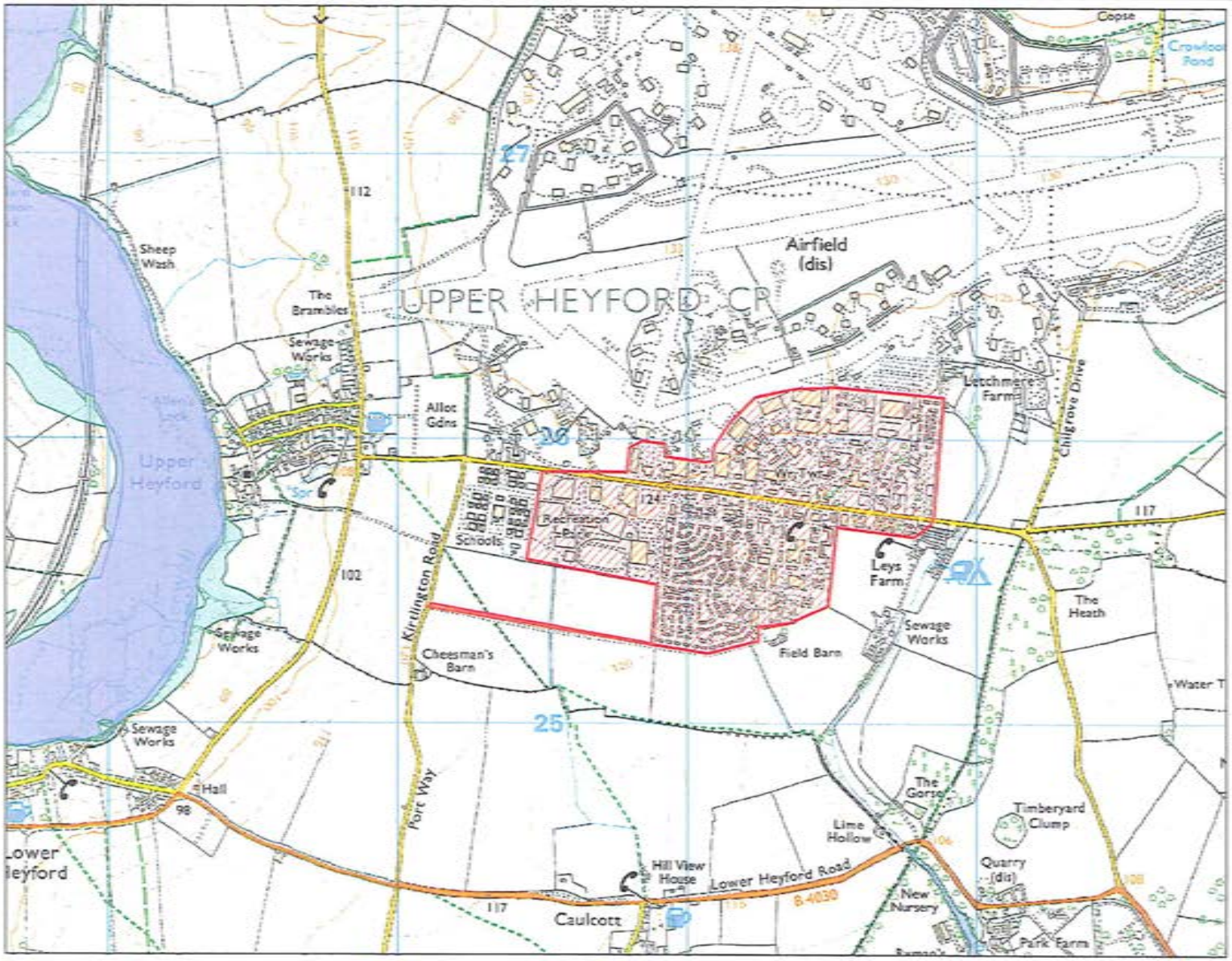
VAT Registration Number: GB 662 4901 34

If you wish to make payment over the phone please quote reference WIR33071. Please note that for security reasons we ask only the Cardholder call for telephone payment. Representatives calling on behalf of the Cardholder will be denied the option of telephone payment. Please call our External Relations Team on **01491 828352** for telephone payment.

However, if you wish to pay by cheque, the processing cost will be £25.00, making the total cost £61.75. Please make your cheque payable to the Environment Agency and send it to this office at the address below. We will process your request when we receive your payment.

Please let us know if you require a VAT receipt.

WIR33071 Flood Map centred on Upper Heyford site created 13 May 2010



Environment Agency

Scale 1:20,410

N W E S

- Flood Map - Defences
- Areas Benefiting from Flood Defences
- Flood Map - Flood Storage Areas
- Flood Map - Flood Zone 3
- Flood Map - Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

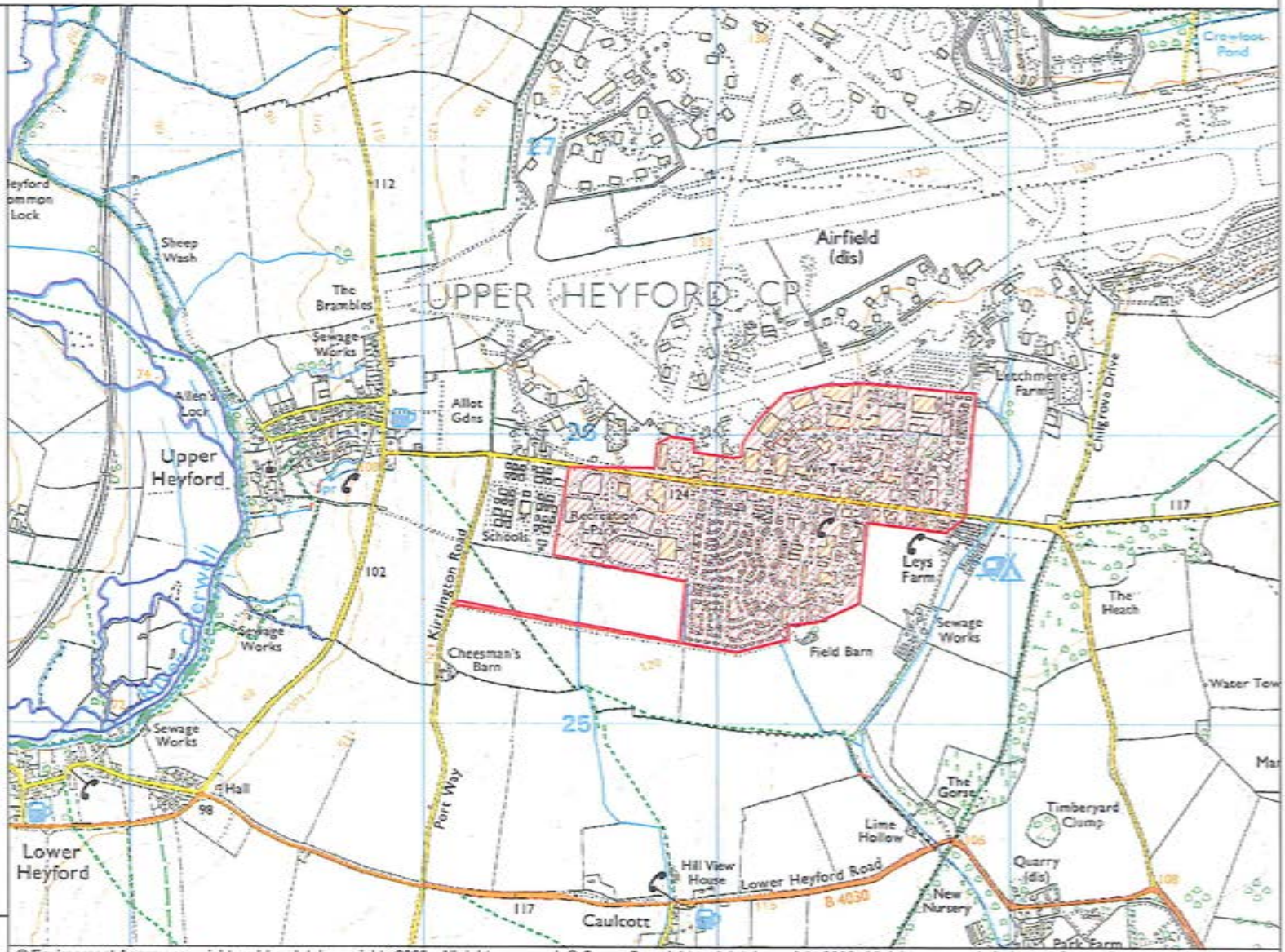
WIR33071 Watercourses near Upper Heyford site created 13 May 2010

Environment Agency

Legend

Detailed River Network

- Primary River
- Secondary River
- Tertiary River
- D/S of High Water Mark
- D/S of Seaward Extension
- Lake / Reservoir
- Canal
- Extended Culvert (greater than 50m)
- Canal Tunnel
- Underground River (inferred)
- Underground River (local knowledge)



0 190 380 570 m.

N W E S

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WIR33071 Watercourses near Upper Heyford site created 13 May 2010

Environment Agency

Legend

Detailed River Network

- Primary River
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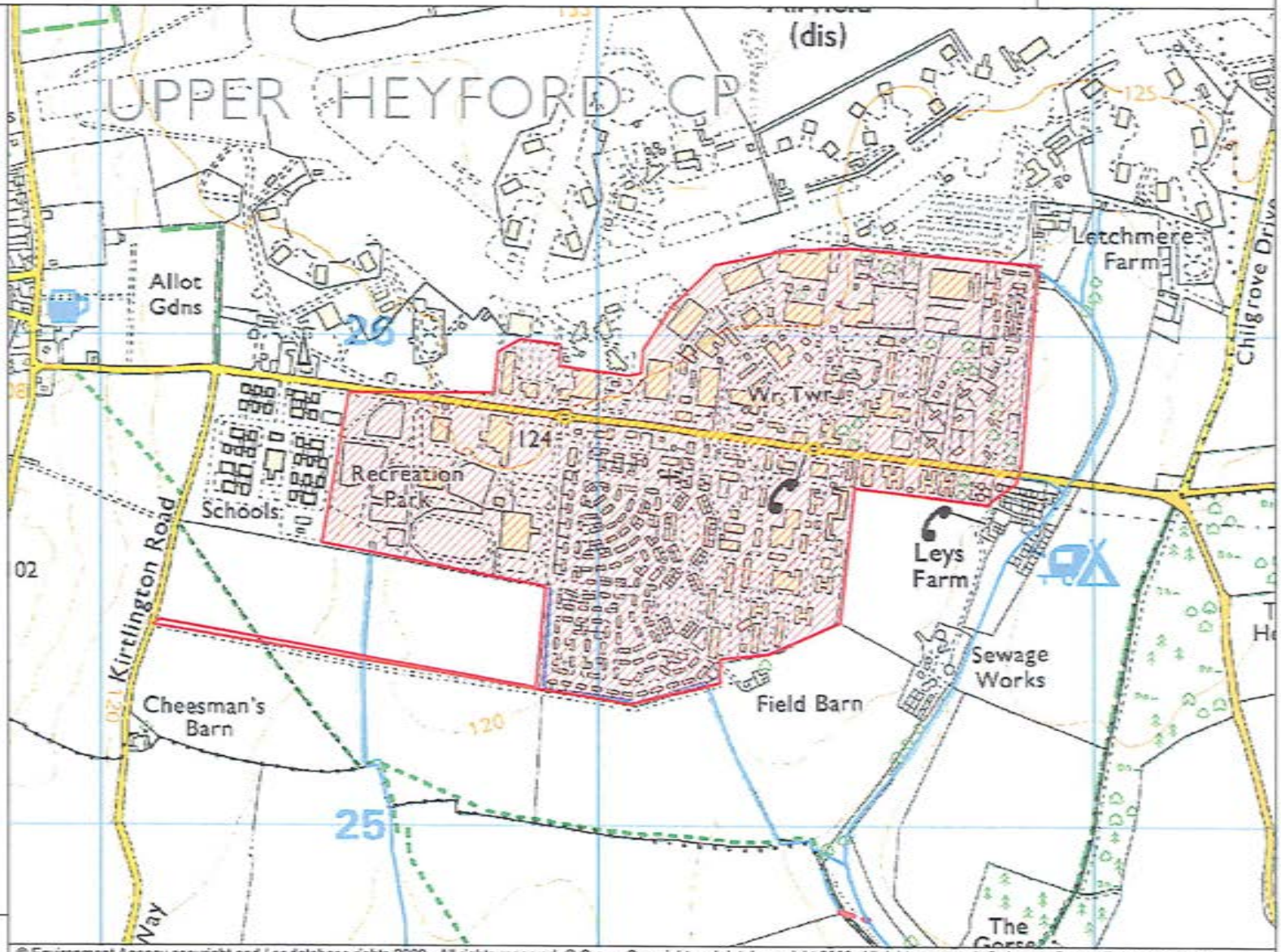

0 110 220 330 m.

N W E S

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Ms Sophie Tarran
Waterman Transport & Development Ltd
Pickfords Wharf
Clink Street
London
SE1 9DG

Our ref: WA/2010/108040/01-L01
Your ref: 11234 WTD

Date: 24 May 2010

Dear Ms Tarran

PROPOSED RESIDENTIAL LED MIXED USE SCHEME.
UPPER HEYFORD AIRPORT, UPPER HEYFORD, OX25 5TD. (CHERWELL).

Thank you for your email dated 05 May 2010 regarding the above site.

Your email includes:

- a pre-application enquiry form
- a letter dated 30 April 2010 from Waterman
- a plan showing the site boundary

We have read the letter dated 30 April 2010 regarding flood risk and have the following comments to make:

1. We confirm that the entire site lies within Flood Zone 1, but a Flood Risk Assessment (FRA) will be required due to the size of the site. FRAs are required for sites greater than 1 hectare in size in accordance with Planning Policy Statement 25: Development and Flood Risk (PPS25).
2. There are no main rivers on the site. We do not have comprehensive records of ordinary watercourses (all watercourses not classified as main rivers). The Local Planning Authority are likely to have more detailed records of the locations of ordinary watercourses and culverted sections, but they are not necessarily recorded anywhere. The term watercourse includes all open, bridged, culverted or piped rivers, streams, ditches, drains, cuts, dykes, sluices and passages through which water flows. It is the responsibility of the applicant to identify all watercourses as part of the baseline assessment of the onsite drainage characteristics, in the PPS 25 compliant FRA.
3. As a minimum, it must be demonstrated in the FRA that existing surface water

Cont/d..

discharge rates will not be exceeded across a range of storm events up to and including the 1 in 100 year storm event with an allowance for climate change. The FRA should include a calculation of existing runoff rates and as well as greenfield rates for the site. The proposed discharge rates should be as close to the greenfield rates as possible, to ensure that the development offers a significant reduction in flood risk, in accordance with the guidance of PPS 25. The suggested methods for calculating runoff from hardstanding and greenfield areas are acceptable. Any surface water drainage scheme should utilise sustainable drainage techniques, offering ecological, water quality and amenity benefits wherever possible, in accordance with the *SUDS Management Train* (Ciria C609) and the *SUDS Manual* (Ciria C697). To summarise, the surface water scheme should clearly show that:

- peak discharge rates from the site will be reduced as a result of the proposed development, across a range of storm events, up to and including the 1 in 100 year storm with a suitable allowance for climate change (the design storm event)
- discharge volumes from the site will not increase as a result of the proposed development, across a range of storm events, up to and including the design storm event
- the site will not flood from surface water up to and including the design storm event or any surface water flooding beyond the 1 in 30 year storm event, up to and including the design storm event can be safely contained on site;
- the likely flood flow routes and the impact of a storm that exceeds the capacity of the system has been considered.
- the future management and/or adoption of the system has been fully explored.

Any works that will impede the flows of an ordinary watercourse, such as culverting, requires the prior written approval of the local authority under the Public Health Act 1936, and the prior written consent of the Environment Agency under the terms of the Land Drainage Act 1991/Water resources Act1991. The Environment Agency seeks to avoid culverting, and its consent for such works will normally be withheld.

Please have regard to policy NRM4 (Sustainable flood risk management) of the South East Plan dated May 2009.

Yours sincerely

Ms Michelle Kidd
Planning Liaison Officer

Direct dial 01491 828455
Direct fax 01491 834703
Direct e-mail michelle.kidd@environment-agency.gov.uk

End

waterman

MEETING NOTES

Project: Upper Heyford

Subject: Environment Agency Meeting

Date: 19 July 2010

Present: Michelle Kidd (MK), Environment Agency
Ian Norriss (IN), Environment Agency
Gavin Angell (GA), Dorchester Holdings
Bruce Calton (BC), Scott Brownrigg
Brendan McCarthy (BM), Waterman
Sophie Tarran (ST), Waterman

ITEM	MATTERS ARISING	ACTION
1.0	**Introduction**	
1.1	BM thanked everyone for attending and tabled the agenda for the meeting. All parties were introduced.	
2.0	**Masterplan and Planning Background**	
2.1	GA stated that the previous scheme was consented in January 2010, and that the new Masterplan built on the parameters of this scheme.	
2.2	BC described the development of the new Masterplan, noting the sustainable approach which retained the existing housing stock, and the requirement from the Council to retain the Parade Ground, some existing buildings and the open space throughout the Site.	
2.3	BC explained that the retention of the existing housing, which is of low density, means that the remainder of the Site needs to be developed more densely to provide the number of dwellings consented by the previous planning application. This has led to certain areas of the Site becoming spatially constrained, with amenity space, protection of ecology and drainage requirements all needing to be incorporated into the Masterplan.	
3.0	**Flood Risk to the Site**	
3.1	ST noted that the site was at a low risk of flooding from all sources. This was due in part to the topography of the Site, being located on a plateau and therefore above any watercourse. Furthermore, consultation with the Council and the Environment Agency (EA) had not noted any historical flooding in the vicinity as a direct result of the Site, and no on-site flooding had been reported.	
3.2	Due to the low risk of flooding at the Site, ST noted that the primary focus of the Flood Risk Assessment (FRA) would be the management of surface water runoff resultant from the Site.	

3.3	IN recalled that in the previous assessment undertaken at the Site, it was noted that local residents had reported flooding which was potentially due to runoff from the Site. No knowledge of this incident had been reported to Waterman and ST requested a copy of this information. **Action: IN to circulate reports of historic flooding to BM and ST**	**Environment Agency**
4.0	**Surface Water Drainage Strategy**	
4.1	Further to circulation of the indicative drainage strategy (16th July) ST outlined the main aspects of the proposed strategy. This strategy would focus on source control methods of attenuation, restricting flows to the existing rate allowing for 30% climate change. The rate of discharge was calculated through the Modified Rational Method and IH124, which was agreed in previous correspondence with the EA.	
4.2	IN noted that although this was acceptable in principle, as it met the minimum requirements of PPS25, the restriction in discharge was less than that accepted in the previous application and he would like to see some degree of betterment over the existing situation. **Action: Waterman to investigate whether an increase in storage could be accommodated within the scheme. Waterman to take into consideration IN's reference to historic flooding.**	**Waterman**
4.3	ST stated that the current scheme was precautionary and presumed no infiltration. IN agreed that infiltration would go towards betterment as the volume of surface water runoff would be decreased, not simply the peak discharge rate. IN confirmed that if infiltration measures were utilised, soakage tests would be required. If existing soakaways were located IN confirmed that indicative soakage rates obtained from these features could be utilised for planning purposes.	
4.4	IN confirmed that the SuDS techniques incorporated within the indicative drainage strategy were acceptable due to the existing urban nature of the Site. IN welcomed the inclusion of ponds as this provides betterment in terms of ecology over the existing situation.	
4.5	MK asked whether water butts were going to be considered for inclusion within the scheme. BC and GA confirmed that these would be incorporated within the new housing stock to satisfy Code for Sustainable Homes, and could potentially be retrofitted on the existing houses. BC stated that rainwater harvesting would also be considered for the school; however GA confirmed that this would be a detail for Oxfordshire County Council to agree at the design stage, as the developer would not have control over this area of the development. IN clarified that the volumes collected through rainwater harvesting could not be quantified as additional attenuation storage.	

4.6	MK asked whether we would be submitting the FRA and drainage strategy to the EA prior to planning submission. BM stated that he hoped to submit these documents, but that if timescales proved that this was unachievable, Waterman would re-consult regarding the surface water drainage strategy to agree this aspect of the proposals.	
4.7	BM queried whether the EA would accept additional attenuation in the balancing pond downstream of the Site if its capacity was increased. IN stated that the capacity of the pond to deal with the existing flows would need to be confirmed before he would consider this, but that this feature would provide water quality benefits and could be considered as an element of the SuDS treatment train for the drainage system.	
4.8	BM questioned how best to produce the drainage schematic for outline planning purposes, while ensuring that information was sufficient for the EA to accept the development proposals. IN and BM agreed that it would be acceptable to show the proposed discharge rates and attenuation volumes for each catchment across the Site included within the Parameter Plans. IN stated that he would like to visually see the placement of above ground pond features within the submitted plans, but that there could be flexibility regarding the placement of below ground attenuation and that it would be acceptable to show broad areas where permeable paving and underground tanks were proposed.	

Outcome

1. Further investigations to be undertaken of the potential to increase the volume of storage, on receipt of further information from the EA.

Tarran, Sophie G

From: Tarran, Sophie G
Sent: 04 August 2010 14:47
To: 'Ian.Norriss@environment-agency.gov.uk'
Subject: FW: C11234 100802 STIN surface water attenuation proposals
Attachments: Figure 1.2 Site Boundary Plan.pdf; Indicative Surface Water Strategy 2.pdf

Good afternoon Ian,

Further to our verbal conversation, please could you confirm that you are happy with the intended surface water strategy as it stands, on submission of the additional information as set out below.

I will ensure that these proposals are acceptable to the team within the additional meeting scheduled for Tuesday, and leading on from this hope to issue a copy of the FRA after receiving sign off from the client prior to planning submission if timescales allow.

If you have any questions in the interim please feel free to get in contact.

Kind Regards,

Sophie

From: Tarran, Sophie G
Sent: 02 August 2010 17:44
To: 'Ian.Norriss@environment-agency.gov.uk'
Subject: C11234 100802 STIN surface water attenuation proposals

Good afternoon Ian,

Many thanks for sending through the additional information. I have had chance this afternoon to assess this and taken new information into consideration while reassessing the proposed surface water strategy.

Flooding in Caulcott associated with Gallos Brook, Letter from James Macnamara
Regarding this location, please note that the Site boundary is such (as seen in attached Figure 1.2) that the proposed development will not drain through this section of the watercourse. Therefore, the development would not affect surface water runoff in this location and there is no scope to provide attenuation in relation to this.

Anecdotal evidence reported by Environment Agency staff member
This report of flooding is unsubstantiated. However, to provide a level of betterment it is proposed to limit the rate of discharge over the existing situation within this stretch of watercourse and provide a greater extent of attenuation where appropriate.

Surface water drainage proposal
The catchment areas draining into this section of watercourse are namely Areas 3 and 4. It is proposed to limit surface water entering this section of watercourse (i.e. from Catchments 3 and 4) by an additional 10% over the existing situation, while accounting for the affects of climate change.

Area 3 (delineated in black) is a constrained central area of the Site which has many functions to perform. It would therefore not be appropriate to provide additional storage in this location. As there is no scope within Area 3 it is proposed to offset the allowable rate of discharge within Area 4. This would require discharge from Area 4 to be

restricted to 82 l/s and necessitate an additional storage volume of approximately 166m3 (please see attached sketch).

As discussed within our meeting the Site is greatly constrained with regard to space, and available above ground locations have been maximised where possible, taking into consideration all other aspects required of the scheme. It is therefore proposed to accommodate this additional volume within a sub-surface attenuation tank, located to the south of proposed pond 4a. This will ensure that the required area of play can still be incorporated at ground level.

These measures would ensure that discharge in the section of watercourse flowing past the caravan site is restricted and would aid in alleviating any issues as suggested by anecdotal evidence.

If you would like to discuss this matter further please do not hesitate to get in contact. As previously mentioned I have a team meeting tomorrow afternoon, and if we could reach agreement of the intended strategy before this time it would be greatly appreciated.

Kind Regards,

Sophie

From: Norriss, Ian [mailto:Ian.Norriss@environment-agency.gov.uk]
Sent: 02 August 2010 14:30
To: Tarran, Sophie G
Subject: RE: C11234 100802 STIN upper heyford surface water attenuation

Hi Sophie

I've attached the letter from James Macnamara, District Councillor of Astons and Heyfords Ward, dated 19th August 2008. I draw your attention to the bottom of the fifth page for his comments on flooding in Caulcott.

I have also attached a plan which identifies Caulcott and the caravan park at which my colleague has suggested there has been historic flooding.

The Heyford Hill site includes large areas of impermeable surfaces and is upstream of both Caulcott and the caravan park, on different tributaries of the Gallos Brook. With the anecdotal historic flooding in mind, I think it is reasonable to expect a reduction in surface water discharge rates from the baseline.

I look forward to receiving further details of the scheme. Any questions please don't hesitate to get in contact.

Kind Regards

Ian Norriss

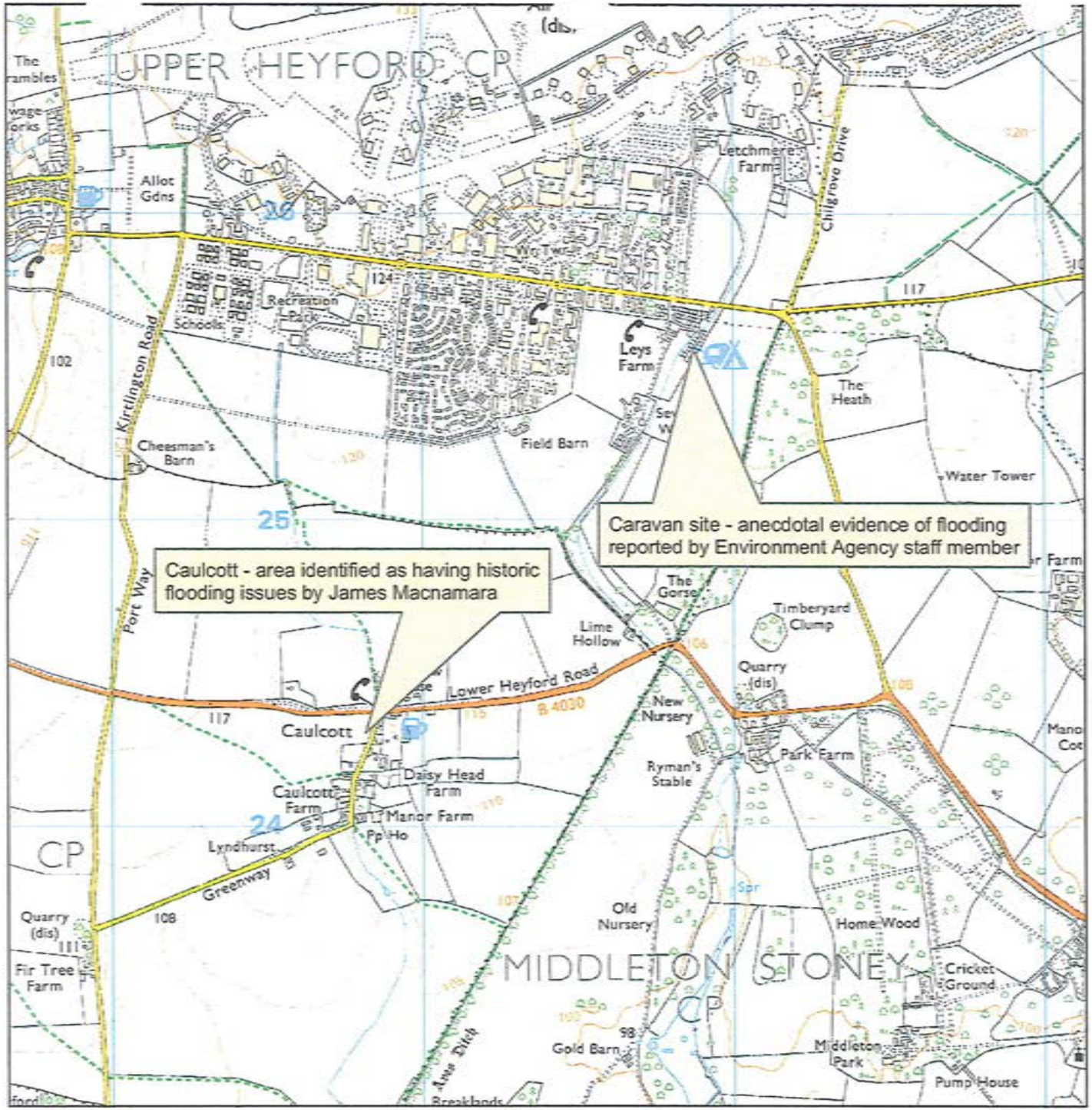
Development and Flood Risk Engineer

Environment Agency

Internal tel: 7 25 8309

External tel: 01491 828309

Please be aware that the Environment Agency is updating the way it responds to requests for flood risk information, including Flood Risk/Consequence Assessments (FRA/FCA), from 3rd August 2009.



Environment Agency

N

Areas believed to have suffered from flooding downstream of Heyford Park

0 290 580 1,160 Meters

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northwestern group of HAS's (3052-5) should be enacted as these both overdominate the houses at Aston View (in Somerton parish) and, if used for employment, could damage their amenity through noise and industrial activity. Given the total numbers of HAS's and EH's concurrence with the RCPB, preserving this small and unimportant group has no conservation value.

In general, it would be good to see minor structures which do not contribute to the perceived historic value of the Base removed. A particular (though invisible) concern is with the capacity for further pollution from the POL system, if not removed.

Employment uses on the flying field (mainly in the HAS's) need to respect EH's intentions to preserve the Cold War ambience, since this is the sole justification for preserving these intrusive structures. It seems completely illogical to preserve them to memorialise the Cold War and then turn them into a haphazard industrial estate which looks nothing like a Cold War air base. I cannot think of any grounds on which industrial development would have been permitted on this site if the air base had not been here, so employment uses should only be allowed if they do not impinge at all on this primary purpose.

This implies tight restrictions on vehicle movements and parking, external storage, lighting, signage, external decoration and security measures. Benign uses which seem particularly appropriate are data storage and library stacks, which can be installed and dismantled without touching the HAS's, inside or out, and fireworks storage in the Bomb Stores. Since I carry no torch for the Cold War heritage cause, I would be happy to see the use of the QRA, where the retention of the fence is important to EH, for secure storage.

Employment uses in the technical area: a hotel and conference facility seem inappropriate to the size of settlement and will generate additional traffic. Given the existence of such facilities within a narrow radius at Hopcrofts Holt, Middle Aston, Middleton Stoney and Weston on the Green, this may be damaging to existing local employment. Planning permission already exists for such a facility at a sustainable location on the south edge of Bicester.

Employment numbers should be limited to those sustainable from the agreed housing totals, in the interests of sustainability and the amenity of surrounding villages, and not derived from maximising usage of existing buildings. Population should determine employment and not vice versa, in accordance with the RCPB methodology. A permanent cap on numbers would also serve to limit unplanned future growth without completely removing flexibility between buildings and use classes.

Water, finally, raises two issues:

- **Supply:** prior to the last two wet summers, surrounding villages have experienced issues with water supply and need assurance that the additional demands of both residential and business uses have been taken care of before they are occupied.
- **Run-off:** the Gallos Brook through Caulcott has caused flooding at the lower end of the village. Residents need assurance that run-off from the development will not exacerbate this.

Tarran, Sophie G

From: Norriss, Ian [Ian.Norriss@environment-agency.gov.uk]
Sent: 04 October 2010 13:32
To: Tarran, Sophie G
Subject: RE: C11234 100921 STIN confirmation prior to submission

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Sophie

Sorry for the delay in my response. I have been away.

All formal site specific comments from me should really go out through our planning liaison team to ensure constitency.

I can say that as a good practice measure we would like to see attenuation devices retrofitted in areas of the development site to only be refurbished (to achieve a betterment), but we will not require this on this development site.

Kind Regards

Ian Norriss

Development and Flood Risk Engineer

Environment Agency

Internal tel: 7 25 8309

External tel: 01491 828309

From: Tarran, Sophie G [mailto:s.g.tarran@waterman-group.co.uk]
Sent: 21 September 2010 16:59
To: Norriss, Ian
Subject: C11234 100921 STIN confirmation prior to submission

Click here to report this email as spam.

Good afternoon Ian.

The FRA is being issued to the client for sign off before being submitted for planning. To tie up loose ends I wanted to include our verbal agreement that the drainage strategy only needs to attenuate flows from developed areas of the Site.

As previously agreed, areas which are only intended to be refurbished (i.e. no changes in hard/soft landscaping, facade alterations such as new windows and repainting) would not need to be attenuated as the infrastructure would remain as existing.

If you could respond confirming this in writing it would be greatly appreciated.

Many thanks.

Kind Regards,

Sophie

Sophie Tarran
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Clink Street
London
SE1 9DG
t +44 20 7928 7888
f +44 20 7902 0992
www.watermangroup.com

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D. Surface Water Management Calculations

Waterman

CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	1 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title Upper Heyford, Catchment Area 1

Calculations Title Surface Water Management - Summary Sheet

LOCATION	CALCULATIONS	OPTIONS

Surface water at the Site will be managed in accordance with PPS25 requirements, i.e. surface water discharge restricted to the existing rate plus 30% clmate change.

Existing surface water discharge regime:

	Area (ha)	Calculation method	Discharge Rate
Hard landscaped	6.34	Wallingford (Page 2)	715.3 l/s
Soft landscaped	4.23	IoH 124 (Page 3)	45.3 l/s

Maximum allowable discharge rate for 1 in 100 year storm = **760.6 l/s**

Proposed surface water discharge regime:

Proposed hard landscaped area	6.34	ha	6.34 ha
Proposed soft landscaped area	4.23	ha	
Contributing soft landscaping (10%)*	0.423	ha	0.423 ha
Total Area contributing to discharge =			**6.763 ha**
(hard landscaping + contributing soft landscaping)			

* = Typical contributing discharge from soft landscaping is approximately 10% of the equivalent area of hard landscaping.

Intial attenuation estimate

An initial estimate of the volume of surface water attenuation has been undertaken, using WinDes Quick Storage Estimate software application. A summary of these calculations are provided on Page 4.

The preliminary estimate of surface water attenuation is : **1649 m^3**

Based on an allowable discharge of :	760	l/s
A hard landscaped area of:	6.763	ha

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	2 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title **Upper Heyford, Catchment Area 1**

Calculations Title **Surface Water Management - Modified Rational Method**

LOCATION	CALCULATIONS	OPTIONS
	Calculations based on: Design and Analysis of urban storm drainage. The Wallingford Procedure, Volume 1 Principles methods and practice.	
	User Input Data	
	Exisiting hard landscaped area 6 ha	
	SAAR (From FEH / Windes) 691	
	M5_60 (From Windes) 20	
	Ratio R (From Windes) 0.405	
	PIMP (% impervious) 100.0%	
	Soil Type 0.40	
	Very Low Runoff (well drained sandy, loamy or earthy peat soils) 0.15	
	Low Runoff (Very permeable soils (e.g. gravel, sand) 0.30	
	Moderate (Very fine sands, silts and sedimentary clays) 0.40	
	High Runoff (Clayey or loamy soils) 0.45	
	Very High Runoff (Soils of the wet uplands) 0.50	
Fig. 9.7	UCWI (From Figure 9.7 of Wallingford Method) 65	
Fig 6.3a/b	Z1 (From Figure 6.3a or 6.3b) 1.00	
Tab 6.2/6.3	Z2 (From Table 6.2 & Table 6.3) 2.02	
Eqn. 13	Qp (peak discharge) = 2.78 Cv CR i A	
	Where: Qp (Peak Discharge) i = rainfall intensity A = Total Area	
	Calculating Rainfall Intensity (i)	
Eqn 6.4	MT-D =Z1 x Z2 x (M5-60min)	
	M5_60 20 Z1 1.00 Z2 2.02	
	Thus M100_60 is: 40.4 mm	
Eqn 7.20	Cv = PR/100	
Eqn 7.3	PR = (0.829 PIMP) + (25.0 SOIL) + (0.078 UCWI) - 20.7	
	PIMP (Percentage of catchment which is impervious) 100.0 %	
Page 52	Note: PIMP can not be less than 40% 40.0 %	
	Thus value of PIMP to be used 100.0 %	
	Soil: 0.40 UCWI: 65	
	PR = 77.27	
	Thus Cv = 0.77	
Sec 7.10	CR (Recommended for simulation and design) 1.3	
	Qp for 1 in 100 year 60 minute duration = 715.3 l/s or 112.8 l/s/ha	

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	3 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

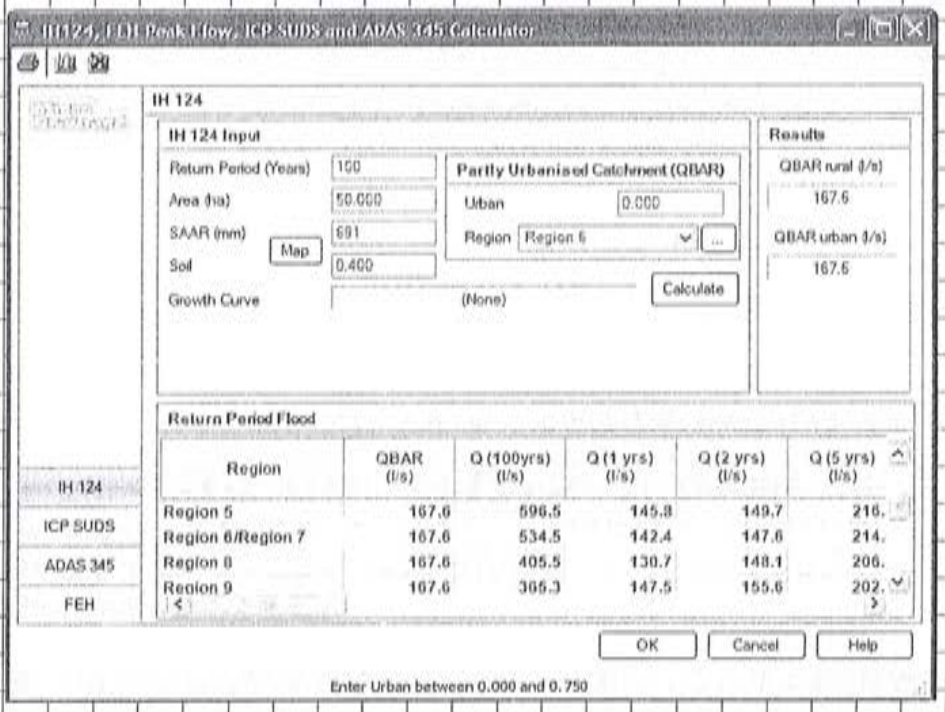
Project Title Upper Heyford, Catchment Area 1

Calculations Title Surface Water Management - IoH 124

LOCATION	CALCULATIONS	OPTIONS

In order to calculate the rate of surface water discharge from the permeable portion of the Site, the Windes Microdrainage version W.12.4 Source Control module has been utilised. Rural runoff has been calculated using the IoH 124 Methodology, the input and output data for which are shown below;

An area of 50ha has been used in the calculations as this is the smallest catchment area which the IoH 124 method can calculate. The 50ha output is then prorated as set out in IoH 124.



Qbar (1 in 2.333)	167.6	l/s/50ha	3.4	l/s/ha				
1 in 100	534.5	l/s/50ha	10.7	l/s/ha	or	**45.3**	**l/s**	

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	4 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

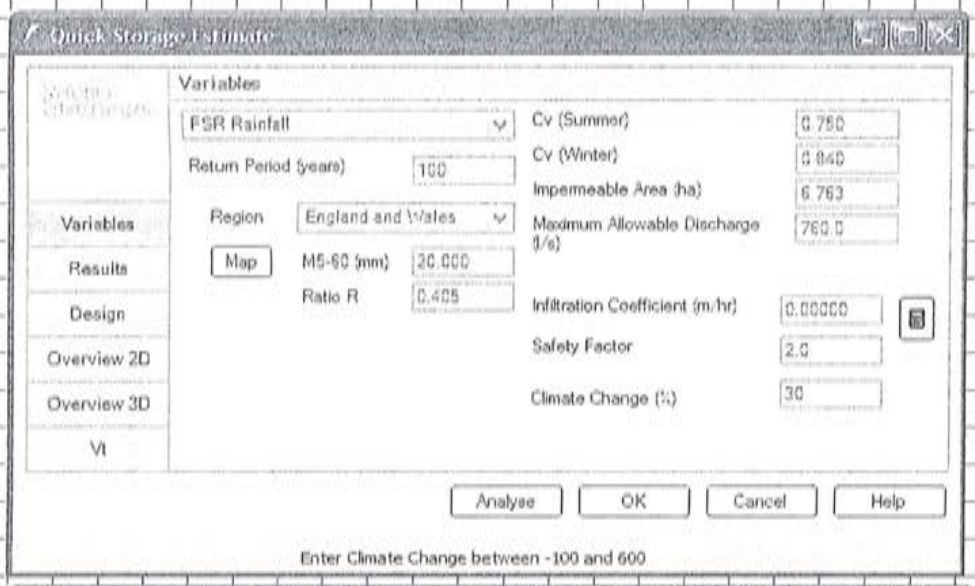
Project Title Upper Heyford, Catchment Area 1

Calculations Title Preliminary surface water attenuation volume.

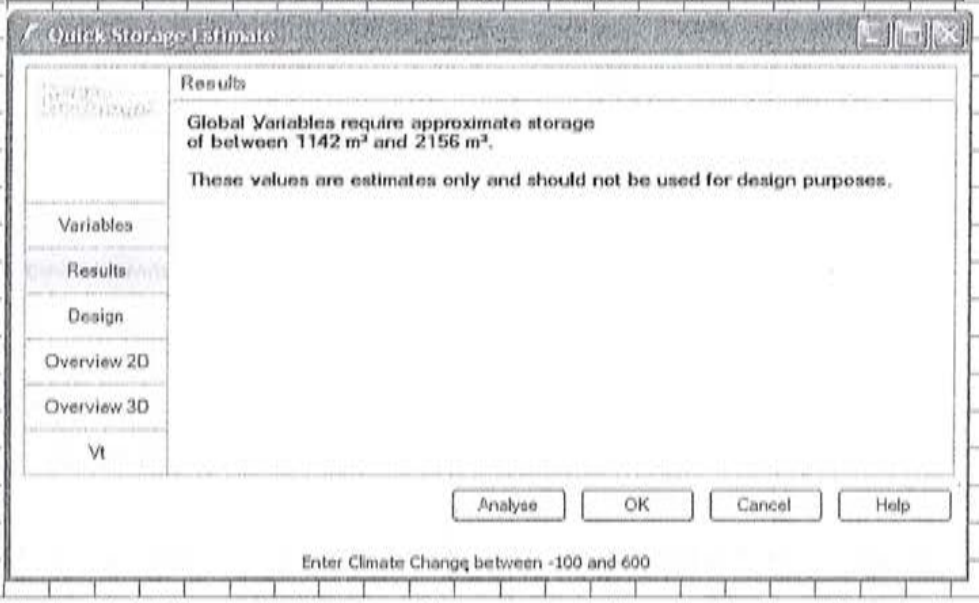
LOCATION	CALCULATIONS	OPTIONS

In order to calculate the volume of surface water attenuation required for the Site, Windes Microdrainage version W.12.4, Source Control module, Quick Storage Estimate has been used. The input and output data for which are shown below;

Input:



Output:



As Windes Quick Storage Estimate provides a range of attenuation volumes it is considered that an average value of the range is suitable for preliminary design sizing.

Minimum:	1,142	m^3		
Maximum:	2,156	m^3	Preliminary Estimate:	**1649** m^3

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	1 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title Upper Heyford, Catchment Area 2

Calculations Title Surface Water Management - Summary Sheet

LOCATION	CALCULATIONS	OPTIONS

Surface water at the Site will be managed in accordance with PPS25 requirements, i.e. surface water discharge restricted to the existing rate plus 30% clmate change.

Existing surface water discharge regime:

	Area (ha)	Calculation method	Discharge Rate	
Hard landscaped	9.11	Wallingford (Page 2)	1027.8	l/s
Soft landscaped	3.91	IoH 124 (Page 3)	41.8	l/s

Maximum allowable discharge rate for 1 in 100 year storm = **1069.6 l/s**

Proposed surface water discharge regime (60/40 instead of 70/30):

Proposed hard landscaped area	7.81	ha	7.81	ha
Proposed soft landscaped area	5.21	ha		
Contributing soft landscaping (10%)*	0.521	ha	0.521	ha

Total Area contributing to discharge = **8.331 ha**
(hard landscaping + contributing soft landscaping)

* = Typical contributing discharge from soft landscaping is approximately 10% of the equivalent area of hard landscaping.

Intial attenuation estimate

An initial estimate of the volume of surface water attenuation has been undertaken, using WinDes Quick Storage Estimate software application. A summary of these calculations are provided on Page 4.

The preliminary estimate of surface water attenuation is : **1893 m^3**

Based on an allowable discharge of :	1069	l/s
A hard landscaped area of:	8.331	ha

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	2 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title Upper Heyford, Catchment Area 2

Calculations Title Surface Water Management - Modified Rational Method

LOCATION	CALCULATIONS	OPTIONS
	Calculations based on: Design and Analysis of urban storm drainage. The Wallingford Procedure, Volume 1 Principles methods and practice.	
	User Input Data	
	Exisiting hard landscaped area 9 ha	
	SAAR (From FEH / Windes) 691	
	M5_60 (From Windes) 20	
	Ratio R (From Windes) 0.405	
	PIMP (% impervious) 100.0%	
	Soil Type 0.40	
	Very Low Runoff (well drained sandy, loamy or earthy peat soils) 0.15	
	Low Runoff (Very permeable soils (e.g. gravel, sand) 0.30	
	Moderate (Very fine sands, silts and sedimentary clays) 0.40	
	High Runoff (Clayey or loamy soils) 0.45	
	Very High Runoff (Soils of the wet uplands) 0.50	
Fig. 9.7	UCWI (From Figure 9.7 of Wallingford Method) 65	
Fig 6.3a/b	Z1 (From Figure 6.3a or 6.3b) 1.00	
Tab 6.2/6.3	Z2 (From Table 6.2 & Table 6.3) 2.02	
Eqn. 13	Qp (peak discharge) = 2.78 Cv CR i A	
	Where: Qp (Peak Discharge) i = rainfall intensity A = Total Area	
	Calculating Rainfall Intensity (i)	
Eqn 6.4	MT-D =Z1 x Z2 x (M5-60min)	
	M5_60 20 Z1 1.00 Z2 2.02	
	Thus M100_60 is: 40.4 mm	
Eqn 7.20	Cv = PR/100	
Eqn 7.3	PR = (0.829 PIMP) + (25.0 SOIL) + (0.078 UCWI) - 20.7	
	PIMP (Percentage of catchment which is impervious) 100.0 %	
Page 52	Note: PIMP can not be less than 40% 40.0 %	
	Thus value of PIMP to be used 100.0 %	
	Soil: 0.40 UCWI: 65	
	PR = 77.27	
	Thus Cv = 0.77	
Sec 7.10	CR (Recommended for simulation and design) 1.3	
	Qp for 1 in 100 year 60 minute duration = 1,027.8 l/s or 112.8 l/s/ha	

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	3 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

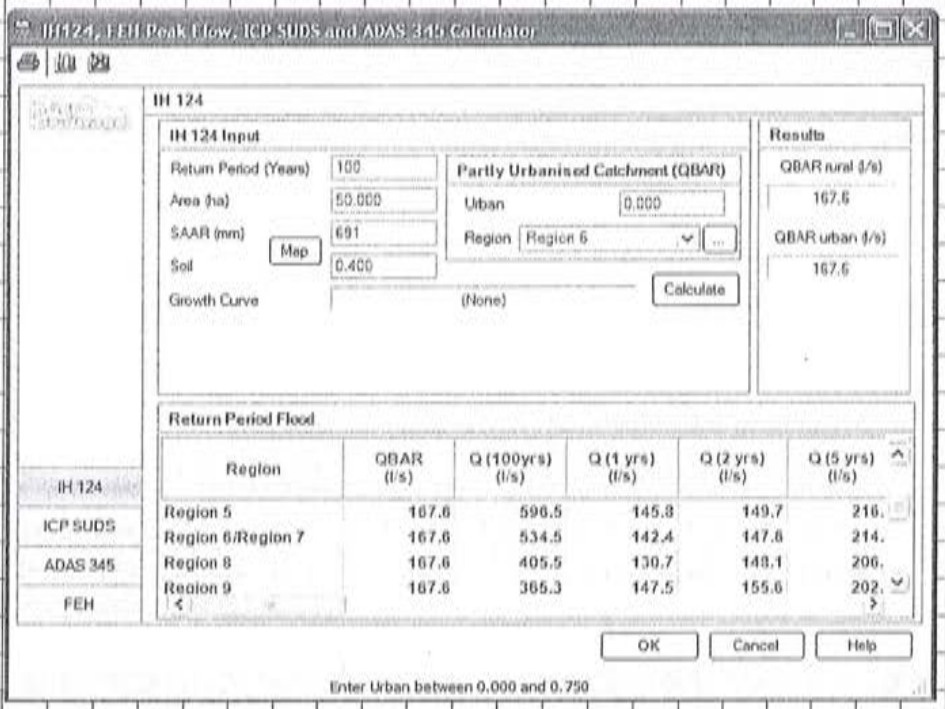
Project Title Upper Heyford, Catchment Area 2

Calculations Title Surface Water Management - IoH 124

LOCATION	CALCULATIONS	OPTIONS

In order to calculate the rate of surface water discharge from the permeable portion of the Site, the Windes Microdrainage version W.12.4 Source Control module has been utilised. Rural runoff has been calculated using the IoH 124 Methodology, the input and output data for which are shown below;

An area of 50ha has been used in the calculations as this is the smallest catchment area which the IoH 124 method can calculate. The 50ha output is then prorated as set out in IoH 124.



Qbar (1 in 2.333)	167.6	l/s/50ha	3.4	l/s/ha				
1 in 100	534.5	l/s/50ha	10.7	l/s/ha	or	**41.8**	**l/s**	

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	4 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

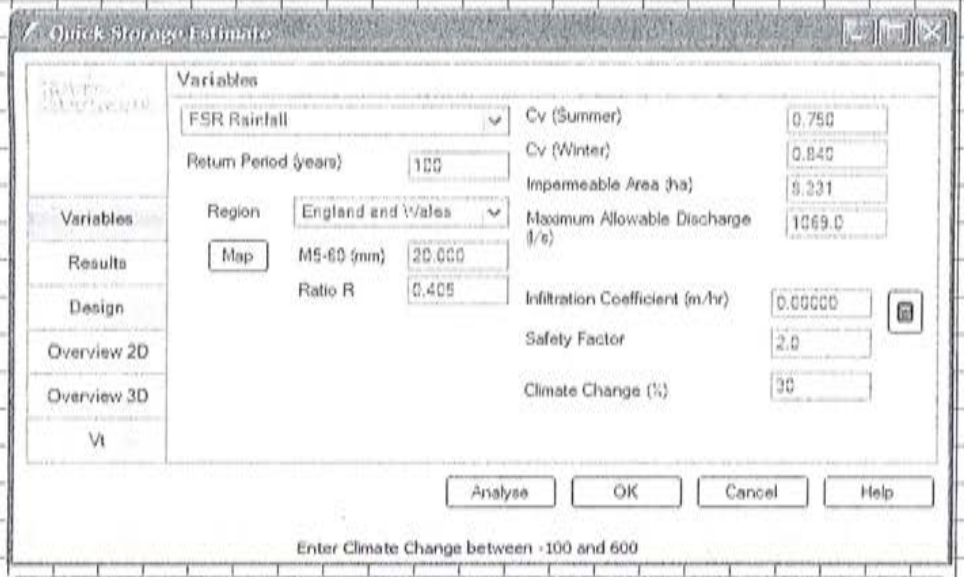
Project Title Upper Heyford, Catchment Area 2

Calculations Title Preliminary surface water attenuation volume.

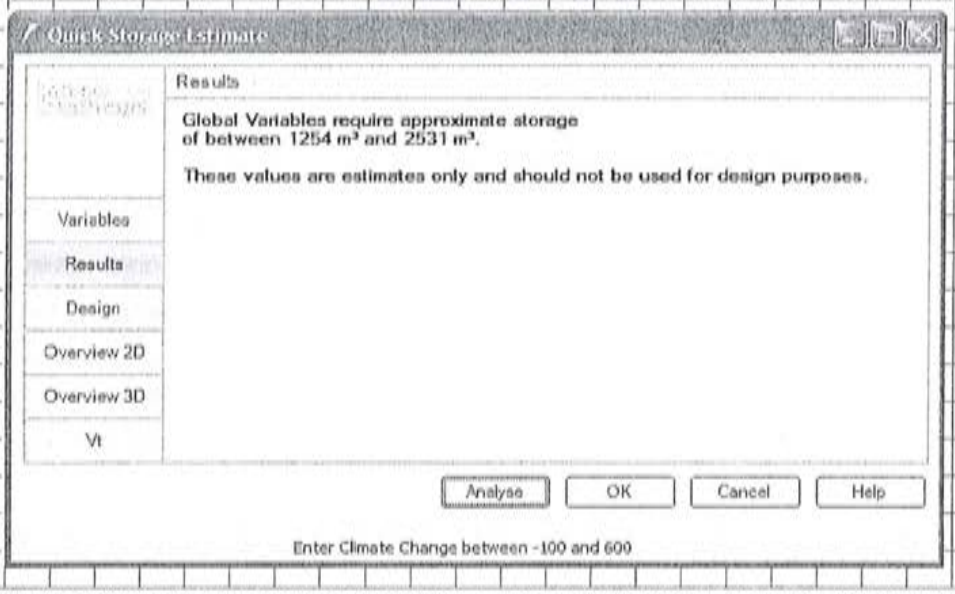
LOCATION	CALCULATIONS	OPTIONS

In order to calculate the volume of surface water attenuation required for the Site, Windes Microdrainage version W.12.4, Source Control module, Quick Storage Estimate has been used. The input and output data for which are shown below;

Input:



Output:



As Windes Quick Storage Estimate provides a range of attenuation volumes it is considered that an average value of the range is suitable for preliminary design sizing.

Minimum:	1,254	m^3			
Maximum:	2,531	m^3	Preliminary Estimate:	**1893**	m^3

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	1 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title Upper Heyford, Catchment Area 3

Calculations Title Surface Water Management - Summary Sheet

LOCATION	CALCULATIONS	OPTIONS

Surface water at the Site will be managed in accordance with PPS25 requirements, i.e. surface water discharge restricted to the existing rate plus 30% clmate change.

Existing surface water discharge regime:

	Area (ha)	Calculation method	Discharge Rate
Hard landscaped	7.81	Wallingford (Page 2)	881.2 l/s
Soft landscaped	3.35	IoH 124 (Page 3)	35.9 l/s

Maximum allowable discharge rate for 1 in 100 year storm = **917.1 l/s**

Proposed surface water discharge regime:

Proposed hard landscaped area	7.81	ha	7.81	ha
Proposed soft landscaped area	3.35	ha		
Contributing soft landscaping (10%)*	0.335	ha	0.335	ha

Total Area contributing to discharge = **8.145 ha**
(hard landscaping + contributing soft landscaping)

* = Typical contributing discharge from soft landscaping is approximately 10% of the equivalent area of hard landscaping.

Intial attenuation estimate

An initial estimate of the volume of surface water attenuation has been undertaken, using WinDes Quick Storage Estimate software application. A summary of these calculations are provided on Page 4.

The preliminary estimate of surface water attenuation is : **1986 m^3**

Based on an allowable discharge of :	917	l/s
A hard landscaped area of:	8.15	ha

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	2 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title Upper Heyford, Catchment Area 3

Calculations Title Surface Water Management - Modified Rational Method

LOCATION	CALCULATIONS	OPTIONS
	Calculations based on: Design and Analysis of urban storm drainage. The Wallingford Procedure, Volume 1 Principles methods and practice.	
	User Input Data	
	Exisiting hard landscaped area 7.81 ha	
	SAAR (From FEH / Windes) 691	
	M5_60 (From Windes) 20	
	Ratio R (From Windes) 0.405	
	PIMP (% impervious) 100.0%	
	Soil Type 0.40	
	Very Low Runoff (well drained sandy, loamy or earthy peat soils) 0.15	
	Low Runoff (Very permeable soils (e.g. gravel, sand) 0.30	
	Moderate (Very fine sands, silts and sedimentary clays) 0.40	
	High Runoff (Clayey or loamy soils) 0.45	
	Very High Runoff (Soils of the wet uplands) 0.50	
Fig. 9.7	UCWI (From Figure 9.7 of Wallingford Method) 65	
Fig 6.3a/b	Z1 (From Figure 6.3a or 6.3b) 1.00	
Tab 6.2/6.3	Z2 (From Table 6.2 & Table 6.3) 2.02	
Eqn. 13	Qp (peak discharge) = 2.78 Cv CR i A	
	Where: Qp (Peak Discharge) i = rainfall intensity A = Total Area	
	Calculating Rainfall Intensity (i)	
Eqn 6.4	MT-D =Z1 x Z2 x (M5-60min)	
	M5_60 20 Z1 1.00 Z2 2.02	
	Thus M100_60 is: 40.4 mm	
Eqn 7.20	Cv = PR/100	
Eqn 7.3	PR = (0.829 PIMP) + (25.0 SOIL) + (0.078 UCWI) - 20.7	
	PIMP (Percentage of catchment which is impervious) 100.0 %	
Page 52	Note: PIMP can not be less than 40% 40.0 %	
	Thus value of PIMP to be used 100.0 %	
	Soil: 0.40 UCWI: 65	
	PR = 77.27	
	Thus Cv = 0.77	
Sec 7.10	CR (Recommended for simulation and design) 1.3	
	Qp for 1 in 100 year 60 minute duration = 881.2 l/s or 112.8 l/s/ha	

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	3 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

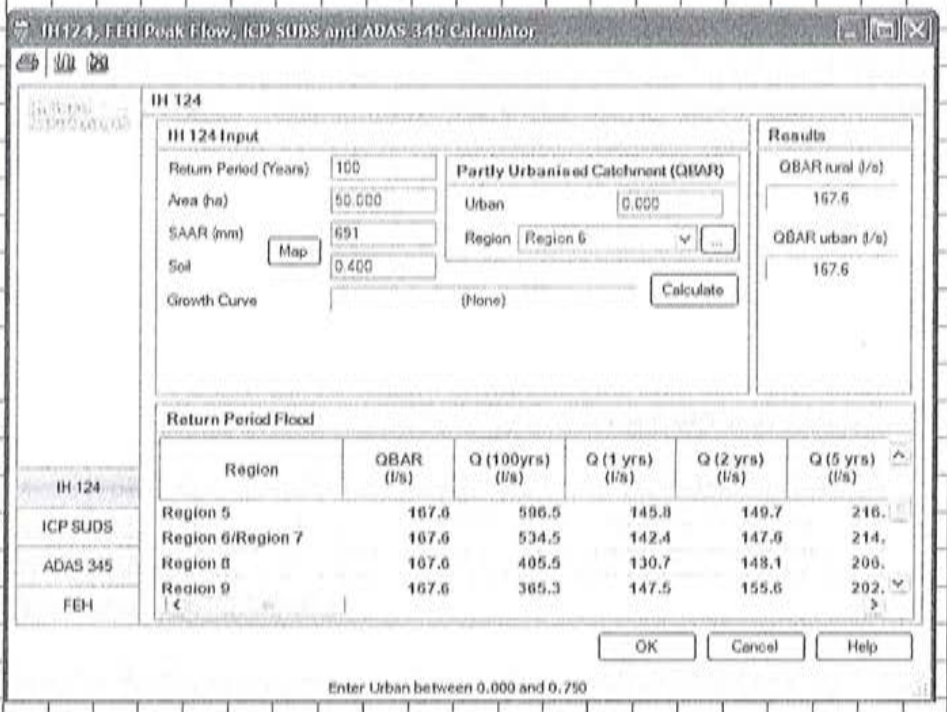
Project Title Upper Heyford, Catchment Area 3

Calculations Title Surface Water Management - IoH 124

LOCATION	CALCULATIONS	OPTIONS

In order to calculate the rate of surface water discharge from the permeable portion of the Site, the Windes Microdrainage version W.12.4 Source Control module has been utilised. Rural runoff has been calculated using the IoH 124 Methodology, the input and output data for which are shown below;

An area of 50ha has been used in the calculations as this is the smallest catchment area which the IoH 124 method can calculate. The 50ha output is then prorated as set out in IoH 124.



Qbar (1 in 2.333)	167.6	l/s/50ha	3.4	l/s/ha			
1 in 100	534.5	l/s/50ha	10.7	l/s/ha	or	**35.9**	**l/s**

waterman

CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	4 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

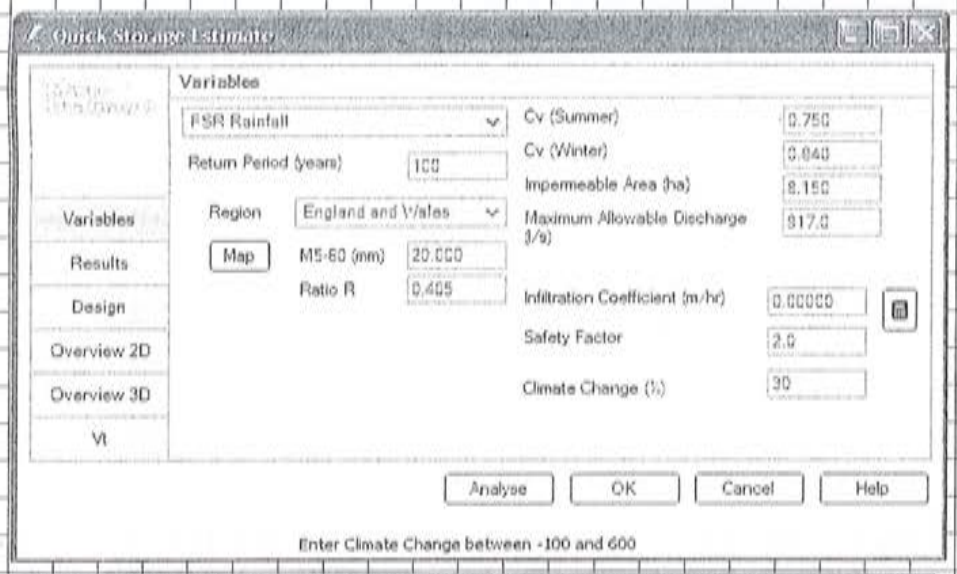
Project Title Upper Heyford, Catchment Area 3

Calculations Title Preliminary surface water attenuation volume.

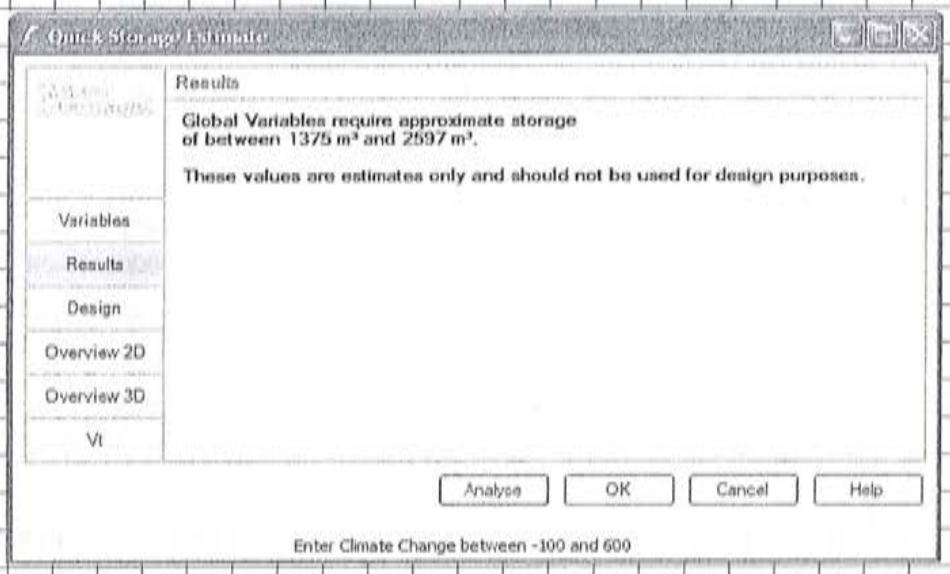
LOCATION	CALCULATIONS	OPTIONS

In order to calculate the volume of surface water attenuation required for the Site, Windes Microdrainage version W.12.4, Source Control module, Quick Storage Estimate has been used. The input and output data for which are shown below;

Input:



Output:



As Windes Quick Storage Estimate provides a range of attenuation volumes it is considered that an average value of the range is suitable for preliminary design sizing.

Minimum:	1,375	m^3			
Maximum:	2,597	m^3	Preliminary Estimate:	**1986**	m^3

Waterman

CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	1 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title **Upper Heyford, Catchment Area 4**

Calculations Title **Surface Water Management - Summary Sheet**

LOCATION	CALCULATIONS	OPTIONS

Surface water at the Site will be managed in accordance with PPS25 requirements, i.e. surface water discharge restricted to the existing rate plus 30% clmate change. Further restriction to reduce flows into the eastern watercourse by 10% over the existing situation.

Existing surface water discharge regime:

	Area (ha)	Calculation method	Discharge Rate	
Hard landscaped	1.65	Wallingford (Page 2)	186.2	l/s
Soft landscaped	0.71	IoH 124 (Page 3)	7.6	l/s

Maximum allowable discharge rate for 1 in 100 year storm = 193.8 l/s

Proposed surface water discharge regime (60/40 instead of 70/30):

Proposed hard landscaped area	1.42	ha	1.42	ha
Proposed soft landscaped area	0.94	ha		
Contributing soft landscaping (10%)*	0.094	ha	0.094	ha
Total Area contributing to discharge =			**1.514**	**ha**
(hard landscaping + contributing soft landscaping)				

* = Typical contributing discharge from soft landscaping is approximately 10% of the equivalent area of hard landscaping.

The Environment Agency require a 10% reduction in discharge to the eastern watercourse, namely Catchment Areas 3 and 4, to reduce flood risk downstream.

Area 3: allowable discharge 917.1 l/s, 10% =	91.71	l/s
Area 4: allowable discharge 193.8 l/s, 10% =	19.38	l/s
Total reduction in allowable discharge =	111.09	l/s

Discharge from Area 3 to remain as existing, required reduction to be offset in Area 4

Allowable discharge (193.8 - 111.09) = **82.7** **l/s**

Intial attenuation estimate

An initial estimate of the volume of surface water attenuation has been undertaken, using WinDes Quick Storage Estimate software application. A summary of these calculations are provided on Page 4.

The preliminary estimate of surface water attenuation is : **511** **m^3**

Based on an allowable discharge of :	82	l/s
A hard landscaped area of:	1.514	ha

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	2 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

Project Title **Upper Heyford, Catchment Area 4**

Calculations Title **Surface Water Management - Modified Rational Method**

LOCATION	CALCULATIONS		OPTIONS
	Calculations based on: Design and Analysis of urban storm drainage. The Wallingford Procedure, Volume 1 Principles methods and practice.		
	User Input Data		
	Exisiting hard landscaped area	2 ha	
	SAAR (From FEH / Windes)	691	
	M5_60 (From Windes)	20	
	Ratio R (From Windes)	0.405	
	PIMP (% impervious)	100.0%	
	Soil Type	0.40	
	Very Low Runoff (well drained sandy, loamy or earthy peat soils)	0.15	
	Low Runoff (Very permeable soils (e.g. gravel, sand)	0.30	
	Moderate (Very fine sands, silts and sedimentary clays)	0.40	
	High Runoff (Clayey or loamy soils)	0.45	
	Very High Runoff (Soils of the wet uplands)	0.50	
Fig. 9.7	UCWI (From Figure 9.7 of Wallingford Method)	65	
Fig 6.3a/b	Z1 (From Figure 6.3a or 6.3b)	1.00	
Tab 6.2/6.3	Z2 (From Table 6.2 & Table 6.3)	2.02	
Eqn. 13	Qp (peak discharge) = 2.78 Cv CR i A		
	Where: Qp (Peak Discharge) i = rainfall intensity A = Total Area		
	Calculating Rainfall Intensity (i)		
Eqn 6.4	MT-D =Z1 x Z2 x (M5-60min)		
	M5_60 20 Z1 1.00 Z2 2.02		
	Thus M100_60 is: 40.4 mm		
Eqn 7.20	Cv = PR/100		
Eqn 7.3	PR = (0.829 PIMP) + (25.0 SOIL) + (0.078 UCWI) - 20.7		
	PIMP (Percentage of catchment which is impervious)	100.0 %	
Page 52	Note: PIMP can not be less than 40%	40.0 %	
	Thus value of PIMP to be used	100.0 %	
	Soil: 0.40 UCWI: 65		
	PR =	77.27	
	Thus Cv =	0.77	
Sec 7.10	CR (Recommended for simulation and design)	1.3	
	Qp for 1 in 100 year 60 minute duration =	**186.2 l/s** or 112.8 l/s/ha	

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	3 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

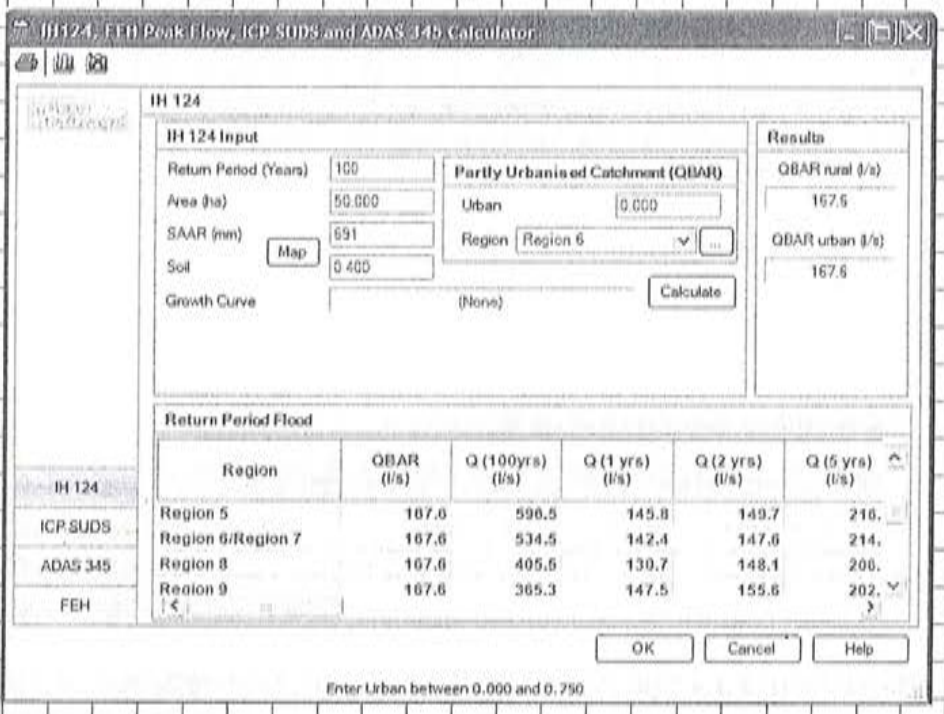
Project Title Upper Heyford, Catchment Area 4

Calculations Title Surface Water Management - IoH 124

LOCATION	CALCULATIONS	OPTIONS

In order to calculate the rate of surface water discharge from the permeable portion of the Site, the Windes Microdrainage version W.12.4 Source Control module has been utilised. Rural runoff has been calculated using the IoH 124 Methodology, the input and output data for which are shown below;

An area of 50ha has been used in the calculations as this is the smallest catchment area which the IoH 124 method can calculate. The 50ha output is then prorated as set out in IoH 124.



Qbar (1 in 2.333)	167.6	l/s/50ha	3.4	l/s/ha			
1 in 100	534.5	l/s/50ha	10.7	l/s/ha	or	**7.6**	**l/s**

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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	4 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S.Brown	Date	20.09.10

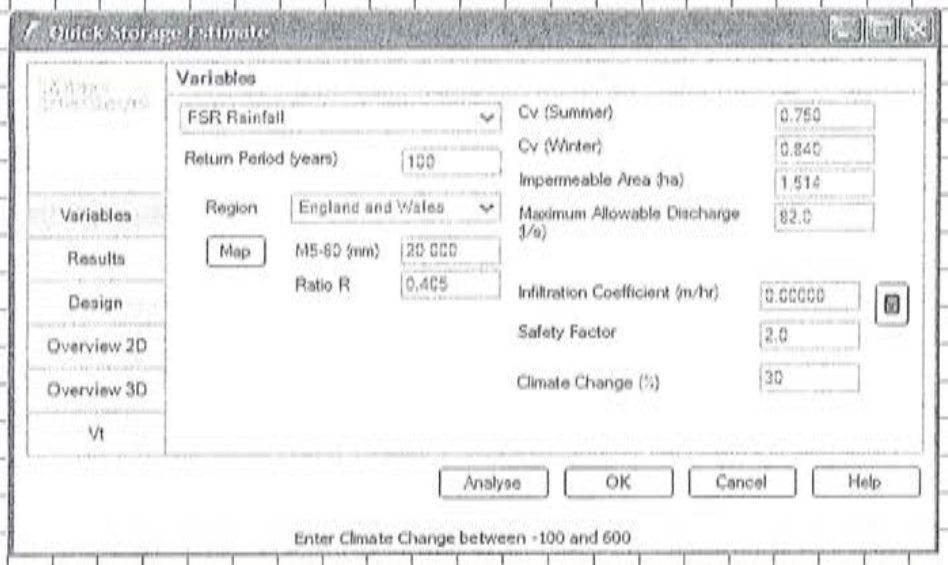
Project Title **Upper Heyford, Catchment Area 4**

Calculations Title **Preliminary surface water attenuation volume.**

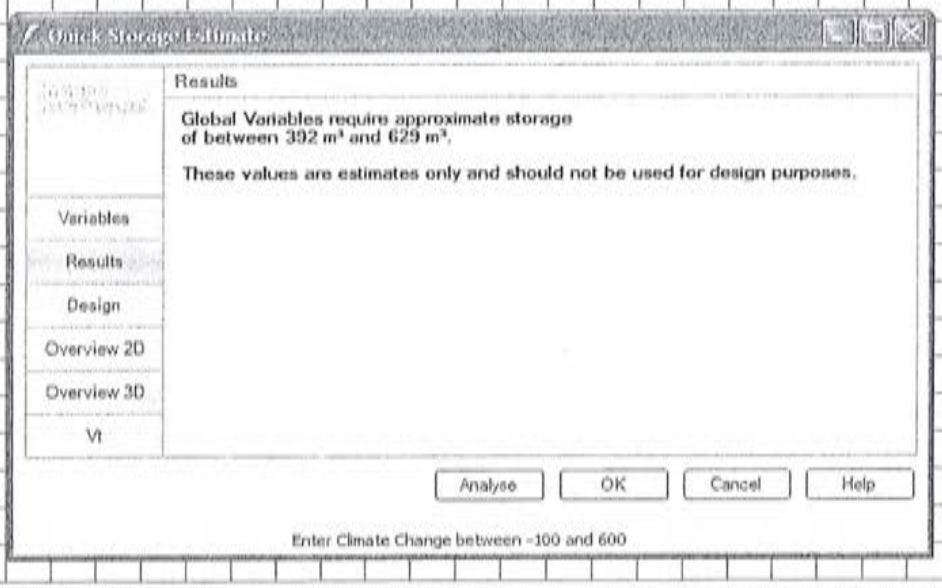
LOCATION	CALCULATIONS	OPTIONS

In order to calculate the volume of surface water attenuation required for the Site, Windes Microdrainage version W.12.4, Source Control module, Quick Storage Estimate has been used. The input and output data for which are shown below;

Input:



Output:



As Windes Quick Storage Estimate provides a range of attenuation volumes it is considered that an average value of the range is suitable for preliminary design sizing.

Minimum:	392	m^3			
Maximum:	629	m^3	Preliminary Estimate:	**511**	m^3

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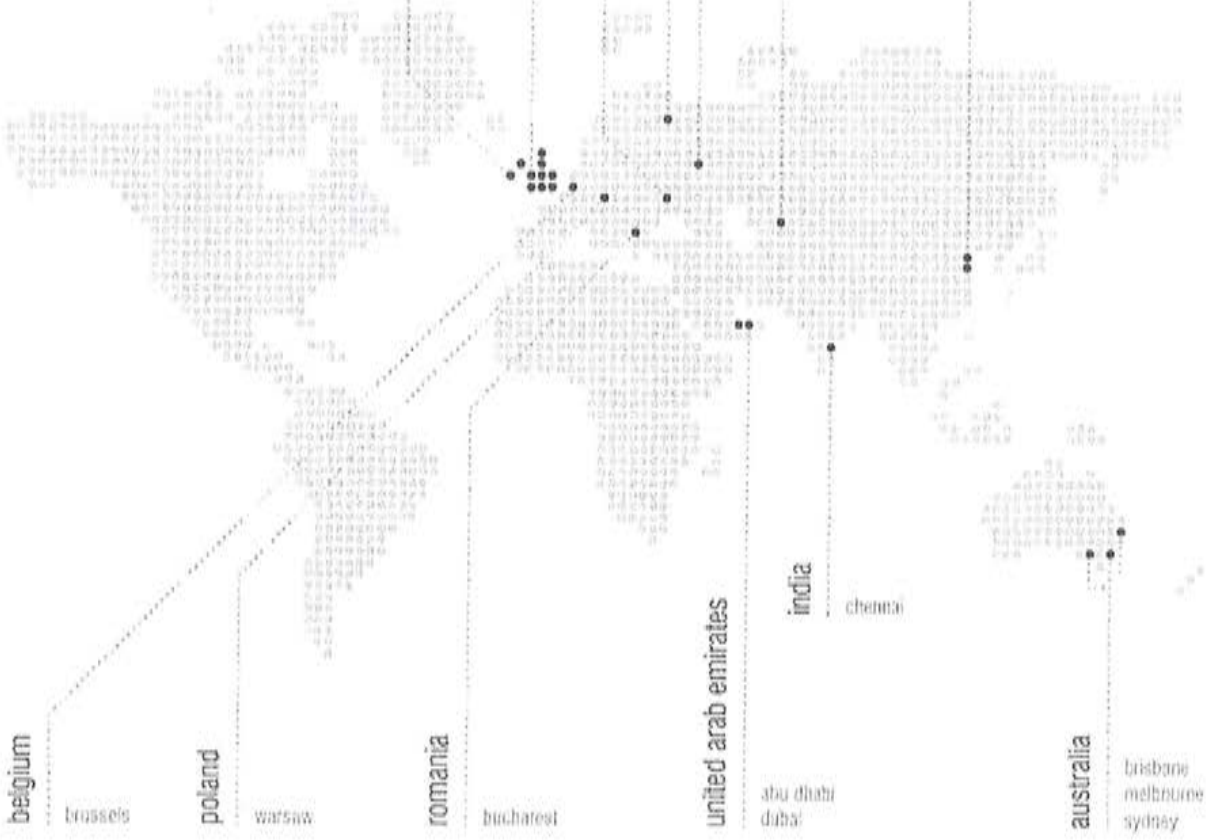

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