Proposed Residential Development
At Land Adjacent to Dalmahoy Road & A71, Edinburgh
Drainage & Engineering Assessment Report

GM CIVIL AND STRUCTURAL CONSULTING ENGINEERS LTD
TANNOCHSIDE BUSINESS PARK, GROVE HOUSE- 1ST FLOOR
1 KILMARTIN PLACE, TANNOCHSIDE
UDDINGSTON, G71 5PH
Tel: 01698 816455
www.gmcivilandstructural.co.uk
(Registered In Scotland Number SC392802)

CONTROL SHEET

CLIENT: **Inverdunning (Hatton Mains) Ltd**

PROJECT TITLE: **Proposed Residential Development at Land Adjacent to Dalmahoy Road & A71, Edinburgh**

REPORT TITLE: **Drainage & Engineering Assessment Report**

PROJECT REFERENCE: **7485**

Issue and Approval Schedule:

ISSUE 1	Name	Signature	Date
Prepared by	Mike Carlin		20/02/20
Reviewed by	Gordon Maxwell		20/02/20

Contents

Section 1 – Introduction

Inverdunning (Hatton Mains) Ltd, has lodged formal LDP application to Edinburgh City Council for development of land for circa 1200 No. Residential Dwellings with associated access roads and in-curtilage driveways and associated parking courts at land adjacent to Dalmahoy Road and the A71, Edinburgh.

GM Civil and Structural Consulting Engineers Ltd (GM), have been commissioned to assess the engineering master planning, drainage and SUDS, as well as any potential constraints. The report will investigate desktop ground conditions, topography, earthworks and drainage strategy as part of a LDP Application.

1.1 Site Description

The site is located approximately 24km to the southwest of Edinburgh city Centre, located within the administrative boundary of City of Edinburgh Council. The approximate centre of the site is located at Ordnance Survey Grid Reference NT1469 4854. The site is bordered by the A71, to the south, and by agricultural fields to the north, northwest and east. To the southwest, lies Easter Hatton Mains and along the southern border lies Ratho Park Carvery, which, incorporates St Mary's Church Hall and refectory cottage (A Listed Building).

This building lies out with the existing development site, therefore, will be retained. The site is bisected by Dalmahoy Road, a duel lane minor road.

The site is approximately 58 Ha in size, consisting of previously undeveloped land, in the form of agricultural fields, in the greenbelt.

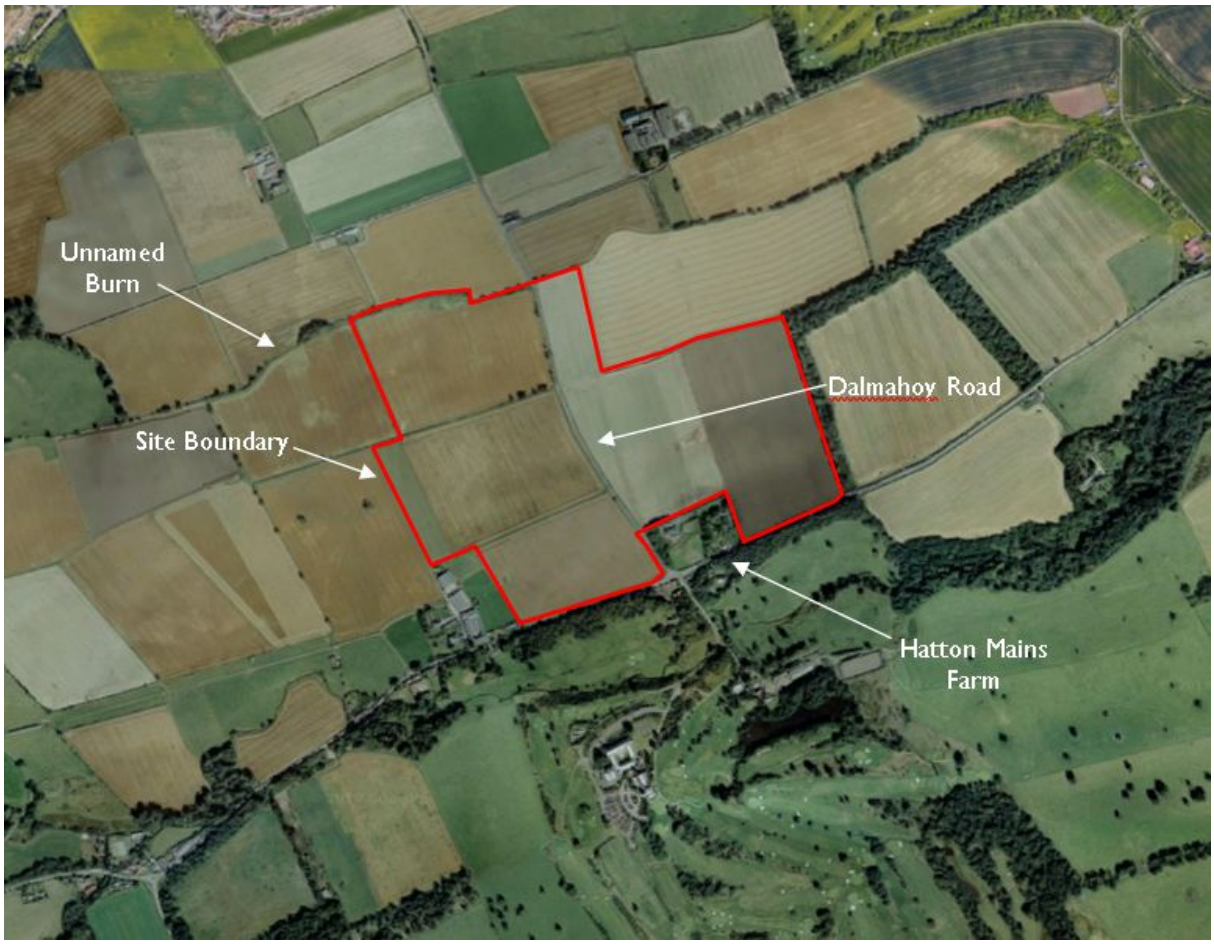

Figure 1 - Site Description

1.2 Masterplan Proposals

An overall site masterplan has been prepared showing the possible extent of residential development and associated infrastructure as shown in figure 2 below. Large areas of open space are incorporated to provide public amenity and to accommodate the site topography.

Access will be by way of a T-junction off A71. For further information on the site access and travel proposals, refer to the Transportation Assessment.

Figure 2 – Site Masterplan Layout

Section 2 – Site Topography and Earthworks

2.1 Topography

The site topography has been assessed from the detailed topographical survey (refer to Appendix A – Topographical Survey).

Proposed levels have been assessed in areas identified as being out with acceptable gradients, in certain areas the levels will require to be engineered to provide development platforms that will allow drainage connection levels to be achieved.

There is an existing watercourse to the north of the site, which, is running in a west to east direction and appears to be an unnamed tributary of the Union Canal.

The area to the south east corner, around this watercourse forms the lowest part of the site, where levels are around 86m AOD.

The highest levels are around the middle of the site, along the western boundary and are around 101m AOD.

2.2 Earthworks

As part of the engineering assessment of the masterplan, GM prepared an engineering levels layout and a drainage strategy layout to ensure the masterplan proposals could drain the foul and surface water flows from the site via a gravity system, with all internal roads and junctions complying with the National Road Guidelines.

GM prepared an initial cut / fill volumetric exercise to ascertain initial earthwork volumes required to construct suitable formation level platforms (refer to Appendix B – Earthworks Isopachyte).

Indicative earthworks volumes can be summarised as follows:

Table 1 – Topsoil

Initial Site Topsoil Strip	
Description	**Volumes (m3)**
200mm Topsoil Strip	114,600m3
Total Topsoil Required for Soft Landscape Areas	66,335m3
Total Surplus Topsoil to Be Removed from Site	**48,265m3**

Table 2 – Bulk Cut / Fill Earthworks (Zone 1)

Bulk Earthworks	
Description	**Volumes (m3)**
Bulk Cut	30,140m3
Bulk Fill	222,060m3
Net FILL Requirement	**191,920m3**

Table 3 – Bulk Cut / Fill Earthworks (Zone 2)

Bulk Earthworks	
Description	**Volumes (m3)**
Bulk Cut	126,500m3
Bulk Fill	64,420m3
Net CUT Requirement	**62,080m3**

Table 4 – Bulk Cut / Fill Earthworks (Zone 3)

Bulk Earthworks	
Description	**Volumes (m3)**
Bulk Cut	100,300m3
Bulk Fill	2,050m3
Net CUT Requirement	**98,250m3**

Table 5 – Bulk Cut / Fill Earthworks (Zone 4)

Bulk Earthworks	
Description	**Volumes (m3)**
Bulk Cut	43,280m3
Bulk Fill	18,500m3
Net Fill Requirement	**24,760m3**

Table 6– Final Site Earthworks to Form Formation Platforms (Includes Anticipated Arisings)

Site Earthworks	
Description	**Volumes (m3)**
Bulk Cut / Fill Volume Below Formation Level Model = (Nett Fill)	6,810m3
Bulk CUT Volume Generated	300,220m3
Bulk FILL Volume Generated	307,030m3
Number of Dwellings	1200 No.
Assume Additional Surplus Volume Generated Per Dwelling	60m3
Additional Surplus Volume Generated from Dwellings	72,000m3
Total Bulk CUT Volume Required to Be Exported	**65,190m3**

From the above figures, it is expected that Bulk CUT volume required to be exported will be increased by arisings from drainage tracks, therefore, it is considered that the development cannot be designed to provide an earthworks balance. (Refer to Appendix B – Earthworks Isopachyte).

2.3 Soil Movement

The above earthworks and soil movement have been considered in respect of phasing, site works and post construction impact.

Topsoil

The first site earthworks operation will be the stripping of overlying topsoil. This is likely to be undertaken in several phases and redistributed in the areas of proposed open space with some stockpiled for re-use. As the phase 1 development progresses some of this stockpile will be replaced in gardens and open space whilst, during the latter stages, the phase 2 topsoil strip will be progressing.

A landscape consultant will assess the stockpiled topsoil quality during the works to assess ongoing condition and requirement for additional nutrients to maintain suitability.

The thickness of existing topsoil has been taken as 200mm for this report, however, the exact thickness and volumes will be confirmed during the detailed site investigation works.

Subsoil

During regrading works, subsoils will be lifted and placed to facilitate development platform levels, as well as generated from excavations, road construction, drainage tracks etc. Site works will be programmed to minimise double handling of soils undertaken during appropriate weather conditions to ensure no unsuitable material / slurry is generated and the quality of the soils are maintained.

Site Restoration

On completion of construction works, all areas of open space / landscaping will be undertaken in accordance with the agreed specification, including topsoil improvement if necessary.

During the maintenance period the ground conditions will be monitored and if necessary remedial works undertaken including, if necessary, the addition of localised land drainage.

Section 3 – Drainage Systems

This section of the report outlines the existing drainage circumstances for the site and identifies both in the form of drawings and calculations proposals for the foul and surface water drainage to serve the new residential development with associated car parking, discharges to the existing adopted sewer network, and appropriate SUDS measures.

Scottish Planning Policy 2014 – Planning and Flooding requires that the Planning Authorities are satisfied with drainage proposals for development and this may be achieved via Drainage Impact Assessments.

The purpose of this section of the report is to assess the impact of surface water run-off from the proposed development and to demonstrate how the proposed drainage infrastructure impacts on the existing network / watercourse. The objectives of the proposed drainage infrastructure include developing of natural catchments where possible, controlling pollution at source and reducing any negative effects on the existing drainage network.

The proposed drainage strategy for the masterplan development complies with The Water Environment (Controlled Activities) (Scotland) Regulations 2005. The proposed surface water drainage network incorporates sustainable urban drainage (SUDS) prior to connection to the existing watercourse.

The proposed drainage strategy:

- In-curtilage Porous Block Paviour system (SUDS) with no risk of groundwater pollution via infiltration
- End of line Detention Basins and various Roadside Treatment Trenches (SUDS) with no risk of groundwater pollution via infiltration
- Final Discharges to an existing watercourse.

3.1 Current Public Drainage Systems

There is an existing 225mm diameter combined sewer approximately 700m to the north of the site on Dalmahoy Road / Hillview cottages, Ratho, which, runs from west to east.

The combined sewer network collects foul & surface water from the existing residential properties within Hillview Cottages and Ratho Park Road, Ratho.

There is an existing surface water watercourse, which, runs along the northern boundary of the development site in a west to east direction before entering a culvert under Dalmahoy Road. (Refer to Appendix C – Scottish Water Record Plans)

3.2 Current Private Drainage Systems Within The Site

From historical record plans, it has been ascertained that the site of the proposed 1200No Residential Dwellings had previously been associated with farmland activities. Scottish Water Record Plans do not show any apparatus within this site.

3.3 Foul

Scottish Water have confirmed that a full DIA will be required for the site to ascertain if there is currently sufficient capacity within the existing network to service the development proposals. GM Civil & Structural Consulting Engineers are currently in discussions with Scottish Water regarding permission to connect the foul water flows from the development to the existing 225mm diameter combined sewer network manhole and tail to the south of Dalmahoy Road / Hillview Cottages, Ratho.

The proposed topography of the Development site confirms the internal road gradients to be falling with the direction of flow from the proposed development site, therefore, a gravity connection for foul water flows to the watercourse on the northern boundary can be achieved, before being pumped via a foul water pump station to the existing Scottish Water drainage system within Ratho.

3.4 Surface Water

Scottish Water have confirmed verbally that there is currently no capacity within the existing network to service the development proposals.

Surface water from the overall development will be collected via surface water gravity sewers prior to discharging to the existing watercourse within the northern part of the proposed development masterplan via SUDS measures. The drainage proposals have been prepared in line with the current masterplan and take cognisance of the minimum required floor levels and ensure that the sewers meet the requirements of Sewers for Scotland 4th Edition.

Treatment of surface water run-off from the internal road network, parking courts and roofs will be via various SUDS Basins and roadside treatment trenches, which, will collect, treat and attenuate all surface water run-off prior to discharging to the existing watercourse within the southern section of the development site.

The surface water flows will be limited to the 1 in 2-year Greenfield run-off rate of 40l/s via Hydrobrake flow control device, prior to discharging to the existing watercourse within the northern section of the development site.

3.5 Sustainable Drainage

Treatment of surface water run-off from the internal driveways, small parking courts roofs will be via porous block paviour system, which, will collect, treat and attenuate all surface water run-off from each in-curtilage plots.

North – an unnamed burn lies immediately north of the site. Land use beyond this is dominated by open / agricultural land, with some development present in the form of residential dwellings approximately 700m north of the watercourse, within the settlement of Ratho.

East – Land immediately east comprises open / agricultural land.

South – Land immediately south comprises of the A71 and Dalmahoy Hotel & Country Club.

West – Land immediately west comprises open / agricultural land.

Preliminary visual inspection of the site identified some variable undulation in topography.

An intrusive site investigation will be undertaken and will confirm existing water table, if any, and whether ground water flooding is a risk and to what severity.

An approximate breakdown of the development site is as follows: -

Total Area= 58.43 ha

Soft Landscaping 23.37ha

Hard Surfaces 35.06ha

A review of the geographical data for the site summarises the hydrological characteristics of the region as follows: -

Table 7: Hydrological Design Criteria

SAAR (Seasonal Annual Average Rainfall)	745mm From the Wallingford Procedure standard average annual rainfall map.
M5 – 60 (5-year Storm Event of 60 Minute Duration)	14mm From the Wallingford Procedure Map M5-60 min: rainfall depths (in mm) of five-year return period and 60-minute duration.
R (Rainfall Ratio)	0.3 From the Wallingford Procedure Map of Ratio r: ratio of sixty minute to two-day rainfalls of five-year return period.
Hydrological Region	2
SOIL Factor	0.47 Class 4 as derived from the Winter Rain Acceptance Potential Map.

3.5.1 Planning and Agreement of Design Criteria

Discussions are being held with the local authority, Scottish Water and SEPA and will continue from preliminary through to detailed design.

The characteristics of SUDS components and site constraints were reviewed to ensure a complete understanding of hydraulic, water quality, amenity and ecological constraints and opportunities were developed.

As a result of the discussions, design criteria for the site were set as follows (refer table 8):

Table 8: Summary of SUDS Design Criteria

Criteria	Design event	Design Objective
Protection against flooding.		
Protection against flooding from drainage system.	Site 10 / 30-year event plus 40% uplift (for climate change).	No flooding on site, except where planned and approved.
	Site 100 / 200-year event plus 30% uplift (for climate change).	Control risks to people and property. Finished floor levels = Max flood storage levels (1 in 200-year critical storm plus 30% uplift (or climate change) + 0.6m freeboard.
Protection against flooding from overland flows.	Site 100 / 200-year event plus 30% uplift (for climate change), short duration events.	Planned flood routing and temporary storage accommodated on site.
Protection against flooding from adjacent land.	Adjacent catchment, 100 / 200-year event (plus 30% uplift (for climate change).	Planned flood routing.

3.5.2 Hydraulic Design Criteria

- The surface water discharge for the access roads / parking courts and roofs will be connecting to the existing unnamed watercourse, therefore a strict criterion was imposed such that run-off from the proposed development for a 1 in 200-year event + 30% For climate change should be restricted to the Greenfield site 1 in 2-year run-off rate.
- The site is classed as Greenfield with cohesive soils, therefore, no infiltration is expected to be achieved.
- Safe flood flow paths across the site for events greater than 30 years.
- All property to be set at least 0.6 m above the 200-year flood levels plus 30% uplift (for climate change).
- Long-term storage is required to minimise the flood volumes discharged to the existing unnamed watercourse.

- Discharges from the site are limited to Greenfield flow rates.
- A 30 % allowance on rainfall is required for climate change.
- Sewers to be designed to meet criteria for sewers for Scotland 4th edition. All surface water runoff to be managed by the various end of line SUDS (Detention Basins).

3.5.3 Water Quality Design Criteria

The development is a low-risk residential site (1200 houses) within which, the proposed drainage network will discharge to the existing watercourse within the northern area of the site.

The SUDS Manual (CIRIA 2015) recommends a risk-based approach to levels of treatment for residential areas. Table 9 shows the recommended levels of treatment based on land use characteristic and sensitivity of the receiving water. The SUDS Manual (CIRIA2015) states the minimum level of treatment for residential developments is two levels.

Treatment level guidance is adapted for use in Scotland by SEPA Regulatory Method WAT-RM-08[1] (SEPA 2014), which takes a more detailed approach to development size and risk (Table 5). Regulatory Method WAT RM-08 stipulates that a residential development of greater than 1000 houses requires two levels of treatment for discharge to a normal sensitivity watercourse.

Table 9*:* Number of treatment stages by land type and receiving water sensitivity (Source: The SUDS Manual), CIRIA C753, 2015.

Receiving water sensitivity → / Runoff catchment characteristic ↓	Low	Medium	High
Roofs only	1	1	1
Residential roads, parking areas, commercial zones	2	2	3
Refuse collection/ industrial areas/ loading bays/lorry parks/highways	3	3	4

[1] SEPA Regulatory Method WAT-RM-08 v5.2 August 2014 cited; this has been superseded by Version: v6.1 (January 2017) to correspond with the simple index approach (CIRIA 2015).

Table 10: SEPA method to select appropriate levels of SUDS based upon catchment risk (Source: SEPA Regulatory Method WAT-RM-08 v5.2 August 2014).

	Number of houses / car park spaces				
Receiving Water Type	**<25**	**25-50**	**>50-100**	**100-1000**	**>1000**
Normal sensitivity watercourse	1 level	1 level	2 levels	2 levels	2 levels
Low sensitivity watercourse	1 level	1 level	1 level	2 levels	2 levels
Transitional waters	Minimal	Minimal	Minimal	Minimal	Section 4.5
Coastal waters	None	None	None	None	Section 4.5
GBR applies	*Standing planning advice* Local Authority checks source control design				
GBR applies	*SEPA provides site-specific planning advice* LA checks source control design				
GBR applies	*SEPA provides site-specific planning advice* LA checks source control design, Scottish Water checks pond/basin design if Sewers for Scotland 2				
Licence required	*SEPA provides site-specific planning advice* LA, Scottish Water, SEPA may check design				

The proposal for two levels of treatment is further reinforced by SUDS for Roads (Pittner and Allerton, 2009) which stipulates within Section 2.4.1.

"2.4.1 It is generally accepted that roads require two levels of treatment, although for smaller developments, residential roads may require only one level, depending on the sensitivity of the receiving watercourse. In addition, major trunk roads and motorways may merit three levels of treatment depending on traffic volumes and receiving watercourse sensitivity."

Discussions with SEPA identified that "This is a medium development relative to catchment size".

Consequently, the proposed drainage design incorporates road gullies to provide effective pre-treatment prior to a SUDS technique.

3.5.4 Amenity Design Criteria

There is limited space for surface water drainage which has high amenity value within residential development zones themselves. It is therefore important to develop a drainage solution that is fully integrated with, and complimentary to, the public open space areas, and that is visually attractive and safe for the public to enjoy.

3.5.5 Biodiversity Design Criteria

The watercourse corridor will maximise the ecological potential of any surface water systems within the public open space.

3.6 SUDS Selection

SUDS characteristics were reviewed to allow appropriate selection of surface water drainage components for the site. The main constraints / opportunities driving SUDS selection are summarised In Table 11 below:

Table 11: Site Constraints and Opportunities Driving SUDS Selection

Characteristic	Constraint /Opportunity
Development Type	• Residential development proposed, therefore solution requires particular consideration and provision for construction site runoff management; sediment management and water quality protection required before discharge to existing combined sewer network.
Soils	• Infiltration maybe possible in certain areas.
Groundwater	• Groundwater is not zoned as being sensitive.
Space Available	• Limited amount of green space, drainage opportunities around periphery of the site. • Space available for swales adjacent to access roads.
Site Topographical Characteristics	• Area comprises gently / steep sloping terrain.
Ownership / Maintenance	• Scottish Water adopted foul water pipe network on Hillview Cottages / Dalmahoy Road, Ratho. All proposed internal sewers to be designed to Sewers for Scotland 4th edition as they are likely to be adopted. None of the permeable surface drainage within the curtilage of each plot will be adopted.
Cost	• Pipe and storage systems designed to minimise capital maintenance costs.
Public Safety	• Health & Safety risks reduced by appropriate design and location of components. • Public education and awareness raising required for surface water drainage systems.

To take full account of all site constraints and opportunities, together with the benefits offered by a range of SUDS components, a SUDS scheme was designed taking account of Minimum Water Quality Management Requirements For discharges to Receiving Surface Waters and Groundwater (Table 12) and The Simple Index Approach, the results of which, are shown within Table 13 below.

Table 12: Minimum Water Quality Management Requirements for Discharges To Receiving surface Waters And Groundwater

Minimum water quality management requirements for discharges to receiving surface waters and groundwater

Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries[2]	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]*	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]*	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]* In England and Wales, Risk Screening[4] must be undertaken first to determine whether consultation with the environmental regulator is required. In Northern Ireland, the need for risk screening should be agreed with the environmental regulator.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit[3]. Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required[5].	

Notes

The minimum water quality management requirements for discharges to receiving surface waters and groundwater are presented here. (For Northern Ireland, this guidance should be considered as interim until such time as Northern Ireland publishes its own legislation/policy/guidance.)

1 These are not required in Scotland and Northern Ireland. For England and Wales, see Step 3 of the simple index approach (Section 26.7.1).

Protected surface water resources will include those designated for drinking water abstraction or for other environmental protection reasons. Protected groundwater resources are represented by SPZ1s in England and Wales.

2 In Scotland, the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 General Binding Rules, Rule 10 (d) (iv) effectively provides an exemption from requiring SuDS for coastal discharges. However, control of any contaminants likely to be present in surface water runoff is still required, but can be delivered using alternative methods such as proprietary treatment products. As the term 'SuDS' in this manual includes proprietary treatment products, this exemption is not valid in this context.

Table 13: Simple Index Approach Results

SIMPLE INDEX APPROACH: SUMMARY TABLE

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SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type	Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/motorways)				
Pollution Hazard Level	Medium				
Pollution Hazard Indices					
TSS	0.7				
Metals	0.6				
Hydrocarbons	0.7				
SuDS components proposed					
Component 1	Detention basin	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulic and treatment as set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Detention basins should be designed to ensure the effective retention and management of sediment, such that the sediment will not be resuspended and washed out in subsequent events		
Component 2	Detention basin	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulic and treatment as set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Detention basins should be designed to ensure the effective retention and management of sediment, such that the sediment will not be resuspended and washed out in subsequent events		
Component 3	None				
Pollution Mitigation Indices					
TSS	0.75				
Metals	0.75				
Hydrocarbons	0.9				
Groundwater protection type	None				
Groundwater protection Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices					
TSS	0.75	Note: In order to meet both Water Quality criteria set out in the SuDS Manual (Chapter 4), interception should be delivered for all impermeable areas wherever possible. Interception delivery and treatment may be met by the same components, but interception requires separate evaluation.	Reference to local planning documents should also be made to identify any additional protection required for nature due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England		
Metals	0.75				
Hydrocarbons	0.9				
Acceptability of Pollution Mitigation					
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				

The drainage solution proposed for the site is as follows (Appendix D – Drainage Strategy Layouts And Associated Construction Details):

The roofs and driveways are to be utilised for in-curtilage SUDS by utilising permeable paving to provide pollution control and some flow attenuation. The parking bays could be designed to lie above a granular sub-base, or above modular, geocelluar system units. The granular sub-base option has been selected.

Treatment of surface water run-off from the internal road network and parking courts will be via three Detention Basins and various roadside treatment trenches, which, will provide storage, treatment and flow attenuation.

3.7 Initial System Design

Surface Water Quality Treatment Design

Determine unit treatment volume Vt using the alternative approximate (Wallingford) method.

Reference to the Wallingford procedure vol. 3 maps would indicate that the M5 – 60 rainfall depths is approximately 14mm and the winter rain acceptance potential (WRAP) classification of the general soil on the site is class 4.

Vt (m^3 / ha) = 9 (soil / 2) D + (1 soil / 2) DI)

Where from the Wallingford procedure vol 1 section 7.4, SOIL is the soil index for WRAP class 4 soil,

Soil = 0.47

D = M5 – 60 rainfall depth = 14mm and

I = Impervious Fraction = 0.40

Vt (m^3 / ha) = 9D (Soil / 2 + (1 – Soil / 2) I)

= 9 x 14 (0.47 / 2 + (1 – 0.47 / 2) I)

= 29.61 + 96.39

For I = 0.4

Vt (m^3 / ha) = 29.61 + 96.39 x 0.4

= 50.40 m^3 / ha

For site catchments' area = 58.43 ha

Total design treatment volume TVt

= Vt m x total site catchments' area

= 58.43 x 50.40

= 2944.87m^3

Total design treatment volume TVt

= Say 2945m^3

The above gives a clear indication that facilities designed to deal with water quantity control will require to be much larger than those designed to deal solely with water quality treatment.

3.7.1 Protection from Increased Flow Rate and Volume of Run-Off

Greenfield Run-Off Rate Analysis

(Based on a unit area (1.0 ha) of development site)

The proposed Residential development area has an impermeable to permeable ratio of 60:40, which for 1.0 ha of development site would equate to 0.60 ha of impermeable hard surface and 0.40 ha of permeable landscaping / garden surfaces.

Taking a basic run – off coefficient from the permeable surfaces / areas at say 10 per cent then the permeable areas of the development site can be accounted for in a 60:40 ratio development by taking 60% + 10% of 40 % = 64% of the development areas as effectively impermeable.

Therefore 0.64 ha is fully impermeable for each 1.0 ha of gross development area.

The peak surface water run – off flow figures and therefore the subsequent attenuation volume calculations will be calculated using the Wallingford procedure – Design Act Analysis of urban storm drainage – volume 4 – modified rational method.

Therefore, the basic data for use with this modified rational method is as follows:

- M5 – 60 rainfall = 14mm
- r ratio = approx. 0.3
- Volumetric run – off coefficient = 0.75

A.D.6 Determination of the Required Limiting 10 Per Cent Pre – Development Peak Discharge Flow

For r = 0.3, Z1 factor for M5 – 60 = 1.00, so from Table A2, Z2 ratio factor 1.03, where Z1 to Z2 are Wallingford procedure scaling factors.

The development site area of approx. 58.43 ha in this case is relatively small for the area reduction factor (ARL) to have any significant bearing on any calculated peak flows particularly when considering that the ARL would relate to both pre and post development calculations so take ARL = 1.0 in this case. Where Qp is the discharge flow (in litres per second), then the required limiting pre-development peak discharge flow = 10 % of Qp for M5 – 60 storm where Qp = 3.61 Cv AI, so pre – development peak discharge flow.

= 0.361 Cv AI

Where A = Area of catchments (in ha) and

Cv = Volumetric run off coefficient

Rain Intensity I

M5 – 60 x Z1 x Z2 x 60 / D

= 14 x 1.0 x 1.03 x 60 / 60

= 14.42mm / hr

For proposed development area limiting pre-development peak discharge flow.

= 0.361 Cv AI

Limiting development area peak flow

= 0.361 x 0.75 x 1 x 14.42

= 3.9 l / s / ha

Therefore, the post – development run – off from the proposed 35.06 ha development should be limited to a maximum discharge of 35.06 x 3.9 = 136.73 l/ s.

Post – development limiting discharge for water quantity / flooding control.

= 40 l / s

Note:- (The allowable discharge rate was calculated using the area of the site which drains to the watercourse pre-development).

3.8 Maintenance Schedules

Regular inspection and maintenance of a sustainable urban drainage system (SUDS) will ensure that it is fit for purpose and operates as designed in the long term. Access to key structural items (for example inlets / outlets) will enable effective inspection and maintenance.

Inspection and maintenance responsibilities for the SUDS and the surrounding area should be placed with a responsible organisation. Most maintenance activities can be incorporated within a landscape maintenance schedule. Recommended inspection and maintenance activities for the detention basins is provided in Table 14. (adapted from The SUDS Manual C753, CIRIA 2015). Recommended inspection and maintenance activities for the existing culvert is provided in Table 15.

Table 14. Detention Basin Inspection Requirements and Maintenance Schedule for Residential Developments (Adapted from CIRIA 2015).

Inspection	**Activity**	**Frequency**
	Inspect / pipework / inlets / outlet and spillway for blockages	Six-monthly or annually and following heavy rainfall
	Inspect inlets and base for silt accumulation to establish silt removal frequencies	Six-monthly or annually
	Check penstock / flow control device is operational	Six-monthly or annually
	Check fencing for breaches	Six-monthly or annually
Maintenance	**Activity**	**Frequency**
Regular	Litter and debris removal	Monthly (and always before grass cutting / mowing and following heavy rainfall)
	Grass cutting in and around the basin - assume long grass	Seven cuts p/a
	Remove nuisance plants (weeds)	As required
	Tidy last season dead growth	As required
	Remove accumulated sediment from inlet(s) /outlet and dispose of on-site in suitable locations	If above pipe invert or ponding is evident
	Remove accumulated sediment from micro-pool and dispose of on-site in suitable locations	When the level exceeds 50% of micro-pool volume
	Maintain grass spillway level	Monthly; treat as amenity grass
Irregular	Manage wetland plants / algal growth in outlet micro pool	As required
	Re-seed / re-turf areas of poor grass growth	As required
	Prune shrubs	As required
	Reinstate scour protection materials at inlet / outlet	As required
	Repair damaged inlet / outlet pipework and headwalls	As required
	Repair fencing breaches	As required

Table 15. Culvert Inspection Requirements and Maintenance for Residential Developments (Adapted from CIRIA 1997 and EA 2014).

Inspection	Activity	Frequency
	Inspect trash screens to ensure that they are free from litter / debris / vegetation and in good condition. Ground level at inflow and outflow to be maintained at culvert invert level	Six-monthly or annually and following heavy rainfall
	Culvert barrel to remain free from debris / vegetation; any identified material to be removed by contractor	Six-monthly or annually and following heavy rainfall
Maintenance	**Activity**	**Frequency**
Regular	Removal of litter / debris / vegetation from the trash screen	Monthly to coincide with basin inspection. Increase as appropriate if informed by the inspection regime
	Removal of sediment accumulation at invert of culvert; level to be maintained at invert	As required
	Removal of any debris / vegetation within the culvert, assuming safe practice of work	As required
Structural items	Trash screen repairs	As required
	Culvert repair	As required

3.9 Foul Flows:

The previous site consisted of previous use as farm land and as such no foul flows existed.

Post development (based on "Sewers for Scotland 4th Edition" 4000 litres/dwelling/day)

The proposed development consists of 1200 units

$$Q = \frac{4000 \times 1200}{24 \times 60 \times 60} = 55.56 \text{ litres/sec (Peak)}$$

3.10 Flooding

Historic Information

The design of new developments must take into consideration the latest Planning Policies (SPP and PAN 69) as well as Scottish Water and SEPA guidelines. The purposes of this report are to outline how flood prevention in accordance with these guidelines has been considered for the development.

The SEPA flood map shows flooding adjacent to the unnamed watercourse along the northern boundary beyond the development site.

The SEPA flood map does not show any fluvial flooding within the development boundary, however, pluvial flooding is shown within the south western boundary.

Fluvial / Tidal Flooding

The development is not within the zone of influence of fluvial or tidal flow.

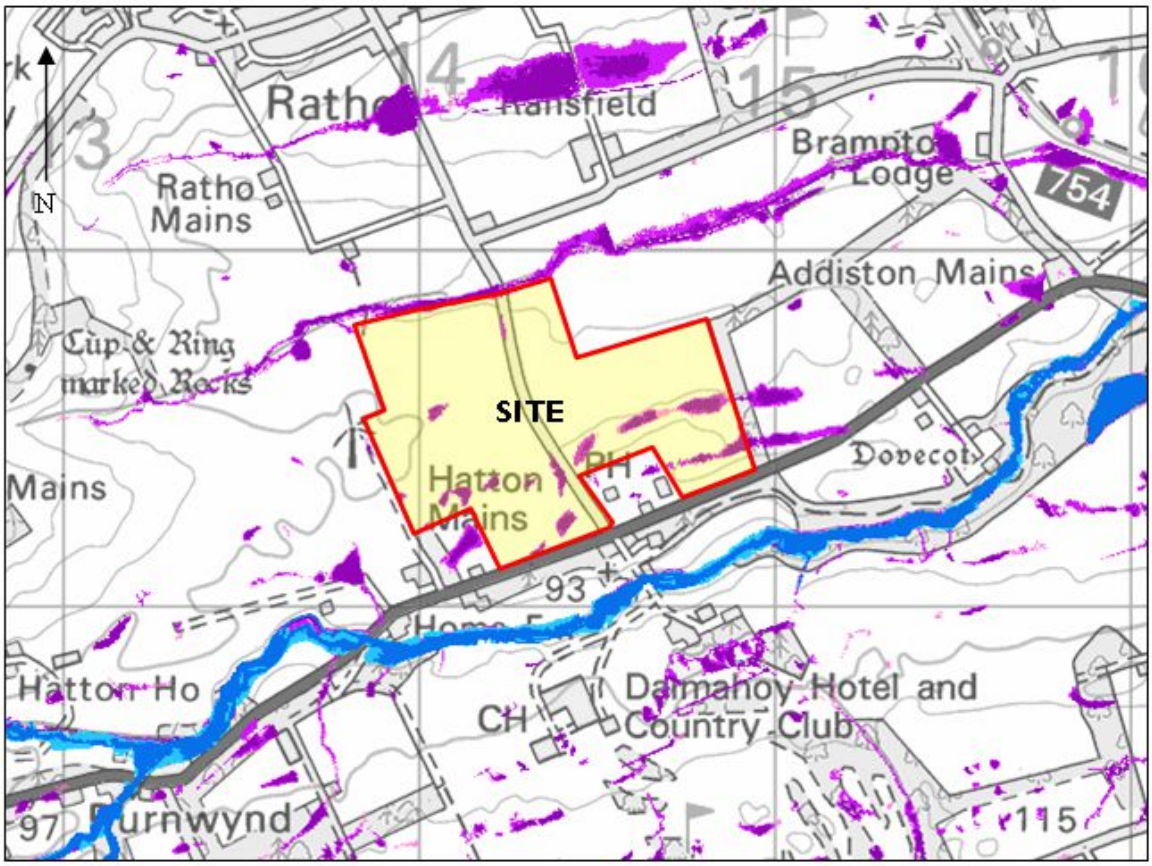

*Image courtesy of Scottish Environmental Protection Agency (SEPA) with site indicated in red.

Figure 3 – SEPA Flood Map

The above findings are reinforced by the SEPA flood map, which, has no record of any river or tidal flooding within the development area.

Ground Water Flooding

The intrusive site investigation has yet to be undertaken, however, it is expected that it will not indicate near surface water table and, as such, the ground water flooding risk is expected to be low.

Pluvial Flooding

The existing average site levels are approximately between 101m to 86m.

In conclusion, we have considered potential sources of flooding and concluded that the site is not shown to be at risk from minimal fluvial flooding.

Proposed Mitigation and Management of Flood Risk

The results of the Flood Risk Assessment carried out by Millard Consulting in November 2018 can be summarised as follows:-

Figure 4 below indicates the extent of predicted floodplain associates with the 1 in 200yr flood (also known as the functional floodplain). No built development should take place within the functional floodplain, however, alternatives such as open space, footpaths etc can be considered, provided these uses are compatible with occasional flooding, and providing ground levels are unaltered and flow paths are not obstructed by features such as walls or solid fences.

It is important that access is available to maintain the watercourse (e.g. removing debris or clearing fallen timber etc), hence, we recommend a maintenance strip of open ground 5 metres wide along the right hand (southern) bank of the watercourse (this area can of course serve a dual purpose as per the previous paragraph).

It is important to ensure that all FFL's for new houses are at least 600mm above the predicted 1in 200yr flood level, including, a 20% increase in flood flow to allow for any future effects of anticipated climate change. This allows a suitable freeboard to take into account not only predicted flood levels, but also to allow for inherent uncertainties regarding the actual flood levels, which, could occur.

Figure 4 below summarises the likely flood extents and sets out minimum FFL's for the entire site. It is important to point out that for the majority for the site, the minimum FFL's are irrelevant since the site rises steadily away from the watercourse.

There are no issues with emergency access and egress during a flood event for this site, as can be seen within Figure 4, all routes into and out of the site are predicted to remain clear.

In order to avoid any increase in flood risk, surface water run-off generated by the site should be dealt with following the principals of Sustainable Urban Drainage Systems.

As there are no changes proposed to the landforms or structures affecting flood flows, there is no anticipated increase in flood risk to any third-party property.

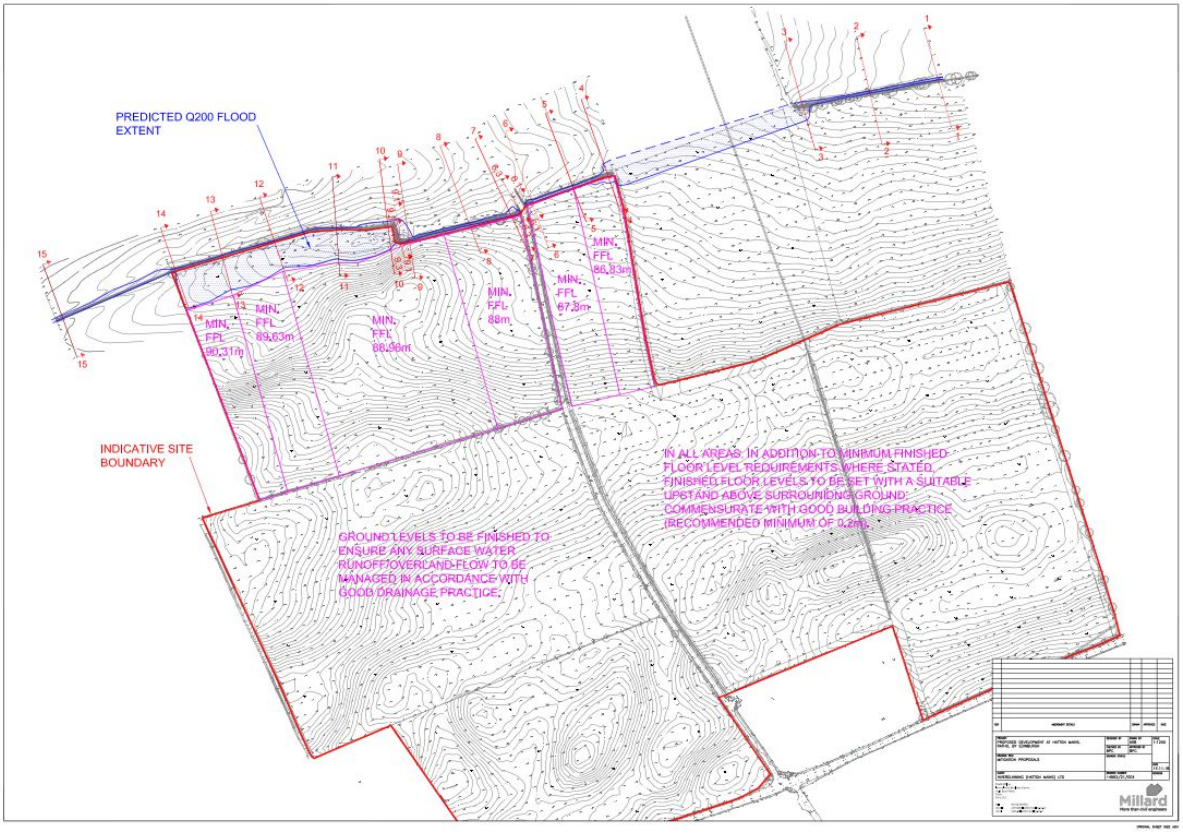

Figure 4 – Q200 Flood Extent

3.11 Contaminated Water Arising from Construction

This should be addressed by the contractor's method statement, however, any possible contaminated water should be contained within the site boundaries. During the construction process it is likely that the running surface, will consist of a material, which has some free draining properties thus allowing any spillage to be contained. Prior to construction of the final layout the running surface material would be removed off-site including any small pockets of possible contamination.

Section 4 – Ground Conditions

A phase 1 geotechnical desktop report has been undertaken by Mason Evans on October 2018 and indicative ground conditions are summarised as follows: -

4.1 Historical Assessment:

The Site

The first Ordnance Survey map edition of 1853/55 indicated the site consisted of unoccupied agricultural ground and this has remained the case to present day.

The Surrounding Area

The surrounding area is indicated to have been occupied by predominantly agricultural land, recreational areas and residential properties. Development to the village of 'Ratho' to the north has undergone significant residential expansion since the 1960's.

4.2 Superficial Soils

The British Geological Survey geological map indicates the natural superficial deposits below the site to generally comprise glacial till (generally recorded as a sandy, gravelly CLAY), with localised moundy SAND and GRAVEL within the south western site area. Due to the 'greenfield' nature of the site, we do not expect significant made ground deposits to underlie the site.

Historical boreholes from the surrounding area (i.e. >200 m) support the geological survey map.

Rockhead is recorded to be generally shallow within the surrounding area, recorded at depths between <1.00 m and 4.00 m bgl.

4.3 Solid Geology

The British Geological Survey solid geology map indicates the solid strata to consist sedimentary bedrock, belonging to the Carboniferous aged Lower Oil Shale Group, described as sandstones, interbedded with siltstones and mudstones, seams of oil-shale and coal, dipping in an unknown direction.

The survey map conjectures the 'Dalmahoy Shale' to outcrop approximately 75 m to the south-east of the site, dipping to the north (forming part of a syncline). The 'Dalmahoy Shale' is understood to outcrop below the 'Pupherston Shale' Group (recorded to be 115 m thick, consisting three oil shales varying between 4 foot and 6 foot thick), and is indicated to be approximately 8 foot thick. This is the only known locality of the 'Dalmahoy Shale'

The BGS map indicates a geological fault in the central western site area, downthrown to the north.

4.4 Hydrology and Hydrogeology

Interpretation of the site hydrogeology required consideration of the general geological conditions. In this instance the available information indicates the ground conditions to be potentially comprised of four geological units: TOPSOIL, Glacial Till, SAND and GRAVEL deposits and sedimentary bedrock. The typical permeabilities of each of these strata are recorded in Table 16.

TABLE 16 - Typical Material Permeability

Material	Permeability
TOPSOIL	$10^{-4} – 10^{-3}$
Glacial Till	$10^{-4} – 10^{-9}$
SAND and GRAVEL	$10^{-4} – 10^{-3}$
Sedimentary Bedrock	$10^{-4} – 10^{-8}$

At present, surface run-off below the site would be relatively low over the site given that the site was surfaced predominantly in arable crops and grass. Infiltration of surface water would therefore be expected to be high.

It was considered that a shallow groundwater body would not exist within the glacial till deposits on site, due to the low permeability range of cohesive deposits. Groundwater may still be encountered within the glacial till soil underlying the site, though this is likely to be localised and perched, likely the result of surface water infiltration.

Given the moderate infiltration and moderate permeability of the localised SAND and GRAVEL deposits within the south western site area, it was considered possible that shallow groundwater body could exist.

Notwithstanding the above, given the limited range of these deposits (i.e. southwestern site area only), we would not consider any groundwater encountered to be representative of a groundwater body, instead this would be localised and perched, likely the result of surface water infiltration.

The potential for a deeper groundwater table below rockhead is moderate given the permeability range of the sedimentary strata. The presence of any potential deep groundwater table would be dependent on secondary porosity, such as fracturing; this would also control any potential movement between shallow and deep lying groundwater bodies. SEPA indicated the bedrock groundwater body to be the 'Livingston'.

The nearest surface water is an unnamed burn located along the northern site boundary. SEPA hold not information on this feature, but we would consider it to be a potential sensitive receptor in terms of the captioned site.

In consideration of the available information regarding groundwater, the following general comments could be made.

TABLE 17 - Surface Water and Groundwater Pathways

Surface water run-off	Surface water run-off below the site would be relatively low over much of the site given that it was surfaced entirely in arable crops and grass. Consequently, the infiltration of surface water would therefore expected to be relatively high.
Groundwater migration through superficial materials	The site was anticipated to be predominantly underlain by natural cohesive glacial till deposits which would not likely facilitate shallow sub-surface migration of water. As such, it is considered unlikely that a shallow groundwater body would underlie the site.

4.5 Mining & Quarrying

The northern, eastern, southern and central site area is recorded to be located within a 'Coal Mining Reporting Area' (Appendix B), and as such we consulted with The Coal Authority to gain more information on historical coal mining activities below the site.

A report provided by The Coal Authority, states that the property is 'not within a surface area that could be affected by known past underground mining'. Importantly, The Coal Authority does not make mention of the likelihood for unrecorded shallow mine workings.

The Coal Authority report does not record any known coal mine entries within, or within 20 m of, site boundary. In terms of mine gas emissions, The Coal Authority report notes it has 'no record of mine gas emissions requiring action'. This further supports the conclusion that there is no record of coal mining activities within the site, or surrounding site area.

A review of the Memoirs of the Geological Survey Scotland *'The Oil-Shales of the Lothians'* book provided further information on the Dalmahoy Shale. The memoirs indicate that the seam is not wide spread, and has only been recorded in the indicated locality, and won't be wide spread throughout the area.

The memoirs indicate that the seam had been historically investigated for extraction potential, however no subsequent operations were undertaken, and the seam was not wrought (worked).

A review of the stratigraphic column indicates the 'Dalmahoy Shale' to underlie the 'Pumpherston Shale' Group. Though the precise vertical separation is not known, it is indicated from the memoirs that there is a 'considerable' distance between the Dalmahoy and the Pumpherston Group.

Furthermore, a review of the geological survey map did not indicate the presence of the Pumpherston Shale group to outcrop within the site. Additionally, the memoirs for the Dalmahoy area (which encompasses the site) do not indicate the presence of historical workings at the level of the 'Pumpherston Shale' Group.

A review of the available historical Ordnance Survey maps indicated that there were no quarrying activities within the site or immediate surrounding area (i.e. 250 m).

As such, and with cognisance to the above, we do not consider the site to be at any potential risk from mineral instability as a result of past shallow mine workings (i.e. oil-shale or coal) or quarrying activities.

4.6 Contamination:

In order to address the any potential risk to the various receptors highlighted, we advise that a programme of investigations should be instigated, as described, to examine the soils and groundwater conditions. This should examine potential contamination impacts and the pathways by which receptors may be at significant risk.

Given that no significant contamination sources are anticipated, the investigations should be initially non-targeted, consisting trial pits and soil boreholes to recover samples of the soils and groundwater (were available). If possible, samples of the nearby surface water body along the northern site boundary should be retrieved during Phase II investigations.

Given the on-going site usage for agriculture, testing should also be undertaken for pesticides and herbicides.

4.7 Ground/Mine Gases:

The historical researches suggest the potential for localised made ground to exist (i.e. associated with the farm steading development). As such, a detailed ground gas risk assessment, including a programme of gas monitoring from standpipes installed in boreholes, will be required.

We do not consider the site to be at risk from radon gas.

4.8 Foundations:

The natural soils appear suited to sustaining medium loaded structures but may also be capable of tolerating significantly greater loadings. As such, intrusive ground investigations will be required to confirm the load bearing characteristics of the underlying natural soils.

Based on existing site layouts, we would expect standard spread foundations (for standard two storey developments) to be appropriate. However, in the future, due to potential significant earthworks, foundation solutions may differ.

4.9 Earthworks:

It is understood that earthworks are being considered for the site. The potential for shallow rock over parts of the site will be a consideration. However, the anticipated glacial till soils over most of the site would usually be suitable for re-use, although improvement, such as lime stabilisation, may be required.

4.10 Mining and Mine Entries:

Based on our detailed researches, we do not consider the site to be at any potential risk from mineral instability as a result of past shallow mine workings or quarrying activities.

4.11 Invasive Plants:

No invasive plant species were recorded during our site walkover survey.

A detailed invasive plant species survey has been commissioned and is in the process of being undertaken. The findings from this survey will be reported under separate cover.

Section 5 – Conclusions

5.0 Earthworks

The initial cut / fill earthworks volumes can be summarised as follows:

Site Earthworks	
Description	**Volumes (m3)**
Bulk Cut / Fill Volume Below Formation Level Model = (Nett Fill)	6,810m3
Bulk CUT Volume Generated	300,220m3
Bulk FILL Volume Generated	307,030m3
Number of Dwellings	1200 No.
Assume Additional Surplus Volume Generated Per Dwelling	60m3
Additional Surplus Volume Generated from Dwellings	72,000m3
Total Bulk CUT Volume Required to Be Exported	**65,190m3**

From the above figures, it is expected that Bulk CUT volume required to be exported will be increased by arisings from drainage tracks, therefore, it is considered that the development cannot be designed to provide an earthworks balance. (Refer to Appendix B – Earthworks Isopachyte).

5.1 Drainage

The objectives of treating and managing surface water via source control SUDS and limiting the impact on the sewerage network have been achieved with the drainage proposals for this development. In curtilage treatment for impermeable surfaces (driveways and roof run-off) using permeable paving and the treatment provided by the Detention Basins and Treatment Trench for the proposed road network run-off provides an appropriate SUDS treatment train for the development proposed.

Attenuation of storm events up to and including 200 years (+30% for future climate change) is accommodated within the proposed SUDS, ensuring no detrimental impact on the existing watercourse.

5.2 Flood Mitigation

The results indicate that the extent of predicted flooding within the proposed development site relatively small in extent, hence, mitigation required is relatively limited.

No built development should take place without should take place within the functional floodplain, however, alternative uses such as open space, footpaths etc can be considered, provided these are compatible with occasional flooding and providing ground levels are unaltered and flow paths are not obstructed by features such as walls or solid fences.

We recommend a maintenance strip of open ground 5 metres wide is incorporated into the masterplan layout to extend along the right hand (southern) bank of watercourse (this area can of course serve a dual purpose, e.g. as a footpath).

All FFL's for new houses to be at least 600mm above the predicted 1 in 200yr flood level including a 20% increase as per Figure 4.

There are no issues with emergency access and egress during a flood event for this site, all routes into and out of the site are predicted to remain clear.

In order to avoid any increase in flood risk, surface water run-off generated by the site should be dealt with following the principals of SUDS.

As there are no changes proposed to the landforms or structures affecting flood flows, there is no anticipated increase in flood risk to any third-party property.

5.3 Ground Conditions

General

Phase 1 desk study researches have indicated that there is a low risk that the site is potentially impacted by contamination relating to historical activities both on-site and in the surrounding area. Notwithstanding this, further evaluation through Phase II investigations, including the testing of soil/water samples, and examining the characterisation of the soils and groundwater bodies beneath the site, would be required. In addition, potential gas emissions, sourced from any biodegradable soils, require to be assessed through monitoring. Foundation options for any new development will be influenced by the thickness and condition of the superficial deposits.

Chemical Contamination

In order to address the any potential risk to the various receptors highlighted, we advise that a programme of investigations should be instigated, as described, to examine the soils and groundwater conditions. This should examine potential contamination impacts and the pathways by which receptors may be at significant risk.

Given that no significant contamination sources are anticipated, the investigations should be initially non-targeted, consisting trial pits and soil boreholes to recover samples of the soils and groundwater (were available). If possible, samples of the nearby surface water body along the northern site boundary should be retrieved during Phase II investigations

Given the on-going site usage for agriculture, testing should also be undertaken for pesticides and herbicides.

Gas Emissions

The historical researches suggest the potential for localised made ground to exist (i.e. associated with the farm steading development). As such, a detailed ground gas risk assessment, including a programme of gas monitoring from standpipes installed in boreholes, will be required.

We do not consider the site to be at risk from radon gas.

Foundations

The natural soils appear suited to sustaining medium loaded structures (refer to section 4.2) but may also be capable of tolerating significantly greater loadings. As such, intrusive ground investigations will be required to confirm the load bearing characteristics of the underlying natural soils.

Based on existing site layouts, we would expect standard spread foundations (for standard two storey developments) to be appropriate. However, in the future, due to potential significant earthworks, foundation solutions may differ.

Mining and Quarrying

Based on our detailed researches, we do not consider the site to be at any potential risk from mineral instability as a result of past shallow mine workings or quarrying activities.

Development Considerations

A number of development geo-environmental considerations could arise from the recommended Phase II investigations. These include:

- Possible remediation of localised contaminated land (though considered unlikely).
- Gas Preclusion measures may be required (though considered unlikely).
- Possibility of significant earthworks
- Foundations designs will be determined by the condition of the underlying natural soils, plus the requirement (if any) of earthworks.

We highlight that these considerations are speculative without the more detailed information that would arise following Phase II investigations, following which the impact of each should be re-assessed. The advised scope of these investigations would include:

- Trial pits to assess the shallow soils and ground conditions
- Soil boreholes with installations for gas and groundwater monitoring.
- Geo-environmental testing (including soil re-usability) of soil and water samples.
- Monitoring of ground gas and groundwater.
- Phase II Geo-environmental interpretive report.

References

Pittner, C. and Allerton, G., 2009. SUDS for roads. Edinburgh: WSP Development and Transport.

Scottish Environment Protection Agency (SEPA). Regulatory Method (WAT- RM-08) - Sustainable urban drainage systems (SUDS or SUD Systems). SEPA, 2014.

CIRIA. 2015. The SUDS Manual. Report C753. CIRIA, London.

Millard Consulting Flood Risk Assessment, November 2018

Mason Evans Phase 1Desktop Study, October 2018

Appendix A
Topographical Survey

DO NOT SCALE.

1. All drawings are to be read in conjunction with the Specification and all the relevant Architects and Specialists Drawings.
2. It is the Contractors responsibility to check all dimensions on site. Dimensions MUST NOT be scaled from this drawing.
3. Any discrepancies between this drawing and the actual site conditions should be reported immediately to the Engineer.

Rev	Amendments	Date	By	Chk.
-	Initial Issue	20.02.20	DA	MC

INFORMATION

GM Civil and Structural
Consulting Engineers Ltd
1st Floor, Grove House
1 Kilmartin Place
Tannochside Business Park
Uddingston
G71 5PH

Tel: 01698 816455
Email: Info@gmcivilandstructural
Web: gmcivilandstructural.co.uk

Project Title

HATTON MAINS
EDINBURGH

Client

INVERDUNNING Ltd.

Drawing Title

TOPOGRAPHICAL SURVEY

Scale
1:2000

Sheet Size A1 Plot 1:1

Project No.	Drawing No.	Revision
7485	SK105	-

Appendix B
Earthworks Isopachyte Drawings

SITE EARTHWORKS

200mm Topsoil Strip	114,600	m3
Topsoil Re-used for Gardens & Landscaping	66,335	m3
Bulk Cut Volume Generated	300,220	m3
Bulk Fill Volume Generated	307,030	m3
Bulk Cut / Fill Volume Below Formation Level = Nett Fill	6,810	m3

NOTE: THE FIGURES ABOVE ARE INDICATIVE ONLY AND TAKE NO ACCOUNT OF SITE GENERATED SLURRY FROM BAD WEATHER / SITE OPERATIONS OR BULKING

SITE EARTHWORKS - ZONED

ZONE 1 - CUT = 30,140m³
FILL = 222,060m³
NETT FILL = 191,920m³

ZONE 2 - CUT = 126,500m³
FILL = 64,420m³
NETT CUT = 62,080m³

ZONE 3 - CUT = 100,300m³
FILL = 2,050m³
NETT CUT = 98,250m³

ZONE 4 - CUT = 43,280m³
FILL = 18,500m³
NETT CUT = 24,780m³

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CONTOURING LEGEND

FILL MAJOR CONTOUR:
FILL MINOR CONTOUR:
ZERO CONTOUR:
CUT MAJOR CONTOUR:
CUT MINOR CONTOUR:

NOTES

1. THE BULK FIGURES AND DRAWING INDICATE THE RELATIVE CUT AND FILL DIFFERENCE BETWEEN THE PROPOSED FORMATION LEVELS (-450mm) AND EXISTING GROUND LEVELS -200mm TOPSOIL STRIP.
2. PROPOSED FORMATION HAS BEEN TAKEN AS A STANDARD 450mm BELOW PROPOSED FINISHED GROUND LEVEL FOR THE TOTAL SITE AT THIS STAGE.
3. NO ARISINGS FOR DRAINAGE TRACKS BELOW FORMATION HAVE BEEN TAKEN INTO ACCOUNT AS PART OF THIS EXERCISE.
4. NO ARISINGS BELOW FOUNDATION TRACKS (i.e. TRENCH FILL) HAVE BEEN TAKEN INTO ACCOUNT AS PART OF THIS EXERCISE.
5. IT SHOULD BE NOTED THAT THESE QUANTITIES ARE PRODUCED FROM A COMPUTER GENERATED GROUND MODELLING PACKAGE AND NO BULKING FACTOR HAS BEEN INCORPORATED WITHIN THESE FIGURES.

Rev	Amendments	Date	By	Chk.
-	Initial Issue	20.02.20	DA	MC

INFORMATION

GM Civil and Structural
Consulting Engineers Ltd
1st Floor, Grove House
1 Kilmardin Place
Tannochside Business Park
Uddingston
G71 5PH

Tel: 01698 816455
Email: info@gmcivilandstructural
Web: gmcivilandstructural.co.uk

Project Title

HATTON MAINS
EDINBURGH

Client

INVERDUNNING Ltd.

Drawing Title

PROPOSED EARTHWORKS
ISOPACHYTE

Scale 1:2000 Sheet Size A1 Plot 1:1

Project No.	Drawing No.	Revision
7485	SK106	-

Appendix C
Scottish Water Record Plans

Plotted by:
gleadmin

N

Hatton Mains
Waste

SCALE: 1:5000

Date Plotted: 23/09/2016

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.

Scottish Water
Trusted to serve Scotland

Castle House,
6 Castle Drive,
Dunfermline,
KY11 8GG
Tel no. 0800 0778

Plotted by: gisadmin

N

Hatton Mains
Water

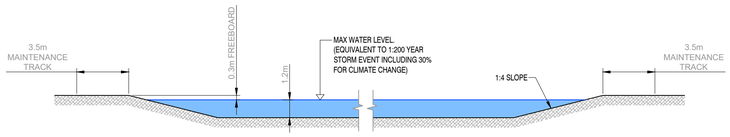
SCALE: 1:2000

Date Plotted: 23/09/2016

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.

Scottish Water
Trusted to serve Scotland
Castle House,
6 Castle Drive,
Dunfermline,
KY11 8GG
Tel No: 0800 0778 8778

Appendix D
Drainage Strategy Layouts
Drainage Construction Details
Platforming Levels Strategy



TYPICAL SECTION THROUGH SUDS BASIN

SCALE 1:200

DO NOT SCALE.

1. All drawings are to be read in conjunction with the Specification and all the relevant Architects and Specialists Drawings.
2. It is the Contractors responsibility to check all dimensions on site. Dimensions MUST NOT be scaled from this drawing.
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LEGEND:

- SITE BOUNDARY
- DRAINAGE ZONE 1
- DRAINAGE ZONE 2
- DRAINAGE ZONE 3
- DRAINAGE ZONE 4
- SUDS BASIN
- SURFACE WATER DRAINAGE

NOTES:

1. EACH ZONE HAS BEEN BROKEN INTO 60/40 SPLIT FOR DESIGN PURPOSES WHICH IS 60% ROOFS / HARDSTANDING AREAS AND 40% GARDEN / LANDSCAPED AREAS.
2. ALL BASINS HAVE BEEN DESIGNED TO ACCOMMODATE A 1:200 YEAR STORM EVENT INCLUDING AN ADDITIONAL 30% FOR CLIMATE CHANGE AS RECOMMENDED BY LOCAL COUNCIL FLOODING REQUIREMENTS.

Rev	Amendments	Date	By	Chk.
C	Legend updated. Manholes numbered.	20.02.20	DA	MC
B	Drainage Zones amended in line with masterplan discussions.	19.07.19	DA	MC
A	SUDS basin sizes reduced and suds basin omitted.	25.03.19	DA	MC
-	Initial Issue	14.02.19	DA	MC

INFORMATION

GM Civil and Structural
Consulting Engineers Ltd
1st Floor, Grove House
1 Kilmartin Place
Tannochside Business Park
Uddingston
G71 5PH

Tel: 01698 816455
Email: Info@gmcivilandstructural
Web: gmcivilandstructural.co.uk

Project Title

HATTON MAINS
EDINBURGH

Client

INVERDUNNING Ltd.

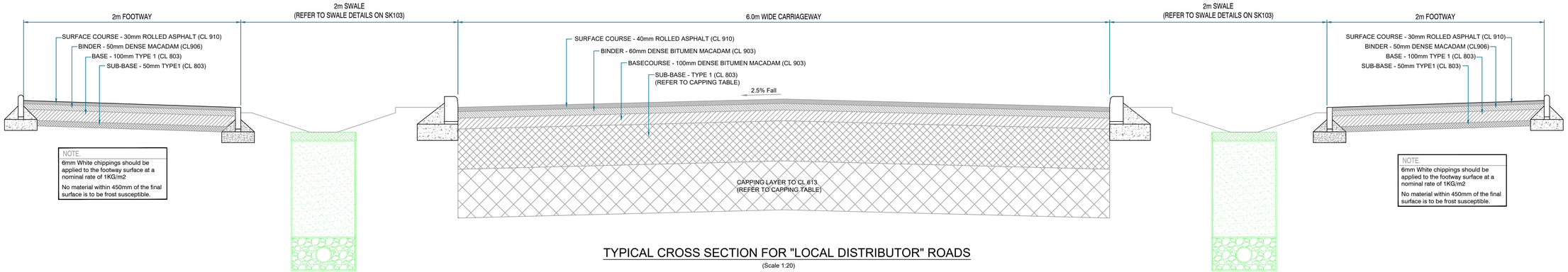
Drawing Title

SURFACE WATER
DRAINAGE STRATEGY

Scale
1:2000

Sheet Size A1 Plot 1:1

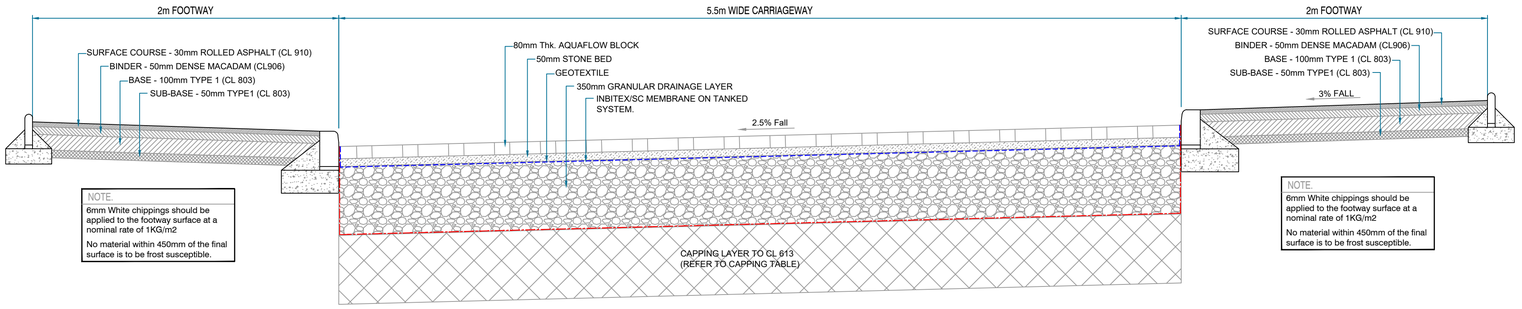
Project No.	Drawing No.	Revision
7485	SK100	C



TYPICAL CROSS SECTION FOR "LOCAL DISTRIBUTOR" ROADS

(Scale 1:20)

CBR Value	Sub-Base	Capping Layer
≥ 5%	370mm	225mm
2% < CBR < 5%	370mm	350mm
≤ 2%	370mm	600mm



TYPICAL CROSS SECTION FOR "GENERAL ACCESS" ROADS

(Scale 1:20)

CBR Value	Sub-Base	Capping Layer
≥ 5%	370mm	225mm
2% < CBR < 5%	370mm	350mm
≤ 2%	370mm	600mm

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Rev	Amendments	Date	By	Chk.
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INFORMATION

GM Civil and Structural
Consulting Engineers Ltd
1st Floor, Grove House
1 Kilmartin Place
Tannochside Business Park
Uddingston
G71 5PH

Tel: 01698 816455
Email: Info@gmcivilandstructural
Web: gmcivilandstructural.co.uk

Project Title

HATTON MAINS
EDINBURGH

Client

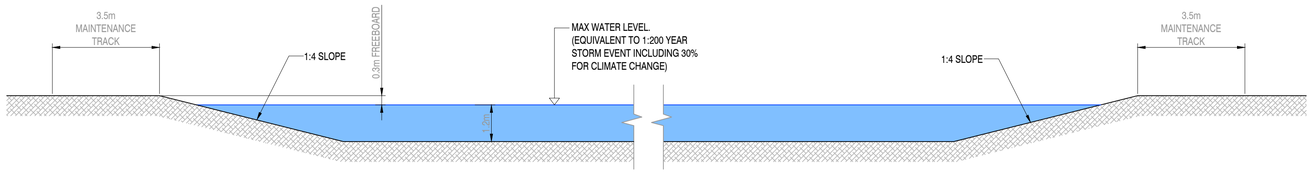
INVERDUNNING Ltd.

Drawing Title

TYPICAL ROAD CONSTRUCTION DETAILS

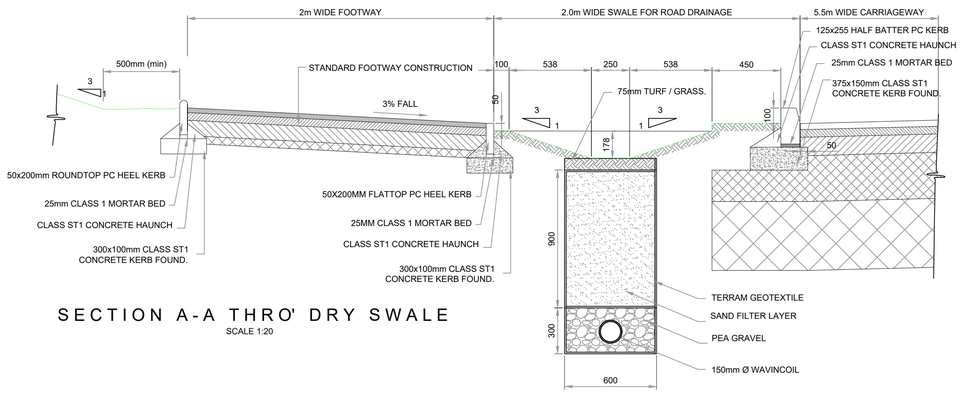
Scale: AS SHOWN — Sheet Size A1 — Plot 1:1

Project No.	Drawing No.	Revision
7485	SK102	-



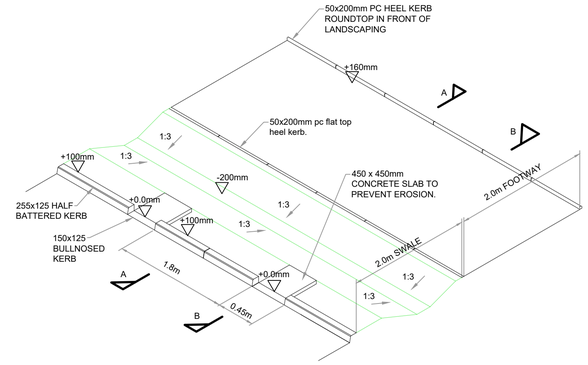
TYPICAL SECTION THROUGH SUDS BASIN

SCALE 1:100



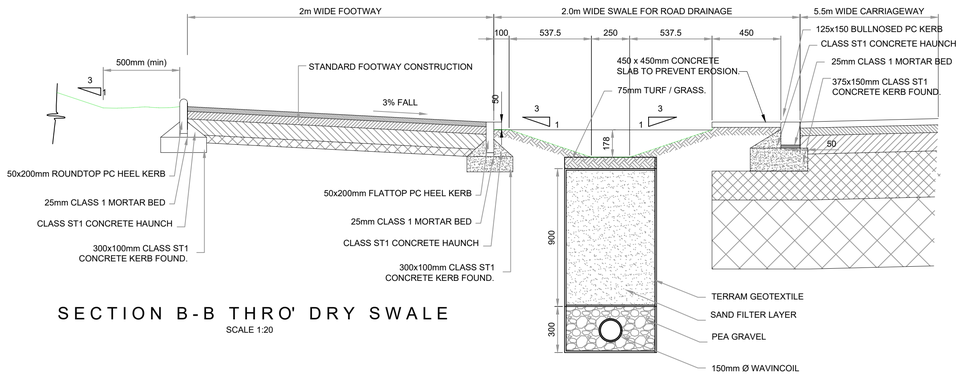
SECTION A-A THRO' DRY SWALE

SCALE 1:20



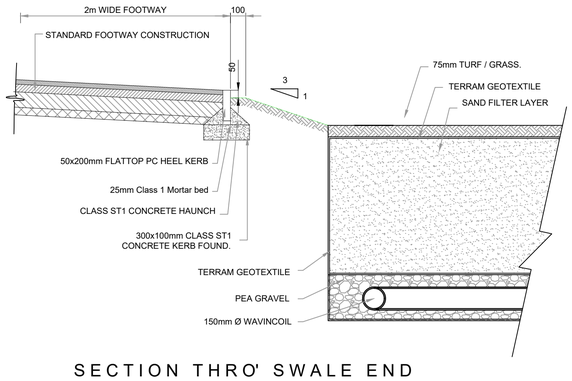
TYPICAL DRY SWALE DETAIL

SCALE 1:50



SECTION B-B THRO' DRY SWALE

SCALE 1:20



SECTION THRO' SWALE END

SCALE 1:20

DO NOT SCALE.

1. All drawings are to be read in conjunction with the Specification and all the relevant Architects and Specialists Drawings.
2. It is the Contractors responsibility to check all dimensions on site. Dimensions MUST NOT be scaled from this drawing.
3. Any discrepancies between this drawing and the actual site conditions should be reported immediately to the Engineer.

Rev	Amendments	Date	By	Chk.
-	Initial Issue	25.03.19	DA	MC

INFORMATION

GM Civil and Structural
Consulting Engineers Ltd
1st Floor, Grove House
1 Kilmartin Place
Tannochside Business Park
Uddingston
G71 5PH

Tel: 01698 816455
Email: Info@gmcivilandstructural
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Project Title

HATTON MAINS
EDINBURGH

Client

INVERDUNNING Ltd.

Drawing Title

DRAINAGE DETAILS
(SHEET 1 OF 2)

Scale
AS SHWON

Sheet Size A1 Plot 1:1

Project No.	Drawing No.	Revision
7485	SK103	-

NOTE:-
ALL SEWERS MUST BE PROTECTED DURING CONSTRUCTION. THE MAIN CONTRACTOR IS LIABLE FOR ANY DAMAGE DURING THE CONSTRUCTION WORKS.

NOTE - FOUL WATER NETWORK
THE FOUL WATER NETWORK INCLUDING PUMPING STATION AND RISING MAIN WILL BE MAINTAINED AND VESTED BY SCOTTISH WATER, CUSTOMER CONNECTIONS, THE BRIDGE, BUCHANAN GATE BUSINESS PARK, CUMBERNAULD ROAD, STEPPS, GLASGOW G33 6FB TELEPHONE No. 0800 3890379

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LEGEND:

- SITE BOUNDARY
- DRAINAGE ZONE 1
- DRAINAGE ZONE 2
- DRAINAGE ZONE 3
- DRAINAGE ZONE 4
- FOUL WATER DRAINAGE
- FOUL WATER RISING MAIN

DRAINAGE NOTES:

1. All Drainage works to be carried out in accordance with the Sewers for Scotland (Fourth Edition).
2. Pipes to comply with the above Specification. The Contractor should obtain approval from Scottish Water for all materials used.
3. All Surface and foul water lateral connections are to be 150mm diameter, unless noted otherwise.
4. All house drainage to be 100mm Dia.
5. 150mm Dia. pipes to be laid between disconnecting manhole and main drain.
6. All gully connections to be 150mm diameter.
7. Concrete surround to be provided where cover is less than 1500mm.
8. Existing manhole inverts and outfall connections to be checked on site prior to construction of site.
9. Existing sewers which are to be diverted, to be removed and backfilled with suitable material or alternatively sewers will be grouted.
10. Existing manholes which are to be abandoned, to be removed and backfilled with suitable material.
11. Concrete surround to be provided to house drainage under driveways where cover is less than 900 mm
12. Refer to Architects layout for location and dimension of all internal drainage and rainwater pipes.
13. Pipe bedding surround to house drainage to comply with BS 8301 : 1985 Section 3.and to manufacturers recommendations. Refer to drawing no. GM/9192/106 & 107 for Standard Drainage Details.

Rev	Amendments	Date	By	Chk.
-	Initial Issue	20.02.20	DA	MC

INFORMATION

GM Civil and Structural
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1st Floor, Grove House
1 Kilmardin Place
Tannochside Business Park
Uddingston
G71 5PH

Tel: 01698 816455
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Web: gmcivilandstructural.co.uk

Project Title

HATTON MAINS
EDINBURGH

Client

INVERDUNNING Ltd.

Drawing Title

FOUL WATER
DRAINAGE STRATEGY

Scale 1:2000 Sheet Size A1 Plot 1:1

Project No.	Drawing No.	Revision
7485	SK104	-

DO NOT SCALE.

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3. Any discrepancies between this drawing and the actual site conditions should be reported immediately to the Engineer.

FGL CONTOURING LEGEND

MAJOR CONTOUR:

MINOR CONTOUR:

ZONE LEGEND

- SITE BOUNDARY
- ZONE 1
- ZONE 2
- ZONE 3
- ZONE 4

Rev	Amendments	Date	By	Chk.
B	Minor Amendments.	20.02.20	DA	MC
A	Platform levels and areas adjusted to provide achievable development areas. Earthworks volume updated.	19.07.19	DA	MC
-	Initial Issue	22.05.19	DA	MC

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Consulting Engineers Ltd
1st Floor, Grove House
1 Kilmartin Place
Tannochside Business Park
Uddingston
G71 5PH

Tel: 01698 816455
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HATTON MAINS
EDINBURGH

Client

INVERDUNNING Ltd.

Drawing Title

PLATFORMING LEVELS STRATEGY
WITH BULK EARTHWORKS
VOLUMETRICS

Scale
1:2000

Sheet Size A1 Plot 1:1

Project No.	Drawing No.	Revision
7485	SK110	B

Appendix E
PDS Flow Surface Water Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	14.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	9.000	5.00	92.500	1800	314550.387	669469.169	1.500
S2			92.000	1800	314474.822	669431.749	1.562
S3			91.500	1800	314425.396	669507.166	1.663
S4			93.250	1800	314392.545	669560.402	3.830
S20	8.820	5.00	93.250	1800	314254.897	669353.111	1.500
S21			92.500	1800	314294.817	669386.023	1.095
S22			93.000	1800	314262.614	669478.651	2.249
S23			95.000	1800	314232.256	669566.956	4.872
S24			95.000	1800	314217.234	669610.459	5.179
S25			93.900	1800	314298.205	669637.157	4.647
S5			93.250	1875	314371.506	669656.463	4.652
S6			89.000	1875	314354.322	669753.875	1.061
S7			89.000	1875	314339.820	669839.644	1.641
S30	5.160	5.00	89.500	1500	314195.916	669821.190	1.875
S31			89.000	1500	314259.517	669811.448	1.804
S32			88.700	1800	314299.090	669816.661	1.908
S8	3.360	5.00	88.500	1950	314293.336	669850.956	2.240
S9			88.500	1950	314286.825	669883.193	2.459
S10			87.000	1950	314263.148	669894.431	1.134

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S1	S2	84.323	0.600	91.000	90.438	0.562	150.0	300	6.10	40.7
1.001	S2	S3	90.170	0.600	90.438	89.837	0.601	150.0	300	7.27	37.7
1.002	S3	S4	62.556	0.600	89.837	89.420	0.417	150.0	300	8.08	36.0
1.003	S4	S5	98.338	0.600	89.420	88.764	0.656	150.0	300	9.36	33.6
2.000	S20	S21	51.738	0.600	91.750	91.405	0.345	150.0	300	5.67	41.9
2.001	S21	S22	98.066	0.600	91.405	90.751	0.654	150.0	300	6.95	38.5
2.002	S22	S23	93.378	0.600	90.751	90.128	0.623	150.0	300	8.16	35.8
2.003	S23	S24	46.024	0.600	90.128	89.821	0.307	150.0	300	8.76	34.6
2.004	S24	S25	85.259	0.600	89.821	89.253	0.568	150.0	300	9.87	32.7
2.005	S25	S5	75.801	0.600	89.253	88.748	0.505	150.0	300	10.86	31.2
1.004	S5	S6	98.916	0.600	88.598	87.939	0.659	150.0	300	12.14	29.5
1.005	S6	S7	86.986	0.600	87.939	87.359	0.580	150.0	300	13.28	28.2
1.006	S7	S8	47.841	0.600	87.359	87.040	0.319	150.0	300	13.90	27.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	1.281	90.6	992.4	1.200	1.262	9.000	0.0
1.001	1.281	90.6	920.4	1.262	1.363	9.000	0.0
1.002	1.281	90.6	877.5	1.363	3.530	9.000	0.0
1.003	1.281	90.6	819.0	3.530	4.186	9.000	0.0
2.000	1.281	90.6	1001.6	1.200	0.795	8.820	0.0
2.001	1.281	90.6	920.1	0.795	1.949	8.820	0.0
2.002	1.281	90.6	856.1	1.949	4.572	8.820	0.0
2.003	1.281	90.6	828.4	4.572	4.879	8.820	0.0
2.004	1.281	90.6	782.4	4.879	4.347	8.820	0.0
2.005	1.281	90.6	746.4	4.347	4.202	8.820	0.0
1.004	1.281	90.6	1424.7	4.352	0.761	17.820	0.0
1.005	1.281	90.6	1360.0	0.761	1.341	17.820	0.0
1.006	1.281	90.6	1327.5	1.341	1.160	17.820	0.0

Links

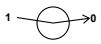
Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
3.000	S30	S31	64.343	0.600	87.625	87.196	0.429	150.0	300	5.84	41.4
3.001	S31	S32	39.915	0.600	87.196	86.930	0.266	150.0	300	6.36	40.0
3.002	S32	S8	34.774	0.600	86.792	86.560	0.232	150.0	300	6.81	38.8
1.007	S8	S9	32.888	0.600	86.260	86.041	0.219	150.0	300	14.33	27.0
1.008	S9	S10	26.209	0.600	86.041	85.866	0.175	150.0	300	14.67	26.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
3.000	1.281	90.6	579.2	1.575	1.504	5.160	0.0
3.001	1.281	90.6	559.2	1.504	1.470	5.160	0.0
3.002	1.281	90.6	543.0	1.608	1.640	5.160	0.0
1.007	1.281	90.6	1930.6	1.940	2.159	26.340	0.0
1.008	1.281	90.6	1906.4	2.159	0.834	26.340	0.0

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	314550.387	669469.169	92.500	1.500	1800		0	1.000	91.000	300
S2	314474.822	669431.749	92.000	1.562	1800		1 0	1.000 1.001	90.438 90.438	300 300
S3	314425.396	669507.166	91.500	1.663	1800		1 0	1.001 1.002	89.837 89.837	300 300
S4	314392.545	669560.402	93.250	3.830	1800		1 0	1.002 1.003	89.420 89.420	300 300
S20	314254.897	669353.111	93.250	1.500	1800		0	2.000	91.750	300
S21	314294.817	669386.023	92.500	1.095	1800		1 0	2.000 2.001	91.405 91.405	300 300
S22	314262.614	669478.651	93.000	2.249	1800		1 0	2.001 2.002	90.751 90.751	300 300
S23	314232.256	669566.956	95.000	4.872	1800		1 0	2.002 2.003	90.128 90.128	300 300
S24	314217.234	669610.459	95.000	5.179	1800		1 0	2.003 2.004	89.821 89.821	300 300
S25	314298.205	669637.157	93.900	4.647	1800		1 0	2.004 2.005	89.253 89.253	300 300
S5	314371.506	669656.463	93.250	4.652	1875		1 2 0	2.005 1.003 1.004	88.748 88.764 88.598	300 300 300
S6	314354.322	669753.875	89.000	1.061	1875		1 0	1.004 1.005	87.939 87.939	300 300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S7	314339.820	669839.644	89.000	1.641	1875	1	1.005	87.359	300
									
						0	1.006	87.359	300
S30	314195.916	669821.190	89.500	1.875	1500				
						0	3.000	87.625	300
S31	314259.517	669811.448	89.000	1.804	1500	1	3.000	87.196	300
									
						0	3.001	87.196	300
S32	314299.090	669816.661	88.700	1.908	1800		1	3.001	86.930	300
						0	3.002	86.792	300
S8	314293.336	669850.956	88.500	2.240	1950		1	3.002	86.560	300
							2	1.006	87.040	300
							0	1.007	86.260	300
S9	314286.825	669883.193	88.500	2.459	1950		1	1.007	86.041	300
							0	1.008	86.041	300
S10	314263.148	669894.431	87.000	1.134	1950		1	1.008	85.866	300

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal	30 year (l/s)	266.8
FSR Region	Scotland and Ireland	Skip Steady State	x	100 year (l/s)	339.3
M5-60 (mm)	14.000	Drain Down Time (mins)	240	Check Discharge Volume	✓
Ratio-R	0.300	Additional Storage (m³/ha)	20.0	100 year 360 minute (m³)	5791
Summer CV	0.750	Check Discharge Rate(s)	✓		
Winter CV	0.840	1 year (l/s)	116.3		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	40	0	0	100	30	0	0
10	40	0	0	200	30	0	0
30	40	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.47	Betterment (%)	0
Greenfield Method	IH124	Region	1	QBar	136.8
Positively Drained Area (ha)	26.340	Growth Factor 1 year	0.85	Q 1 year (l/s)	116.3
SAAR (mm)	745	Growth Factor 30 years	1.95	Q 30 year (l/s)	266.8
Soil Index	4	Growth Factor 100 years	2.48	Q 100 year (l/s)	339.3

Pre-development Discharge Volume

Site Makeup	Greenfield	SPR	0.47	Storm Duration (mins)	360
Greenfield Method	FSR/FEH	CWI	111.852	Betterment (%)	0
Positively Drained Area (ha)	26.340	Return Period (years)	100	PR	0.457
Soil Index	4	Climate Change (%)	0	Runoff Volume (m³)	5791

Node S1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	91.000	Product Number	CTL-SHE-0234-3000-1200-3000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	30.0	Min Node Diameter (mm)	1800

Node S20 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	91.750	Product Number	CTL-SHE-0234-3000-1200-3000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	30.0	Min Node Diameter (mm)	1800

Node S30 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	87.625	Product Number	CTL-SHE-0183-1720-1200-1720
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	17.2	Min Node Diameter (mm)	1500

Node S8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	86.260	Product Number	CTL-SHE-0265-4000-1200-4000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	40.0	Min Node Diameter (mm)	1800

Node S1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	91.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	5000.0	0.0	1.200	5000.0	0.0	1.201	0.0	0.0

Node S20 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	91.750
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	4800.0	0.0	1.200	4800.0	0.0	1.201	0.0	0.0

Node S30 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	87.625
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2750.0	0.0	1.200	2750.0	0.0	1.201	0.0	0.0

Node S8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	86.260
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	5200.0	0.0	1.200	5200.0	0.0	1.201	0.0	0.0