

Flood Risk and Drainage Assessment

Machaire BESS, Rasharkin, Co. Antrim

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1 INTRODUCTION

1.1 Terms of Reference

This Flood Risk and Drainage Assessment was commissioned by RES UK and Ireland to support a planning application for a proposed battery energy storage system at Magheraboy Road, Rasharkin, Co Antrim.

The assessment will determine potential sources of flooding at the site and their associated risk to life and property. The assessment will determine the suitability of the site for development in relation to flood risk from various sources and propose design and mitigation measures where appropriate.

1.2 Statement of Authority

This report and assessment have been prepared and reviewed by qualified professional flood analysts specialising in the fields of hydrology, drainage and flood risk as required by DfI Rivers. The key staff members involved in this project are as follows:

- Lydia Johnston *BEng (Hons) MIEI* – Senior Engineer specialising in the fields of flood risk assessment and hydraulic modelling in Northern Ireland and the Republic of Ireland.
- Jill Dick *MEng (Hons)* – Senior Engineer specialising in the fields of drainage and surface water management design.
- Kyle Somerville *BEng (Hons) CEng MIEI* – Director and Chartered Engineer with expertise in flood risk assessment and surface water management.

1.3 Approach to the Assessment

Consideration has been given to the extent flooding at the site from fluvial and pluvial sources, infrastructure failure, overland flow, and ponding of localised rainfall within the site.

For the purposes of this study, the following have been considered:

- Available information on historical surface water flooding in the area.
- Site level information based on OSNI 10m DTM data and third-party topographical survey.
- Observations based on a site visit undertaken in October 2024;
- Detailed assessment (by flood modelling) of potential flooding from watercourses;
- Assessment of potential flooding to the site from overland sources.
- Assessment of potential flood risk to adjacent lands caused by development at the site; and
- Determination of the availability of safe discharge of surface water from the site.

Revised PPS 15 – Planning and Flood Risk Annex D remains the operational planning policy in the absence of an adopted local development plan strategy at the time of writing. Further guidance is also provided in:

- CIRIA Research Project 624 “Development and Flood Risk: Guidance for the Construction Industry”; and
- Technical Flood Risk Guidance in relation to Allowances for Climate Change in Northern Ireland.

1.4 Application Site

The site is located at Rasharkin Co. Antrim. It is located at Irish Grid reference 296941,414604 and has an area within its boundary of 5.97Ha.

The site context and location are shown on drawings submitted in support of the application.

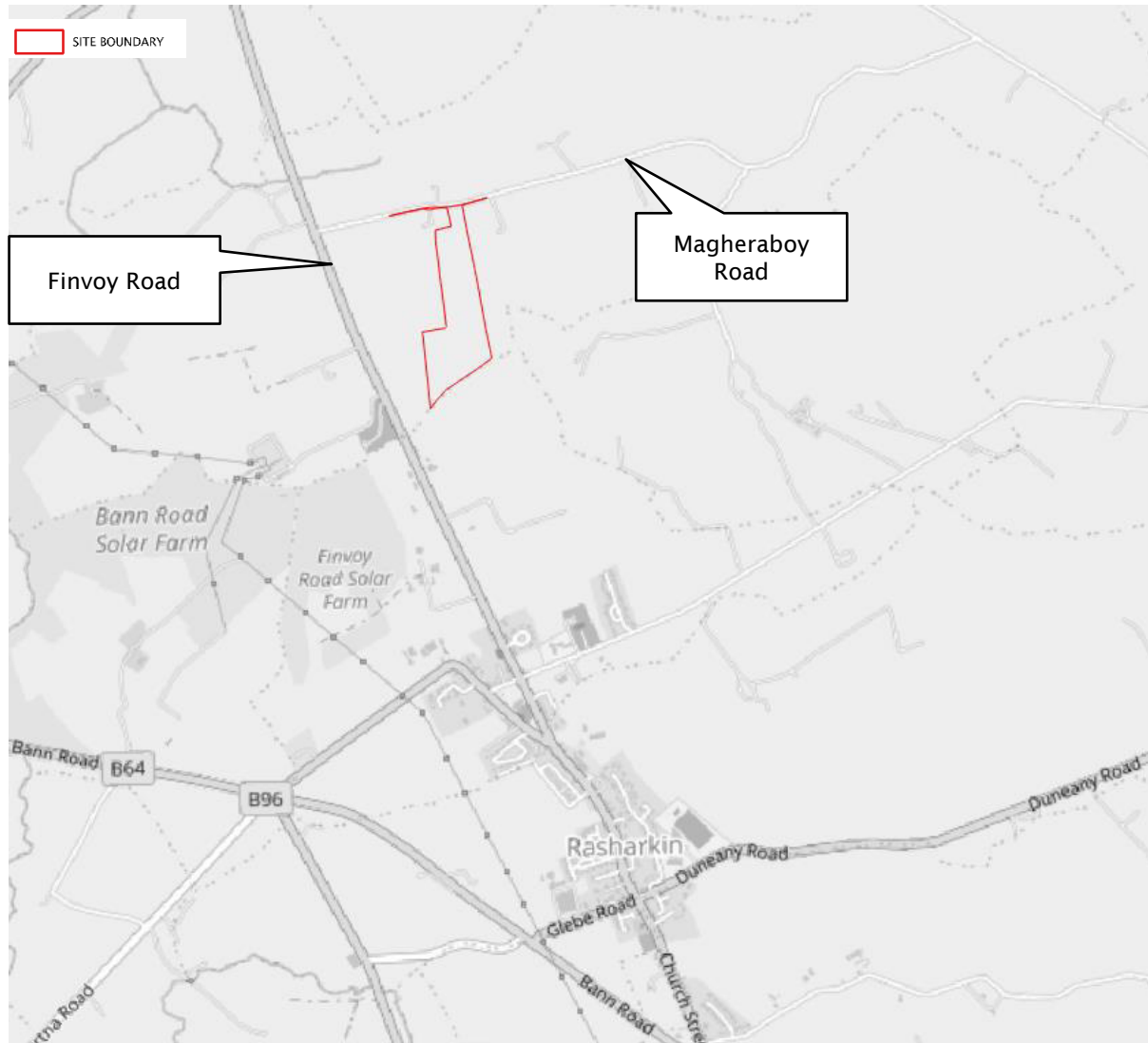


Figure 1-1 Site Location

1.4.1 Existing Land Use

The site currently comprises undeveloped agricultural land.

1.4.2 Proposed Land Use

Development proposals include construction of a battery energy storage system with associated hardstanding and landscaping.

A schematic showing change of land use for the site is included on the following figure.

Figure 1-2 Summary of Land Use Change

Existing		Proposed	
Land Use:	Undeveloped	Land Use:	Industrial / Grid Infrastructure
Impermeable Area	0%	Impermeable Area	37%
			

1.5 Site Characteristics

1.5.1 Topography

The lands within the site boundary slopes from the northwest to the southeast. Approximate ground levels within the site observed on 10m DTM data patched with 10m topographical survey data are between 75.41 – 86.93 mOD. Topography of the site and environs is shown on the following figure.

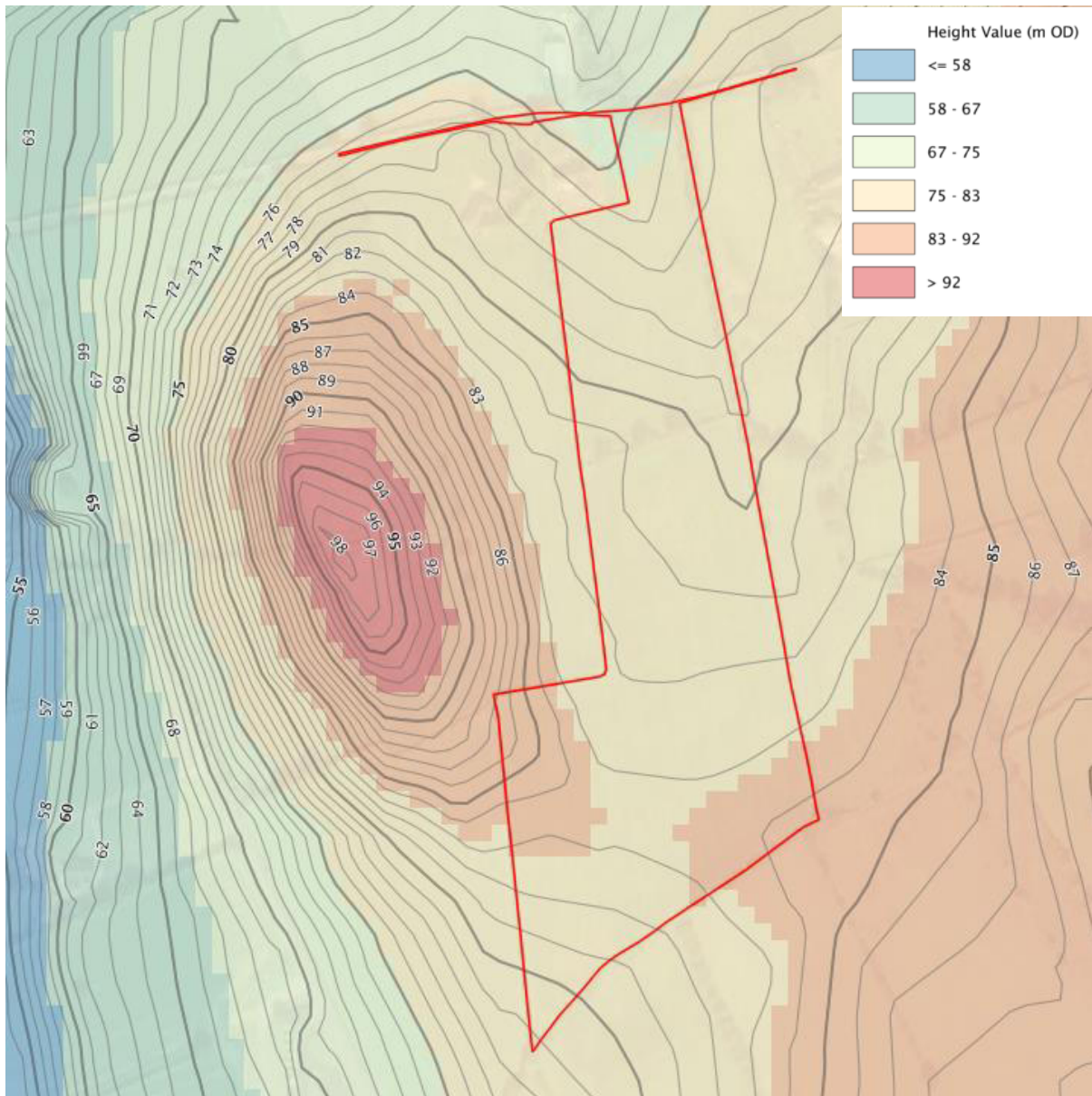


Figure 1-3 Application Site Topography

1.5.2 Hydrology and Watercourses

A review of Designated Watercourses indicates that the nearest designated watercourse is the Culmore Ext (MW2703) located approximately 340m northwest of the site.

A review of OSNI mapping for undesignated watercourses, PRONI historical mapping, site observations and topographical survey indicates that:

- An undesignated watercourse flows adjacent to the site's north eastern boundary and parallel to Magheraboy Road at the northern boundary where access to the development is required. The undesignated watercourse is a catchment of the Culmore Ext.
- This bounding watercourse passes through a field access structure upstream of the site. A 1,100mm diameter pipe culvert is located along the watercourse at Magheraboy Road, at the downstream (northern) side of the site. A further section of culverting is located north of the site at a field access point.
- A localised field drain/ditch is located along the southern boundary. The drain serves an agricultural land drainage function limited to the field that the site lies within, and connectivity to any downstream watercourse could not be confirmed at site walkover.

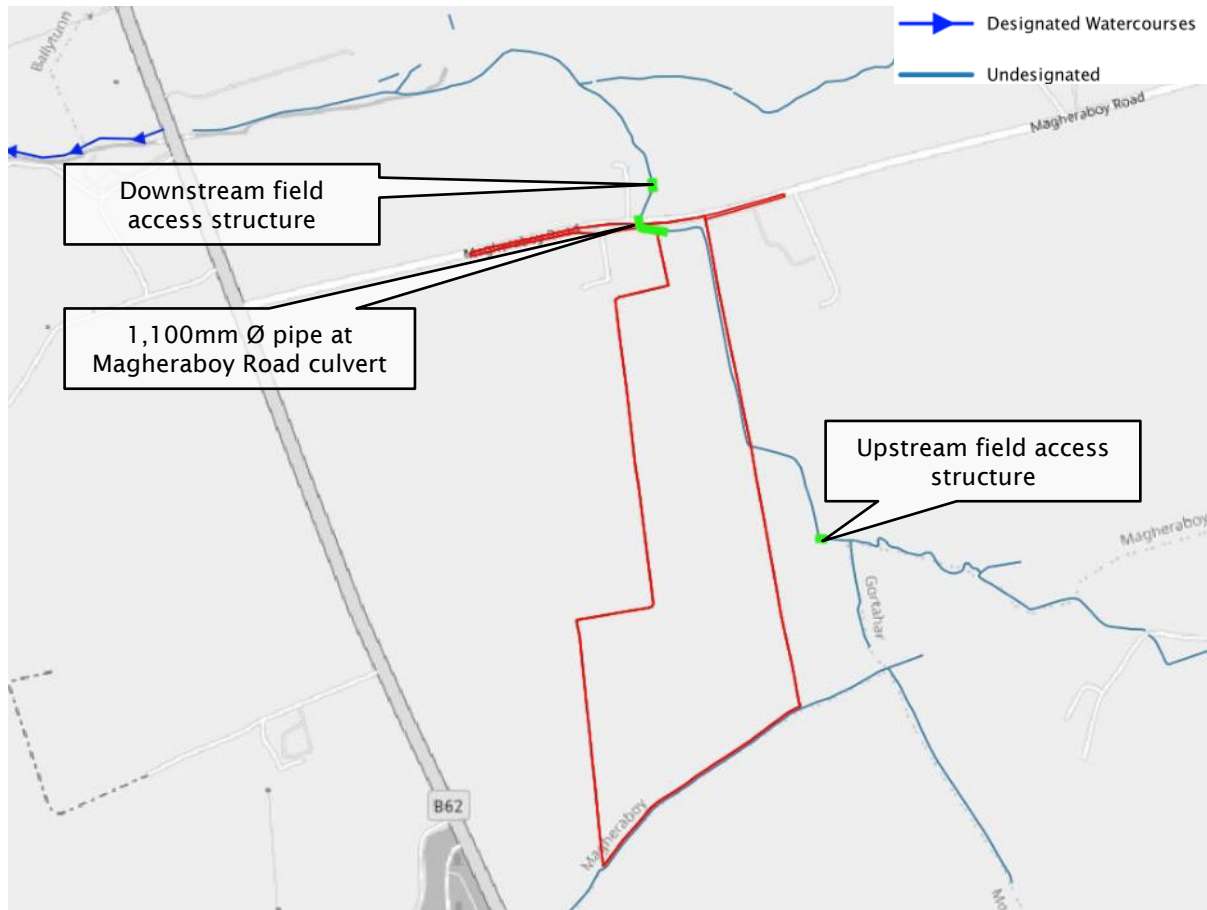


Figure 1-4 – Watercourses and relevant structures

1.5.3 [Geology](#)

A review of GSNI geology data has been undertaken to inform this assessment. Underlying superficial site geology based on GSNI 10k mapping within site is indicated to be Diamicton Till. Additionally, AFBI soil classification data was consulted, indicating Basalt Till where surface water gleys are characteristic of low permeability.

2 BACKGROUND INFORMATION REVIEW

As part of the study data collection phase, several available sources of information were investigated to develop an understanding of the potential risk of flooding to the site.

The following review highlights the key findings of the anecdotal evidence collection exercise.

2.1 Internet / Media / Background Search

A brief media search returned no evidence of past flood events within the vicinity of the site.

2.2 Northern Ireland Water

2.2.1 Out of Sewer Flooding

Northern Ireland Water is unable to provide an indication of history of flooding from its assets for reasons of data protection.

2.2.2 Asset information / Out of Sewer Flooding

A review of NI water asset information indicates there are no drainage or wastewater assets located within or in proximity to the site boundary from which out of sewer flooding may be generated.

2.3 DfI Rivers

2.3.1 Flood Maps NI

The extent of development was reviewed with reference to Flood Maps (NI)¹. The findings are summarised as follows:

- The strategic fluvial flood map indicates that the site is affected by the 1% AEP+CC fluvial flood extents², where the watercourse bounding the site's eastern and northern sides has been indicatively modelled.
- The indicative surface water flood map indicates that lands within the site boundary are partially affected by the 0.5% AEP+CC flood extents.
- There is no historical record of flooding within or in proximity of the development.
- The site is unaffected by the inundation zone of any controlled reservoir.

¹ Flood Maps (NI). (2016) Flood Hazard & Flood Risk Maps for NI. Available from: <http://riversagency.maps.arcgis.com/apps/webappviewer/index.html?id=fd6c0a01b07840269a50a2f596b3daf6>

² Department for Infrastructure (2018). Flood Maps NI. Available from: <https://www.infrastructure-ni.gov.uk/topics/rivers-and-flooding/flood-maps-ni>.

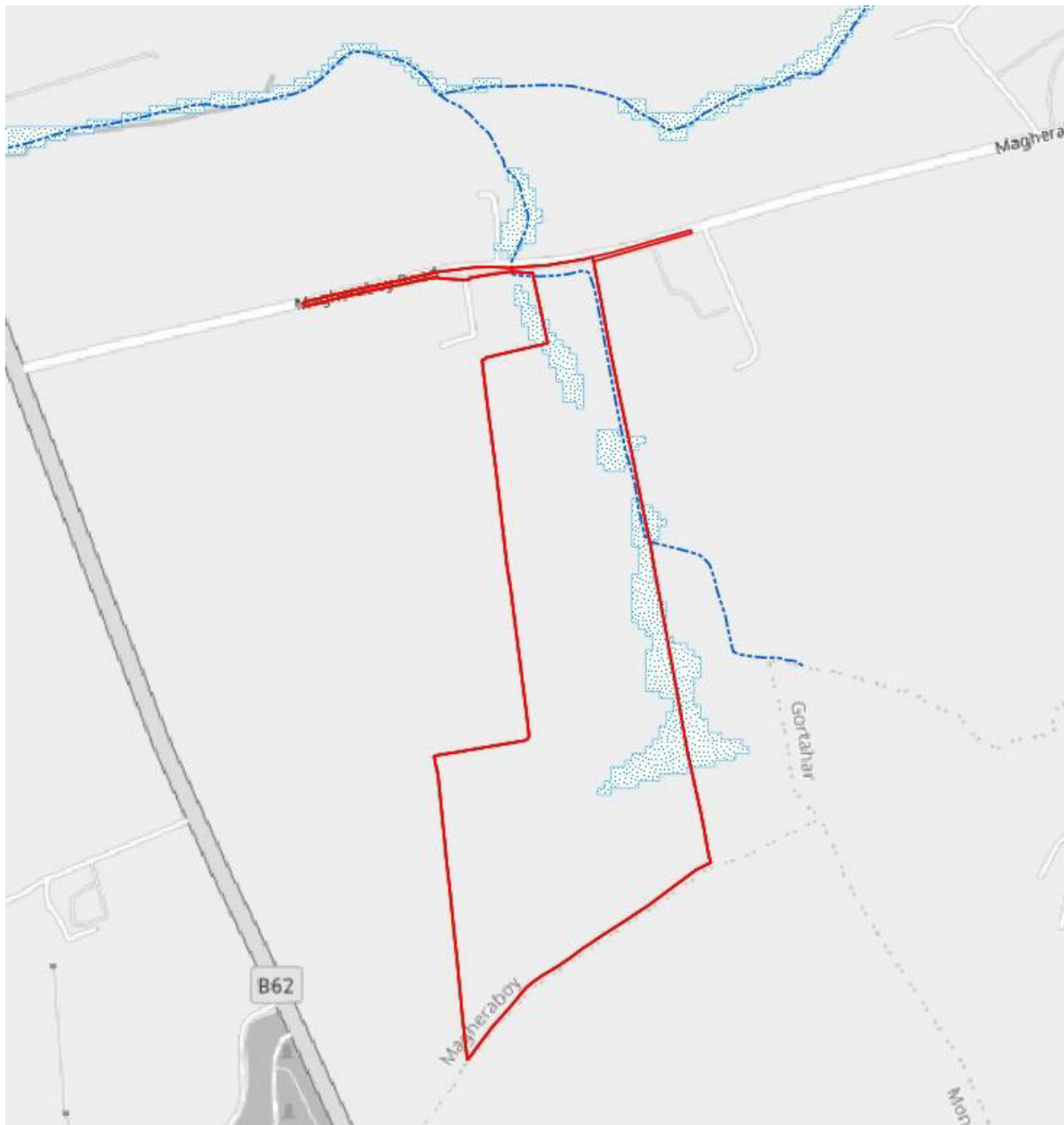


Figure 2-1 Extract from Flood Maps NI - Strategic 1% AEP + CC Fluvial Flood Extent

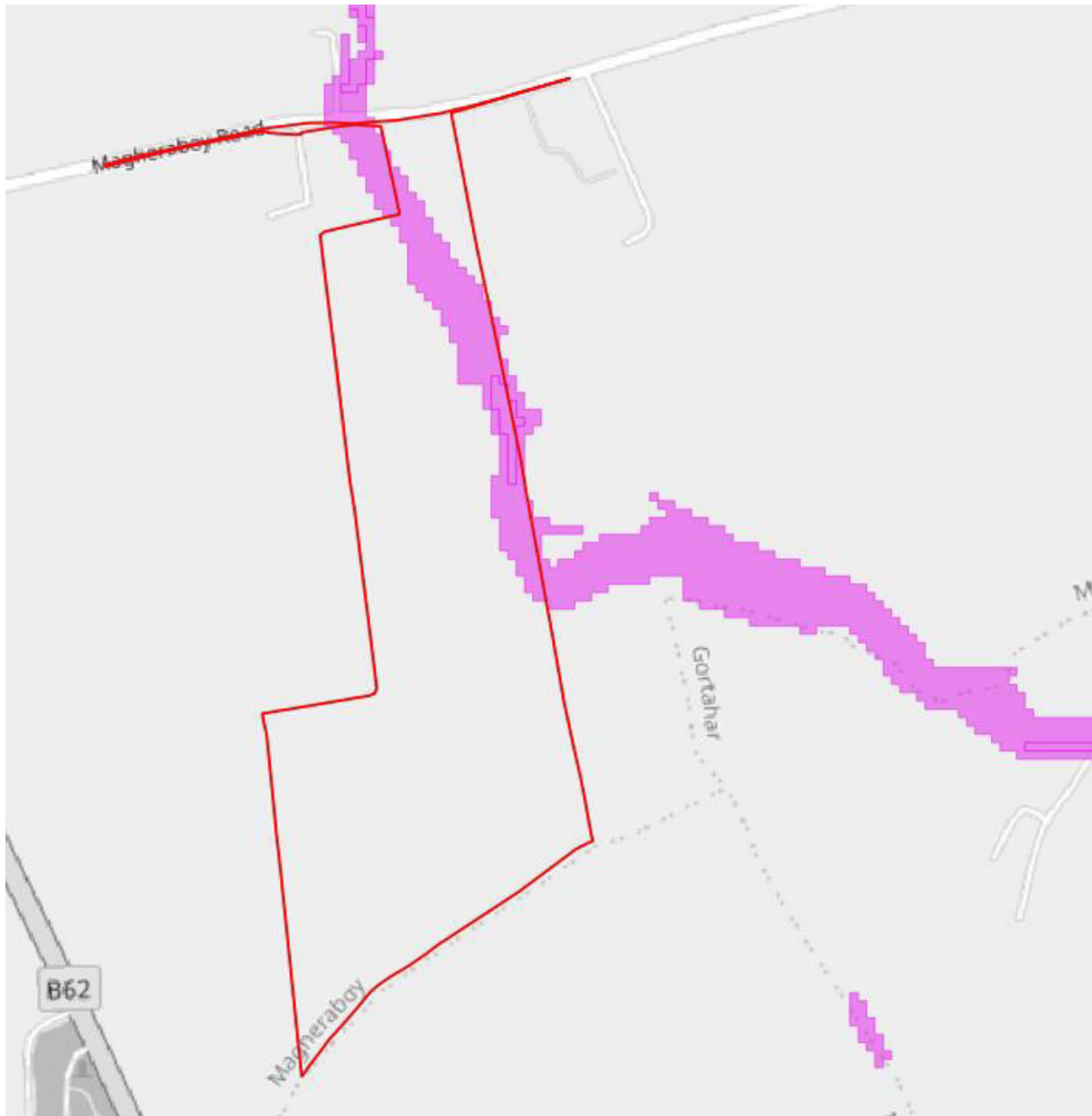


Figure 2-2 Extract from Flood Maps (NI) – Indicative 0.5% AEP+CC Surface Water Flood Extent

3 FLOOD RISK ASSESSMENT

3.1 Initial Assessment

This assessment addresses Revised PPS15 – Planning and Flood Risk in the absence of existing DfI Rivers consultation response.

Table 3-1: Initial Assessment - Flood Mechanism and Policy Screening

Policy	Flood Mechanism	Initial Assessment	Assess Further?	Policy Applies?
FLD 1 - Development in Fluvial & Coastal Flood Plains	Fluvial Flooding	FMNI strategic fluvial mapping indicates a floodplain at the site. Flood modelling is required to better define flood risk.	Yes	Yes
	Coastal Flooding	N/A	No	
	Flood Defence / Failure	The site does not lie in a defended area.	No	
	Culvert blockage	The undesignated watercourse is culverted adjacent to the site entrance.	Yes	
FLD 2 - Protection of Flood Defence & Drainage Infrastructure	Development near drainage or flood defence assets	The site access is adjacent to an undesignated watercourse and maintenance wayleave is required.	Yes	Yes
FLD 3 - Development and Fluvial Flood Risk Outside Flood Plains	Surface water flooding	The site is affected by surface water flooding indicated on Flood Maps NI.	Yes	Yes
	Surface water discharge	The development exceeds the threshold for a drainage assessment (change of use / hardstanding > 1000sqm).	Yes	
	Culvert Blockage	N/A	No	
	Urban Drainage / Local Drainage Failure	No indication of urban drainage flooding / sewer incapacity in initial evidence searches.	No	
	Groundwater	Ground conditions are likely to have low permeability	No	
FLD 4 - Artificial Modification of Watercourses	Development affecting watercourses	A section of culvert to an undesignated watercourse is required to access the site	Yes	Yes
FLD 5 - Development in Proximity to Reservoirs	Reservoir Flooding	The site is not located within the inundation zone of a controlled reservoir.	No	No

3.2 Fluvial Flood Risk

Flood Maps (NI) indicates that the undesignated watercourse at the site's north eastern boundary has been modelled indicatively. The indicative model is unsuitable for site specific assessment of flood risk. Therefore, a detailed site-specific river model has been developed for the watercourse. See Appendix E for methodology and details.

The model has been used to assess the flood risk to the proposed development and the effects of it. Results and findings are presented below.

All flood modelling is for the 1% AEP (Q100) flood. DfI Rivers will advise the planning authority that the effect of climate change is a material consideration, and so it is conservatively assumed that the climate change scenario will form the basis for applying policy FLD1. As per DfI Technical Flood Risk Guidance in Relation to Allowances for Climate Change in NI, an estimation of the effect of climate change has been derived through modelling an increase of present day design flows by 20%.

3.2.1 Existing Scenario Flooding

Flood model results indicate that the majority of the site is not affected by fluvial flooding, as illustrated on Figure 3-1, with detailed flood mapping provided in Appendix G.

An overland flow path emanates from the watercourse upstream of the site; however this does not reach the proposed development or its access track.

The inlet of the culvert which passes under Magheraboy Road at the northern side of the site is predicted to be surcharged by the 1% AEP CC flood. This results in out-of-bank flooding at the site's north western corner, flowing generally northward over Magheraboy Road and following the route of the downstream watercourse. Downstream culverts at a field access crossing are also noted to cause flood waters to back up along the modelled reach.

Flood levels vary from 81.17m OD to 74.72m OD from the upstream flooding at the site's eastern boundary to the Magheraboy Road culvert respectively.

The design of the proposed access at Magheraboy Road has been developed in parallel with the findings of this report and has been sited outside of the floodplain. As a result, all built development will be located outside of the existing floodplain.



Figure 3-1 Existing Scenario - Flood Extent by Depth - 1% AEP + CC

3.2.2 Proposed Development Scenario

As the proposal includes a new culvert to allow access from Magheraboy Road, a proposed development scenario was modelled. The proposed access has been designed to be located outside of the floodplain and with culvert dimensions to ensure a suitable freeboard for the 1% AEP + CC model simulation.

The proposed culvert dimensions are 2,100mm width x 1,500mm height, to suit the watercourse channel and allowing for freeboard to adjacent flooding caused by surcharge at the inlet of the Magheraboy Road pipe culvert. The culvert provides 0.3m freeboard above the predicted flood levels.

A flood map for the proposed access scenario is shown at Figure 3-2. Detailed flood mapping is provided on figure FL01 in Appendix G.

With regard to **the effect of the development on flood risk elsewhere**, the proposed access culvert causes no change in the predicted floodplain along the modelled watercourse or on Magheraboy Road. An increase in flood level of 0.08m is predicted to occur at the cross section along the open watercourse at the upstream face of the proposed box culvert (at the site's north eastern corner). This increase is retained within the watercourse channel, where the north eastern bank (Magheraboy Road side) remains 1.29m above the flood level. Additionally, the western bank (within the site) remains 0.43m above the flood level for the proposed access culvert scenario. The location of the flood level increase is within the site boundary.

No change in flood levels are calculated for the proposed access culvert scenario extending along the site's eastern boundary or along the downstream floodplain over Magheraboy Road.

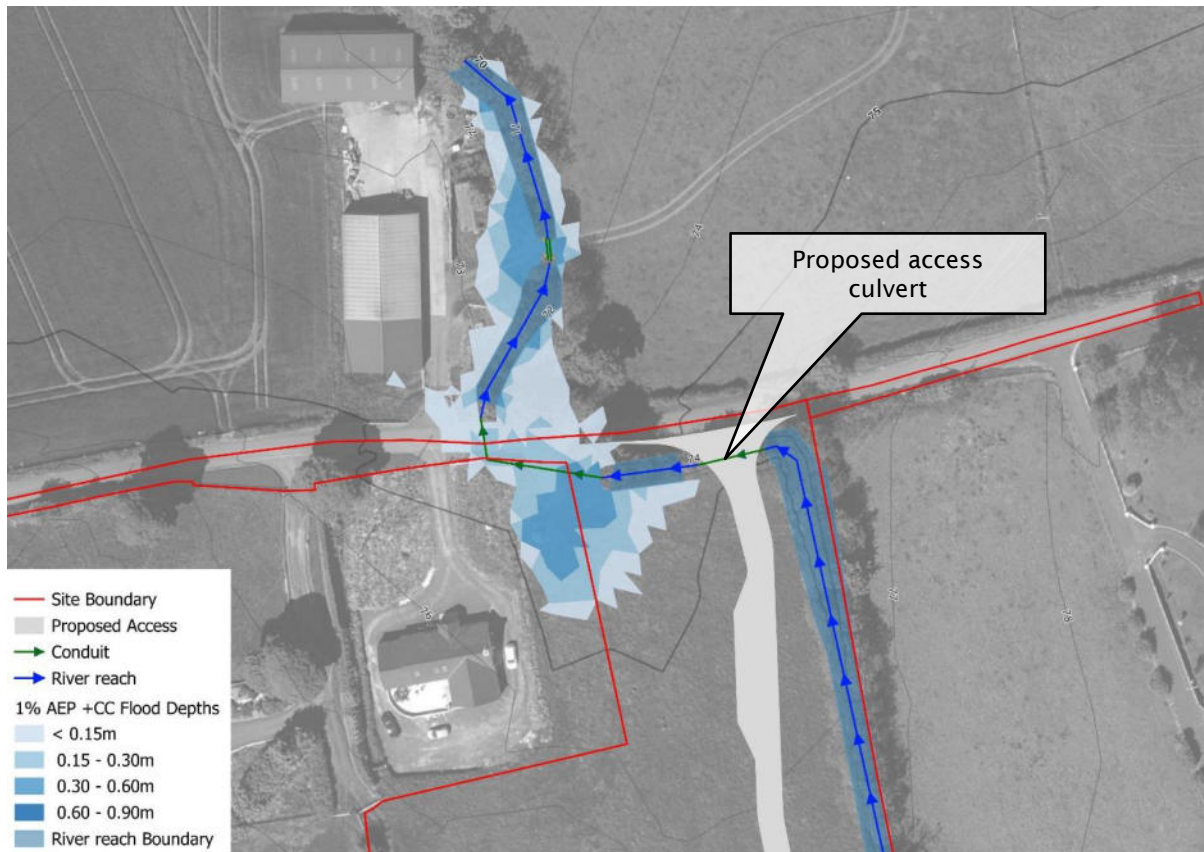


Figure 3-2 Proposed Access Culvert Scenario - Flood Extent by Depth - 1% AEP +CC

3.2.2.1 Effect of Culvert Blockage

Where the watercourse flows under Magheraboy Road via an existing 1100mm dia. pipe, it was deemed necessary to assess the impact of potential culvert blockage on flooding at the site. The inlet at this location is constructed with a headwall and without a screen and is undesignated.

A model scenario considered a 50% blockage of the Magheraboy Road culvert and results showed a predicted increase of up to 0.12m in flood levels at the northern side of the site. The additional depth of flooding is not significant, where the culvert is already bypassed overland for the unblocked scenario and is significantly undersized.

The effect of culvert blockage is contained within the recommended 0.6m freeboard to adjacent tracks development and no further mitigation is required.

3.3 Surface Water

3.3.1 Flood risk to site

Flood Maps NI indicates surface water flooding within and adjacent the site. The extent of surface water flooding coincides with the 1% AEP strategic fluvial flood extents from FMNI and as such is more appropriately assessed as fluvial. Refer to Section 3.2.

3.3.2 Effect of the Development

The site is currently greenfield. The proposed development will result in an increase to the rate and volume of runoff from the site, when compared to the existing scenario.

An estimate of unmitigated post-development runoff for the site has been made as part of this assessment. Runoff estimates are based on plans submitted as part of the current planning application. A comparison of existing and proposed runoff rates in litres per second (l/s) is given in Table 3-2.

Table 3-2 Comparison of Surface Water Runoff Rates (Peak [1hr] Runoff Rates)

Return Period	Existing Site (lps)	Proposed Site (lps)	Increase (lps)
1 in 2 year (1hr)	35.6	70.8	35.2
1 in 30 year (1hr)	61.7	181.7	120
1 in 100 year (1hr)	73.4	232.7	159.2

3.3.3 Potential for Overland Flooding

The site slopes from northwest to southeast.

A “rolling ball” hydrological analysis has been used to evaluate likely flow path / flow accumulation routes that would occur in the event of uncontrolled runoff from the site, shown in Figure 3-3. Run-off and uncontrolled overland flow from the site majority drains from the south to north, with the exception of the south-western corner which is draining south-west.

Mitigation of surface water flood risk to adjacent lands, up to the surface water protection standard (1% AEP rainfall event including climate change) required by DfI Rivers for new development, shall be by provision of an adequate drainage system. See Section 5.2.5

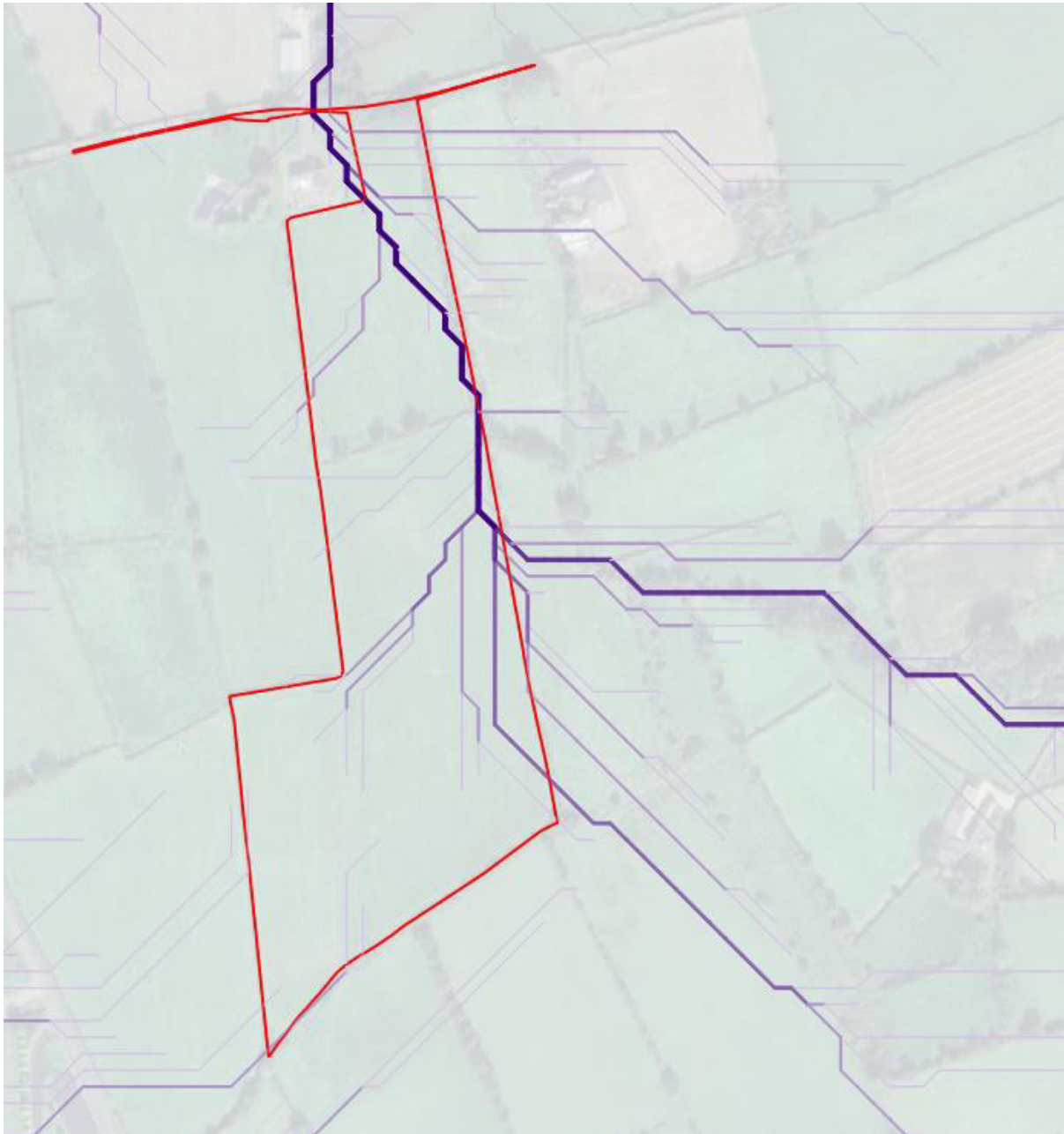


Figure 3-3 Overland Flow Paths

3.3.3.1 Effect on Drainage Networks

The site is currently greenfield. The development will utilise a new outfall to the undesignated watercourse within the site boundary. Flows shall be limited to an agreed greenfield equivalent rate (10lps/ha).

For the purposes of demonstrating that safe and authorised discharge of surface water can be achieved, a Schedule 6 application for consent to discharge to the undesignated watercourse was submitted to DfI Rivers (ref. IN1-24-18568). Consent has been received and is available in Appendix B.

Where runoff is limited to a greenfield equivalent rate up to the DfI flood protection standard then there can be no significant increase in flood risk to the downstream drainage network. Requirements for the attenuation and discharge of surface water based on the proposals at the site are discussed in Section 5.2.

4 WASTEWATER

4.1 WASTEWATER

The proposed development is unmanned. There are no welfare facilities included as part of this planning application and thus no requirement for wastewater disposal.

4.2 Pollution Control (Oils)

Permanent drainage pollution control shall include measures per Guidance for Pollution Prevention (GPP3) – use and design of oil separators in surface water drainage systems and The Control of Pollution (Oil Storage) Regulations (NI) 2010. Requirements vary dependant on drained surface type and specific measures are in place dependant on the proposed land use.

- Operations on the site involve infrequent visits by non-permanent staff. The site has been assessed as having sufficiently few traffic movements to be low risk, i.e., risk of infrequent light contamination and small spills only.
- Transformers utilise oil on site. No oil is stored on site for purpose of refuelling, i.e., the only oil on site is contained within the transformers. Transformers are bunded within an area by impervious block/concrete. The bund is uncovered.
- Clean rainwater arising from collection within the bund sump shall undergo pumped release via a proprietary “BundGuard” or similar approved, which features high level alarm to notify and trigger the dewatering process as and when required to maintain capacity within the bund; and an oil detector pump. An additional level of treatment is conservatively provided via class 1 bypass separator prior to discharge to site main drainage. Water Order Consent for the proposal to discharge treated rainwater to the surface water drainage system shall be sought post-planning consent.
- In the event of spillage and in the absence of foul sewerage to serve the development, contaminated bund water shall be disposed of by a licenced waste carrier at a licenced offsite treatment location which is in compliance with OFTEC Publication no. 39 – Guidance on the Disposal of Bundwater and Condensate. Removal of oils shall be undertaken by experienced personnel.

The location and specification of the separator is shown on the Drainage Layout within Appendix D

4.3 Emergency Response Approach (Fire Suppression)

The proposed Battery Energy Storage System (BESS) site has been designed to be self-sufficient in managing a potential battery-based fire event, ensuring that fire spread is prevented without reliance on fire service intervention. However, in the event that fire services choose to intervene, firefighting water may be utilized for cooling adjacent units in cases where control of a BESS unit is lost.

It is intended that an onsite water supply would not be required to achieve the fire response strategy outlined in 3.1. However, if agreed as necessary in development of the Fire Risk Management Plan, a supply of 1,900 litres per minute for at least 2 hours in line with the NFCC Guidance could potentially be achieved through an existing hydrant located approximately 365 metres from site or provision of a piped hydrant, sourcing the water from the existing water main running alongside Magheraboy Road. While an existing hydrant or a proposed piped hydrant solution is considered a potential option, further assessment would be needed to confirm if the required water supply could be achieved through this approach. Should the assessment determine that these solutions would not be viable, provision has been made for potential water tank locations

Where it is conservatively assumed that water used for cooling could become contaminated, then it will be controlled and prevented from leaving the site laterally (in site drainage) or by migrating vertically to groundwater. Lateral migration is prevented by installation of an emergency control shut-off isolation valve to the site drainage network upstream of the proposed drainage discharge location where it would enter a watercourse. Vertical migration is prevented by ensuring an impermeable liner under the stone formation used to form the unbound surface and subbase at the BESS area

The volume of storage available within the lined gravel sub-base is 2384 cu.m (15893 sq m x 0.6m deep subbase with 25% voids) and exceeds the minimum recommended volume (228 cu.m) required to contain water used for boundary cooling per NFCC Grid Scale Battery Energy Storage System Planning – Guidance for FRS. The system ensures that there is sufficient storage to allow arrangement for pumping facilities to remove contaminated water for transport and disposal offsite

5 SUMMARY OF FINDINGS AND RECOMMENDATIONS

5.1 Summary of Findings

A detailed flood model has been developed to inform the flood risk assessment.

A detailed assessment of fluvial flooding mechanisms affecting the site has indicated that part of the site is affected by the 1% AEP +CC fluvial flood extent; however, the proposed development has been sited outside of the fluvial flood extent.

The minimum required design flood levels at the site are those shown along the adjacent 1% AEP + CC fluvial flood as shown on the flood mapping FL01 in Appendix G.

The proposed development includes the addition of a short culvert to provide access at the northern boundary. A box culvert has been assessed as the recommended design for the proposed access structure to ensure that flood risk to and from the site is addressed and to satisfy the design requirements of Schedule 6 approval with DfI Rivers LAO.

The proposal has been demonstrated to cause no adverse effect of fluvial flood risk elsewhere. The proposed development is resilient to the effect of culvert blockage and no other significant flood mechanism exists at the site. Management of run-off from the site shall be by providing an adequate drainage system, as discussed below.

5.2 Design Measures

This section details measures which have been incorporated into the proposal submitted in support of the planning application.

5.2.1 FLD1 – Land Use

The proposed development has been sited outside of the modelled 1% AEP + CC fluvial floodplain and the policy is not engaged.

5.2.2 FLD1 – Design Levels

DfI Rivers recommends that development sited adjacent to a floodplain should facilitate a minimum freeboard of 0.6m vs the adjacent 1% AEP +CC flood levels. Assessment of potential culvert blockages has concluded that a 0.6m freeboard is suitable to ensure that the development is resilient to this residual risk.

All built development (BESS infrastructure and site access) shall provide a minimum of 0.6m freeboard to adjacent flood levels. Flood maps in Appendix G show that flooding varies from 81.17m OD at the southern extent of the floodplain along the site's eastern boundary, to 74.93m OD at the site's north eastern corner.

Proposal drawings are included in Appendix A.

5.2.3 FLD1 / FLD4 Proposed Access Culvert

The proposed access culvert shall comprise a box culvert with the parameters as presented on the below table. Design drawings for the proposed access culvert are included at Appendix H.

Freeboard to the design flood level has been assessed against CIRIA standards and where culvert dimensions >1200mm require a 300mm freeboard.

The proposed structure shall be subject to DfI Rivers Schedule 6 authorisation. An application has been submitted to DfI Rivers LAO in parallel with the planning application.

The flood modelling presented in this assessment has demonstrated that the structure is suitable and causes no adverse impact on flood risk elsewhere. Therefore, there is certainty that DfI Rivers LAO could have no reason to withhold consent on engineering grounds.

Policy permits the culverting of watercourses for access and the proposal complies with the requirement for crossings to be kept to a minimum.

Table 5-1 Proposed access culvert details

Culvert Detail	Dimension/Level	Comment
Span	2.1m	As optimised by flood model
Height	1.5m	Dictated by flood levels and 0.3m freeboard for soffit
Length	13.6m	As per access design
Upstream invert level	73.66m OD	To provide 0.3m soffit freeboard at upstream culvert flood level
Downstream invert level	73.62m OD	Optimised to achieve 0.3m freeboard for the soffit relative to downstream floodplain

5.2.4 FLD2 - Maintenance Strip

A 5m buffer from top of bank of all watercourses, free of built development that would impede maintenance, is shown on the drainage plan located in Appendix D.

5.2.5 FLD3 – Drainage Design and SuDS

A design has been undertaken to inform this assessment with supporting calculations and design drawings included in Appendix C and D respectively.

5.2.5.1 Design Standard

Surface water drainage on unbound surfaced areas of the site shall be by filter drain. Bound hardstand areas shall be by conventional gully pipe network. Drainage will not be eligible for adoption and will be privately maintained. Therefore, NIW design standards are not applicable. The design complies with the following mandatory standards:

- The drainage network / site layout should ensure containment and control of the 100-year (1% AEP) return period storm within the site to ensure no offsite effect elsewhere.
 - The drainage network should also allow for a 20% allowance for climate change at all the above listed return periods.
- To suit DfI Rivers flood protection standards.

Other drainage shall comply with Northern Ireland Building Regulations. SuDS features shall be designed in accordance with guidance as stated in CIRIA C753 SuDS manual.

5.2.5.2 Discharge Rate and Location

The drainage strategy relies upon connection to the existing undesignated watercourse bounding the site.

Surface water discharge from the site shall be limited to the greenfield equivalent rate of 10 litres per sec / Hectare for the development area. DfI Rivers has consented the discharge, file reference IN1-24-1856, copy enclosed in Appendix B.

5.2.5.3 Exceedance

It has been demonstrated that flows from the site up to the DfI flood protection design standard (1 in 100 year/1% AEP including climate change) can be safely contained within the drainage network without out of system flooding, refer to Appendix C.

Runoff in the event of other exceedance (i.e., blockage or other failure) will tend to follow flow routes tending towards the north of the site as per the present-day scenario (refer to Figure 3-1).

Mitigation of such exceedance shall be by robust maintenance of the drainage network described subsequently.

5.3 Maintenance Requirements

5.3.1 [Watercourse Maintenance](#)

The owner / occupier shall be required to fulfil their obligations under the Drainage Order as riparian landowner in relation to maintenance of the undesignated watercourses at the site.

In particular, the existing pipe inlet at Magheraboy Road and the proposed culvert inlet along the undesignated watercourse should be inspected and cleared at a suitable frequency to reduce any potential increased frequency of flood risk to the proposed development as a result of culvert blockage.

5.3.2 [Drainage System Maintenance](#)

Site drainage will be eligible for adoption and shall be maintained by NI Water. The detailed drainage layout for the site ensures that key features requiring maintenance are in accessible public places.

Maintenance plans for un-adopted drainage features are shown in Table 5-2.

Table 5-2 Site Drainage Maintenance Schedule

Inlets, Outlets, Controls, and Inspection Chambers		
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly
	Remove debris and sediment from chambers	Monthly for first six months, then quarterly or after significant storm
Remedial actions	Repair/rehabilitate where required	As required
Monitoring	Check all structures to ensure all is in good condition and operating as designed.	Annually
	(Flow controls) check for evidence of blockage	Monthly or after significant storm.
	(Flow controls) check for damage to components	Annually or after significant storm.
Filter Drain		
Regular Maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet, outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly

	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required
Attenuation basin,		
Regular Maintenance	Remove litter and debris	Monthly
	Cut grass for spillways and access routes. Cut grass: Meadow grass in and around basin.	Monthly (during growing season) or as required. Half yearly (spring / before nesting season and autumn)
Remedial Actions	Re-seed areas of poor vegetation cover.	As required
	Remove sediment from inlets, outlets and basin when required.	Every 5 years or as required
Monitoring	Check all structures to ensure all is in good conditions and operating as designed	Annually

5.4 Planning Policy Summary

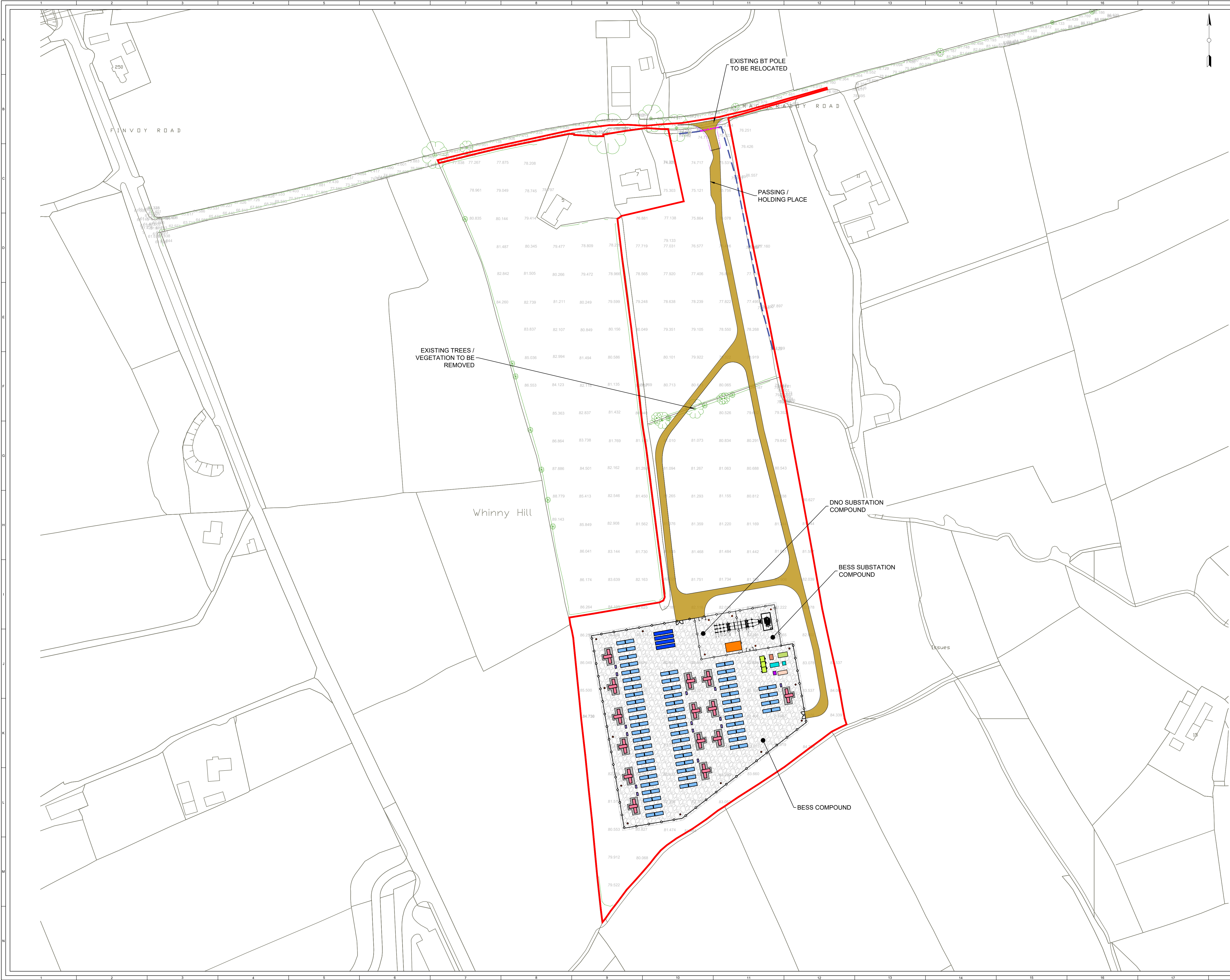
The following table summarises the findings, mitigation, and policy context of those flood mechanisms and policies deemed to be required to be investigated further by the initial assessment.

Table 5-3: PPS15 FLD3 Policy Summary

Planning Policy	Assessment / Mitigation
FLD 1 - Development in Fluvial & Coastal Flood Plains	The proposed development is located outside of the 1% AEP +CC fluvial floodplain as has been established by a flood model. Finished development levels to provide a minimum freeboard of 0.6m to the adjacent 1% AEP +CC flood levels. A proposed access culvert has been designed to provide a soffit freeboard of 0.3m and has been optimised to result in no adverse impact on flood risk elsewhere. The recommended 0.6m freeboard for development levels is resilient to adjacent flooding, including the effect of potential blockages of existing local culverts. The proposal complies with Policy FLD1.
FLD 2 - Protection of Flood Defence & Drainage Infrastructure	The proposals include suitable maintenance strips to the designated watercourse at the site to allow for maintenance. The proposal complies with FLD2.
FLD 3 - Development and Pluvial Flood Risk Outside Flood Plains	Site drainage design ensures the site is drained and flood resilient. Drainage design is per the requirements of DfI in relation to flood protection standards on the site and elsewhere. Runoff shall be limited to the greenfield equivalent rate and shall not affect flooding elsewhere. DfI Rivers has consented discharge to the undesignated watercourse adjacent to the site. The proposal complies with FLD3
FLD 4 - Artificial Modification of Watercourses	The proposed culvert for access is a permissible exception to FLD4. The proposal has been determined to cause no adverse effect to flooding elsewhere and complies with DfI Rivers standards in relation to capacity and freeboard.
FLD 5 - Development in Proximity to Reservoirs	Does not apply (see Table 3 1)

Appendix A

Drawings



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KEY:

- DEVELOPMENT BOUNDARY (OUTSIDE OF LINE DENOTES BOUNDARY)
- PALISADE WELDMESH OR ACOUSTIC FENCE
- BATTERY STORAGE ENCLOSURE (BSE)
- 2 No. POWER CONVERSION SYSTEMS (PCS) WITH TWIN MV SKID AND APRON SLAB DNO SUBSTATION BUILDING
- DNO SUBSTATION BUILDING
- BESS SUBSTATION BUILDING
- AUXILIARY TRANSFORMER
- LV SWITCHGEAR ROOM
- AGGREGATION PANEL WITH LV PILLAR
- PRE-INSERTION RESISTOR
- CAPACITOR BANK
- HARMONIC FILTER AND RESISTOR
- SPARES CONTAINER
- LIGHTING / CCTV COLUMN
- ACCESS TRACK
- SURFACE FINISH TYPICALLY COMPRISING STONE OR ASPHALT
- EXISTING TREES AND VEGETATION
- GATE
- EXISTING FENCE MODIFIED
- EXISTING DRAINAGE INFRASTRUCTURE
- PROPOSED CHANNEL CROSSING / CULVERT

NOTES:

1. EQUIPMENT DETAILS AND CONFIGURATION WITHIN THE ENERGY STORAGE COMPOUND ARE INDICATIVE AND SUBJECT TO DETAILED DESIGN.

3	BM	AP	PH	2025-02-20	UPDATED KEY
2	BM	AP	PH	2025-02-19	DESIGN EVOLUTION
1	BM	AP	PH	2024-10-29	FIRST ISSUE
ISSUE	DRAWN	CHKD	APPO	DATE	REVISION NOTES
PURPOSE	PLANNING				COORDINATES
SCALE	1:1,250	@ A1	DATUM		N/A
LAYOUT DWG	N/A		T-LAYOUT NO.		N/A
PROJECT TITLE					
MACHAIRE ENERGY STORAGE					
DRAWING TITLE					
INFRASTRUCTURE LAYOUT					
RES DRAWING NUMBER					REV
05511-RES-LAY-DR-PT-001					3
THIS DRAWING IS THE PROPERTY OF RENEWABLE ENERGY SYSTEMS LIMITED AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION					
 BEAUFORT COURT, EGG FARM LANE, KINGS LANGLEY, HERTS WD4 8LR, UK TEL: +44 (0) 1923 296200 WWW.RES-GROUP.COM					

Appendix B

Correspondence



E:

37 Castleroe Road
Coleraine
Co Londonderry
BT51 3RL

Tel: 028 703 42357

Rivers.Coleraine@infrastructure-ni.gov.uk

Our reference: IN1-24-18568
Coordinates: X296,923 Y414,609

Date: 8th January 2025.

Dear Iain,

RE: DRAINAGE (NORTHERN IRELAND) ORDER 1973 - A SCHEDULE 6 APPLICATION TO DISCHARGE STORM WATER FROM PROPOSED DEVELOPMENT, MARGHERABOY ROAD, RASHARKIN.

Thank you for your recent correspondence dated 8th November 2024. The watercourse affected by your proposal is undesignated under the terms of the Drainage (Northern Ireland) Order 1973.

DfI - Rivers Directorate '**is satisfied**' with your proposal to discharge storm water at a rate of 61.4 lit/sec (equivalent to greenfield run-off), from the above proposed development into the aforementioned watercourse. The discharge should be to the points indicated as per your drawing M01616-36_SK02 _ S6 CONCEPT DESIGN submitted with your application.

DfI - Rivers Directorate is satisfied with your proposals subject to the following conditions:

- The attenuation methods proposed in your drawing M01616-36_SK02 _ S6 CONCEPT DESIGN submitted with your application are acceptable providing the consented discharge rate of (61.4\ l/s) is not exceeded.

- The applicant should fully satisfy themselves that the internal site storm system is hydraulically and structurally capable of carrying design peak flows.
- Suitable anti-erosion measures must be in place, particularly at discharge points.
- The riparian/developers should satisfy themselves that were they intend to discharge to a watercourse they have obtained any permissions, consents, or maintenance agreements to reflect any increase in flow, disturbance or change in bed level and have these in place before works commence with riparian land/property owners that may be affected.
- In giving its consent DfI - Rivers Directorate would stress that it is your responsibility to ensure that the proposed discharge to the watercourse does not result in any obstruction to flow arising from a blockage, structural failure, poor workmanship, or any other reasons. Similarly, it is your responsibility to make provision for existing drainage. Moreover, if in the future another landowner wishes to drain land adjoining this site and within the same catchment, they should not be prevented from doing so.
- Riparian/developers should fully satisfy themselves that any proposal will not in any way increase the flood risk within the catchment.
- With respect to working maintenance strips, under section 6.32, Policy FLD 2 of Planning Policy Statement 15, the following is clearly stated:

“Where a new development proposal is located beside a flood defence, control structure or watercourse it is essential that an adjacent working strip is retained to facilitate future maintenance by DfI - Rivers Directorate, other statutory undertaker or the riparian landowners. The working strip should have a minimum width of 5 meters, but up to 10 meters where considered necessary, and be provided with clear access and egress at all times. The retention of a working strip along watercourses will have added benefits, including general amenity, enhanced biodiversity and increased control over water pollution, the latter assisting in the implementation of the Water Framework Directive.”

DfI - Rivers Directorate' recommendations are that the wayleave should be protected from impediments including tree planting, hedges, permanent fencing, sheds, land raising, permitted development rights or future unapproved development by way of a planning condition, and the maintenance strip be provided with clear access and egress at all times.

Riparian/developers should note that in accordance with Paragraph 11 of Schedule 6 of the Drainage (Northern Ireland) Order 1973 any consents/approvals given by DfI - Rivers Directorate under Schedule 6 shall not affect the liability of any riparian/developers to comply with other legislation. DfI - Rivers Directorate consent is from a drainage and flood risk aspect only. It is your responsibility to contact any other parties which may have an interest in your proposals e.g. NIEA, Landowners, DfI Roads, Fisheries etc.

In particular, applicants should be aware of the need to obtain DAERA Inland Fisheries/Loughs Agency consent to remove bed material from a watercourse. Details may be viewed at: -

<https://www.daera-ni.gov.uk/articles/authorisations-under-fisheries-act-ni-1966><http://www.loughs-agency.org/>.

Details on how to prevent pollutants from entering a watercourse can be viewed at: -

https://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017

Please note that failure to adhere to the above conditions is a contravention of the Drainage (Northern Ireland) Order 1973 and may result in legal proceedings. This consent is valid for a period of 24 months from the date of this letter. If the proposals are not completed within this period of time they should be resubmitted for further appraisal.

Should you require any further information or clarification, please do not hesitate to contact me at the above address, quoting the above reference number.

Yours sincerely,



DfI - Rivers Directorate

Appendix C

Calculations

Project Machaire energy storage station
Ref M01616-36
Date 27/02/2025

Purpose

To estimate the indicative (1-hr) change in runoff rate on a site caused by the proposed development. Note that proposed / indicative runoff rates are outline only and rely on the routing equation within the Modified Rational and Wallingford methods; actual runoff rates may differ significantly dependant on the nature of the surface water drainage network proposed and should be determined using hydraulic modelling.

Existing Site	A1	A2	A3	A4	TOTAL	
Roof	0				0	m ²
Bitmac / Paved / Hardstanding	0				0	m ²
					0	m ²

Proposed Site	A1	A2	A3	A4	TOTAL	
Roof	3102				3102	m ²
Bitmac / Paved / Hardstanding	2452	8845			11296	m ²
					14398	m ²

Site Details

Total Site Area	5.97	Ha	
SAAR	951	mm	From FEH3
SAAR4170	951	mm	From FEH3
UCWI	108	mm	
IOH124 region	1		from map ->
SOIL	4		From WRAP maps
SOIL	0.45		
DEEPSTOR	0.39		



Modified Rational Method (MRM):

	Existing		Proposed		
Length (m)	200	m	200	m	From Site Maps
Impermeable Area (ha)	0.000	Ha	1.440	Ha	
Max Height	86.1	mAOD	86.1	mAOD	From Survey
Min Height	79.3	mAOD	79.3	mAOD	From Survey
DeltaH	6.800		6.800		
Slope (%)	3.40		3.40		
Te (mins)	10.76		10.76		
ARF	0.000		0.984		

	Existing Site		Proposed Site	
PIMP	0.000	%	100.000	%
Percentage Runoff PR	0.45	%	81.87	%
Cv	0.00		0.82	
Cr	1.3		1.3	

Institute of Hydrology Report 124 (IoH 124) "Flood Estimation on Small Catchments" method

	Existing		Proposed	
Remaining Greenfield Area	5.97	Ha	4.53	Ha
% Greenfield	100.00	%	75.88	%

Existing Site - Peak (1-hr) Runoff Rates

Return Period	Permeable Runoff (IOH124) (lps)	Impermeable Runoff (MRM) (lps)	Total Runoff (lps)
1 in 2 year (1hr)	35.6	0.0	35.6
1 in 30 year (1hr)	61.7	0.0	61.7
1 in 100 year (1hr)	73.4	0.0	73.4

Proposed Site - Peak (1-hr) Runoff Rates

Return Period	Permeable Runoff (IOH124) (lps)	Impermeable Runoff (MRM) (lps)	Total Runoff (lps)
1 in 2 year (1hr)	27.0	43.8	70.8
1 in 30 year (1hr)	46.8	134.9	181.7
1 in 100 year (1hr)	55.7	177.0	232.7

Summary - Peak (1-hr) Runoff Rates

Return Period	Existing Site (lps)	Proposed Site (lps)	Increase (lps)	Increase (%)
1 in 2 year (1hr)	35.6	70.8	35.2	99%
1 in 30 year (1hr)	61.7	181.7	120.0	195%
1 in 100 year (1hr)	73.4	232.7	159.2	217%

By	Checked	Revision	Reason for Change	Date
IB	JD	Original		25/02/2025
IB	JD	2	Minor Amendment	27/02/2025

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	0.000
M5-60 (mm)	17.200	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.288	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.000		

Designed with Level Soffits

Network Design Table for Surface Network 2

« - Indicates pipe capacity < flow

PN	Length	Fall	Slope	I.Area	T.E.	Base	k	HYD	DIA	Section	Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow (l/s)	(mm)	SECT	(mm)			Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E (m)	I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
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Network Design Table for Surface Network 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	17.343	0.162	107.1	0.092	5.00	0.0	0.600	o	375	Pipe/Conduit	
1.001	60.213	0.301	200.0	0.172	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.002	60.643	0.303	200.1	0.183	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.003	40.694	0.203	200.5	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	31.982	0.364	87.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	55.076	0.442	124.6	0.180	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	66.702	0.445	149.9	0.110	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	45.973	0.230	199.9	0.159	5.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.17	82.225	0.092	0.0	0.0	0.0	1.75	193.4	12.5
1.001	49.49	5.95	82.063	0.264	0.0	0.0	0.0	1.28	141.1	35.4
1.002	47.00	6.74	81.762	0.447	0.0	0.0	0.0	1.28	141.0	56.9
1.003	45.49	7.27	81.459	0.447	0.0	0.0	0.0	1.28	140.9	56.9
1.004	44.75	7.55	81.256	0.447	0.0	0.0	0.0	1.93	213.6	56.9
2.000	50.00	5.65	82.225	0.180	0.0	0.0	0.0	1.41	99.5	24.4
2.001	47.66	6.52	81.783	0.290	0.0	0.0	0.0	1.28	90.6	37.5
3.000	50.00	5.69	82.300	0.159	0.0	0.0	0.0	1.11	78.4	21.5

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Network Design Table for Surface Network 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.009	29.443	0.196	150.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.009	41.35	8.99	79.620	1.190	0.0	0.0	0.0	1.06	42.3«	142.7

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Manhole Schedules for Surface Network 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S6	296991.324	414398.022	296991.324	414398.022	Required	
S7	296981.850	414452.277	296981.850	414452.277	Required	
S8	296929.978	414352.942	296929.978	414352.942	Required	
S9	296923.066	414398.392	296923.066	414398.392	Required	
S10	296916.105	414441.019	296916.105	414441.019	Required	
S11	296968.422	414480.047	296968.422	414480.047	Required	
S12	296911.201	414470.123	296911.201	414470.123	Required	
S13	296908.717	414487.220	296908.717	414487.220	Required	

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Network 2019.1

Manhole Schedules for Surface Network 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S14	296962.504	414496.216	296962.504	414496.216	Required	
S15	296958.293	414523.397	296958.293	414523.397	Required	

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<u>Simulation Criteria for Surface Network 2</u> <table><tr><td>Volumetric Runoff Coeff 0.750</td><td>Manhole Headloss Coeff (Global) 0.500</td><td>Inlet Coeffiecient 0.800</td></tr><tr><td>Areal Reduction Factor 1.000</td><td>Foul Sewage per hectare (l/s) 0.000</td><td>Flow per Person per Day (l/per/day) 0.000</td></tr><tr><td>Hot Start (mins) 0</td><td>Additional Flow - % of Total Flow 0.000</td><td>Run Time (mins) 60</td></tr><tr><td>Hot Start Level (mm) 0</td><td>MADD Factor * 10m³/ha Storage 2.000</td><td>Output Interval (mins) 1</td></tr></table> Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> <table><tr><td>Rainfall Model</td><td>FSR</td><td>M5-60 (mm) 15.800</td><td>Cv (Summer) 0.750</td></tr><tr><td>Return Period (years)</td><td>2</td><td>Ratio R 0.263</td><td>Cv (Winter) 0.840</td></tr><tr><td colspan="3">Region Scotland and Ireland Profile Type Summer Storm</td><td>Duration (mins) 30</td></tr></table>			Volumetric Runoff Coeff 0.750	Manhole Headloss Coeff (Global) 0.500	Inlet Coeffiecient 0.800	Areal Reduction Factor 1.000	Foul Sewage per hectare (l/s) 0.000	Flow per Person per Day (l/per/day) 0.000	Hot Start (mins) 0	Additional Flow - % of Total Flow 0.000	Run Time (mins) 60	Hot Start Level (mm) 0	MADD Factor * 10m³/ha Storage 2.000	Output Interval (mins) 1	Rainfall Model	FSR	M5-60 (mm) 15.800	Cv (Summer) 0.750	Return Period (years)	2	Ratio R 0.263	Cv (Winter) 0.840	Region Scotland and Ireland Profile Type Summer Storm			Duration (mins) 30
Volumetric Runoff Coeff 0.750	Manhole Headloss Coeff (Global) 0.500	Inlet Coeffiecient 0.800																								
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Hot Start (mins) 0	Additional Flow - % of Total Flow 0.000	Run Time (mins) 60																								
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Return Period (years)	2	Ratio R 0.263	Cv (Winter) 0.840																							
Region Scotland and Ireland Profile Type Summer Storm			Duration (mins) 30																							
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<u>Hydro-Brake® Optimum Manhole: S16, DS/PN: 1.009, Volume (m³): 1.8</u>																																																																													
Unit Reference MD-SHE-0190-1780-0900-1780 Sump AvailableYes Design Head (m)0.900 Diameter (mm)190 Design Flow (l/s)17.8 Invert Level (m)79.620 Flush-Flo™Calculated Minimum Outlet Pipe Diameter (mm)225 ObjectiveMinimise upstream storage Suggested Manhole Diameter (mm)1500 ApplicationSurface																																																																													
<table><tr><td colspan="2">Control Points</td><td>Head (m)</td><td>Flow (l/s)</td><td colspan="2">Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td colspan="2">Design Point (Calculated)</td><td>0.900</td><td>17.8</td><td colspan="2">Kick-Flo®</td><td>0.655</td><td>15.3</td></tr><tr><td colspan="2">Flush-Flo™</td><td>0.314</td><td>17.8</td><td colspan="2">Mean Flow over Head Range</td><td>-</td><td>14.9</td></tr></table>						Control Points		Head (m)	Flow (l/s)	Control Points		Head (m)	Flow (l/s)	Design Point (Calculated)		0.900	17.8	Kick-Flo®		0.655	15.3	Flush-Flo™		0.314	17.8	Mean Flow over Head Range		-	14.9																																																
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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																																																																													
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Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																		
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Innovyze	Network 2019.1																																						
<u>Storage Structures for Surface Network 2</u> <u>Tank or Pond Manhole: S15, DS/PN: 1.008</u> Invert Level (m) 79.650 <table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>344.7</td><td>0.200</td><td>400.2</td><td>0.400</td><td>457.7</td><td>0.600</td><td>516.6</td><td>0.800</td><td>576.9</td><td>0.946</td><td>621.8</td></tr><tr><td>0.100</td><td>372.0</td><td>0.300</td><td>428.8</td><td>0.500</td><td>487.0</td><td>0.700</td><td>546.6</td><td>0.900</td><td>607.6</td><td></td><td></td></tr></table>				Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	344.7	0.200	400.2	0.400	457.7	0.600	516.6	0.800	576.9	0.946	621.8	0.100	372.0	0.300	428.8	0.500	487.0	0.700	546.6	0.900	607.6		
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Date 25/02/2025 16:06 File M01616-36 MD new layout.mdx					Designed by JD Checked by IB						
Innovyze					Network 2019.1						
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2</u>											
<u>Simulation Criteria</u>											
Areal Reduction Factor 1.000			Manhole Headloss Coeff (Global) 0.500			MADD Factor * 10m³/ha Storage 2.000					
Hot Start (mins) 0			Foul Sewage per hectare (l/s) 0.000			Inlet Coefficient 0.800					
Hot Start Level (mm) 0			Additional Flow - % of Total Flow 0.000			Flow per Person per Day (l/per/day) 0.000					
Number of Input Hydrographs 0				Number of Offline Controls 0				Number of Time/Area Diagrams 0			
Number of Online Controls 1				Number of Storage Structures 1				Number of Real Time Controls 0			
<u>Synthetic Rainfall Details</u>											
Rainfall Model			FSR M5-60 (mm) 16.800			Cv (Summer) 0.750					
Region Scotland and Ireland			Ratio R 0.280			Cv (Winter) 0.840					
Margin for Flood Risk Warning (mm)						300.0		DVD Status ON			
Analysis Timestep 2.5 Second Increment (Extended)						Inertia Status ON					
DTS Status						ON					
Profile(s)						Summer and Winter					
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880,						4320, 5760, 7200, 8640, 10080					
Return Period(s) (years)						100					
Climate Change (%)						20					

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Innovyze	Network 2019.1										
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2</u>											
<table><thead><tr><th></th><th>US/MH</th><th>Level</th></tr><tr><th>PN</th><th>Name</th><th>Exceeded</th></tr></thead><tbody><tr><td>1.000</td><td>S1</td><td></td></tr></tbody></table>				US/MH	Level	PN	Name	Exceeded	1.000	S1	
	US/MH	Level									
PN	Name	Exceeded									
1.000	S1										
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Mossley Mill	M01616-36 Storm Rev 1	
Newtownabbey	Machaire BESS	
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Innovyze	Network 2019.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2

									Water	Surcharged	Flooded			Pipe
US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Flow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)
1.001	S2	15	Winter	100	+20%	100/15	Summer		82.751	0.313	0.000	0.73		96.8
1.002	S3	15	Winter	100	+20%	100/15	Summer		82.637	0.500	0.000	0.99		130.4
1.003	S4	15	Winter	100	+20%	100/15	Summer		82.532	0.698	0.000	0.77		99.3
1.004	S5	15	Winter	100	+20%	100/15	Summer		82.426	0.795	0.000	0.57		109.0
2.000	S6	15	Winter	100	+20%	100/15	Summer		83.027	0.502	0.000	0.66		62.0
2.001	S7	15	Winter	100	+20%	100/15	Summer		82.908	0.825	0.000	0.80		69.2
3.000	S8	15	Winter	100	+20%	100/15	Summer		82.931	0.331	0.000	0.72		53.1
3.001	S9	15	Winter	100	+20%	100/15	Summer		82.837	0.467	0.000	1.10		80.1
2.002	S10	15	Winter	100	+20%	100/15	Summer		82.722	1.084	0.000	1.23		139.2
4.000	S11	15	Winter	100	+20%	100/15	Summer		82.478	0.053	0.000	1.05		42.8
1.005	S12	15	Winter	100	+20%	100/15	Summer		82.266	0.999	0.000	1.86		246.6
1.006	S13	15	Winter	100	+20%	100/15	Summer		81.868	0.716	0.000	1.60		243.5
1.007	S14	15	Winter	100	+20%				80.909	-0.180	0.000	0.53		244.3
1.008	S15	240	Winter	100	+20%	100/15	Summer		80.534	0.659	0.000	0.62		18.4
1.009	S16	240	Winter	100	+20%	100/15	Summer		80.524	0.679	0.000	0.45		17.8

PN	US/MH	Status	Level
	Name		Exceeded
1.001	S2	SURCHARGED	
1.002	S3	SURCHARGED	
1.003	S4	SURCHARGED	
1.004	S5	SURCHARGED	

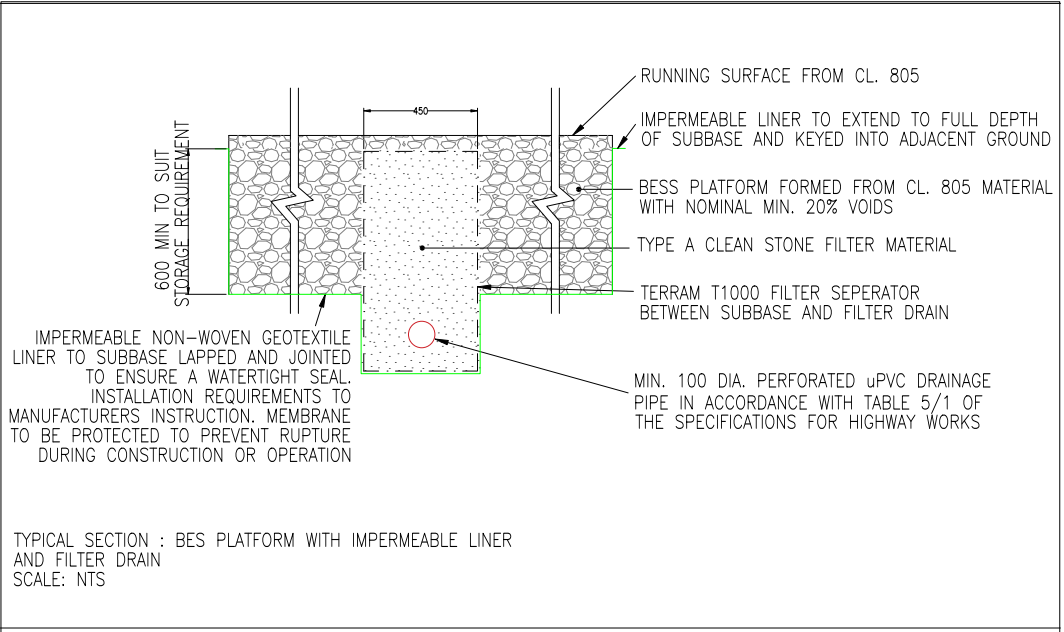
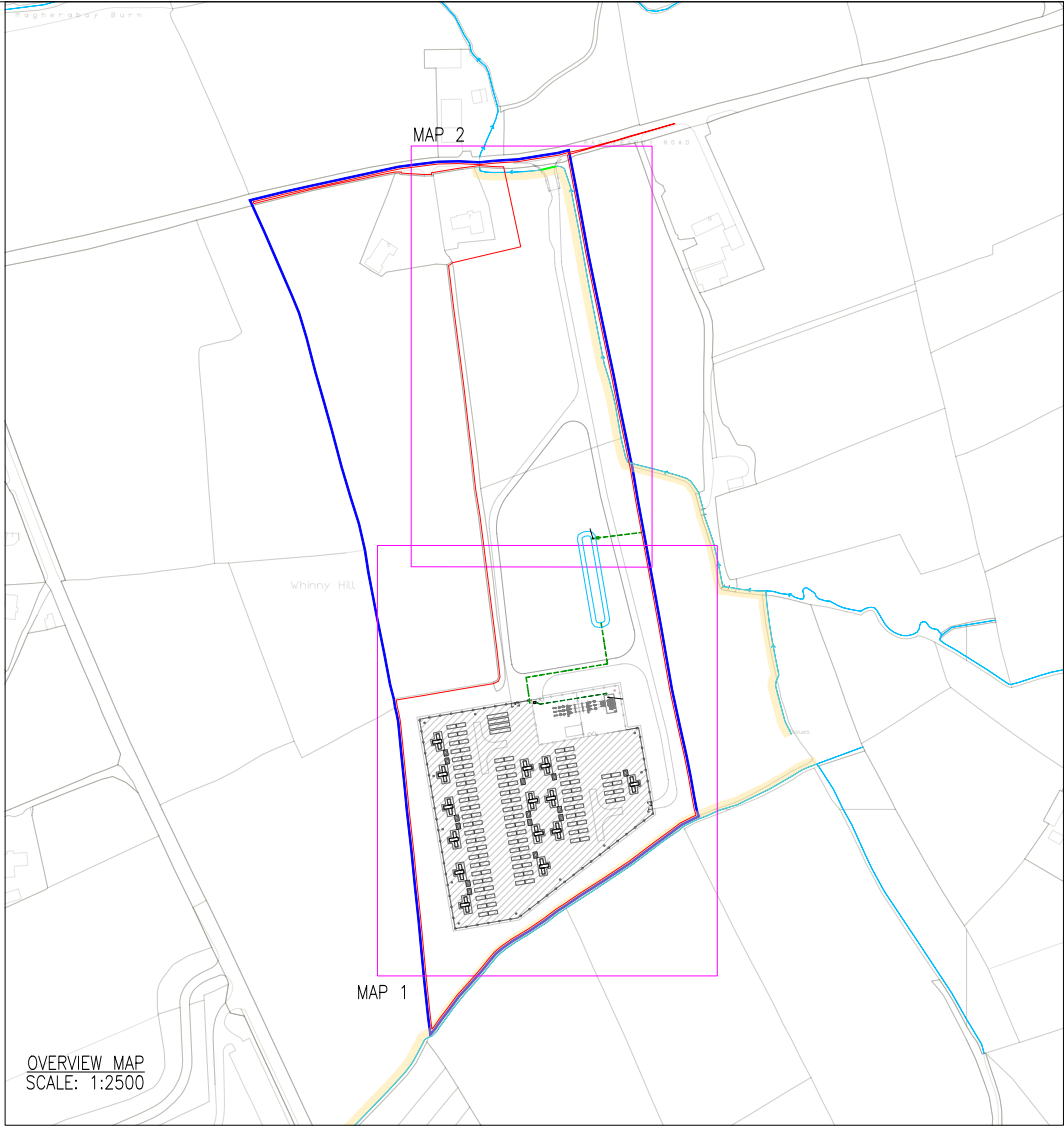
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Innovyze	Network 2019.1		
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2</u>			
	PN	US/MH Name Status	Level Exceeded
	2.000	S6 FLOOD RISK	
	2.001	S7 SURCHARGED	
	3.000	S8 SURCHARGED	
	3.001	S9 SURCHARGED	
	2.002	S10 SURCHARGED	
	4.000	S11 SURCHARGED	
	1.005	S12 SURCHARGED	
	1.006	S13 SURCHARGED	
	1.007	S14 OK	
	1.008	S15 FLOOD RISK	
	1.009	S16 FLOOD RISK	
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Appendix D

Drainage Plan



SCALE: 1:500



TYPICAL SECTION : BES PLATFORM WITH IMPERMEABLE LINER AND FILTER DRAIN
SCALE: NTS

NOTES

- GENERAL
1. THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.
 2. THIS DRAWING SHALL BE REVIEWED IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS.
 3. THIS DRAWING IS NOT TO BE SCALED FROM.
 4. THE CONTRACTOR IS TO UNISE WITH ALL STATUTORY UNDERTAKERS IN REGARD TO LOCATING ALL EXISTING SERVICES WITHIN AND ADJACENT TO THE SITE OF THE WORK

LEGEND

- SITE BOUNDARY
- LAND OWNERSHIP BOUNDARY
- CARRIER PIPE
- FILTER DRAIN
- CULVERT TO ACCESS
- WATERCOURSE (OPEN)
- 5m MAINTENANCE BUFFER

ISSUE	DRN	APP	DATE	NOTES / DESCRIPTION
2	IB	DKS	27/02/25	MINOR AMENDMENT
1	IB	DKS	25/02/25	FOR REVIEW

STATUS FOR REVIEW

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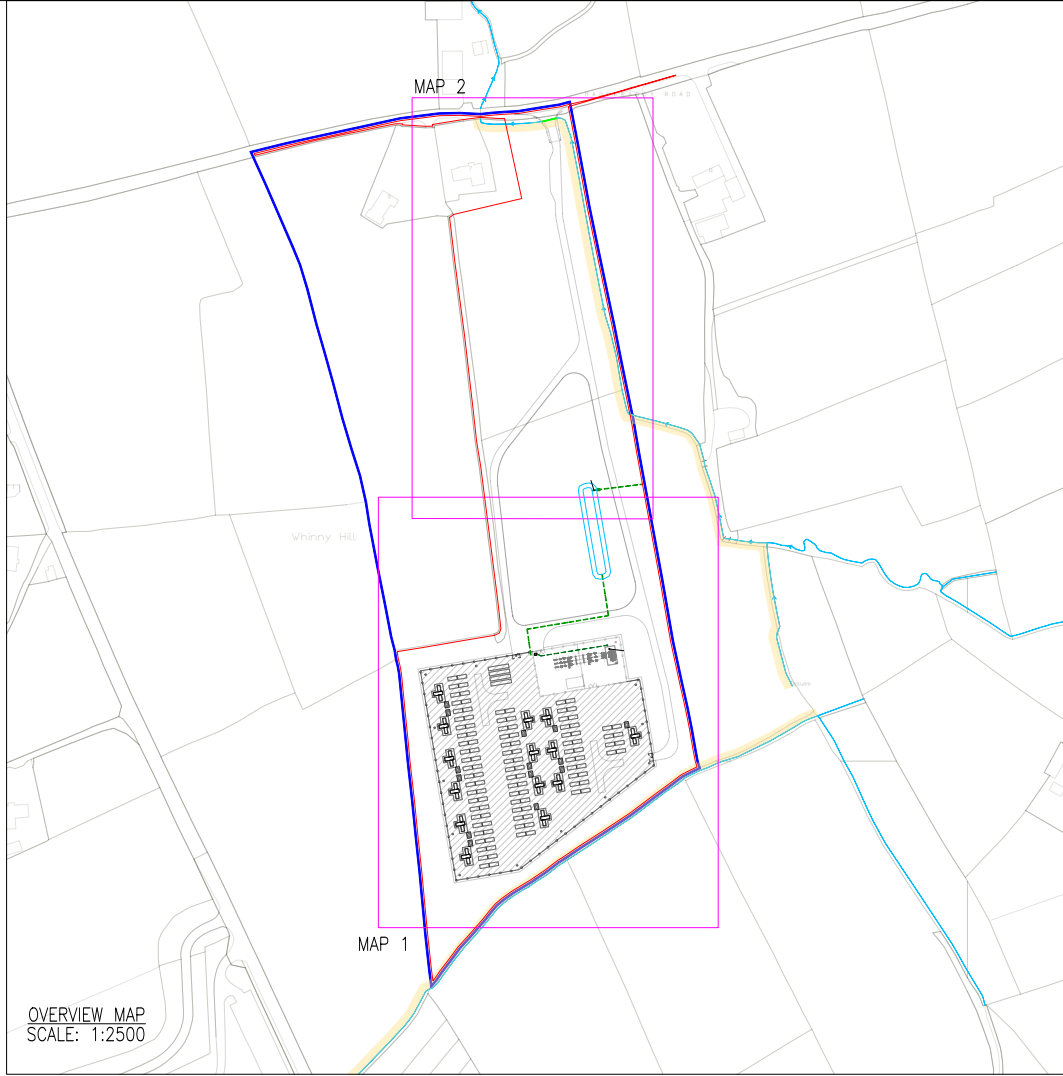
Mossley Mill, Lower Ground (West)
Carrinmore Road North
Newtownabbey
Co. Antrim, BT36 5QA

PROPOSED BATTERY ENERGY
STORAGE SYSTEM, MAGHERABOY RD

res

PROPOSED DRAINAGE LAYOUT
GENERAL ARRANGEMENT
1 OF 2

SCALE	AS SHOWN	ORIGINAL SIZE	A1
DRAWN	IB	CHECKED	DKS
DATE	27/02/2025		
PROJECT NO.	M01616-36	DWG NO.	DWG_100
ISSUE NO.	2		



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2. THIS DRAWING SHALL BE REVIEWED IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS.
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- LEGEND
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ISSUE	DRN	APP	DATE	NOTES / DESCRIPTION
2	IB	JD	27/02/25	MINOR AMENDMENT
1	IB	DKS	25/02/25	FOR REVIEW

STATUS	FOR REVIEW
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Co. Antrim, BT36 5QA

PROPOSED BATTERY ENERGY
STORAGE SYSTEM, MAGHERABOY RD

res

DRAWING TITLE

PROPOSED DRAINAGE LAYOUT
GENERAL ARRANGEMENT
2 OF 2

SCALE		ORIGINAL SIZE	
AS SHOWN		A1	
DRAWN	CHECKED	DATE	
IB	DKS	27/02/2025	
PROJECT NO.	DRAWING NO.	ISSUE NO.	
M01616-36	DWG_101	2	

Appendix E

Hydraulic Modelling

PREAMBLE

The undesignated watercourse at the site has not been previously modelled in detail, as per Flood Maps NI. A sufficiently detailed flood model was developed, proportionate to the scale of the application site. An Infoworks ICM 1D-2D hydraulic model has been developed, allowing accurate determination of flood levels at the site.

The estimation of peak flows for the required design annual probability has been necessary to determine the peak inflows for input to an unsteady state hydraulic model. The following hydrological and hydraulic analysis was undertaken to support the application site.

HYDROLOGICAL ASSESSMENT

Catchment Extent

Assessment of the catchment contributing flows to the watercourse in proximity to the proposal location was conducted using data from various sources, including the following:

- FEH Web Portal
- DfI Rivers Catchment App
- 10m DTM
- Ground truthing / visual observations

The assessment was conducted to ensure that a suitably conservative catchment extent was used in the calculation of peak flows. The catchment for the watercourse was assessed at the downstream end of the site. The examined catchment extents datasets are shown in Figure E - 1 and the corresponding catchment areas are given in Table E - 1.

A geospatial analysis tool was used to produce a catchment boundary based on a ground model based on 10m DTM. This delineated a site-specific catchment for the watercourse at the downstream end of the site. The site-specific catchment generally extends south east from the site and includes only areas which drain towards the watercourse at the site.

The FEH Web Portal dataset catchment includes an area of lands to the north east. However, the terrain analysis and background mapping confirms that this north eastern area drains away from the site catchment, as indicated by the watercourse route labelled on Figure E - 1.

DfI Rivers catchment web app catchment dataset was also examined and noted to include an area south west of the site. Site observations and terrain analysis confirmed that lands south west of the site drain westward and do not contribute to the site catchment.

Examination of background mapping, contour mapping and site observations concluded that the site-specific catchment was suitable to adopt and was therefore taken forward to the hydrological assessment as it is based on the most accurate ground model dataset.

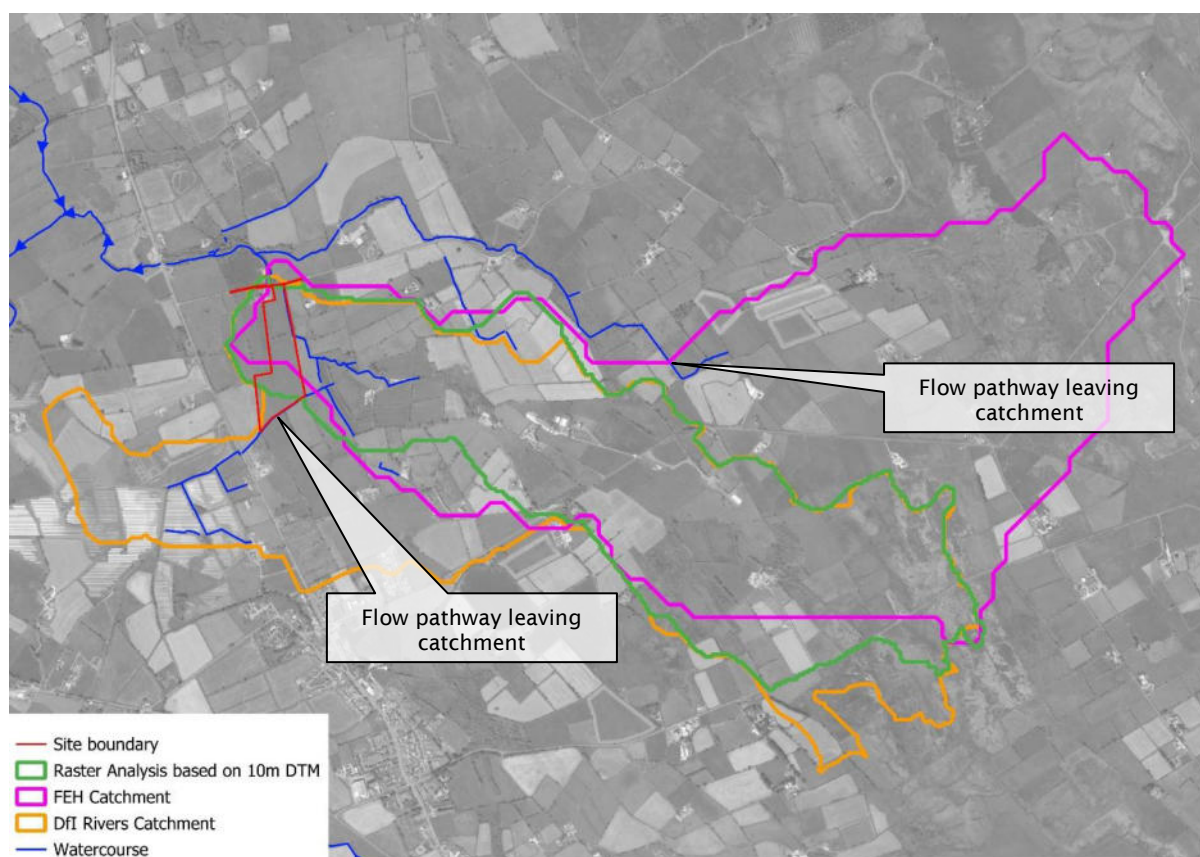


Figure E - 1 Site Catchment

Table E - 1 Catchment Area Summary

Analysis Method	Catchment Area (km2)
FEH Dataset	3.58
DfI Rivers web-app	2.79
Raster Analysis based on 10m DTM	1.85

Peak Flow Estimation and Hydrograph Shape

The estimation of peak flow for the required design annual probability has been necessary to determine the peak inflow for input to a steady state hydraulic model. The derivation of the 1% AEP peak flow for the watercourses were assessed using the FEH Revitalised Flood Hydrograph (ReFH2) Method as FEH-based methods are recommended for use in all instances. The catchment size was insufficient for application of the Statistical method.

FEH catchment descriptors have been verified where possible using OS 1:50,000 raster and vector mapping, and site observations. The design flow was calculated for the watercourse as per the site-specific catchment and detailed calculations for the determination of the design flow is contained in Appendix F. A hydrograph profile was determined based on the ReFH2 analysis.

Table E - 2 Hydrology Summary

Analysis Method	1% AEP Design Flow (m ³ /s)
FEH ReFH2 Method	3.94

Application to the Model

The calculated design flow was applied as a point inflow at the upstream extent of the modelled reach of the watercourse. Application of the hydrology, with flow estimation downstream of the site, but the flow applied upstream of the site, is a conservative approach.

HYDRAULIC MODEL SIMULATION

Infoworks ICM v2024.3.0 was utilised as it provides a fully integrated 1D-2D hydrodynamic model which uses a dynamic engine solving full St. Venant equations for both the 1D and 2D simulations. Simulations are conducted in an unsteady state with the numerical simulation applied on a non-structured mesh which makes the model fully flexible from the geometric point of view. The hydraulic model for the site has the purpose of providing peak water levels from the derived design flow estimates for the watercourse in the vicinity of the site, where the most conservative flood levels predicted were adopted for the purposes of this assessment.

Model extents were informed through a site walkover which investigated both the river channels and surrounding areas in proximity to the proposal location. Figure E.2 details these extents and many of the model elements incorporated in the model build process. The river channels and culverts have been modelled in 1D, with banks and surrounding floodplains represented via the 2D zone. Each of these elements has been detailed further in subsequent sections with information provided regarding the source of the data and justification of the parameters selected.



Figure E - 2 Model Geometry

1-Dimensional River Reaches

River Sections

The geometry of natural channels is irregular and cannot be characterised using simple mathematical relationships. Therefore, representation in mathematical models requires that the stream geometry, in the form of discrete cross sections, be taken transversely at key locations in the watercourse.

Invert levels and bank levels of the watercourse were provided in a topographic survey of the site completed by a third-party surveyor. Due to the nature and scale of development and associated risk, it was determined that a linked 1D-2D model would be of sufficient detail to generate conservative estimates of flood levels at the site.

The positions of the cross sections were based primarily on the location of available invert levels and structures, together with significant changes in channel and structure geometry. Detail from the topographic survey and observations and measurements taken onsite determined the channel geometry.

The roughness of the river reach is represented by applying Manning's n roughness values to the river sections for floodplains and river channel. A roughness value of 0.045 was used representing a natural channel winding with pools, shoals and some weeds and stones.

Structures

Table E – 3 provides specific details for the structures included in the model geometry.

Table E - 3 Structure Register – Existing

Location	Model Reference	Detail	Comment
Located c. 325 m upstream from Magheraboy Road. Upstream from the site to the east.	Upstream: CULV 3 US Downstream: CULV 3 DS	<u>Opening:</u> Shape: Rectangular Width: 1200mm Height: 450mm Roughness (Top): 0.015 Roughness (Bottom): 0.045	Size of conduit applied as representative of deck bridge captured during site survey. Roughness as per appropriate for conduit material.
At Magheraboy Road crossing of watercourse	Upstream: CULV 2 US Downstream: CULV 2 DS	<u>Opening:</u> Shape: Circular Width: 1100 Height: 1100 Roughness (Top): 0.015 Roughness (Bottom): 0.015	Dimensions as per survey. Headwall without screen at inlet. Roughness as per appropriate for conduit material.
Located C. 30m downstream from Magheraboy Road, north of the site.	Upstream: CULV 1 US Downstream: CULV 1 DS	<u>Opening:</u> Shape: Twin Circular Width: 500 Height: 500 Roughness (Top): 0.015 Roughness (Bottom): 0.015	Dimensions as per survey. Separate twin pipes and inlets represented. Roughness as per appropriate for conduit material.

River Banks

The river reach bank lines were developed using the ground model produced from the topographical survey and 10m DTM. Bank coefficients were reduced from default values as required to establish model stability in areas of bank overtopping. Minimum values of 0.5 were used for both discharge coefficient and modular limit to ensure conveyance between the 1D and 2D domains.

2-Dimensional Surface Model Areas

Topography

Out of bank topography was based on a combination of 10m DTM and topographical survey. The DTM data was updated with ground based topographic survey data of the site to create a combined terrain model which provided improved definition in the area of interest.

2D Zone

The terrain model was loaded into InfoWorks ICM as a ground model, and subsequently converted into 2D mesh elements (the surface used to simulate flows across the topography within the model). The

2D zone has a maximum triangle area of 10m², minimum area of 2m² with terrain sensitive meshing selected providing a maximum height variation of 0.5m.

Boundary Conditions

A normal depth boundary condition was applied to downstream floodplain boundaries in the 2D zone. This boundary has been sited sufficiently downstream of the study area to limit the possibility of levels being artificially influenced by the boundary condition. The normal condition assumes that slope balances friction forces with flow depth and velocity remaining constant when water reaches the boundary, so water can flow out without energy losses.

Surface Roughness

A Manning's n Roughness value of 0.05 has been applied to the 2D zone to represent the area over which water would flow which predominantly waste land with scrubs and grassland. A roughness zone was used to represent decreased roughness of 0.015 for Magheraboy Road as per typical road surface.

Surface Infiltration

No infiltration has been included in the model in keeping with the approach used in similar Rivers Agency SFRA detailed models. The absence of infiltration in the model is likely to present conservative results.

Assumptions and Limitations of Modelling

The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model developed for the purposes of the study it is assumed that:

- The terrain model (based on 10m DTM supplemented by ground-based topographic survey) accurately represents the surface topography and associated flow paths.
- The design flows are an accurate representation of flows of a given return period; and
- Roughness does not vary with time.

The primary limitations of the study are noted as follows:

- Sewerage and culverted surface water drainage have not been modelled.
- No allowance for infiltration has been made within the model; and,
- The model does not represent any topographic features smaller than the minimum resolution of the underlying terrain model derived for the site.

MODEL SENSITIVITY

A model sensitivity analysis was carried out to assess the sensitivity of the simulation to changes in flow, roughness, and downstream boundary within the baseline model.

Roughness

The sensitivity of the model to roughness was assessed by varying the roughness values in the model. Roughness values in the 1D domain were modified by 20%, open river sections were increased from Manning's n roughness 0.045 to 0.054.

Water levels increased by a maximum of 0.09m at river sections adjacent to the site. This leads to a new overland flow path emanating from the open channel at the north eastern side of the site and crossing the northern portion of the site footprint.

This shows the model is moderately sensitive to roughness, Manning's n roughness values have been carefully specified to ensure that a suitably conservative value was adopted, and there is confidence that the model roughness is suitably conservative.

The overland flow path resulting from the increased river section roughness scenario occurs at depths of less than 0.05m within the site. This is mitigated by the recommended freeboard for the development and no additional mitigation is required.

Analysis of increasing the Manning's n roughness value from 0.05 to 0.06 for the 2D domain was found to cause no material change in the predicted floodplain at the site.

Bank Coefficients

Model sensitivity to variation in bank coefficients was tested by reducing all river reach bank coefficients by 50% from typical defaults, corresponding to discharge coefficients of 0.5 and modular limits to 0.45.

This sensitivity testing produced no material change to predicted flood levels at the site, confirming that the model is not sensitive to reduction in bank coefficients.

Analysis was also carried out to alter bank discharge coefficients and modular limits to the default values of 1.0 and 0.9 respectively across all river reaches. This produced instability in some portions of the model, particularly at the downstream end of the site where overland flooding is predicted. This confirmed the necessity of reduced bank parameters in this area for the baseline model.

Boundary

The downstream boundary of the model was edited to assess the effects of flood levels at the site in the event of a change to the downstream conditions. The water level of the last surveyed section was raised by 1m, causing no measurable change to flood levels at the site.

The downstream extent of the model was carefully sited to ensure that there was sufficient difference in elevation between the model boundary and site such that a reasonable variation in water level at the boundary would have no influence on water levels predicted at the site.

Summary

The sensitivity analysis demonstrates that the model is not overly sensitive to variation in any parameter, and that the freeboard to development levels exceeds the effects of the model sensitivity analysis.

The model can therefore be deemed reliable and fit for its intended purpose of determining flood risk at the site.

PROPOSED SCENARIO

A proposed scenario was developed to assess the effect of new development. The proposal requires an access crossing over the watercourse at Magheraboy Road. As informed by model iterations and assessment of impact on local flood risk, the access crossing is proposed at the site's north eastern boundary.

A box culvert was introduced along 1D river reach at the location of the proposed entrance. A mesh level zone was incorporated into the 2D mesh to reflect the proposed access lane over the watercourse. The new culvert was represented as follows:

- 2100mm width x 1500mm height as dictated by the channel dimensions, flood levels, impact on flood risk and the 300mm freeboard requirement for the culvert soffit. The proposed culvert length is 13.60m, as per the minimum required to allow for the radii of the access entrance.
- Upstream invert of 73.66m OD and downstream invert of 73.62m OD to tie to adjacent channels, allow for sufficient construction depth above the culvert soffits and account for flood levels within the watercourse.
- 0.015 Manning's n roughness as per a concrete surface.
- Proposed access deck level over the culvert of 75.60m OD to represent the access tying to Magheraboy Road and sufficient freeboard. A roughness zone for the proposed access was also introduced to reflect a new access of reduced Manning's n roughness of 0.015.
- Inline banks were added to the model at the upstream and downstream faces of the proposed access to ensure that any conveyance between the 1D-2D would be represented at these locations.

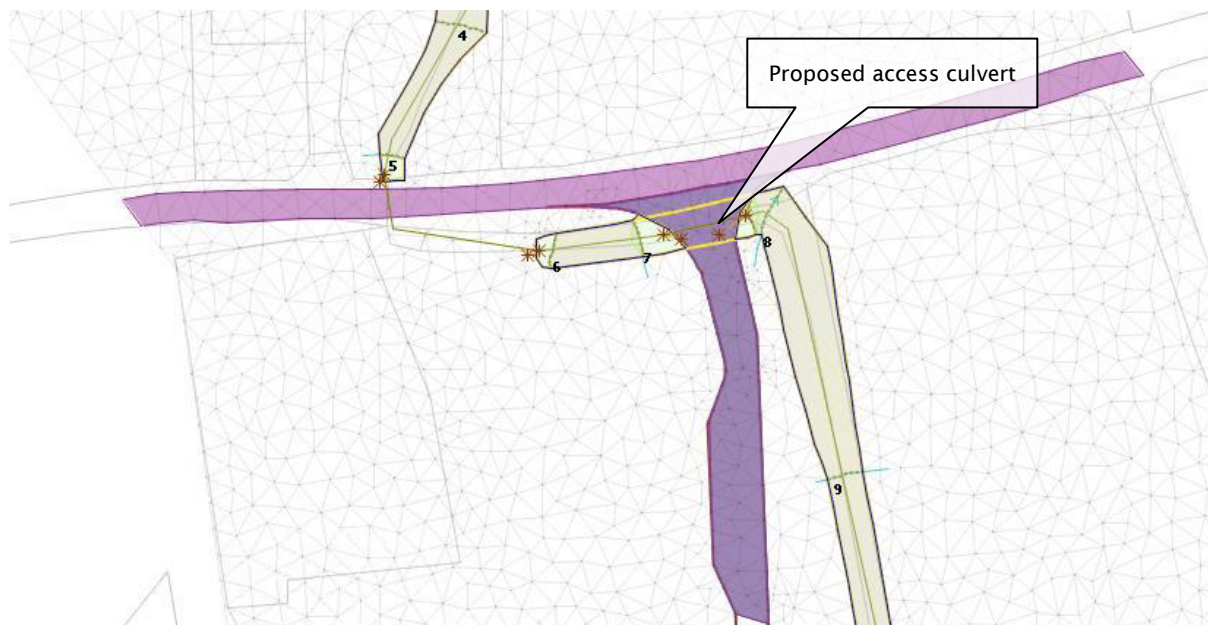


Figure E - 3: Proposed Access Culvert Model Geometry

Appendix F

Hydrological Calculations

UK Design Flood Estimation

Generated on Thursday, December 12, 2024 10:17:18 AM by terminal
Printed from the ReFH2 Flood Modelling software package, version 4.1.8879.22310

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site detailsChecksum: EE3A-573B

Site name: FEH_Catchment_Descriptors_296900_414900_v5_0_1

Easting: 296900

Northing: 414900

Country: England, Wales or Northern Ireland

Catchment Area (km²): 1.85 [3.58]*

Using plot scale calculations: No

Model: 2.3

Site description:None

Model run: 100 year

Summary of results

Rainfall - FEH22 (mm):	53.63	Total runoff (ML):	47.06
Total Rainfall (mm):	49.80	Total flow (ML):	92.15
Peak Rainfall (mm):	12.38	Peak flow (m³/s):	3.94

Parameters

Where the user has overridden a system-generated value, this original value is shown in square brackets after the value used.
* Indicates that the user locked the duration/timestep

Rainfall parameters (Rainfall - FEH22)

Name	Value	User-defined?
Duration (hh:mm:ss)	03:45:00	No
Timestep (hh:mm:ss)	00:15:00	No
SCF (Seasonal correction factor)	0.96	No
ARF (Areal reduction factor)	0.97	No
Seasonality	Summer [Winter]	Yes

Loss model parameters

Name	Value	User-defined?
Cini (mm)	96.19	No
Cmax (mm)	237.08	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.78	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m ³ /s)	0.07	No
BL (hr)	24.84	No
BR	0.96	No

Urbanisation parameters

Name	Value	User-defined?
Sewer capacity (m ³ /s)	0	No
Exporting drained area (km ²)	0	No
Urban area (km ²)	0	No
Effective URBEXT2000	0	n/a
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
00:00:00	0.798	0.000	0.325	0.000	0.073	0.073
00:15:00	1.062	0.000	0.437	0.004	0.072	0.076
00:30:00	1.433	0.000	0.597	0.019	0.071	0.090
00:45:00	1.968	0.000	0.834	0.046	0.071	0.117
01:00:00	2.774	0.000	1.203	0.093	0.071	0.164
01:15:00	4.078	0.000	1.828	0.166	0.071	0.238
01:30:00	6.596	0.000	3.105	0.279	0.073	0.352
01:45:00	12.384	0.000	6.325	0.457	0.076	0.533
02:00:00	6.596	0.000	3.633	0.753	0.081	0.834
02:15:00	4.078	0.000	2.338	1.165	0.089	1.254
02:30:00	2.774	0.000	1.630	1.635	0.102	1.736
02:45:00	1.968	0.000	1.176	2.128	0.119	2.247
03:00:00	1.433	0.000	0.867	2.618	0.140	2.758
03:15:00	1.062	0.000	0.648	3.075	0.166	3.241
03:30:00	0.798	0.000	0.490	3.456	0.196	3.652
03:45:00	0.000	0.000	0.000	3.674	0.228	3.902
04:00:00	0.000	0.000	0.000	3.682	0.261	3.943
04:15:00	0.000	0.000	0.000	3.562	0.293	3.855
04:30:00	0.000	0.000	0.000	3.361	0.323	3.684
04:45:00	0.000	0.000	0.000	3.106	0.351	3.457
05:00:00	0.000	0.000	0.000	2.819	0.376	3.195
05:15:00	0.000	0.000	0.000	2.517	0.398	2.915
05:30:00	0.000	0.000	0.000	2.224	0.417	2.640
05:45:00	0.000	0.000	0.000	1.965	0.433	2.397
06:00:00	0.000	0.000	0.000	1.734	0.446	2.180
06:15:00	0.000	0.000	0.000	1.523	0.457	1.980
06:30:00	0.000	0.000	0.000	1.325	0.466	1.791
06:45:00	0.000	0.000	0.000	1.138	0.473	1.611
07:00:00	0.000	0.000	0.000	0.960	0.479	1.439
07:15:00	0.000	0.000	0.000	0.792	0.482	1.275
07:30:00	0.000	0.000	0.000	0.633	0.484	1.117
07:45:00	0.000	0.000	0.000	0.482	0.485	0.966
08:00:00	0.000	0.000	0.000	0.342	0.484	0.826
08:15:00	0.000	0.000	0.000	0.223	0.482	0.705

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
08:30:00	0.000	0.000	0.000	0.142	0.479	0.620
08:45:00	0.000	0.000	0.000	0.088	0.475	0.563
09:00:00	0.000	0.000	0.000	0.053	0.471	0.523
09:15:00	0.000	0.000	0.000	0.029	0.467	0.495
09:30:00	0.000	0.000	0.000	0.014	0.462	0.476
09:45:00	0.000	0.000	0.000	0.005	0.458	0.462
10:00:00	0.000	0.000	0.000	0.001	0.453	0.454
10:15:00	0.000	0.000	0.000	0.000	0.448	0.448
10:30:00	0.000	0.000	0.000	0.000	0.444	0.444
10:45:00	0.000	0.000	0.000	0.000	0.440	0.440
11:00:00	0.000	0.000	0.000	0.000	0.435	0.435
11:15:00	0.000	0.000	0.000	0.000	0.431	0.431
11:30:00	0.000	0.000	0.000	0.000	0.426	0.426
11:45:00	0.000	0.000	0.000	0.000	0.422	0.422
12:00:00	0.000	0.000	0.000	0.000	0.418	0.418
12:15:00	0.000	0.000	0.000	0.000	0.414	0.414
12:30:00	0.000	0.000	0.000	0.000	0.410	0.410
12:45:00	0.000	0.000	0.000	0.000	0.406	0.406
13:00:00	0.000	0.000	0.000	0.000	0.401	0.401
13:15:00	0.000	0.000	0.000	0.000	0.397	0.397
13:30:00	0.000	0.000	0.000	0.000	0.393	0.393
13:45:00	0.000	0.000	0.000	0.000	0.390	0.390
14:00:00	0.000	0.000	0.000	0.000	0.386	0.386
14:15:00	0.000	0.000	0.000	0.000	0.382	0.382
14:30:00	0.000	0.000	0.000	0.000	0.378	0.378
14:45:00	0.000	0.000	0.000	0.000	0.374	0.374
15:00:00	0.000	0.000	0.000	0.000	0.370	0.370
15:15:00	0.000	0.000	0.000	0.000	0.367	0.367
15:30:00	0.000	0.000	0.000	0.000	0.363	0.363
15:45:00	0.000	0.000	0.000	0.000	0.359	0.359
16:00:00	0.000	0.000	0.000	0.000	0.356	0.356
16:15:00	0.000	0.000	0.000	0.000	0.352	0.352
16:30:00	0.000	0.000	0.000	0.000	0.349	0.349
16:45:00	0.000	0.000	0.000	0.000	0.345	0.345
17:00:00	0.000	0.000	0.000	0.000	0.342	0.342

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
17:15:00	0.000	0.000	0.000	0.000	0.338	0.338
17:30:00	0.000	0.000	0.000	0.000	0.335	0.335
17:45:00	0.000	0.000	0.000	0.000	0.332	0.332
18:00:00	0.000	0.000	0.000	0.000	0.328	0.328
18:15:00	0.000	0.000	0.000	0.000	0.325	0.325
18:30:00	0.000	0.000	0.000	0.000	0.322	0.322
18:45:00	0.000	0.000	0.000	0.000	0.319	0.319
19:00:00	0.000	0.000	0.000	0.000	0.315	0.315
19:15:00	0.000	0.000	0.000	0.000	0.312	0.312
19:30:00	0.000	0.000	0.000	0.000	0.309	0.309
19:45:00	0.000	0.000	0.000	0.000	0.306	0.306
20:00:00	0.000	0.000	0.000	0.000	0.303	0.303
20:15:00	0.000	0.000	0.000	0.000	0.300	0.300
20:30:00	0.000	0.000	0.000	0.000	0.297	0.297
20:45:00	0.000	0.000	0.000	0.000	0.294	0.294
21:00:00	0.000	0.000	0.000	0.000	0.291	0.291
21:15:00	0.000	0.000	0.000	0.000	0.288	0.288
21:30:00	0.000	0.000	0.000	0.000	0.285	0.285
21:45:00	0.000	0.000	0.000	0.000	0.282	0.282
22:00:00	0.000	0.000	0.000	0.000	0.279	0.279
22:15:00	0.000	0.000	0.000	0.000	0.277	0.277
22:30:00	0.000	0.000	0.000	0.000	0.274	0.274
22:45:00	0.000	0.000	0.000	0.000	0.271	0.271
23:00:00	0.000	0.000	0.000	0.000	0.268	0.268
23:15:00	0.000	0.000	0.000	0.000	0.266	0.266
23:30:00	0.000	0.000	0.000	0.000	0.263	0.263
23:45:00	0.000	0.000	0.000	0.000	0.260	0.260
24:00:00	0.000	0.000	0.000	0.000	0.258	0.258
24:15:00	0.000	0.000	0.000	0.000	0.255	0.255
24:30:00	0.000	0.000	0.000	0.000	0.253	0.253
24:45:00	0.000	0.000	0.000	0.000	0.250	0.250
25:00:00	0.000	0.000	0.000	0.000	0.248	0.248
25:15:00	0.000	0.000	0.000	0.000	0.245	0.245
25:30:00	0.000	0.000	0.000	0.000	0.243	0.243
25:45:00	0.000	0.000	0.000	0.000	0.240	0.240

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
26:00:00	0.000	0.000	0.000	0.000	0.238	0.238
26:15:00	0.000	0.000	0.000	0.000	0.236	0.236
26:30:00	0.000	0.000	0.000	0.000	0.233	0.233
26:45:00	0.000	0.000	0.000	0.000	0.231	0.231
27:00:00	0.000	0.000	0.000	0.000	0.229	0.229
27:15:00	0.000	0.000	0.000	0.000	0.226	0.226
27:30:00	0.000	0.000	0.000	0.000	0.224	0.224
27:45:00	0.000	0.000	0.000	0.000	0.222	0.222
28:00:00	0.000	0.000	0.000	0.000	0.220	0.220
28:15:00	0.000	0.000	0.000	0.000	0.217	0.217
28:30:00	0.000	0.000	0.000	0.000	0.215	0.215
28:45:00	0.000	0.000	0.000	0.000	0.213	0.213
29:00:00	0.000	0.000	0.000	0.000	0.211	0.211
29:15:00	0.000	0.000	0.000	0.000	0.209	0.209
29:30:00	0.000	0.000	0.000	0.000	0.207	0.207
29:45:00	0.000	0.000	0.000	0.000	0.205	0.205
30:00:00	0.000	0.000	0.000	0.000	0.203	0.203
30:15:00	0.000	0.000	0.000	0.000	0.201	0.201
30:30:00	0.000	0.000	0.000	0.000	0.198	0.198
30:45:00	0.000	0.000	0.000	0.000	0.197	0.197
31:00:00	0.000	0.000	0.000	0.000	0.195	0.195
31:15:00	0.000	0.000	0.000	0.000	0.193	0.193
31:30:00	0.000	0.000	0.000	0.000	0.191	0.191
31:45:00	0.000	0.000	0.000	0.000	0.189	0.189
32:00:00	0.000	0.000	0.000	0.000	0.187	0.187
32:15:00	0.000	0.000	0.000	0.000	0.185	0.185
32:30:00	0.000	0.000	0.000	0.000	0.183	0.183
32:45:00	0.000	0.000	0.000	0.000	0.181	0.181
33:00:00	0.000	0.000	0.000	0.000	0.179	0.179
33:15:00	0.000	0.000	0.000	0.000	0.178	0.178
33:30:00	0.000	0.000	0.000	0.000	0.176	0.176
33:45:00	0.000	0.000	0.000	0.000	0.174	0.174
34:00:00	0.000	0.000	0.000	0.000	0.172	0.172
34:15:00	0.000	0.000	0.000	0.000	0.171	0.171
34:30:00	0.000	0.000	0.000	0.000	0.169	0.169

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
34:45:00	0.000	0.000	0.000	0.000	0.167	0.167
35:00:00	0.000	0.000	0.000	0.000	0.166	0.166
35:15:00	0.000	0.000	0.000	0.000	0.164	0.164
35:30:00	0.000	0.000	0.000	0.000	0.162	0.162
35:45:00	0.000	0.000	0.000	0.000	0.161	0.161
36:00:00	0.000	0.000	0.000	0.000	0.159	0.159
36:15:00	0.000	0.000	0.000	0.000	0.157	0.157
36:30:00	0.000	0.000	0.000	0.000	0.156	0.156
36:45:00	0.000	0.000	0.000	0.000	0.154	0.154
37:00:00	0.000	0.000	0.000	0.000	0.153	0.153
37:15:00	0.000	0.000	0.000	0.000	0.151	0.151
37:30:00	0.000	0.000	0.000	0.000	0.150	0.150
37:45:00	0.000	0.000	0.000	0.000	0.148	0.148
38:00:00	0.000	0.000	0.000	0.000	0.147	0.147
38:15:00	0.000	0.000	0.000	0.000	0.145	0.145
38:30:00	0.000	0.000	0.000	0.000	0.144	0.144
38:45:00	0.000	0.000	0.000	0.000	0.142	0.142
39:00:00	0.000	0.000	0.000	0.000	0.141	0.141
39:15:00	0.000	0.000	0.000	0.000	0.140	0.140
39:30:00	0.000	0.000	0.000	0.000	0.138	0.138
39:45:00	0.000	0.000	0.000	0.000	0.137	0.137
40:00:00	0.000	0.000	0.000	0.000	0.135	0.135
40:15:00	0.000	0.000	0.000	0.000	0.134	0.134
40:30:00	0.000	0.000	0.000	0.000	0.133	0.133
40:45:00	0.000	0.000	0.000	0.000	0.131	0.131
41:00:00	0.000	0.000	0.000	0.000	0.130	0.130
41:15:00	0.000	0.000	0.000	0.000	0.129	0.129
41:30:00	0.000	0.000	0.000	0.000	0.127	0.127
41:45:00	0.000	0.000	0.000	0.000	0.126	0.126
42:00:00	0.000	0.000	0.000	0.000	0.125	0.125
42:15:00	0.000	0.000	0.000	0.000	0.124	0.124
42:30:00	0.000	0.000	0.000	0.000	0.122	0.122
42:45:00	0.000	0.000	0.000	0.000	0.121	0.121
43:00:00	0.000	0.000	0.000	0.000	0.120	0.120
43:15:00	0.000	0.000	0.000	0.000	0.119	0.119

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
43:30:00	0.000	0.000	0.000	0.000	0.118	0.118
43:45:00	0.000	0.000	0.000	0.000	0.116	0.116
44:00:00	0.000	0.000	0.000	0.000	0.115	0.115
44:15:00	0.000	0.000	0.000	0.000	0.114	0.114
44:30:00	0.000	0.000	0.000	0.000	0.113	0.113
44:45:00	0.000	0.000	0.000	0.000	0.112	0.112
45:00:00	0.000	0.000	0.000	0.000	0.111	0.111
45:15:00	0.000	0.000	0.000	0.000	0.110	0.110
45:30:00	0.000	0.000	0.000	0.000	0.109	0.109
45:45:00	0.000	0.000	0.000	0.000	0.107	0.107
46:00:00	0.000	0.000	0.000	0.000	0.106	0.106
46:15:00	0.000	0.000	0.000	0.000	0.105	0.105
46:30:00	0.000	0.000	0.000	0.000	0.104	0.104
46:45:00	0.000	0.000	0.000	0.000	0.103	0.103
47:00:00	0.000	0.000	0.000	0.000	0.102	0.102
47:15:00	0.000	0.000	0.000	0.000	0.101	0.101
47:30:00	0.000	0.000	0.000	0.000	0.100	0.100
47:45:00	0.000	0.000	0.000	0.000	0.099	0.099
48:00:00	0.000	0.000	0.000	0.000	0.098	0.098
48:15:00	0.000	0.000	0.000	0.000	0.097	0.097
48:30:00	0.000	0.000	0.000	0.000	0.096	0.096
48:45:00	0.000	0.000	0.000	0.000	0.095	0.095
49:00:00	0.000	0.000	0.000	0.000	0.094	0.094
49:15:00	0.000	0.000	0.000	0.000	0.093	0.093
49:30:00	0.000	0.000	0.000	0.000	0.092	0.092
49:45:00	0.000	0.000	0.000	0.000	0.091	0.091
50:00:00	0.000	0.000	0.000	0.000	0.091	0.091
50:15:00	0.000	0.000	0.000	0.000	0.090	0.090
50:30:00	0.000	0.000	0.000	0.000	0.089	0.089
50:45:00	0.000	0.000	0.000	0.000	0.088	0.088
51:00:00	0.000	0.000	0.000	0.000	0.087	0.087
51:15:00	0.000	0.000	0.000	0.000	0.086	0.086
51:30:00	0.000	0.000	0.000	0.000	0.085	0.085
51:45:00	0.000	0.000	0.000	0.000	0.084	0.084
52:00:00	0.000	0.000	0.000	0.000	0.084	0.084

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
52:15:00	0.000	0.000	0.000	0.000	0.083	0.083
52:30:00	0.000	0.000	0.000	0.000	0.082	0.082
52:45:00	0.000	0.000	0.000	0.000	0.081	0.081
53:00:00	0.000	0.000	0.000	0.000	0.080	0.080
53:15:00	0.000	0.000	0.000	0.000	0.079	0.079
53:30:00	0.000	0.000	0.000	0.000	0.079	0.079
53:45:00	0.000	0.000	0.000	0.000	0.078	0.078
54:00:00	0.000	0.000	0.000	0.000	0.077	0.077
54:15:00	0.000	0.000	0.000	0.000	0.076	0.076
54:30:00	0.000	0.000	0.000	0.000	0.076	0.076
54:45:00	0.000	0.000	0.000	0.000	0.075	0.075
55:00:00	0.000	0.000	0.000	0.000	0.074	0.074
55:15:00	0.000	0.000	0.000	0.000	0.073	0.073

Appendix

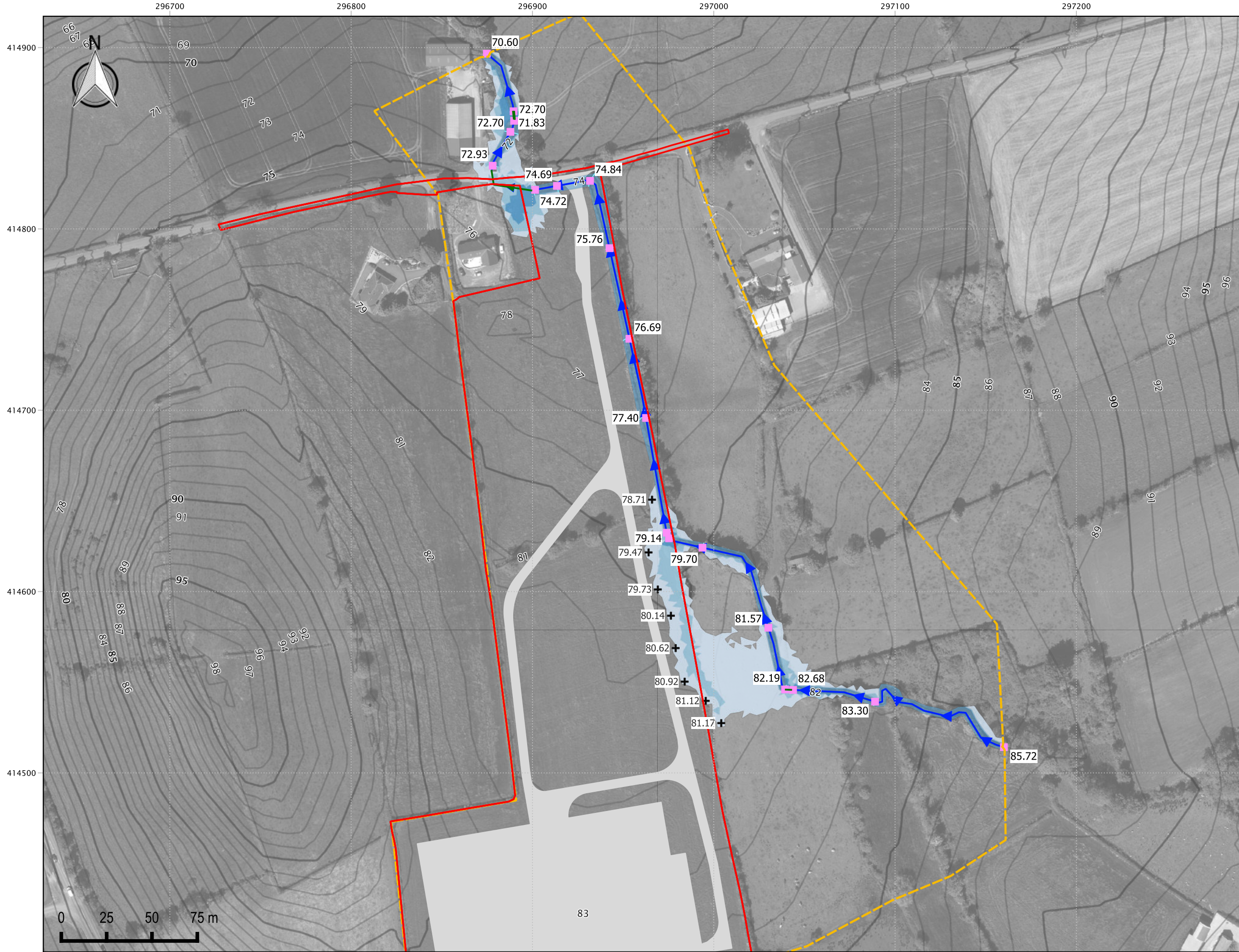
Catchment descriptors *

Name	Value	User-defined value used?
Area (km ²)	1.85 [3.58]	Yes
ALTBAR	153	No
ASPBAR	258	No
ASPVAR	0.71	No
BFIHOST	0.35	No
BFIHOST19	0.34	No
DPLBAR (km)	2.6	No
DPSBAR (mkm ⁻¹)	41.5	No
FARL	1	No
LDP	4.93	No
PROPWET	0.61	No
RMED1H	8.4	No
RMED1D	30.7	No
RMED2D	42.1	No
SAAR (mm)	1135	No
SAAR4170 (mm)	1195	No
SPRHOST	42.48	No
URBEXT2000	0	No
URBEXT1990	0	No
URBCONC	0	No
URBLOC	0	No
DDF parameter C	-0.03	No
DDF parameter D1	0.38	No
DDF parameter D2	0.5	No
DDF parameter D3	0.3	No
DDF parameter E	0.28	No
DDF parameter F	2.2	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.39	No
DDF parameter D2 (1km grid value)	0.49	No
DDF parameter D3 (1km grid value)	0.3	No
DDF parameter E (1km grid value)	0.28	No
DDF parameter F (1km grid value)	2.19	No

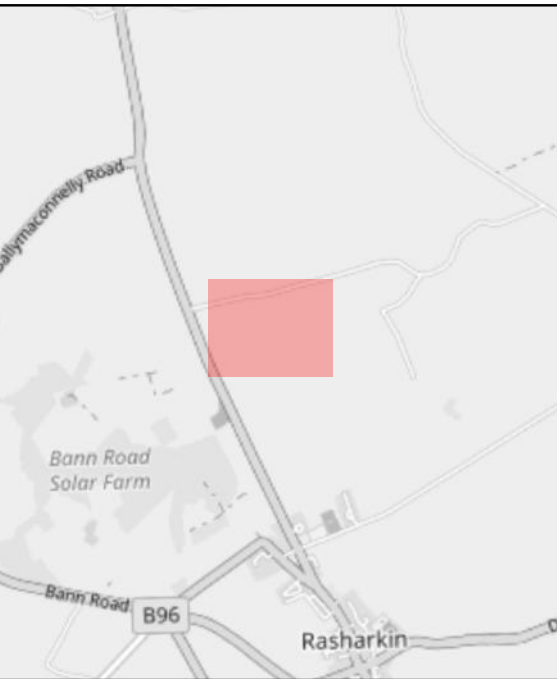
Values in square brackets are the original values loaded from the FEH Web Service or FEH CD-ROM

Appendix G

Flood Maps



MODEL OVERVIEW

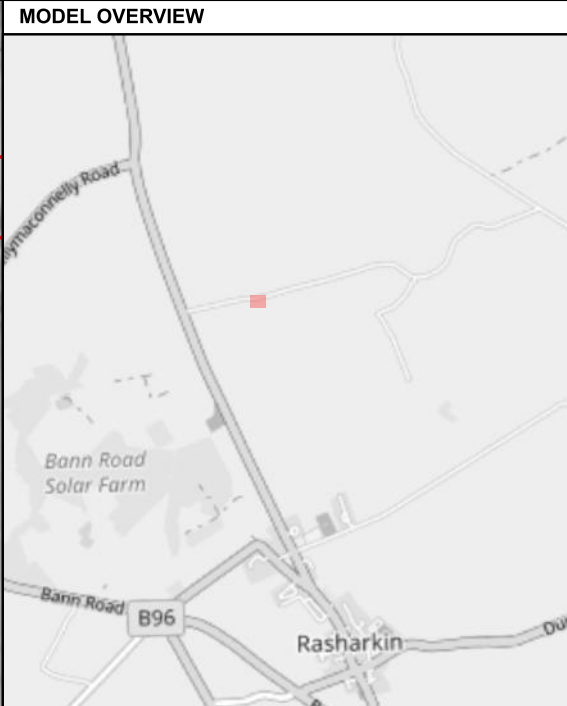
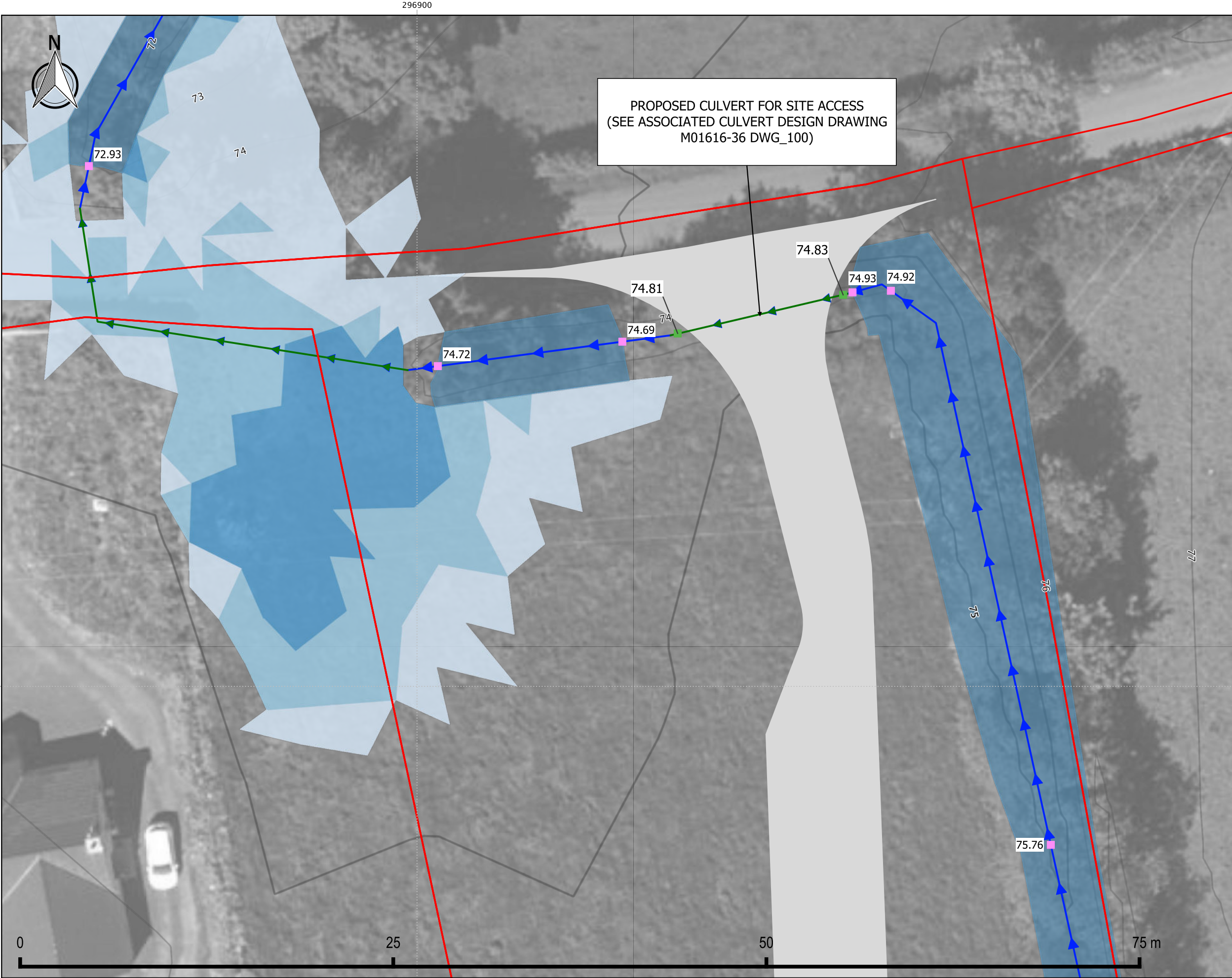


LEGEND

- Site Boundary
- Proposed Hardstanding
- Modelled Extent
- Open Watercourse
- Conduit
- Flood Level Node mOD (In-Channel)
- Flood Level mOD (2D Point Overland)
- 1% AEP +CC Flood Extent Banded by Depth (m)
 - < 0.15m
 - 0.15 - 0.30m
 - 0.30 - 0.60m
 - 0.60 - 0.90m
 - > 0.90m

- NOTES
- ALL LEVELS INDICATED ARE TO ORDNANCE DATUM BELFAST.
 - FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.
 - FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.
 - ALL GRID COORDINATE INFORMATION IS TO IRISH GRID.

M^cCloy Consulting Mossley Mill, Lower Ground (West), Carnmoney Road North, Newtownabbey, BT36 5QA T: 028 9084 8694 E: info@mccloyconsulting.com W: www.mccloyconsulting.com	PROJECT MACHAIRE ENERGY STORAGE STATION, RASHARKIN		HYDROLOGY SCENARIO CLIMATE CHANGE	SCALE 1 : 2000	ORIGINAL SIZE A3	DRAWING COPYRIGHT MCCLOY CONSULTING LTD. ALL RIGHTS RESERVED. BACKGROUND MAP CONTAINS OPENSTREETMAP® OPEN DATA, LICENSED UNDER THE OPEN DATA COMMONS OPEN DATABASE LICENSE (ODbL) BY THE OPENSTREETMAP FOUNDATION (OSMF) (2025)
	MAP TYPE FLOOD EXTENT		GEOMETRY SCENARIO EXISTING	DRAWN BY BM	APPROVED BY DKS	
	SOURCE FLUVIAL	FLOOD EVENT 1% AEP + CC	FIGURE NUMBER M01616-36_FL01	REVISION 2	DATE 27/02/2025	



LEGEND

- Site Boundary
- Proposed Hardstanding
- Open Watercourse
- Conduit
- Flood Level Node (In-Channel)
- Flood Level Node (At Proposed Culvert)
- 1% AEP +CC Flod Extent Banded by Depth (m)
 - < 0.15m
 - 0.15 - 0.30m
 - 0.30 - 0.60m
 - 0.60 - 0.90m
 - > 0.90m

NOTES

1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM BELFAST.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

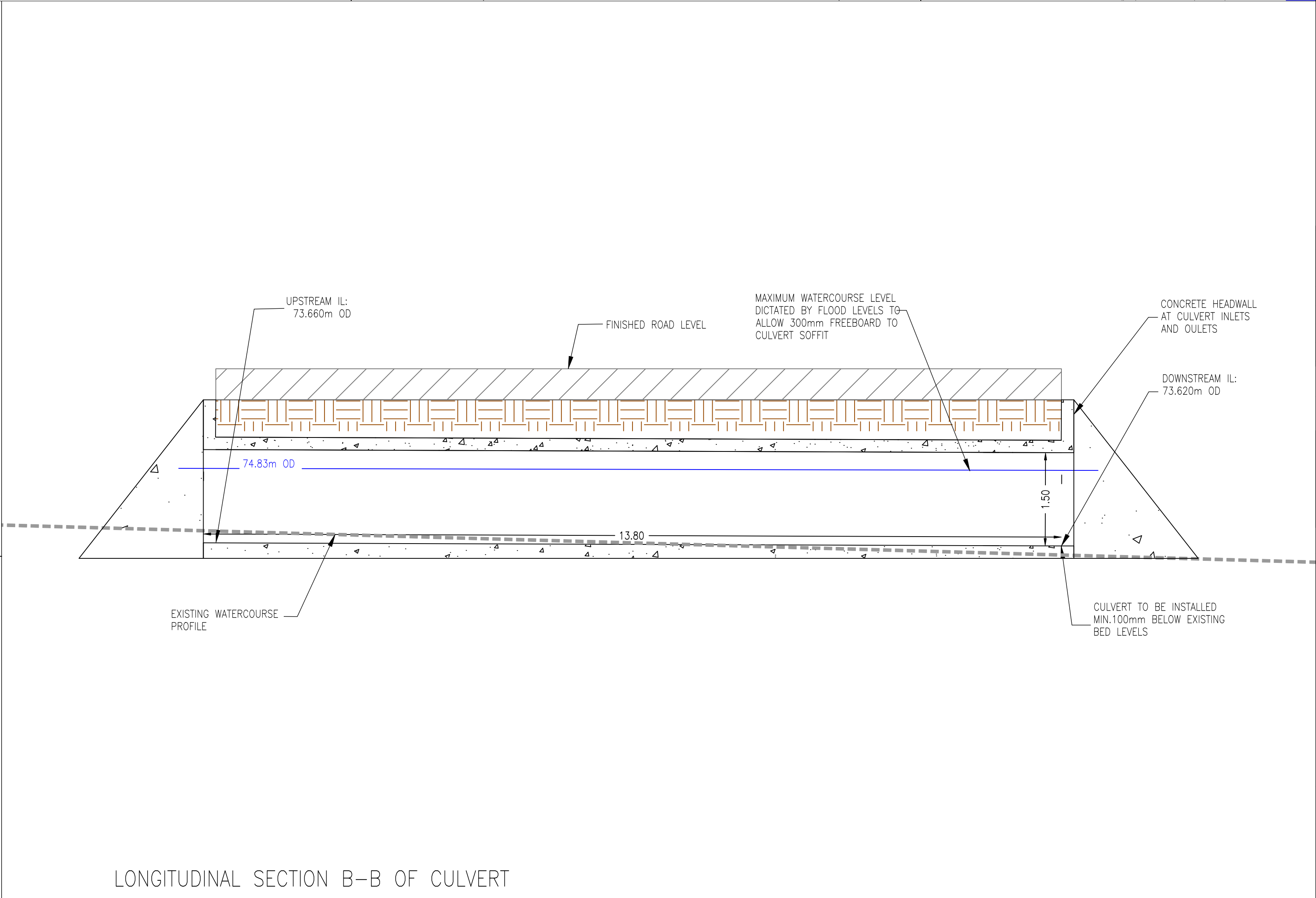
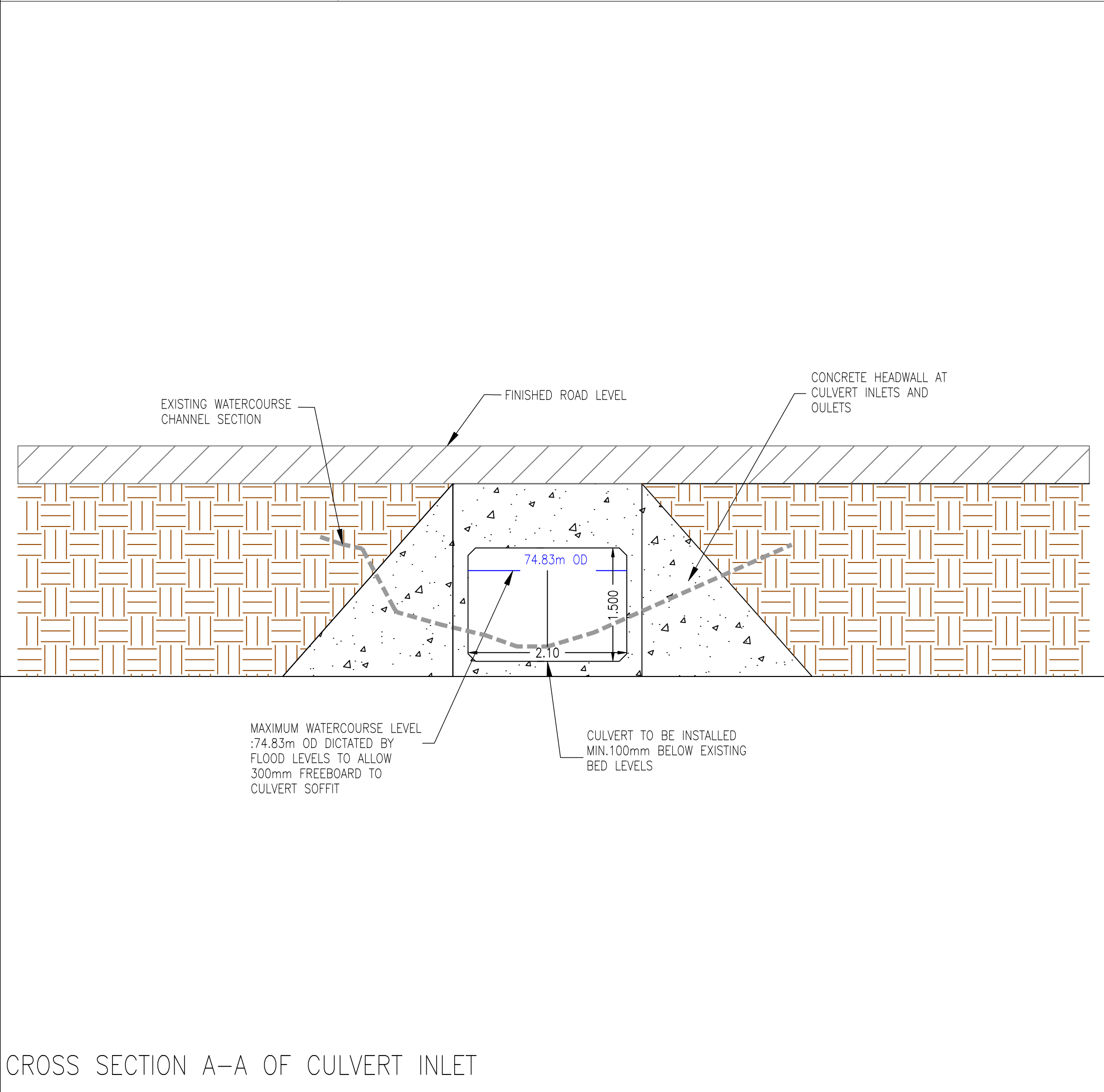
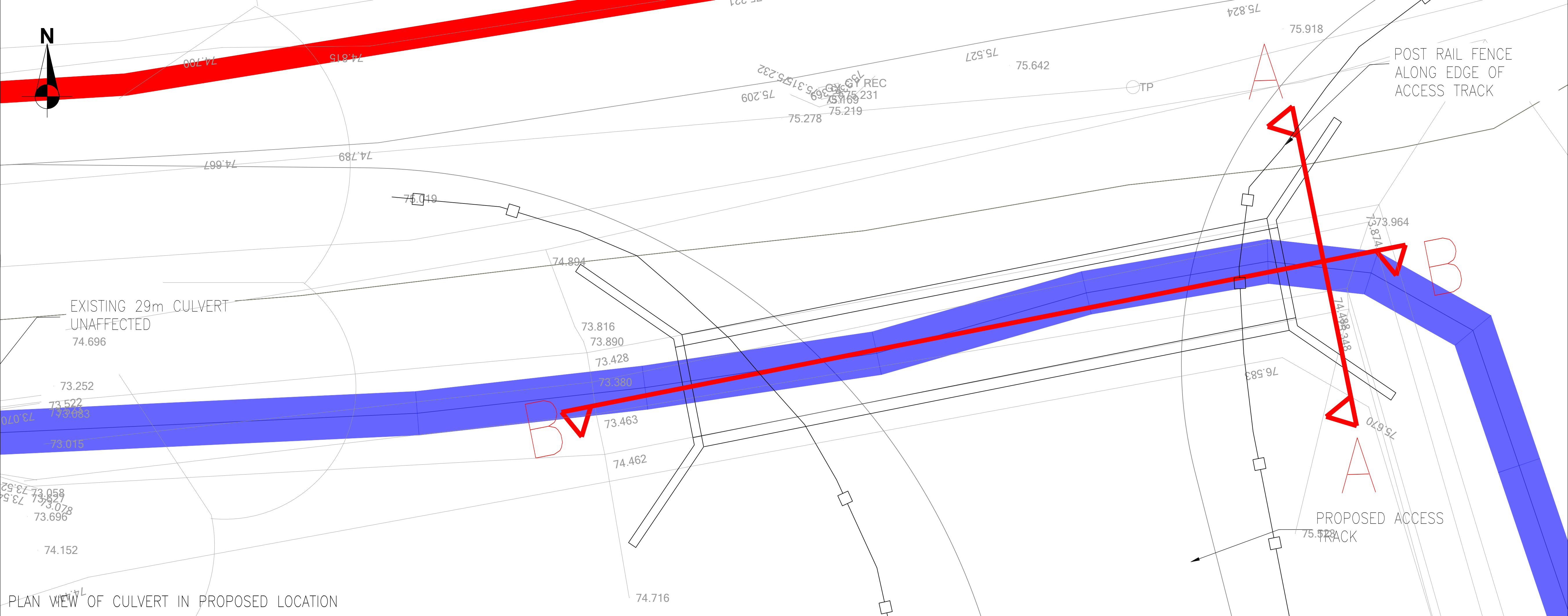
3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

4. ALL GRID COORDINATE INFORMATION IS TO IRISH GRID.

M^cCloy Consulting Mossley Mill, Lower Ground (West), Carnmoney Road North, Newtownabbey, BT36 5QA T: 028 9084 8694 E: info@mccloyconsulting.com W: www.mccloyconsulting.com	PROJECT MACHAIRE ENERGY STORAGE STATION, RASHARKIN		HYDROLOGY SCENARIO CLIMATE CHANGE	SCALE 1 : 250	ORIGINAL SIZE A3	DRAWING COPYRIGHT MCCLOY CONSULTING LTD. ALL RIGHTS RESERVED. BACKGROUND MAP CONTAINS OPENSTREETMAP® OPEN DATA, LICENSED UNDER THE OPEN DATA COMMONS OPEN DATABASE LICENSE (ODbL) BY THE OPENSTREETMAP FOUNDATION (OSMF) (2025)
	MAP TYPE FLOOD EXTENT		GEOMETRY SCENARIO PROPOSED	DRAWN BY LJ	APPROVED BY DKS	
	SOURCE FLUVIAL	FLOOD EVENT 1% AEP + CC	FIGURE NUMBER M01616-36_FL02	REVISION 3	DATE 27/02/2025	

Appendix H

Proposed Access Culvert Design



01	AC	DKS	26/02/2025	FOR REVIEW
ISSUE	DRN	APP	DATE	NOTES / DESCRIPTION
STATUS				
FOR REVIEW				
McCloy Consulting				
T: 028 9084 8694 F: 028 9084 1525 E: info@mcclayconsulting.com W: www.mcclayconsulting.com				
PROJECT				
PROPOSED MACHAIRE BESS				
CLIENT				
res power for good®				
DRAWING TITLE				
PROPOSED SITE ACCESS WATERCOURSE CROSSING LAYOUT & CULVERT DETAIL				
SCALE			ORIGINAL SIZE	
1:50			A1	
DRAWN		CHECKED		DATE
AC		DKS		26/02/2025
PROJECT No.		DRAWING No.		ISSUE No.
M01616-36		DWG_100		01