Land at Balerno

Level 2 Flood Risk Assessment and Outline Drainage Strategy

[redacted]

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Report to: [redacted]

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Contents

Executive Summary

Ecus Limited (Ecus) was commissioned by [redacted] (the Client) in October 2019 to undertake a Flood Risk Assessment (FRA) and conceptual Drainage Strategy (DS), to assess the flood risks associated with the proposed development of a parcel of land located to the north of the village of Balerno, near Edinburgh (the Site). It is understood that the Client are seeking Planning Permission in Principle (PPiP) for the development of residential properties and associated infrastructure.

Flood Risk

This report has considered the flood risk to the proposed site from all potential sources, as required by Scottish Planning Policy 7 (2014) which sets out the guidelines for the prevention and alleviation of flood risk. The SEPA Flood Map indicates that the Site is not at risk of flooding in up to the 1 in 1,000 year annual probability flood event, which corresponds to a low likelihood of flood risk.

Due to the potential increase in surface water runoff volumes and discharge rates with the decrease in in site permeability associated with the development, additional mitigation measures have been proposed as part of the conceptual surface water drainage strategy, to ensure that the increased potential for pluvial flooding does not adversely impact the proposed development, or the surrounding area.

Based on assessment of available information on the potential flood risk sources, it is concluded that the site has low flood risk constraints, provided that suitable measures are taken to address surface water drainage. It is considered as appropriate to take forward for development, in accordance with the local development and national flood management guidance.

Surface Water Drainage Strategy

It is proposed that surface water runoff is discharged to an unnamed watercourse which is located along the eastern boundary of the Site. As the site is currently undeveloped, surface water runoff will be restricted to the existing Greenfield rate or 4.5 l/s/ha, the lower of the two.

It is possible for surface water to not exceed 4.5l/s/ha or the Qbar Greenfield run-off rate while being attenuated on site in up to the 1 in 200 year plus climate change annual probability event. Surface water can be attenuated in an above ground structure and a combination of SuDS features can be used to provide treatment to surface water flows before discharging into the unnamed watercourse.

It is recommended that further site investigations be undertaken in accordance with BRE365, to assess the potential use of infiltration techniques to discharge surface water to the ground, via infiltration, as this would potentially reduce attenuation requirements within the site and satisfy the SuDS hierarchy for discharge of surface waters.

1. Introduction

1.1.1 Ecus Limited (Ecus) was commissioned by [redacted] (the Client) in October 2019 to undertake a Flood Risk Assessment (FRA) and conceptual Drainage Strategy (DS), to assess the flood risks associated with the proposed development of a parcel of land located to the north of the village of Balerno, near Edinburgh (the Site). It is understood that the Client are seeking Planning Permission in Principle (PPiP) for the development of residential properties and associated infrastructure.

1.1.2 The Site covers 34 hectares (ha) and is centred on Site Centroid National Grid Reference (NGR) NT 1576 6736. The area proposed for the development consists of undeveloped greenfield land, and is also characterised by a embanked disused railway running across the site, as well as gas main and electrical asset infrastructure being present across the north half of the Site.

1.1.3 The purpose of this FRA and DS is to:

- Identify the possible hazards posed from all major sources of flooding (fluvial, surface water, groundwater, infrastructural and coastal sources);
- Provide a qualitative assessment of the probability of each potential flood hazard representing a constraint on the proposed development, based on the proposed land use type for the development and likelihood of flood occurrence;
- Investigate and define any potential drainage impacts associated with the Site;
- Conceptually determine and define necessary surface water management controls to ensure no exacerbation of flood risk on site or to external receptors; and
- Recommend appropriate and necessary mitigation measures and additional assessments that may be required to progress the sustainable development of the Site.

1.1.4 The FRA and DS comprises: a desk top review of publicly available information, including information from Scottish Environmental Protection Agency (SEPA), as the statutory regulator in relation to flooding, and The City of Edinburgh Council (CEC), as the local planning authority in the area for the proposed development; a site walkover and assessment of the site constraints, hydraulic controls and drainage elements evident on the Site

1.1.5 This FRA and DS report also details the methodologies employed within this study and recommendations as to any further work or investigation required to support the proposed development of the Site through the planning application process.

1.2 Proposed Development

1.2.1 The Site, is an irregularly shaped parcel of land, roughly rectangular, covering a total area of approximately 34 ha. The Site is bounded by an active railway to the north and undeveloped land to the west, with residential development to the south and east. Access is provided via Ravelrig Road which bisects the centre of the Site.

1.2.2 Current proposals for the Site are for residential development with associated hardstanding, landscaping and other associated infrastructure, including road, footpaths, etc.

1.3 Regulatory Policy and Legislation

1.3.1 This report has been prepared in accordance with the following national and regional policy guidance;

- Scottish Planning Policy (SPP) 7 (2014);
- Online advice on Flood Risk (2015) which superseded Policy Advice Note (PAN) 69;
- Technical Flood Risk Guidance for Stakeholders (2015);
- Delivering Sustainable Flood Risk Management Guidance (2011);
- Surface Water Management Planning Guidance (2013);
- The City of Edinburgh Council, Surface Water Management Plan (SWMP) Guidance (April 2017)
- The City of Edinburgh Council, Surface Flood Risk and Water Management Plan (FRWMP) Requirements (May 2017)
- Edinburgh Local Development Plan (LDP) (November 2016): and
- Edinburgh Design Guidance (October 2017)

1.3.2 Scottish Planning Policy 7 (2014) sets out the guidelines for the prevention and alleviation of flood risk. The main aim of this policy, in relation to flood risk management, is to prevent, avoid and reduce flood risk from all sources. The Flood Risk Framework detailed within SPP 7, categorises areas according to their annual probability of flooding. These categories determine the appropriate planning approach for new development, specifically:

- **Little or No Risk** – annual probability of coastal or watercourse flooding is less than 0.1% (1:1000 years)
    - No constraints.
- **Low to Medium Risk** – annual probability of coastal or watercourse flooding is between 0.1% and 0.5% (1:1000 to 1:200 years)
    - Suitable for most development. A flood risk assessment may be required at the upper end of the probability range (i.e. close to 0.5%), and for essential infrastructure and the most vulnerable uses. Water resistant materials and construction may be required.
    - Generally not suitable for civil infrastructure. Where civil infrastructure must be located in these areas or is being substantially extended, it should be designed to be capable of remaining operational and accessible during extreme flood events.
- **Medium to High Risk** – annual probability of coastal or watercourse flooding is greater than 0.5% (1:200 years)
    - May be suitable for:
        - residential, institutional, commercial and industrial development within built-up areas provided flood protection measures to the appropriate standard already exist and are maintained, are under construction, or are a planned measure in a current flood risk management plan;
        - essential infrastructure within built-up areas, designed and constructed to remain operational during floods and not impede water flow;
        - some recreational, sport, amenity and nature conservation uses, provided appropriate evacuation procedures are in place; and
        - job-related accommodation, e.g. for caretakers or operational staff.

- Generally not suitable for:
  - civil infrastructure and the most vulnerable uses;
  - additional development in undeveloped and sparsely developed areas, unless a location is essential for operational reasons, e.g. for navigation and water-based recreation, agriculture, transport or utilities infrastructure (which should be designed and constructed to be operational during floods and not impede water flow), and an alternative, lower risk location is not available; and
  - new caravan and camping sites.

1.3.3 Where built development is permitted, measures to protect against or manage flood risk will be required and any loss of flood storage capacity would have to be mitigated to achieve a neutral or better outcome.

1.3.4 Water-resistant materials and construction techniques should be used where appropriate. Elevated buildings on structures such as stilts are unlikely to be acceptable.

1.3.5 SEPA's indicative flood risk maps can be used as an initial indication of the likely level of risk. Where appropriate, further investigation should be carried out to better determine the true level of risk.

1.3.6 For surface water flooding, the flood risk framework recommends that:

- Generally all infrastructure or buildings should be built free from surface water flooding during rainfall where the annual probability of flooding is higher than 0.5%, 1:200 years.
- Drainage measures should result in a neutral or better outcome towards flood risk for not only the proposed Site but also outside of it with the consideration of the rainfall on the Site and run-off from adjacent areas.

1.3.7 While the Risk Framework provides guidance for determining high risk areas for flooding, it is also recommended that further consideration should also be given to:

- the characteristics of the Site;
- the use and design of the proposed development;
- the size of the area likely to flood;
- depth of water, likely flow rate and path, rate of rise and duration;
- existing flood prevention measures - extent, standard and maintenance regime;
- an allowance for freeboard;
- cumulative effects of development, especially the loss of flood storage capacity;
- cross boundary effects and the need for consultation with adjacent authorities;
- effects of a flood on access, including by emergency services;
- effects of a flood on proposed open spaces including gardens; and
- the extent to which the development, its materials and construction is designed to be water resistant.

1.3.8 Land raising, a possible flood protection measure, may be accepted in exceptional circumstances provided that it results in a neutral or better outcome for flood risk out with the elevated site. Compensatory storage should be provided where required.

1.3.9 In addition to the above, this report has also been informed by the following documents;

- Fourth Estuary Local Plan District Water of Leith Catchment (potentially vulnerable Area) (August 2018) and;
- City of Edinburgh Council, Water of Leith Management Plan (July 2020)
- City of Edinburgh, SESplan Strategic Flood Risk Assessment (SFRA) (October 2016)

1.4 Scope of Flood Risk Assessment

1.4.1 The objective of this analysis and report is to provide a FRA in accordance with local and national guidance.

1.4.2 The detail and complexity of a FRA should reflect the level of risk to the Site and consider the appropriateness of the proposed development type. This should include assessment of potential risk to property and livelihoods, consideration of climate change and the definition of appropriate flood risk mitigations required to satisfy the planning process.

1.4.3 Policy Env 21 of the Edinburgh LDP (November 2016) states that the council will not grant planning permission unless it can be proven that development proposals don't have a negative impact on flood risk, including:

- *Increase flood risk or be at risk of flooding itself*
- *Impede the flow of flood water or deprive a river system of flood water storage within the areas shown on the Proposals Map as areas of importance for flood management*
- *Be prejudicial to existing or planned flood defence systems*

1.4.4 It is noted that the development layout for the Site has not yet been finalised and as such an overarching assessment has been undertaken, identifying potential constraints and opportunities for the Site and any future development. However, ongoing design of integral site components and characteristics may further mitigate against any assessed flood risk and also allow for further mitigation of any flood risk/s determined as potentially affecting the Site. Significant changes to the Site's overall developable area may necessitate a further review of this document to ensure that risk of flooding is not exacerbated and has been satisfactorily addressed within the development proposal.

1.4.5 Specific elements of this assessment may require review and amendment prior to submission as part of an outline or detailed planning application.

1.5 Scope of Drainage Strategy

1.5.1 The Conceptual Drainage Strategy (DS) will utilise the hierarchy for disposal of surface waters generated as runoff from impermeable areas on the Site, so as to ensure that there is not a potential exacerbation of flood risk elsewhere, as a result of undertaking the development. This will be undertaken in accordance with widely accepted best practice principles detailed in industry guidance such as the C753 SUDS Manual (2016), Sewers for Adoption 7th Edition (2013) and applicable sections of the Planning Policy Guidance (PPG).

1.5.2 Given the proposed development has the potential to reduce the overall Site permeability, surface water runoff must be effectively managed to ensure that there is no exacerbation of potential surface water flooding issues on-site, or at any external receptors, due to the associated increases in surface water runoff rates and volumes.

1.5.3 Any increase in surface water runoff rate, associated with the development of the Site, must be managed in accordance with the guidelines set by CEC, the Lead Local Flood Authority (LLFA) for the area.

1.5.4 Policy Des 6 of the Edinburgh LDP (November 2016) states that the council will require development proposals to incorporate features that will reduce or minimise environmental resources use and impact, including:

- *Sustainable urban drainage measures that will ensure that there will be no increase in rate of surface water run-off in peak conditions or detrimental impact on the water environment. This should include green roofs on sites where measures on the ground are not practical.*

1.5.5 Policy RS 6 of the Edinburgh LDP (November 2016) states that planning permission will not be granted where there is an inadequate water supply or sewerage available to meet the demands of the development and necessary improvements cannot be provided.

1.5.6 In Addition to the above, CEC's SWMP Guidance and FRWMP Requirements state the following for Greenfield Sites:

- *The drainage system must be designed to accommodate the 1 in 200 year rainfall event including a 30% uplift to account for climate change. Where the network cannot accommodate storage below ground level or within formal SuDS structures the developer must demonstrate that all flood waters can be retained within the site boundary. Flood areas within the site boundary must not prevent dry pedestrian egress from the property*
- *A discharge rate from the proposed drainage system during the 200-year plus climate change event should not exceed 4.5l/s/ha or the 2-year greenfield rate, whichever is lower*

1.5.7 Any increase in surface water runoff rates and volumes must be managed to ensure that there is no exacerbation of potential flooding issues on the Site, or at external receptors due to this increase.

1.5.8 This DS will aim to limit future discharge rates to the downstream outfall location to the Greenfield Qbar runoff rate, as calculated for the Site area.

1.5.9 The DS aims to provide surety that the proposed drainage can safely and appropriately convey all surface water from the Site, to appropriate discharge locations. This is to ensure sustainable and safe operation within the Site, as well as ensuring sustainable operation of any receiving infrastructure. These assessments have been undertaken in accordance with prescribed best practice and buildings codes, including prioritising the incorporation of sustainable drainage systems (SuDS), where appropriate and practicable for the management of surface water.

1.6 Consultation with Lead Local Flood Authority

1.6.1 The City of Edinburgh (CEC) Council is the Lead Local Flood Authority (LLFA) for the proposed development. As part of the design of the proposed drainage strategy outlined above, the LLFA was contacted to confirm requirements of the drainage strategy and proposed design concept.

2. Methodology

2.1 Introduction

2.1.1 This report aims to demonstrate that the proposed development is sustainable and will not be impacted by, or exacerbate flood risk, through development of the Site, taking the effects of climate change into account, as well as identifying further opportunities to reduce the probability and consequences of flooding.

2.1.2 As the permission sought is PPiP, this report will aim to identify constraints and opportunities for the Site and provide and indicative review of drainage and flood risk for the Site.

2.1.3 The assessment methodology is as follows:

- Desktop review of the geology, hydrology and other pertinent environmental characteristics of the Site, and how these affect flood risk of the proposed development and site drainage.
- Obtain and review existing baseline flood risk and drainage guidance information from relevant environmental authorities (SEPA, LLFA, etc.).
- Review baseline conditions of flood risk to the Site from all potential sources and existing drainage conditions at the Site by means of a desk study.
- Produce indicative design calculations for the proposed surface water drainage infrastructure to determine the viability of developing the Site and providing adequate storage in line with local planning policy and guidance.
- Review the findings from the above and advise on the suitability of developing the Site and comment on limitations and opportunities for the Site as appropriate.

3. Development Description and Location

3.1 Site Location

3.1.1 The Site is referenced in **Table 1** and **Figure 1 below**

Table 1: Site Referencing Information

Item	Brief Description
Site address	land off Ravelrig Road, Balerno, Edinburgh, Scotland
Council Area	City of Edinburgh Council
Nearest Post Code	EH14 7DG
Approximate OS Grid Reference	X: 315788, Y: 667273
General Locality	The Site primarily comprises undeveloped arable farmland (Greenfield) and borders an active railway to the north and existing residential development to the south. The Site can be accessed via Ravelrig Road which passes through the Site from south to north.

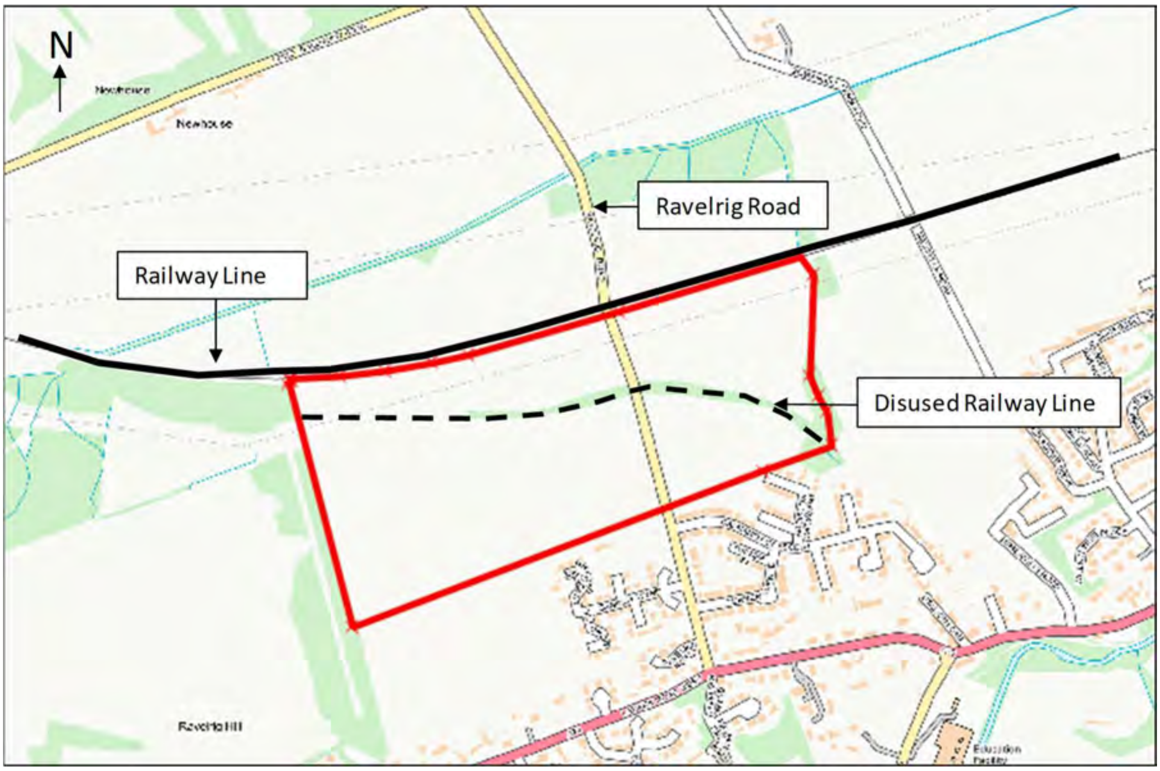


Figure 1: Site Location

3.2 Current Site Conditions

3.2.1 The Site is an irregularly shaped rectangular parcel of land, covering a total area of approximately 34 ha as defined by survey undertaken by ARID Group (Ref: G/R/1000). From, aerial imagery and a topographic survey of the Site, the Site consists of arable farmland with minimal tree coverage across the majority of the Site area. There are stands of trees located on the peripheries of the Site, with a hedge line of trees also evident across the Site, along the disused railway line which runs from the north west corner of the Site to its eastern boundary.

Ground Cover and Topography

3.2.2 A topographic survey conducted by AIRD Group (Ref: G/R/1000), is presented as **Appendix 1** to this report.

3.2.3 Approximate Site levels are shown to be in the region of 183.5 m Above Ordnance Datum (AOD) with greatest elevations being located in southern most areas of the Site, to 119.8 m AOD with lowest elevations being located in the southern most areas of the Site. As well as being bisected by the Ravelrig Road, there is a disused railway line embankment which runs from thin a north west to south east orientation across the Site.

3.2.4 Levels in southern portion range between 183.5 to 140.6 m AOD with levels falling towards the crossing of the public highway and disused rail way from the western and eastern corners of the Site. Levels in the northern portion of the Site range between 149.0 to 120 m AOD with levels being greatest bordering the disused railway line. The Site gradient generally falls towards the north and north east with the lowest point being in the north east corner of the Site, directly adjacent to the unnamed watercourse which lies along the eastern boundary of the Site.

Geology

3.2.5 Information available on Soil Information for Scottish Soils (SIFSS) website (available: http://sifss.hutton.ac.uk/SSKIB_Stats.php, accessed 14/10/19) indicates that the Site is underlain by Macmerry consisting of brown forest soil with imperfect drainage.

3.2.6 British Geological Survey (BGS) Open Geoscience website (available: http://mapapps.bgs.ac.uk/geologyofbritain/home.html accessed 14/10/19) indicates that the Site is entirely underlain by Ballagan Formation – Sandstone Bedrock Formation and superficial stratas of Devensian Glacial Till.

3.2.7 Available BGS website information from one public borehole record (Ref: NT16NE96) located approximately 220 m to the south east of the Site, indicates ground conditions to consist of sandy and gravely clays. Groundwater was not encountered

Hydrogeology

3.2.8 According to the Department for Environment, Food and Rural Affairs (DEFRA) Multi-Agency Geographical Information for the Countryside (MAGIC) map (Available: https://magic.defra.gov.uk/MagicMap.aspx?startTopic, accessed 14/10/19) indicates the Site is not located within a Groundwater Source Protection Zone (SPZ), as defined by SEPA for the protection of a potable groundwater supply.

3.2.9 Information available from SIFSS and BGS indicates that the Site is underlain by sandy and gravely clays with imperfect drainage. This type of soil is considered to have infiltration rate range of approximately 3×10^{-6} m/s and 3×10^{-8} m/s, as defined within Table 25.1 of the CIRIA C753 SuDS Manual V6.

3.2.10 The C753 SuDS Manual guidance states that infiltration viability should be given full consideration where rates of 10^{-6} m/s or greater exist on Site. As the desktop information for the suggests that the potential infiltration rate of the Site is lower than 1×10^{-6} m/s, the discharge of surface water runoff via infiltration to the ground will not be further considered as the primary control or discharge mechanism for management of surface water runoff within the development. The main design concept will therefore focus on providing a suitable alternative which provides a contingency in the event that infiltration tests undertaken on the Site further provide infiltration unviable. This DS concept will therefore largely focus on the attenuation of surface water runoff within the Site, with outfall discharge to a suitable location, of either a watercourse or surface water drainage sewer

3.2.11 Although a desk top assessment of infiltration for the Site indicates that it may prove unviable, it is recommended that site-specific infiltration testing is undertaken within the Site, in accordance with BRE 365 guidance, so as to confirm or preclude the use of infiltration as a potential means of discharging surface water from the proposed development. If favourable infiltration conditions are observed within the Site area, this may result in a reduction of volume required to attenuate surface water runoff rates and volumes within the development. Infiltration testing should be completed prior to, or during, the detailed design stage of the development.

Hydrology

3.2.12 The Water of Leith is located approximately 430 m south of the Site and is classified as main river, originating from the Harperrig Reservoir, flowing in an easterly direction.

3.2.13 The Murray Burn is located approximately 220 m north of the Site and is classified as an ordinary watercourse. The Murray Burn flows in an easterly direction before out falling into the Water of Leith.

3.2.14 An unnamed watercourse is located along the eastern boundary of the Site and is classified as an ordinary watercourse. The drain flows in a northerly direction where if passes beneath the Edinburgh – Glasgow railway line before out falling into the Murray Burn at a confluence approximately 245 m to the north of the Site. A site visit found the watercourse to pass beneath the railway via a box culvert of unknown dimensions. Further consultation with Network Rail may be required so as to confirm the appropriateness of discharging attenuated flows from the Site through this culvert.

3.2.15 An assortment of other land drains and field ditch networks are located in the arable farm land to the north and west of the Site, all ultimately draining the watershed catchment to the common outfall of the Murray Burn.

3.2.16 The Standard Annual Average Rainfall (SAAR) value of **791 mm**, as obtained from the UKSUDS.com website's greenfield runoff rate calculation tool, is 4.6% higher than the observed average rainfall measured at the nearest meteorological station of Edinburgh Gogarbank, located approximately 6.4 km north of the site, which is recorded as being 754 mm on average between 1981-2010 (Available from: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcqrqyr80, accessed 14/10/19).

3.2.17 The SPR (Standard Potential for Runoff) value of **0.47** signifies that the percentage of rainfall contributing to runoff for Greenfield sites is moderate, with approximately 47% of rainfall running off land as surface water in undeveloped, Greenfield conditions.

3.2.18 The average monthly rainfall observations recorded at Gogarbank station, located approximately 6.6 km to the north east of the Site, have been summarised in **Table 2**. The observations at Gogarbank station indicate that the autumnal and winter months experience the most rainfall.

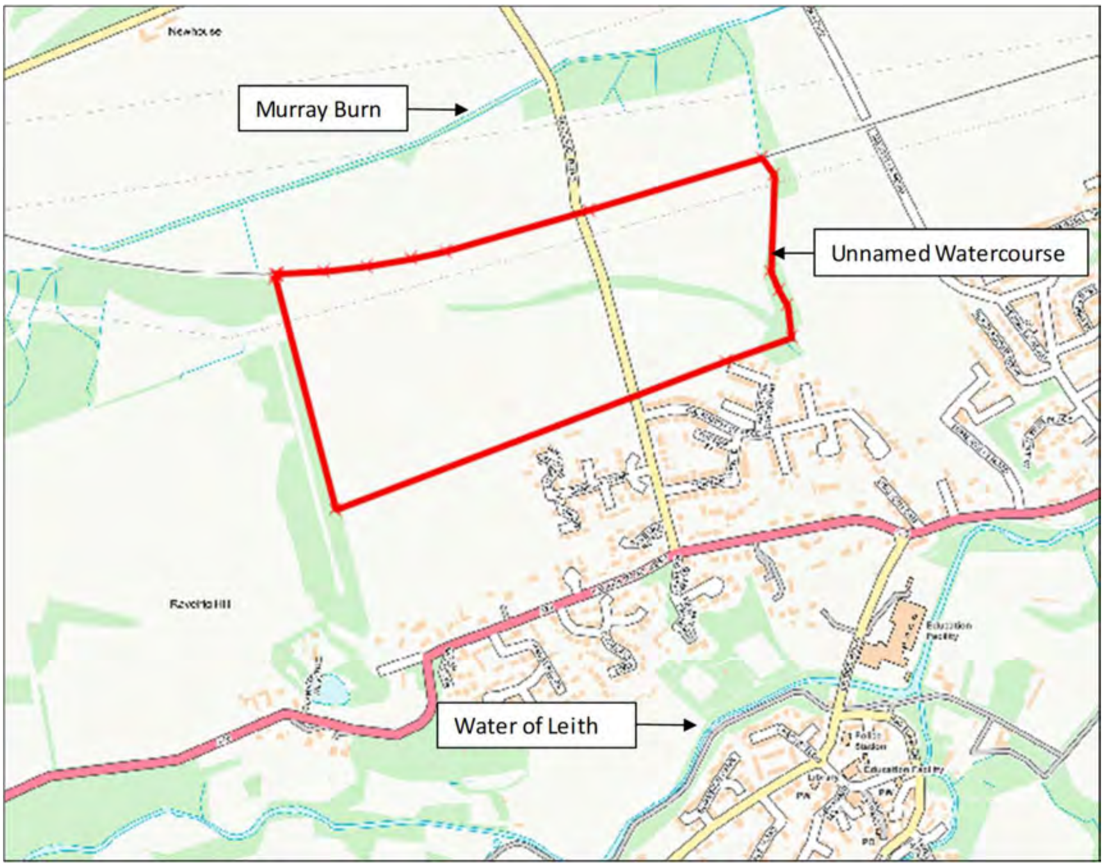


Figure 2: Watercourse Locations

Table 2: Gogarbank Average Monthly Rainfall (source: Met Office, Edinburgh Gogarbank Station)

Month	Rainfall (mm)
Jan	76.3
Feb	53.8
Mar	55.9
Apr	46.1
May	49
Jun	61.5
Jul	64.1
Aug	67.8
Sep	58
Oct	84.5
Nov	73.7
Dec	63.6
Total	754.2

Existing Site Drainage and Assets

3.2.19 The Site is currently undeveloped and has no known surface water drainage infrastructure, as confirmed during a site visit undertaken on 25 October 2019. Given the observed topographic conditions on Site it is reasonable to assume that the Site watershed area drains to the north where it enters an unnamed watercourse along the eastern boundary of the Site or is similarly intercepted and conveyed along trackside railway drainage before discharging into and passing beneath the railway line through a culvert and further flowing north into the Murray Burn. The current drainage regime as based on review of the Site's existing topography, has been further illustrated on Ecus Drawing 2 – 13582/002.

3.2.20 The Site is located in an area covered by Scottish Water (SW) as the statutory undertaker for sewerage and water assets. Sewer records obtained from SW, provided as **Appendix 2** to this report, illustrate a combined sewer located approximately 40 m south at the junction of Ravelrig Road and Dalmahoy Crescent (Manhole ID 9102). The entirety of the Site is not shown to be served by any existing SW surface water or foul water drainage infrastructure.

3.2.21 An intermediate pressure Gas mains runs through the Site, the location of which is indicated on **Drawing 1** (Ref: 13852/001)**.** A linesearch undertaken on 4 October indicates that no other gas main infrastructure runs through the Site. Asset location information as obtained within this Linesearch has also been provided within **Appendix 2** of this report.

Site Walkover Observations

3.2.22 Site walkovers were conducted by Ecus on 25 October 2019 and subsequently 7 November 2019. The photographic recordings of observations made within this site walkover have been presented as **Appendix 3** to this report.

3.2.23 The existing access to the Site is provided via Ravelrig Road with which dissects the Site through the centre (photo 1 and 2).

3.2.24 The unnamed watercourse runs along the eastern boundary of the Site and flows in a northerly direction (see photo 3, 4 and 5).

3.2.25 An inflow into the unnamed watercourse is located along the upper stretch of the watercourse within the Site boundary and is assumed to convey surface water flows from the housing estates to the south (Photo 3).

3.2.26 Once the unnamed watercourse reaches the northern boundary of the Site it passes beneath the Edinburgh - Glasgow railway line via a box culvert (photo 6).

3.2.27 The northern boundary of the Site is the Edinburgh - Glasgow railway line. A land drain runs adjacent to the railway line which conveys flows from the western portion of the Site into the unnamed watercourse (Photo 7).

3.2.28 The remaining area of the Site currently consists of agricultural land, which was observed during the walkover survey to have a gently topographic slope from north west to the south east (Photo 8 and 9).

Proposed Development and Vulnerability

3.2.29 The current planning proposal is for residential development of the land with associated hardstanding and landscaping.

3.2.30 As the masterplan is outline at this stage, and noting the restriction on developable area due to the existing infrastructure and service constraints on the Site, it has been assumed that the developable area of the Site is restricted to land to the south of the

Intermediate Pressure Gas main, which constitutes an area of approximately 22.13 ha (**Drawing 1**) which is approximately 65% of the total Site area.

3.2.31 As defined by Scottish Planning Policy 7 sites not deemed to be at risk of fluvial flooding (outside of 1 in 1,000 year annual probability event) have no constraints in respects to development type.

4. Potential Site Flood Risk

4.1 Sources of Flooding

4.1.1 The report is to consider flood risk from all potential sources. The following section identifies flood risk receptors and potential flood risk sources. Section 5 then discusses in further detail the probability of flooding, any potential impacts and necessary mitigation, where required. A data request has been sent to SEPA for the provision of any flood risk assessment material or maps which may pertain to the Site, however at the time of writing this report, no response has been received.

4.1 Fluvial Flooding

4.1.1 Water of Leith lies approximately 430 m south of the Site. SEPAs Flood Map demonstrates that the Site is at little or no risk of fluvial flooding from Water of Leith and lies outside the 1 in 1,000 year annual probability flood event.

4.1.2 Murray Brook is located approximately 220 m north of the Site. SEPAs Flood Map does not define flood risk from Murray Brook for stretch located to the north of the Site. In the absence of a flood extent, the surface water flood map can be used as a proxy to define flood risk from this source and determine conveyance routes should a flood occur. This shows flooding to be retained to low-lying land immediately adjacent to the Brook.

4.1.3 In addition to the above, site levels along Murray Brook in the vicinity of the Site are expected to be in the vicinity of 115.0 m AOD, while minimum Site levels are noted as being 119.8m AOD. Additionally, minimum levels within the proposed developable area of the Site are shown to be in the order of 131.0 m AOD, with an assessed difference in levels of 16.0 m meaning it is considered to have negligible risk from fluvial flood waters from this source.

4.1.4 There is an unnamed watercourse located along the eastern boundary of the Site. SEPAs Flood Map does not define flood risk from the unnamed watercourse and flood risk from the source has therefore not been quantified. In the absence of a flood extent, the surface water flood map will be used as a proxy to define flood risk from this source and determine conveyance routes should a flood occur. This shows that any flooding would be expected to be either confined to the watercourse channel or restricted to land immediately adjacent to the watercourse.

4.1.5 A review of surrounding levels suggests the contributing watershed catchment for the watercourse would be limited to the land in the immediate vicinity of the watercourse and therefore is not expected to convey significant flows. This is confirmed by the FEH Web Service which fails to pick up a catchment for the unnamed watercourse and as such confirms its limited size as a minor local tributary to the Murray Brook.

4.2 Pluvial Flooding (Surface Water)

4.2.1 SEPAs surface water flood map (Error! Reference source not found.) shows that the majority of the Site is indicated to be at very low risk to pluvial flooding (<0.1% chance of flooding in a given year). While some areas are shown to experience low to high risk of surface water flooding.

4.2.2 Based on a review of the Site topography and available pluvial flood mapping as provide by the SEPAs Flood Map, it can be seen that areas at risk are a result of water being conveyed down Ravelrig Road or water pooling behind the disused railway line, due to insufficient drainage. Flows down Ravelrig Road would not be expected to inundate the Site, noting a raised embankment either side of the highway as observed within the Site walkover.

4.2.3 The proposed levels for the development have not been provided, therefore any potential development within the Site must be considerate of the fact that runoff waters naturally collect in these locations due to the current topographic conditions.

4.2.4 As the proposed development of the Site may potentially reduce the overall site permeability and potentially increase surface water runoff rates and volumes, the surface water discharge controls must ensure that any proposal for drainage, or discharge, does not adversely impact upon downstream drainage infrastructure or offsite receptors.

4.3 Groundwater Flooding

4.3.1 SEPAs flood map indicates that the Site is not susceptible to groundwater flooding; however, noting that underlying bedrock geology of the Site consists of siltstone, there may be some susceptibility to groundwater flooding.

4.3.2 Noting the gradient at the Site, any groundwater would be conveyed off site before building to any significant depth.

4.3.3 Further to this, the potential for groundwater emergence causing flooding within the Site post-development, will be inhibited due to potential pathways for groundwater flooding being largely removed through placement of construction fill material and hardstanding surfaces. Flood risk to the proposed development due to groundwater emergence is therefore considered to be low to negligible provided that all reasonable and practicable mitigation measures for any subsurface construction associated with the development are adhered to.

4.4 Flooding from Sewers

4.4.1 Sewer flooding can occur when the capacity of the infrastructure is exceeded by excessive flows, or as a result of a reduction in capacity due to collapse or blockage, or if the downstream system becomes surcharged. This can lead to sewers flooding onto the surrounding ground via manholes and gullies, which can generate overland flows. SW sewer asset plans were obtained (**Appendix 2** of this report).

4.4.2 SW have been contacted to ascertain whether they hold any records of historic sewer flooding in the vicinity of the Site however, at the time of writing this report, no response has been received..

4.5 Flooding from Artificial Sources

4.5.1 The Threipmuir and Harlaw Reservoirs are located approximately 3.3 km and 2.7 km south and south east of the Site respectively. The Harperrig Reservoir is located approximately 8.20 km south west of the Site.

4.5.2 SEPAs Reservoir Inundation Map shows the majority of the Site to remain flood free in the event of a damn failure with only a small portion along the eastern boundary and within the north eastern corner shown as being potentially at risk of inundation. Flood waters are shown to generally adopt the route of the unnamed watercourse down to the Murray Burn.

4.5.3 While a small portion of the Site is shown to be at risk of flooding from artificial sources, reservoirs are regularly maintained and therefore the potential risk of flooding from reservoir failure is considered to be negligible.

5. Flood Risk Assessment

5.1 Summary

5.1.1 The SEPA Flood Map indicates that the Site is not at risk of flooding in the up to 1 in 1,000 year annual probability flood event, which corresponds to a low likelihood of flood risk. The flood map indicates that the majority of the Site is not susceptible to surface water flooding, with small localised areas experiencing pooling due to topographic features and insufficient drainage adjacent to the railway line in the north of the Site. These areas are proposed to be well removed from any developable area within the Site, as detailed in previous sections of this report. The flood map extents indicated on this map show the potential for flooding from fluvial and coastal sources, and although they are indicative, they are a key tool in defining the appropriateness of a development type or the requirement for further assessment.

5.1.2 As the development is located in an area of low likelihood of flood risk from fluvial flooding, the Site is deemed to be suitable for residential development.

5.1.3 While a portion of the Site is shown to be at risk of flooding from artificial sources, given that this is restricted to a small area along the eastern boundary, any proposed residential development can be located outside the area of inundation.

5.1.4 Section 5 has provided a comprehensive review of information on potential flood risks to the Site from all applicable sources. Table 4 considers each of the sources and defines the probability of flood risk associated with each of the likely impacts.

Table 3: Flood Risk Summary

Source	Probability of Flood Risk	Impacts	Remarks / Mitigation Measure
Tidal	N/A	NA	Site located inland and not tidally influenced.
Fluvial	Very low	Very low / Negligible	Site is located entirely within Flood Zone 1. Review of SFRA reveals no historical evidence fluvial flooding at the Site location. Review of topography shows the developable area to be substantially higher than levels adjacent to the Murray burn and Water of Leith.
Surface	Low	Low	Review of information from multiple sources reveals evidence of surface water flooding potentially affecting small portions of the Site in the current topographic low spots adjacent to the unnamed watercourse in the east or due to backing up behind the disused railway embankment along the Sites northern boundary The proposed development will require the surface water drainage design to ensure surface water runoff flow rates and volumes from the Site are reduced accordingly, managed internally and that any surface waters accumulated in this area are not displaced to external areas.
Sewers	Low	Low / Negligible	The risk of flooding from the surcharging of sewers is considered to be low.

Source	Probability of Flood Risk	Impacts	Remarks / Mitigation Measure
Groundwater	Low	Low / Negligible	Groundwater flood risk is considered to be low.
Artificial Sources	Negligible	low	While artificial sources are located upstream of the Site and portions of the Site are shown to be at risk these can be left undeveloped. Irrespective these structures are maintained regularly and the chance failure of such structures is negligible.

5.1.5 Based on the assessable information presented, the Site is considered as appropriate for development, given the assessed flood risk posed from all sources, the means of adopting suitable mitigation measures to prevent increase in the potential for flood risk and based on the vulnerability of the development type. Further consideration of necessary surface water runoff mitigation measures will be provided, so as to address the potential for increase of surface water arising from the proposed development of the Site.

5.1.6 Taking the findings from the above the SEPA Flood Risk Assessment Checklist (SS-NFR-F-001) has been completed and provided within **Appendix 4**

6. Surface Water Drainage Strategy

6.1 Existing Site Drainage and Surface Water Management

6.1.1 The Site consists of undeveloped Greenfield land and as indicated in **Section 3.2** the Site is not currently served by any existing SW drainage infrastructure and surface water runoff is assumed to be positively drained to the Murray Brook, via the unnamed watercourse and other informal routes across the Edinburgh - Glasgow railway.

6.2 Overview and Concept

6.2.1 As detailed in **Section 3.2**, based on the outline nature of the proposals a developable area of 22.13 ha has been taken (**Drawing 1**).

6.2.2 The above area is considered to be a conservative estimate of the developable area of the Site noting the presence of the Intermediate Pressure Gas main and High Voltage Power Line being located in the northern portion of the Site. As such, any storage requirements resulting from the above area should represent the most conservative requirements for storage on the Site and should ensure any future proposals of similar or lesser extent can satisfy the requirements for progressing development, based on adoption of control and mitigation measures as identified within this conceptual DS.

6.2.3 Ravelrig Road has been excluded from the development area as this will be assumed to continue to drain to existing conditions post development. It is considered that this road is currently served by existing highways drainage infrastructure.

6.2.4 Taking a developable area of 22.13 ha, it has subsequently been assumed that 70% of this area will be impermeable to support the proposed development of the Site, in order to provide a conservative estimate of the drainage and attenuation requirements.

6.2.5 Once exact developable areas are know this drainage strategy will require revision to reflect the most current proposed development layout, to ensure that it accommodates any associated changes in Site permeability and surface water loads generated.

6.2.6 Noting the above the following points have been used to further develop this surface water drainage strategy for accompanying the proposed development and these components described below:

- As per the applicable hierarchy for disposal of surface water, infiltration is the preferred method of discharging surface water runoff from a developed site. This may not be suitable for the proposed development given potentially poor soil infiltration potential and infiltration has therefore been precluded from further assessment for the Site's surface water drainage strategy. Further assessment for the suitability of infiltration can be determined via infiltration / soakaway testing conducted in accordance with BRE 365. This should be explored prior to, or during, the detailed design phase so as to either confirm or deny the suitability of soakaways within the proposed development.
- Following the hierarchy for disposal of surface water, it is proposed that the surface water generated within the proposed development will be discharged to the unnamed watercourse running along the eastern boundary of the Site.
- The 70% impermeable area is assumed to encompass all impermeable areas within a proposed housing development, including roadways, driveways, building footprints and any other associated hardstanding areas.

- While a network is not being designed at this stage an indicative location for the main components will be identified to show how flows will conveyed across the Site post development. It is assumed that this will incorporate a combination of drainage ditches, swales and filter tranches which will treat surface water flows as they're conveyed across the Site to a basin located in the north east corner of the Site, before out falling into the unnamed watercourse in accordance with the drainage hierarchy.

- As required by CEC FRWMP Requirements, the cumulative discharge of surface water to the unnamed watercourse will not exceed 4.5l/s/ha or the 2-year (Qbar) Greenfield run-off rate, with the lower of the calculated discharge rates to be applied for Site attenuation requirements. All flows from the surface runoff water attenuation control will be controlled through a flow vortex device, such as a hydro-brake. These outlets will also be fitted with emergency stopcocks so as to ensure that discharge from the Site from the surface water drainage network may be effectively shut off in the case of an emergency.

- The unnamed watercourse is culverted just north of the Site as it passes beneath the Edinburgh - Glasgow railway line. While discharge rates will be restricted in accordance with local planning policy and guidance, a developer enquiry should be submitted to Network rail in order to determine any additional requirements they may have prior to or during the detailed design stage.

- As recommended within local planning policy and guidance, a 30% increase will be applied to the critical 1 in 200 year rainfall events for the assessment of the Site's internal surface water drainage requirements. The Site surface water drainage strategy will need to accommodate all rainfall events up to and including the critical 1 in 200 year plus (30%) climate change rainfall event, so as to prevent unnecessary flooding within the Site, and reduce the potential for unrestricted discharge to the receiving environments potentially causing flooding in areas off the Site.

- As required by CEC flows paths post development should not be detrimental to adjacent land and should not increase flood risk elsewhere.

6.3 Sustainable Drainage Systems (SuDS)

SuDS Objectives

6.3.1 The Site conceptual surface water drainage strategy is to be reflective of Sustainable Drainage Systems (SuDS) principles. At a particular site these systems are designed to manage both the environmental risks (e.g. pollutant entrainment) resulting from the urban runoff and to contribute, wherever possible, to environmental enhancement. The integration of additional SuDS and surface water quality improvement treatments on the Site should be further considered for incorporation within the wider drainage strategy during the detailed design phase.

The SuDS Management Train

6.3.2 A 'Management Train Approach' should be central to the surface water drainage strategy of the Site. The main objective is treatment and control of runoff as near to source as possible, thus protecting downstream habitats and further enhancing the amenity value of the Site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the Site, and is as follows:

- Prevention – The use of good site design and housekeeping measures to prevent runoff and pollution including rainwater reuse.
- Source controls – Control of runoff at source or as close to source as possible (e.g. soakaway, permeable pavements).
- Site control – Management of water in a local area and can include below ground storage/attenuation, detention basins, large infiltration devices.
- Regional control – Management of water from a site or various sites and can include wetlands and balancing ponds.

6.3.3 The drainage techniques for this development will seek to include, where possible, prevention, source control and site control measures.

6.4 Drainage Strategy Calculations

6.4.1 Preliminary design calculations have been completed to demonstrate that online storage may be provided within the development footprint to allow a controlled flow rate not exceeding 4.5l/s/ha or the 2-year (Q2) Greenfield rate. These calculations for determination of the maximum applicable discharge rate were carried out using the Greenfield Runoff Rate Estimation tool in Microdrainage, and are further summarised in Table 5. The full Microdrainage output of these calculations is provided as **Appendix 5** to this report.

6.4.2 The existing discharge calculation input parameters are as follows:

- Total developable area (approx.) = 22.13 ha
- Site area < 50 ha, therefore the use of Flood Studies Report (FSR) interim Code of Practise for SuDS (ICP-SUDS) model has been adopted for calculation of Greenfield runoff rates. This has also been based on a comparison of applicable Greenfield runoff rates, with the more conservative ICP-SUDS results being adopted for the Site DS proposal.
- Impermeable area (or degree of urbanisation for Greenfield calculation) = assumed no current urbanisation of site = 0% (no urbanisation)
- Hydrologic region = 2
- Soil = 0.47
- SAAR = 895 (greater of the UKSUDs and Microdrainage values so as to provide a more conservative estimate of storage requirements)

Table 4: Greenfield Discharge Rate Comparison (IH 124 vs ICP-SUDS)

		Greenfield Discharge Rate (L/s)	
		IH 124	ICP-SUDS
	Area (ha)	22.13	22.13
Return Periods	Q1	135.5	123.9
	Qbar	155.8	142.4

	Q30	295.5	270.2
	Q100	409.7	374.6

6.4.3 The calculated peak greenfield discharge rate for all events up to and including the peak 1 in 200 year + 30% climate change event is therefore:

- Qbar – 142.4 (L/s)

6.4.4 As stipulated by CEC the discharge rate from the proposed drainage system during the 200-year plus climate change event should not exceed 4.5l/s/ha or the 2-year (Qbar) Greenfield rate, whichever is lower. Taking a developable area of 22.13 ha the Site discharge rate should not exceed 142.4 L/s or 99.6 L/s, whichever is the lower.

6.4.5 Based on this, the Site discharge rate will therefore be restricted to 99.6 L/s.

6.4.6 The discharge rate calculations for the existing Site conditions have been provided so as to undertake further analysis of the requirements for attenuation of the increase in impermeable area required for housing, berths, roads and other associated development.

6.4.7 Based on outline nature of the plans and the assumption that 70% of the developable area (22.13 ha) will be impermeable a total contributing impermeable area has been calculated as:

- 15.49 ha

6.4.8 The design conditions of the attenuation system, will be as follows:

- All discharge for events up to and including the 1 in 200 year + 30% rainfall events, cumulative discharge will be limited to 99.58 L/s.
- All surface water runoff for events up to and including the 1 in 30 year plus 30% return period events will be managed with no flooding of any internal drainage network (to be assessed within the further detailed design phase).
- All surface water runoff for events up to and including the 1 in 200 year plus 30% will be managed within the Site, with any surface storage to be confined within the proposed road network or other appropriate secondary storage areas, with no flooding of pedestrian access and no external flooding from the Site or control structures.
- Site open space and landscaped areas will not produce runoff or drain to the surface water management infrastructure proposed as part of this strategy and are taken into account noting that only 70% of the developable area has been assumed to be impermeable.
- Minimum cover requirements for the attenuation system or drainage network will be to Sewers for Adoption 7th Edition standards for HGV access (1.20m minimum cover), when located in an area to be trafficked.
- The side slope of the attenuation basin should not exceed 1:6 as to allow for safe grass cutting and maintenance.
- Invert level of the attenuation system is currently designed at this outline design stage as 121.5m AOD, based on providing a 1.30 m deep structure. This invert level is based on the average level in the north east corner of the Site, as

observed from the topographic survey (**Appendix 1**). Invert level subject to change following the confirmation of proposed Site levels as defined during the detailed design phase and confirmation of respective outfall location levels.

6.4.9 For the future detailed design of Site drainage requirements, a hydraulic model or analysis of pipe and ditch network sizing and flow requirements would be undertaken using drainage design software subsequent to the design of finished Site levels. It is noted that the volumes provided as part of this conceptual DS assessment are preliminary and may potentially be reduced at a detailed design stage, when more site-specific information is made available, including the potential for use of infiltration as a means of discharging a portion or potentially all surface water runoff generated on the.

6.4.10 On-site infiltration tests will ultimately determine how surface water runoff is managed and may reduce the required attenuation volume. This conceptual calculation and drainage strategy demonstrates an alternative to infiltration is possible for this development. The proposed drainage network will be designed in accordance with Sewers for Adoption 7th Edition (SfA). SuDS guidance will be taken from CIRIA C753 (the SuDS Manual) 6th edition.

6.4.11 It is a requirement of CEC guidance that the drainage systems be designed to not flood any part of the Site in a 1 in 30-year +CC return period design storm (3.33% annual probability of occurrence). The design may require that some areas of the hard-standing areas experience minor flooding in extreme conditions (those in excess of 1 in 30 year events). This is classed as Exceedance flooding or Secondary Storage.

6.4.12 Any such water will be directed away from residential units, where it will discharge into the drainage infrastructure as water levels recede. All exceedance flood water will be retained and managed on-site up to the 200-year plus climate change return period to prevent flood impact to the adjoining neighbours or exacerbating flood impacts on downstream receiving infrastructure. All drainage designs will include the appropriate climate change allowance, in this case a 30% increase in rainfall.

6.4.13 The attenuation basin system has been optimised to minimise the potential need for secondary storage for flood water during the peak 1 in 200 year + 30% climate change rainfall event. The required basin size and indicative proposed location is indicated on **Drawing 1**.

6.5 Drainage Network

6.5.1 In the absence of a Site plan an indicative drainage network has been provided showing how flows would be intercepted and conveyed to the attenuation basin. This includes the main line while branch networks conveying flows to this would need to further assessed at the detailed design stage.

6.5.2 The final surface water drainage network servicing the Site should ideally consist of permeable paving to limit the runoff from any paved areas and subsequent flows should be conveyed across the Site via a combination of drainage ditches, swales and filter trenches in order to provide treatment to any surface water flows before they reach the attenuation basin. This will manage post development conveyance routes and ensure any additional flows are captured before they leave the Site and therefore should not impact flood risk elsewhere (**Drawing 3**). Once the detailed design has been developed, it should ensure that any flow routes do not conflict with the location of dwellings or other key infrastructure.

6.5.3 For any portion of network crossing a highway a minimum cover requirement of 1.20 m must be provided for the internal drainage network to satisfy Sewers for Adoption standards. Further assessment of the proposed internal drainage network levels and the proposed outfall connection points must be undertaken with reference to the proposed finished Site levels, so as to ensure that discharge via gravity may be provided. This should be undertaken during the detailed design stage.

6.5.4 Additional pollutant control measures, such as for the control of silt entrained within surface water runoff, will be provided through the use of silt-trap gullies, channels with silt traps, first flush mechanisms on water, “French drains” with silt traps or other similar filtration technique.

6.6 Surface Water Drainage Design Results

6.6.1 Simulations were conducted for all rainfall events for the 1 in 200 year + 30% climate change return periods using the Source Control Module of Microdrainage. From these simulations it was observed that all runoff may be managed on Site for all events up to and including the critical 1 in 200 year + 30% climate change event , in accordance with the recommended best practise guidance and design criteria, as established in previous sections.

6.6.2 The simulation conducted for the attenuation basin for the 1 in 30 year + 30% climate change return periods indicates that discharge for the peak rainfall event can be maintained below the rate of 99.6 L/s. The maximum discharge rate returned was calculated as 99.6 L/s, for the 1 in 30 +30% climate change year-960 min winter event, with no flooding, requiring a maximum storage volume of 5991.2 m^3.

6.6.3 The discharge for the peak rainfall event for the 1 in 200 year + 30% climate change return periods can be maintained below the rate of 96.84 L/s. The maximum discharge rate returned was calculated as 99.6 L/s, for the peak 1 in 200 year + 30% climate change-1440 min winter event, requiring a total storage volume of 9451.4 m^3.

6.6.4 The above volume could be attenuated in a attenuation basin located in the available attenuation area, noting a total available area of 25,459 m^2 (**Drawing 1**), with the characteristics listed below:

- Max. Discharge = 99.6 L/s for all events up to and including the 1 in 200 year +30 % climate change return period.
- Cover level of attenuation basin = 121.5 m AOD
- Top Area of attenuation basin = 8,510 m^2
- Base Area of attenuation basin = 6,150 m^2
- Internal depth of attenuation basin= 1.30 m
- Gradient of Internal Side Slope: 1:6
- Invert level of attenuation basin = 120.2 m AOD

6.6.5 Microdrainage results outlining the above have been provided in **Appendix 6**.

6.6.6 Taking the findings from the above, the CEC Surface Water Management Checklist has been completed and provided within **Appendix 7**.

6.7 Consultation with Lead Local Flood Authority

6.7.1 CEC is the Lead Local Flood Authority (LLFA) for the proposed development. As part of the design of the outline DS detailed above, the LLFA was contacted to confirm requirements of the drainage strategy and proposed design concept.

6.7.2 CEC was contacted on 5 October 2019 regarding the outline for the proposed drainage strategy for the development. As of writing this report, no response has been received from the council.

7. Conclusions and Recommendations

7.1 Flood Risk Management and Resilience Measures

7.1.1 Based on assessment of the available information regarding potential sources of flood risk, it is concluded that the Site has low flood risk constraints from all sources, provided suitable measures are taken to address surface water management within the Site. It is considered appropriate to take forward for development, in accordance with local development and national flood management guidance and the national planning policy framework. Based on assessment of all potential flood sources, and the applicable vulnerability for the proposed development, the Site is considered as appropriate for applying for further planning approval.

7.1.2 Due to the potential increase in surface water runoff volumes and discharge rates in line with the overall decrease in site permeability, due to development, additional design considerations and mitigation measure have been proposed as part of the Site concept surface water drainage strategy, to ensure that the flooding from pluvial sources does not impact adversely on the proposed development.

7.2 Residual Risk

7.2.1 Flood risk to people and property can be managed but it can never be completely removed; as residual risk remains after flood management or mitigation measures have been put in place in the event that there are flood levels, extents and flows in excess of those hereby quantified and assessed.

7.2.2 As previously indicated, the current analysis has returned results indicating that all surface water runoff arising from rainfall events up to and including the peak 1 in 200 year + 30% climate change rainfall event can be safely and satisfactorily managed on with no flooding, provided the design considerations and criteria provided within this conceptual drainage strategy design are followed and adopted.

7.3 Off Site Impacts

7.3.1 The report has concluded that the risk of flooding to the proposed development layout is acceptable. By including SuDS into the drainage system, this will reduce the potential for surface water flooding impact onto the downstream catchments.

7.3.2 As there is no displacement of flood water or increased rate of runoff into the adjacent properties as part of this proposal, this is consistent with the evaluation that there is minimal risk of potential surface water flooding arising from the development and impacting upon the downstream catchments

7.4 Further Work Required

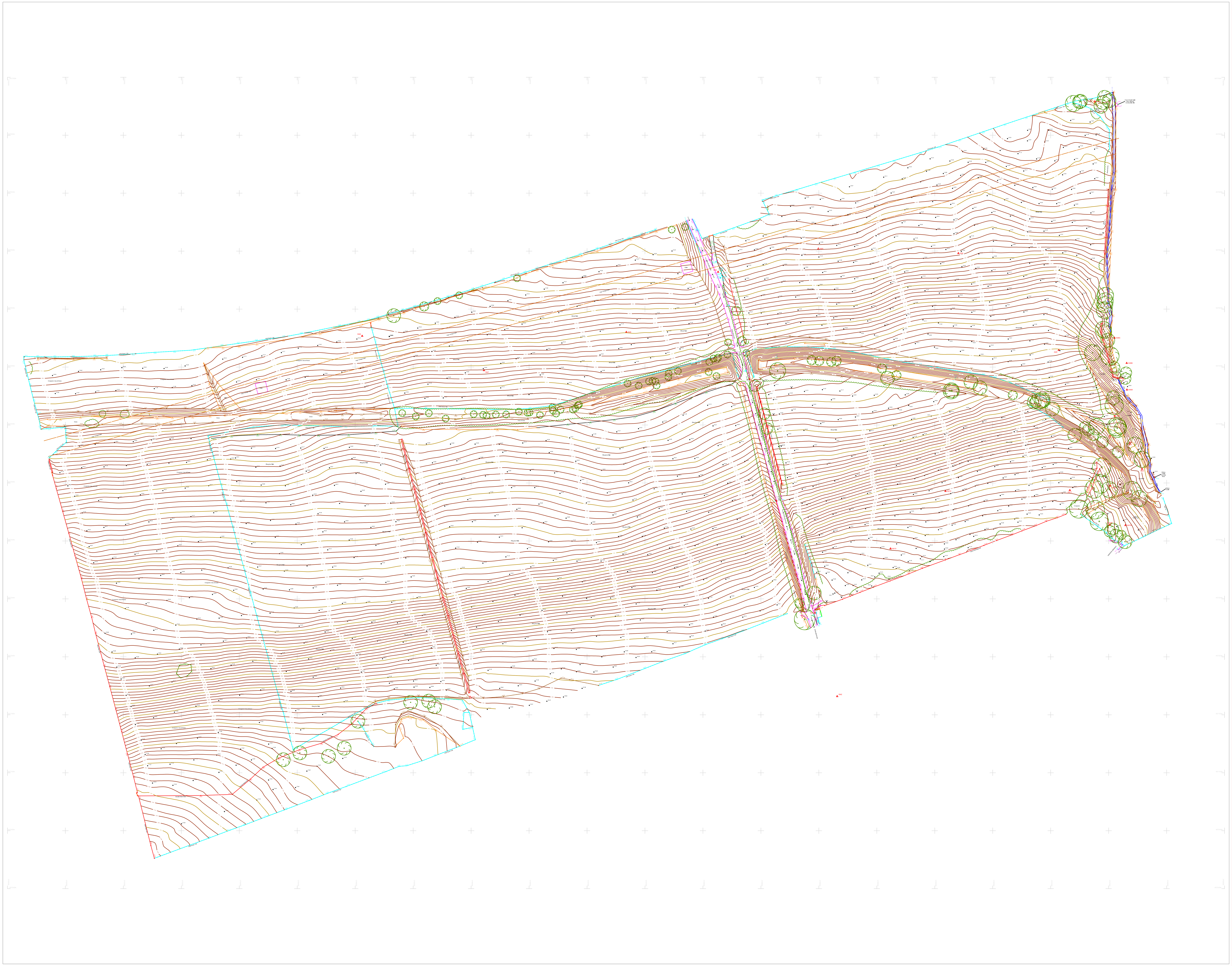
7.4.1 As discussed in **Sections 3 and 6** of this report, the infiltration potential of the Site should be explored to confirm the viability of using soakaway techniques to discharge surface water generated from the development. This would need to be assessed by conducting BRE 365 soakaway testing on-site, and be carried out prior to the detailed drainage design for the proposed development. The use of infiltration may reduce the volume required for attenuation of surface water runoff and reduce the potential for on-site flooding.

7.4.2 The calculations provided within this report indicate that all runoff arising from the proposed development hard-standing areas may be accommodated for all rainfall events, up to and including the 200 year plus 30% climate change rainfall events. The conceptual surface water drainage strategy (**Drawing 1**) attached indicates that there is available space for an attenuation basin and other controls within the proposed development boundary. The recommended mitigation measures and design outputs provided within this report should be used to provide guidance for the further detailed drainage design of surface water infrastructure required to support any future proposed development.

7.4.3 Network Rail should be further consulted, in order to confirm any additional requirements for discharging to the unnamed watercourse at the rate as detailed within the outline DS

7.4.4 With the finalisation of a Site layout masterplan, the conceptual drainage strategy detailed herein will need to be updated to reflect any changes to Site permeability and associate surface water runoff and management requirements to support the proposed development.

Appendix 1 – AIRD Group Topographic Survey (Drawing No. G/R/1000)



LEGEND

CONTROL STATIONS	AG2
BUSH	
TREE	
DROP KERB	DK
EMBANKMENT	TOP BANK / BOTTOM BANK
OVERHEAD ELECTRICITY LINE	
OVERHEAD TELEPHONE LINE	
FOOTPATH	
FENCE	P/W
HEDGE	
FOLIAGE	
EXISTING BUILDING	
CONTOUR	50.00

AV	Air Valve
B	Bollard
BH	Borehole
BM	Bench Mark
BP	Block Paviours
BS	Bus Stop
BT	BT Inspection Chamber
C/B	Close Boarded Fence
CC	CATV Cover
CL	Cover Level
C/L	Chain Link Fence
CP	Catch Pit
DK	Drop Kerb
DP	Downpipe
EB	Electricity Control Box
EL	Eave Level
EP	Electricity Pole
ER	Earthing Rod
FB	Flower Bed
FH	Fire Hydrant
FL	Floor Level
GH	Greenhouse
GL	Ground Level
GP	Gate Post
GR	Grate
GV	Gas Valve
GY	Gulley
IC	Inspection Chamber
IL	Invert Level
KO	Kerb Outlet
I/R	Iron Railings
LP	Lamp Post
MH	Man Hole
MK	Marker Post
MS	Mile Stone Marker
NP	Street Name Plate
O/H	Overhead
P	Post
PB	Post Box
PE	Pipe
PM	Parking Meter
PS	Paving Slabs
P/R	Post & Rail Fence
P/W	Post & Wire Fence
PYL	Electricity Pylon
RE	Rodding Eye
RL	Ridge Level
RS	Road Sign
RSJ	Reinforced Steel Joist
R/W	Retaining Wall
SC	Stop Cock
SL	Soffit Level
SP	Sign Post
ST	Stop Tap
SV	Stop Valve
SY	Stay Wire
TCB	Telephone Call Box
TH	Trial Hole
TL	Traffic Light
T/P	Tactile Paving
ToW	Top Of Wall
TP	Telegraph Pole
WM	Water Meter
WO	Wash Out

Station	Easting	Northing	Level	Description
AM3	315899.662	667552.116	126.576	PEG
AM4 / AM5	[illegible]	[illegible]	[illegible]	PEG
AM6	316155.357	667407.778	148.460	PEG
AM7	316151.168	667390.653	150.804	PEG
AM8	316168.337	667384.726	148.301	PEG
AM9	316178.907	667362.137	148.083	PEG
AM10	316151.239	667347.521	155.725	PEG
AM11	316116.513	667343.728	158.512	PEG
AM12	316009.226	667342.971	156.781	PEG
AM13	315961.848	667293.366	161.493	PEG
AM10A	316164.517	667313.493	157.112	PEG
AM10B	316150.954	667314.006	158.396	PEG
AM4A	316138.128	667679.103	119.016	PEG
AM6A	316165.781	667430.450	140.132	PEG
AM6B	316165.585	667453.444	141.567	PEG
AM6C	316155.032	667475.184	133.763	PEG
SM1	315896.602	667237.970	164.559	P/K NAIL
SM2	315915.823	667165.955	166.034	P/K NAIL
SM3	315863.418	667334.720	151.884	P/K NAIL
SM4	315840.250	667439.641	139.538	P/K NAIL
SM5	315813.074	667532.068	128.774	P/K NAIL
SM6	315733.914	667480.159	132.546	PEG
SM7	315611.105	667447.196	135.654	PEG
SM8	315506.033	667476.814	130.842	PEG

BENCH MARK INFORMATION

3D Co-ordinate System Is Based on O.S GPS Active Network.

SHEET LAYOUT PLAN

Sheet 1 | Sheet 2 | Sheet 3 | Sheet 4

Sheet 1 of 4

AIRD GROUP

CHARTERED SURVEYORS & CONSULTING ENGINEERS
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MANCHESTER Tel:- 0161 973 8500 FAX:- 0161 973 8505

CLIENT

RAPLEYS

PROJECT

RAVELRIG ROAD
BALERNO

TITLE

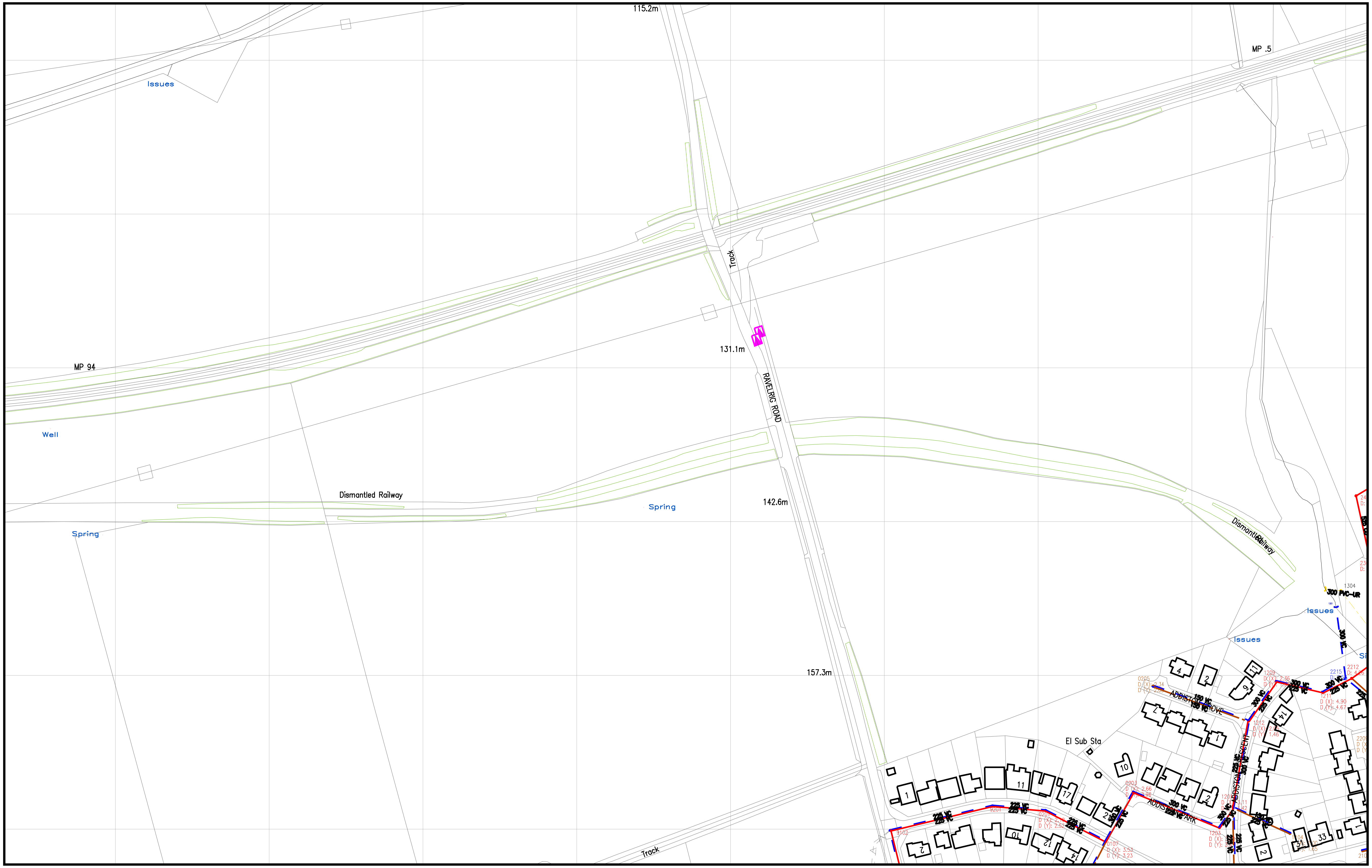
TOPOGRAPHICAL SURVEY

PROJECT NO.

G/R/1000

DRAWN BY: AJM	SCALE: 1:500 @ A0	DATE: 07.10.2019
CHECKED BY: SJB		

Appendix 2 – Scottish Water Sewer Plans (Document Ref – OP-ILHKA040)



N

The representation of physical assets and the boundaries of areas in which Scottish Water and others have an interest does not necessarily imply their true positions. For further details contact the appropriate District Office.

Date Plotted: 29/10/2019

Sewer Plan

OP-ILHKA040

0 236 metres

Scale: 1:2500

Plotted By: intocli02

Scottish Water
Always serving Scotland
Castle House,
6 Castle Drive,
Dunfermline,
KY11 8GG
Tel No: 0845 601 8855

Appendix 3 – Site Walkover Photographs

Photo 1 – Looking up Ravelrig road from the bridge over the Railway Line.

Photo 2 – Site Access to the eastern via gateway. Alternately, Site access to western portion of the Site provided in same location, opposite side of highway.

Photo 3 – Looking up the unnamed watercourse form north to south towards the start of the housing estate located along the south east corner of the Site.

Photo 4 – Looking down the unnamed watercourse from south to north.

Photo 5 – Looking north down the unnamed watercourse where it meets with the Edinburgh - Glasgow railway line

Photo 6 –Unnamed watercourse passing beneath the Edinburgh - Glasgow railway line through a box culvert

Photo 7 - Land drain running adjacent to the Edinburgh - Glasgow railway line conveying flows to the unnamed watercourse

Photo 8 – Looking north east across the Site from the south western corner of the Site

Photo 9 – Looking towards north eastern corner of the Site from the southern corner of the Site on the eastern side of Ravelrig Road.

Appendix 4 – SEPA Flood Risk Assessment Checklist (SS-NFR-F-001)

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 13 - Last updated 15/04/2015)

This document should be attached within the front cover of any flood risk assessments issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. The document will take only a few minutes to complete and will assist SEPA in reviewing FRAs, when consulted by LPAs. This document should not be a substitute for a FRA.

Development Proposal

Site Name	Land at Balerno		
Grid Reference	Easting: 315788	Northing: 667273	
Local Authority	Edinburgh City Council		
Planning Reference number (if known)			
Nature of the development	Residential	If residential, state type:	Not Known
Size of the development site	22.13 Ha		
Identified Flood Risk	Source: Pluvial	Source name:	Surface Water

Supporting Information

Have clear maps / plans been provided within the FRA (including topographic and flood inundation plans)	Yes		
Has a historic flood search been undertaken?	Yes		
Is a formal flood prevention scheme present?	No	If known, state the standard of protection offered	
Current / historical site use	Greenfield, grassland		

Hydrology

Area of catchment	22.13 km^2		
Qmed estimate	0.14 m^3/s	Method:	Catchment Descriptors
Estimate of 200 year design flood flow	0.42 m^3/s		
Estimation method(s) used *	Rainfall-runoff	If other (please specify methodology used):	
		If Pooled analysis have group details been included	Select from List

Hydraulics

Hydraulic modelling method	n/a	Software used:	Select from List
If other please specify			
Modelled reach length	m		
Any structures within the modelled length?	Select from List	Specify, if combination	
Brief summary of sensitivity tests, and range:			
variation on flow (%)	%		
variation on channel roughness			
blockage of structure (range of % blocked)	%	[Reference CIRIA culvert design guide R168, section 8.4]()	
boundary conditions:	**Upstream**	**Downstream**	
(1) type	Flow	Select from List	
	Specify if other	Specify if other	
(2) does it influence water levels at the site?	Select from List	Select from List	
Has model been calibrated (gauge data / flood records)?	Select from List		
Is the hydraulic model available to SEPA?	Select from List		
Design flood levels	200 year ___ m AOD	200 year plus climate change ___ m AOD	

SEPA Scottish Environment Protection Agency

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 13 - Last updated 15/04/2015

Coastal						
Estimate of 200 year design flood level		NA	m AOD			
Estimation method(s) used		Select from List		If other (please specify methodology used):		
Allowance for climate change (m)		NA	m			
Allowance for wave action etc (m)		NA	m			
Overall design flood level		NA	m AOD			
Development						
Is any of the site within the functional floodplain? (refer to SPP para 255)		No		If yes, what is the net loss of storage	NA	m^3
Is the site brownfield or greenfield		Greenfield				
Freeboard on design water level (m)		NA	m			
Is the development for essential civil infrastructure or vulnerable groups?		No		If yes, has consideration been given to 1000 year design flood?	Select from List	
Is safe / dry access and egress available?		Select from List		Min access/egress level	NA	m AOD
If there is no dry access, what return period is dry access available?		NA	years			
If there is no dry access, what is the impact on the access routes?	Max Flood Depth @ 200 year event:	NA	m	Max Flood Velocity:	NA	m/s
Design levels	Ground level		m AOD	Min FFL:	NA	mAOD
Mitigation						
Can development be designed to avoid all areas at risk of flooding?		Yes				
Is mitigation proposed?		No				
If yes, is compenstory storage necessary?		No				
Demonstration of compensatory storage on a "like for like" basis?		No				
Should water resistant materials and forms of construction be used?		No				
Comments						
Any additional comments:		A Flood Risk Assessment (Ref: 13582/FRA/001) identifies the Site not to be at any singifcant risk of flooding from pluvial, fluvial or ground water flooding, with only a low risk of pluvial flooding. This will be mitigated through the implementation of a SuDS system adequatley sized to manage flows in up to the 1 in 200yr +30CC annual probability event.				

Approved by:	
Organisation:	**ECUS Ltd**
Date:	**08/11/2019**

Note: Further details and guidance is provided in 'Technical Flood Risk Guidance for Stakeholders' which can be accesssed here:- **CLICK HERE**

***** ReFH2 is now accepted by SEPA for flow estimates in Scotland. Any use of this method should be compared with other accepted methods.***

Appendix 5 – MicroDrainage Greenfield Runoff Rate Estimation Calculations (IH-124 & ICP-SUDS)

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.470
Area (ha)	22.130	Urban	0.000
SAAR (mm)	895	Region Number	Region 2

Results	**l/s**
QBAR Rural	142.4
QBAR Urban	142.4
Q100 years	374.6
Q1 year	123.9
Q30 years	270.2
Q100 years	374.6

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.470
Area (ha)	22.130	Urban	0.000
SAAR (mm)	895	Region Number	Region 2

Results	**l/s**
QBAR Rural	155.8
QBAR Urban	155.8
Q100 years	409.7
Q1 year	135.5
Q2 years	142.4
Q5 years	183.8
Q10 years	221.2
Q20 years	266.0
Q25 years	282.3
Q30 years	295.5
Q50 years	338.7
Q100 years	409.7
Q200 years	464.3
Q250 years	483.0
Q1000 years	599.8

Warning: It is unusual to use the IH124 method with an area < 50ha. The Interim Code of Practice recommends that the IH124 method is applied with 50ha and the resulting discharge is linearly interpolated for the required area. The ICP SUDS tab will do this automatically.

Appendix 6 - Microdrainage Source Control Simulation for Sub-surface Attenuation Tank System

Summary of Results for 30 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	120.456	0.256	58.3	1632.3	O K
30 min Summer	120.549	0.349	89.7	2246.3	O K
60 min Summer	120.650	0.450	98.1	2942.4	O K
120 min Summer	120.754	0.554	99.5	3670.0	O K
180 min Summer	120.813	0.613	99.6	4094.9	O K
240 min Summer	120.852	0.652	99.6	4376.5	O K
360 min Summer	120.899	0.699	99.6	4717.4	O K
480 min Summer	120.928	0.728	99.6	4936.4	O K
600 min Summer	120.949	0.749	99.6	5091.2	O K
720 min Summer	120.964	0.764	99.6	5201.8	O K
960 min Summer	120.982	0.782	99.6	5334.9	O K
1440 min Summer	120.989	0.789	99.6	5388.4	O K
2160 min Summer	120.967	0.767	99.6	5225.6	O K
2880 min Summer	120.929	0.729	99.6	4943.9	O K
4320 min Summer	120.842	0.642	99.6	4304.0	O K
5760 min Summer	120.761	0.561	99.6	3716.1	O K
7200 min Summer	120.692	0.492	98.9	3234.7	O K
8640 min Summer	120.637	0.437	97.8	2852.6	O K
10080 min Summer	120.595	0.395	96.5	2563.7	O K
15 min Winter	120.486	0.286	68.8	1826.0	O K
30 min Winter	120.589	0.389	96.2	2518.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	57.549	0.0	1331.3	26
30 min Summer	40.351	0.0	1969.3	40
60 min Summer	27.116	0.0	2949.3	68
120 min Summer	17.601	0.0	3874.5	126
180 min Summer	13.575	0.0	4504.8	184
240 min Summer	11.262	0.0	4996.6	242
360 min Summer	8.635	0.0	5763.5	340
480 min Summer	7.143	0.0	6364.6	404
600 min Summer	6.162	0.0	6866.1	470
720 min Summer	5.460	0.0	7299.7	536
960 min Summer	4.509	0.0	8028.2	674
1440 min Summer	3.441	0.0	9139.2	956
2160 min Summer	2.625	0.0	10825.3	1368
2880 min Summer	2.166	0.0	11899.6	1764
4320 min Summer	1.650	0.0	13516.9	2548
5760 min Summer	1.359	0.0	15071.2	3280
7200 min Summer	1.169	0.0	16188.6	3968
8640 min Summer	1.034	0.0	17140.7	4664
10080 min Summer	0.931	0.0	17936.1	5344
15 min Winter	57.549	0.0	1521.2	26
30 min Winter	40.351	0.0	2238.4	39

Summary of Results for 30 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	120.704	0.504	99.1	3313.8	O K
120 min Winter	120.821	0.621	99.6	4150.4	O K
180 min Winter	120.889	0.689	99.6	4646.4	O K
240 min Winter	120.935	0.735	99.6	4983.0	O K
360 min Winter	120.991	0.791	99.6	5407.1	O K
480 min Winter	121.023	0.823	99.6	5646.1	O K
600 min Winter	121.041	0.841	99.6	5780.7	O K
720 min Winter	121.054	0.854	99.6	5882.0	O K
960 min Winter	121.068	0.868	99.6	5991.2	O K
1440 min Winter	121.061	0.861	99.6	5938.5	O K
2160 min Winter	121.010	0.810	99.6	5547.1	O K
2880 min Winter	120.939	0.739	99.6	5019.2	O K
4320 min Winter	120.793	0.593	99.6	3949.5	O K
5760 min Winter	120.672	0.472	98.6	3093.2	O K
7200 min Winter	120.588	0.388	96.2	2515.8	O K
8640 min Winter	120.549	0.349	89.7	2247.7	O K
10080 min Winter	120.524	0.324	82.0	2079.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	27.116	0.0	3322.7	68
120 min Winter	17.601	0.0	4358.5	124
180 min Winter	13.575	0.0	5063.9	182
240 min Winter	11.262	0.0	5614.2	238
360 min Winter	8.635	0.0	6472.1	350
480 min Winter	7.143	0.0	7143.9	458
600 min Winter	6.162	0.0	7704.0	552
720 min Winter	5.460	0.0	8187.9	580
960 min Winter	4.509	0.0	8999.4	736
1440 min Winter	3.441	0.0	10230.1	1046
2160 min Winter	2.625	0.0	12136.2	1492
2880 min Winter	2.166	0.0	13342.8	1904
4320 min Winter	1.650	0.0	15172.1	2680
5760 min Winter	1.359	0.0	16890.4	3352
7200 min Winter	1.169	0.0	18145.4	3968
8640 min Winter	1.034	0.0	19218.5	4592
10080 min Winter	0.931	0.0	20126.7	5344

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	13.700	Shortest Storm (mins)	15
Ratio R	0.250	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 15.490

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	5.170	4	8	5.160	8	12	5.160

Time Area Diagram

Total Area (ha) 0.000

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

Model Details

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 120.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	6150.0	1.300	8509.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0390-9960-1300-9960
Design Head (m)	1.300
Design Flow (l/s)	99.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	390
Invert Level (m)	120.200
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	99.6
Flush-Flo™	0.587	99.6
Kick-Flo®	1.022	88.6
Mean Flow over Head Range	-	79.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	10.8	1.200	95.8	3.000	149.6	7.000	226.5
0.200	38.6	1.400	103.2	3.500	161.3	7.500	234.3
0.300	74.0	1.600	110.2	4.000	172.2	8.000	241.9
0.400	96.6	1.800	116.7	4.500	182.4	8.500	249.2
0.500	99.0	2.000	122.8	5.000	192.1	9.000	256.3
0.600	99.6	2.200	128.6	5.500	201.3	9.500	263.2
0.800	97.2	2.400	134.2	6.000	210.0		
1.000	90.0	2.600	139.5	6.500	218.5		

Summary of Results for 200 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	120.574	0.374	95.6	2420.3	O K
30 min Summer	120.718	0.518	99.3	3416.2	O K
60 min Summer	120.876	0.676	99.6	4550.3	O K
120 min Summer	121.029	0.829	99.6	5690.9	O K
180 min Summer	121.117	0.917	99.6	6373.3	O K
240 min Summer	121.178	0.978	99.6	6844.6	O K
360 min Summer	121.256	1.056	99.6	7465.6	Flood Risk
480 min Summer	121.299	1.099	99.6	7816.3	Flood Risk
600 min Summer	121.323	1.123	99.6	8013.0	Flood Risk
720 min Summer	121.338	1.138	99.6	8131.5	Flood Risk
960 min Summer	121.356	1.156	99.6	8285.4	Flood Risk
1440 min Summer	121.367	1.167	99.6	8373.6	Flood Risk
2160 min Summer	121.351	1.151	99.6	8238.1	Flood Risk
2880 min Summer	121.315	1.115	99.6	7948.2	Flood Risk
4320 min Summer	121.218	1.018	99.6	7164.2	Flood Risk
5760 min Summer	121.102	0.902	99.6	6255.5	O K
7200 min Summer	120.994	0.794	99.6	5427.1	O K
8640 min Summer	120.897	0.697	99.6	4704.6	O K
10080 min Summer	120.814	0.614	99.6	4096.7	O K
15 min Winter	120.617	0.417	97.2	2713.7	O K
30 min Winter	120.778	0.578	99.6	3838.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	85.691	0.0	2110.0	26
30 min Summer	61.039	0.0	3114.2	40
60 min Summer	41.247	0.0	4569.0	70
120 min Summer	26.488	0.0	5906.6	128
180 min Summer	20.263	0.0	6792.9	186
240 min Summer	16.694	0.0	7468.1	246
360 min Summer	12.665	0.0	8499.2	364
480 min Summer	10.391	0.0	9289.4	482
600 min Summer	8.905	0.0	9936.7	600
720 min Summer	7.847	0.0	10486.1	656
960 min Summer	6.422	0.0	11381.0	776
1440 min Summer	4.838	0.0	12603.8	1038
2160 min Summer	3.645	0.0	15053.9	1456
2880 min Summer	2.979	0.0	16386.5	1876
4320 min Summer	2.237	0.0	18374.7	2692
5760 min Summer	1.824	0.0	20254.8	3464
7200 min Summer	1.556	0.0	21577.7	4184
8640 min Summer	1.366	0.0	22694.5	4928
10080 min Summer	1.223	0.0	23622.0	5560
15 min Winter	85.691	0.0	2395.5	26
30 min Winter	61.039	0.0	3515.7	40

Summary of Results for 200 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	120.953	0.753	99.6	5120.8	O K
120 min Winter	121.124	0.924	99.6	6421.7	O K
180 min Winter	121.224	1.024	99.6	7214.4	Flood Risk
240 min Winter	121.292	1.092	99.6	7759.6	Flood Risk
360 min Winter	121.378	1.178	99.6	8463.3	Flood Risk
480 min Winter	121.428	1.228	99.6	8883.7	Flood Risk
600 min Winter	121.459	1.259	99.6	9142.7	Flood Risk
720 min Winter	121.478	1.278	99.6	9297.2	Flood Risk
960 min Winter	121.491	1.291	99.6	9414.5	Flood Risk
1440 min Winter	121.496	1.296	99.6	9451.4	Flood Risk
2160 min Winter	121.461	1.261	99.6	9157.3	Flood Risk
2880 min Winter	121.401	1.201	99.6	8652.8	Flood Risk
4320 min Winter	121.245	1.045	99.6	7384.1	Flood Risk
5760 min Winter	121.052	0.852	99.6	5868.2	O K
7200 min Winter	120.884	0.684	99.6	4607.8	O K
8640 min Winter	120.749	0.549	99.5	3631.9	O K
10080 min Winter	120.648	0.448	98.1	2928.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	41.247	0.0	5135.1	68
120 min Winter	26.488	0.0	6630.4	126
180 min Winter	20.263	0.0	7619.3	184
240 min Winter	16.694	0.0	8372.0	242
360 min Winter	12.665	0.0	9521.6	356
480 min Winter	10.391	0.0	10399.8	470
600 min Winter	8.905	0.0	11115.9	582
720 min Winter	7.847	0.0	11719.7	688
960 min Winter	6.422	0.0	12687.3	884
1440 min Winter	4.838	0.0	13877.8	1106
2160 min Winter	3.645	0.0	16868.1	1580
2880 min Winter	2.979	0.0	18356.6	2028
4320 min Winter	2.237	0.0	20569.4	2936
5760 min Winter	1.824	0.0	22696.0	3688
7200 min Winter	1.556	0.0	24181.8	4392
8640 min Winter	1.366	0.0	25440.1	5016
10080 min Winter	1.223	0.0	26499.1	5648

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	200	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	13.700	Shortest Storm (mins)	15
Ratio R	0.250	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 15.490

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	5.170	4	8	5.160	8	12	5.160

Time Area Diagram

Total Area (ha) 0.000

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

Model Details

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 120.200

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	6150.0	1.300	8509.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0390-9960-1300-9960
Design Head (m)	1.300
Design Flow (l/s)	99.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	390
Invert Level (m)	120.200
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.300	99.6
Flush-Flo™	0.587	99.6
Kick-Flo®	1.022	88.6
Mean Flow over Head Range	-	79.9

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

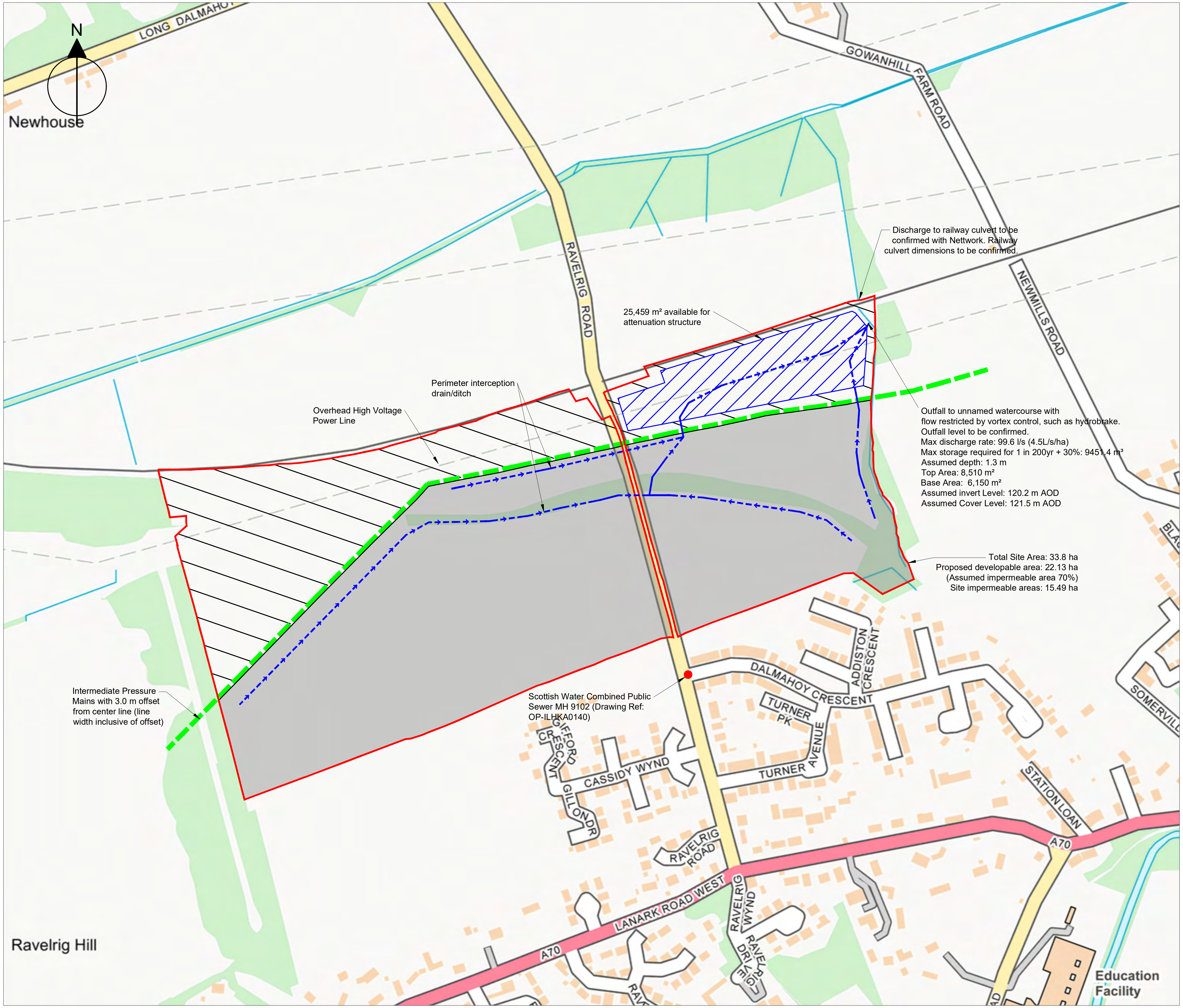
Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	10.8	1.200	95.8	3.000	149.6	7.000	226.5
0.200	38.6	1.400	103.2	3.500	161.3	7.500	234.3
0.300	74.0	1.600	110.2	4.000	172.2	8.000	241.9
0.400	96.6	1.800	116.7	4.500	182.4	8.500	249.2
0.500	99.0	2.000	122.8	5.000	192.1	9.000	256.3
0.600	99.6	2.200	128.6	5.500	201.3	9.500	263.2
0.800	97.2	2.400	134.2	6.000	210.0		
1.000	90.0	2.600	139.5	6.500	218.5		

Appendix 7 – CEC Surface Water Management Checklist

	Item	Provided? (Y/N)	Submission Section Reference	If N comment reason
1	Location Plan.	Y	Section 3.1	
2	Pre development overland flow path arrows for site **and surrounding land**.	Y	Appendix 2	
3	Area of impermeable surface in proposed development.	Y	Section 6.2 Section 6.4	
4	Greenfield runoff calculations for impermeable area.	Y	Section 6.4 and Appendix 5	
5	Confirmation that attenuation is provided to allow 200yr+CC discharge at the lesser of *: • 1:2 year greenfield runoff rate; • 4.5 l/s/ha of **impermeable area.** *Subject to minimum 75mmØ flow control (3l/s)	Y	Section 6.6 and Appendix 6	
6	Volume of attenuation required to allow discharge at greenfield rate (m³). Volume of attenuation provided within the proposed drainage layout (m³).	Y	9451.4m3 9451.4m3	
7	• Hand calculations or • Hydraulic modelling outputs with pipes included[1] and 30year+CC and 200year +CC outputs. (1000year+CC for civil infrastructure[2]).	N		Outline Application
8	Drainage drawing with manhole numbers that cross reference with the hydraulic modelling outputs.	N		Outline Application
9	Confirmation that 30year +CC event remains below ground and that 200year +CC remains attenuated on site safely[3].	Y	Section 6.6 and Appendix 6	
10	Post development flow paths for site and surrounding area (on separate plan to pre development)[4].	Y	Appendix 3	
11	Confirmation of who will adopt and maintain the surface water system including SuDS.	N		Outline Application
12	Confirmation where the surface water ultimately discharges.	Y	Section 6.2	
13	Confirmation that appropriate water quality measures (SuDS treatment) is included in the design in line with relevant guidance.		Section 6.2 and 6.3	
14	If discharging surface water to public sewer - confirmation that Scottish Water agree in principal to proposed connection.	N		Not Discharging to Public Sewer
15	Does the proposed design take cognisance of Section 3.7 Water Environment (Edinburgh Design Guidance) and Policies Des 5 City Local Plan, E44 Rural West Local Plan and Des 8 Edinburgh Local Development Plan?	Y	Overarching Report	

[1] Pipe network only required for FUL and AMC applications. Where part of a larger strategy attenuation network then this must all be represented. For PPP applications minimum requirements are total storage volume and subsequent to-scale representation and location shown on plan layout.
[2] Refer to SPP for definition of civil infrastructure.
[3] All property FFLs are 600mm above this 200-year water level.
[4] For PPP applications where the site layout has not been finalised, an indication of the general intention for overland water flow paths should be presented.

Drawing 1 – 13582/001– Conceptual Drainage Strategy – Indicative



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1. Do not scale from drawing. Indicative only, not issued for construction. All units in meters unless otherwise indicated.
2. The proposed development area is indicative only and following the completion of a site layout masterplan, the associated drainage network should be updated to reflect drainage needs of the site layout.
3. The drainage network is assumed to consist of a combination of ditches, swales and filter trenches. The network has not currently been sized.
4. The maximum area available for attenuation indicated within the plan and is not representative of the actual area required for storage for surface water runoff.
5. Drawing should be read in conjunction with Report 13582/FRA/001.
6. Surface Water calculations performed in MicroDrainage. Attached as Appendix 5 and 6 to 13582/FRA/001.
7. In the absence of site levels a fall towards the drainage network has been assumed.

Site Boundary
SW Ditch or Swale
Intermediate Pressure Gas Main
High Voltage Power Line
Assumed Developable Area
Assumed Undeveloped Area
Area Available for Attenuation
Scottish Water Combined Sewer MH

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Outline Surface Water Drainage Strategy - Indicative Arrangement

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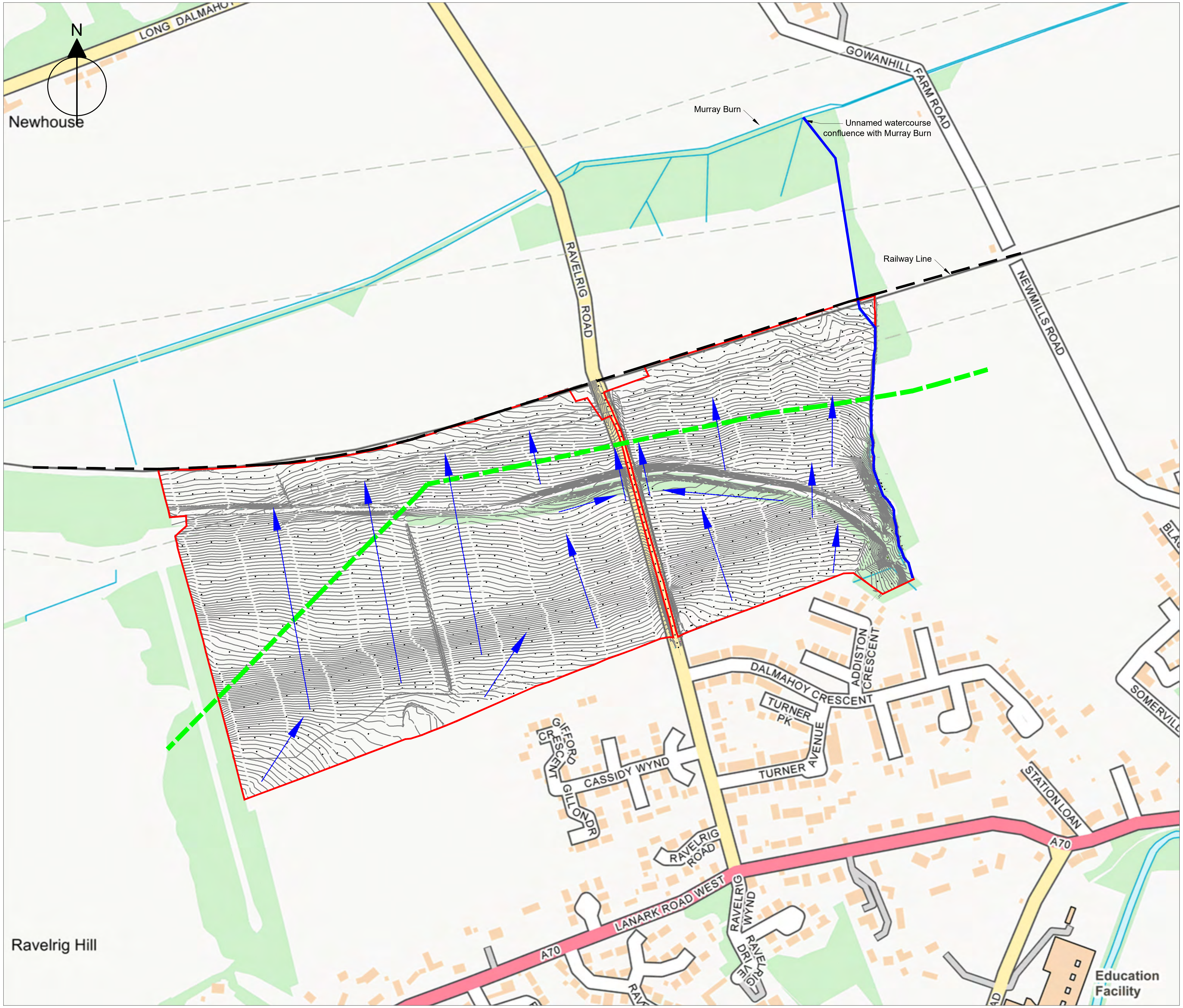
Drawing 2 – 13582/002– Flow Paths Pre-Development



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1. Do not scale from drawing. Indicative only, not issued for construction. All units in meters unless otherwise indicated.
2. Drawing should be read in conjunction with Report 13582/FRA/001.

- Overland Surface Water Flow Path
- Site Boundary
- Existing Watercourse
- Railway Line
- Intermediate Pressure Gas Main

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Flow Paths Pre-Development

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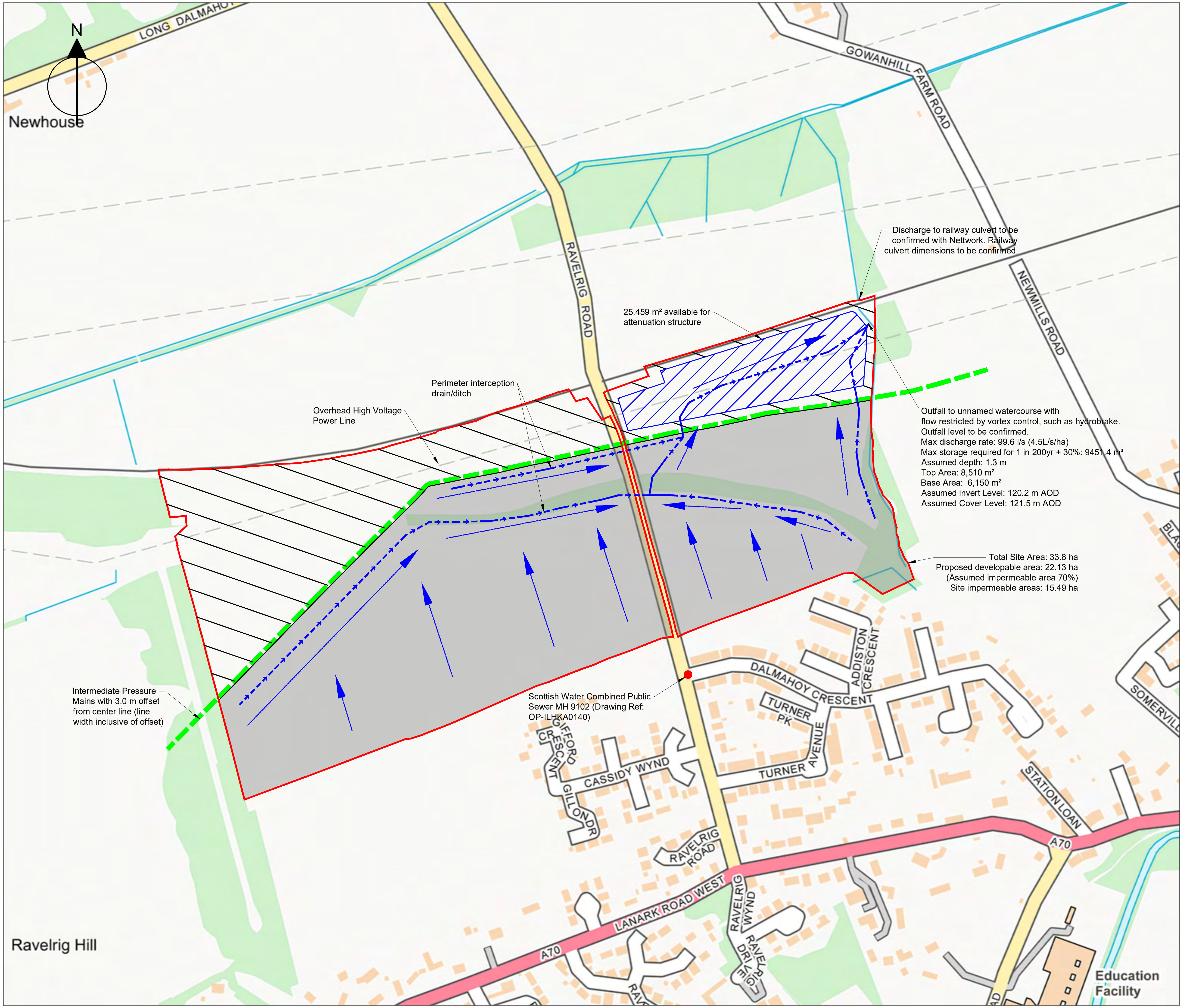
Drawing 3 – 13582/003– Flow Paths Post-Development



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1. Do not scale from drawing. Indicative only, not issued for construction. All units in meters unless otherwise indicated.
2. The proposed development area is indicative only and following the completion of a site layout masterplan, the associated drainage network should be updated to reflect drainage needs of the site layout.
3. The drainage network is assumed to consist of a combination of ditches, swales and filter trenches. The network has not currently been sized.
4. The maximum area available for attenuation indicated within the plan and is not representative of the actual area required for storage for surface water runoff.
5. Drawing should be read in conjunction with Report 13582/FRA/001.
6. Surface Water calculations performed in MicroDrainage. Attached as Appendix 5 and 6 to 13582/FRA/001.
7. In the absence of site levels a fall towards the drainage network has been assumed.

- Site Boundary
- Surface Water Flow Path
- SW Ditch or Swale
- Intermediate Pressure Gas Main
- High Voltage Power Line
- Assumed Developable Area
- Assumed Undeveloped Area
- Area Available for Attenuation
- Scottish Water Combined Sewer MH

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Assumed Flow Paths Post-Development

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