Agenda Item	11
Report No	EDI 07/19

HIGHLAND COUNCIL

Committee: **Environment, Development and Infrastructure**

Date: **31 January 2019**

Report Title: **Drumnadrochit Flood Protection Scheme**

Report By: **Director of Development and Infrastructure**

1. Purpose/Executive Summary

1.1 This report advises Members on the progress of the Drumnadrochit FPS and seeks approval to publish documents for consultation.

1.2 The Planning, Development and Infrastructure Committee was advised on the 3 June 2015 (Report 31/15), of the recommended actions to be taken forward in the first Flood Risk Management Strategy published by SEPA in December 2015, and Local Flood Risk Management Plan published by the Highland Council in June 2016 for the Highland and Argyll Local Plan District. This included the progression through to construction of the Drumnadrochit (River Enrick) scheme. The same report allocated funding from the 'Major Flood Schemes' generic Capital Programme to enable The Highland Council to meet the objectives on the Local Flood Risk Plan. This report outlines the progress on the Drumnadrochit Scheme.

2. Recommendations

2.1 Members are asked to note the drawings and description of Operations for the Drumnadrochit Scheme and approve the publication of these for formal consultation.

3. Legislative and Legal Framework

3.1 The Flood Risk Management (Scotland) Act (2009) establishes powers within Part 4 of the Act for Local Authorities to confirm formal Flood Protection Schemes, thereby removing the need for Scottish Ministerial approval. In addition, if a Flood Protection Scheme was confirmed by the Local Authority, the Act allows Scottish Ministers to deem it to have Planning Permission.

3.2 The Council's Scheme of Delegation (dated on 25 October 2018) allows the Environment, Development and Infrastructure Committee to carry out the functions of Flood Risk Management on behalf of The Highland Council.

3.3 Schedule 2 of the Flood Risk Management (Scotland) Act (2009) sets out a procedure for the making of a Flood Protection Scheme, and this requires a statutory consultation of a proposed scheme.

3.4 The Proposed scheme must be advertised for a period of 28 days, and Objections to the scheme are invited to be submitted for consideration. In order for an Objection to be 'relevant' the Objector must state their full name, address and nature of their Objection.

3.5 A future report will be submitted to this Committee to consider the nature of any Objections, and this committee will then be asked to:

- confirm the Scheme (without modification);
- modify the Scheme (for example to accommodate an objection); or
- reject the scheme.

3.6 Confirmation of a Flood Protection Scheme establishes permission to construct the proposed operations on third party land. This power means that purchase of the land affected is not (usually) required.

3.7 This report seeks approval to begin this process, with the statutory consultation on the proposed scheme for Drumnadrochit.

4. Development of the Drumnadrochit Flood Protection Scheme

4.1 Drumnadrochit has suffered from flooding for many years with reported instances of the River Enrick flooding as far back as the 1800's. More recently the A82 and several properties were flooded in 1997 and the River Enrick has burst its banks and flooded out on many other occasions.

4.2 There are 11 residential properties and 24 business and non-residential properties at risk of flooding from a 1 in 200 year event in Drumnadrochit. The proposed standard of protection to be provided is the 1:200 year return period flood event plus an allowance for the effects of climate change. The design will also include a 'freeboard' allowance for uncertainties in the design process.

4.3 The proposed Flood Protection scheme will include the construction of a defensive earthwork embankment within the agricultural land to the west side of the A82 and the construction of a wall on the southern bank of the River Enrick on the downstream side of the A82 bridge. In addition the scheme will include construction of a defensive wall at Kilmichael to ensure access to the adjacent properties is maintained and flooding on the A831 is reduced.

4.4 There have been two public consultation events on the proposals for Drumnadrochit. In December 2015 a drop in session was held to outline the initial flood modelling carried out which identified the scheme extents. In November 2017 following the completion of the detailed modelling and options appraisal the preferred option was selected. There were no adverse comments at the consultation meeting and therefore the design was developed by the Council's Consultant Engineer.

4.5 The draft Flood Prevention Scheme drawings, description of Operations and Scheme Justification report in **Appendix 1**, is now sufficiently developed to allow formal consultation.

5. Next Steps

5.1 Once committee approval to commence formal consultation on the flood Protection Scheme is received, the design team will complete the formal documents, notices and adverts as required by the Act.

5.2 It is anticipated that the formal publication will take place in late February 2019. The consultation will run for a period of 28 days. A report on the outcome of the consultation, final scheme documentation and scheme cost estimate will be submitted to Committee on the 16 May 2019.

5.3 Members are asked to note, that as the design for the scheme will be progressing between this report and Feb 2019, it is possible that minor modifications to the scheme documents may arise. The scheme, as presented in **Appendix 1**, should therefore be treated as draft.

6. Implications

6.1 Resource - The special meeting held on the 7 March 2018 agreed the Capital programme 2018 to 2023. This programme named Drumnadrochit Flood Protection Scheme and allocated a project budget of £3.111m. The scheme is 80% grant funded by the Scottish Government with the expected income of £2.416m. The grant calculation is based on actual cost and will be confirmed following the contract tender procedure.

6.2 Legal

6.2.1 Confirmation of the Flood Protection Scheme for Drumnadrochit establishes permission to construct the proposed operations on third party land with compensation agreed through the procedures in the Act. There is provision within the Act, with the permission of the Scottish Ministers, to compulsorily acquire land should it be necessary.

6.2.2 A licence application will be required from SEPA regarding Controlled Activities in the River Enrick. Discussions are ongoing with SEPA.

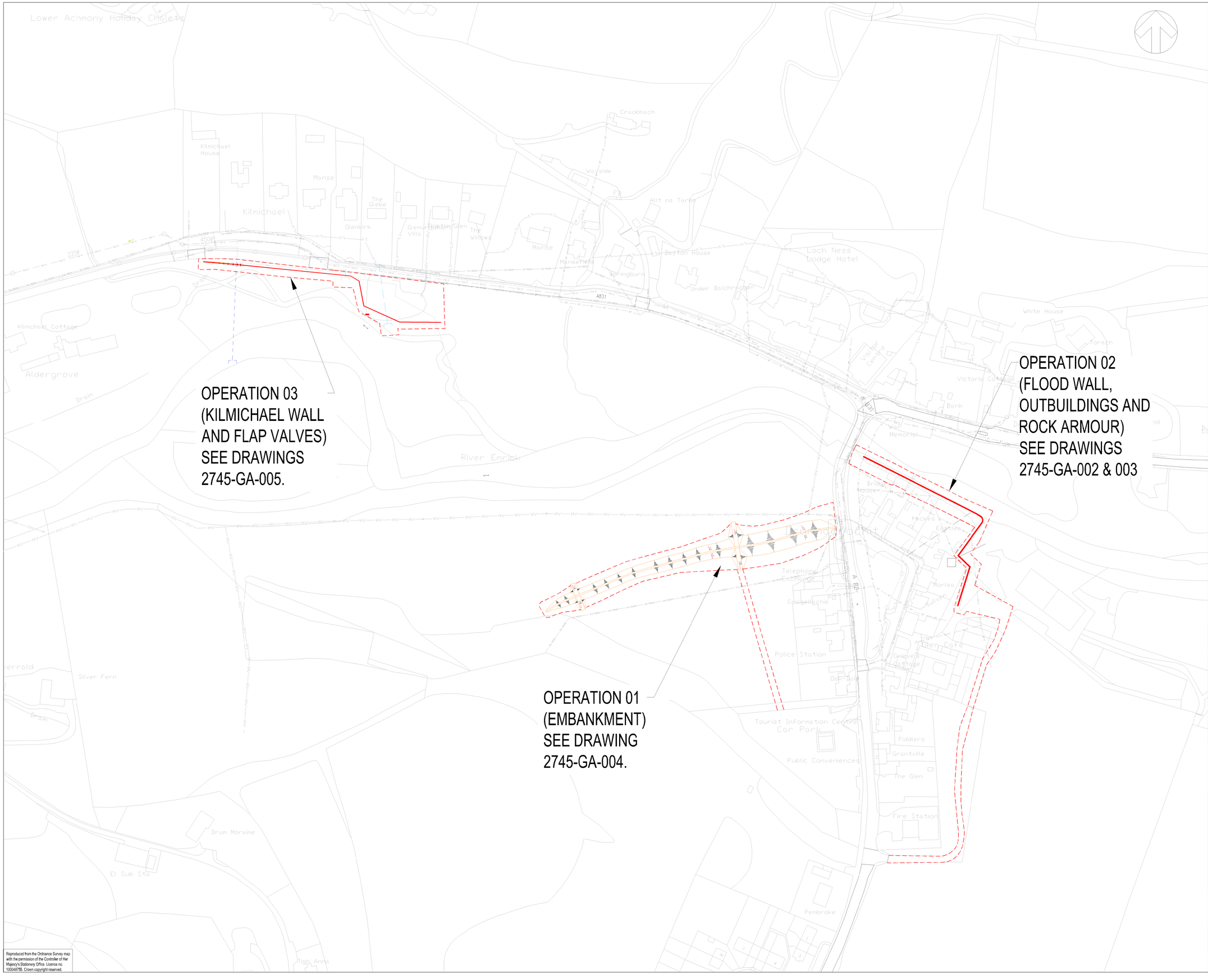
6.3 Community (Equality, Poverty and Rural) - No adverse impacts

6.4 Climate Change / Carbon Clever - Detailed design will incorporate measures to minimise the importation of materials and make best use of natural materials encountered on-site. In addition measures will be put in place to minimise waste during the construction works. The procurement procedures for the construction of the project will be managed to maximise the use of locally sourced goods, services and materials.

6.5 Risk - Any valid objection that is received and that is not subsequently resolved may delay the construction phase of the scheme. A complete ground investigation has been carried out to inform the design and reduce risk of unexpected ground conditions during the works. In Addition surveys of the ecology and environment have been carried out to inform the design and reduce impact. Construction works must commence in 2020/21 to ensure Scottish Government funding.

6.6 Gaelic - The scheme has no significant implications for the use of Gaelic

Designation:	Director of Development and Infrastructure
Date:	22 January 2019
Author:	Garry Smith, Principal Engineer
Background Papers:	PDI 33/16, PDI 52/16, PDI 31/15,



DO NOT SCALE

NOTES:

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LEGEND

- OVERHEAD BT
- SCOTTISH WATER – COMBINED
- SCOTTISH WATER – WATER SUPPLY
- SSE – 11kv POWER
- SSE – LOW POWER
- STREET LIGHTING
- FLOOD WALL
- FLOOD EMBANKMENT
- LIMITS OF LAND AFFECTED BY OPERATIONS AND OF LAND UPON WHICH ENTRY IS REQUIRED

F	08/01/19	BD	NOTES AND EMBANKMENT ADDED TO PLAN	DS	DS
E	27/11/18	MM	NOTES AND KEY AMENDED	DS	DS
D	19/02/18	JR	STREET LIGHTING ADDED TO PLAN	NB	NB
C	19/04/17	PD	ROAD DRAIN & FOUL WATER PIPE ADDED TO PLAN	NM	NM
B	10/04/17	AA	INFORMATION ADDED	NM	NM
A	03/04/17	AA	FIRST ISSUE	NM	NM

DRAWING STATUS: FOR INFORMATION ONLY

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wsp.com

CLIENT: The Highland Council / Comhairle na Gàidhealtachd

SITE/PROJECT: DRUMNADROCHIT FLOOD PROTECTION SCHEME

TITLE: SCHEME OPERATIONS PLAN

SCALE @ A1:	CHECKED:		APPROVED:
1:1250	NB		NB
PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70022745		EA	January 19

DRAWING No:	REV:
2745-GA-001	F

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NOTES

1. ALL LEVELS ARE IN METRES ABOVE ORDINANCE DATUM. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. THE TOPOGRAPHICAL SURVEY INFORMATION COMPRISES TWO SEPARATE SURVEYS, THE ORIGINAL 2017 SURVEY WAS UNDERTAKEN BY A THIRD PARTY. THE LATEST SURVEY WAS CARRIED OUT IN 2017 BY WSP. THE AREA COVERAGE OF THE TWO SURVEYS ARE INDICATED IN THE PLAN VIEW.
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4. PROPOSED DEMOLITION OF OUTBUILDINGS AND REINSTATEMENT FURTHER IN LAND - TO BE AGREED FOLLOWING CONFIRMATION WITH AFFECTED STAKEHOLDERS.
5. ORDNANCE SURVEY MAP INFORMATION IS DEPICTED IN THE PLAN ARRANGEMENT. THIS INFORMATION HAS BEEN USED TO INDICATE THE POSITIONS OF BUILDINGS AND ROADS. THIS INFORMATION IS INDICATIVE ONLY & TOPOGRAPHICAL SURVEY INFORMATION SHOULD TAKE PRECEDENT IN ALL AREAS OF OVERLAP WITH THE OS.
6. FOLLOWING CONSTRUCTION OF FLOOD PROTECTION WALL, GARDENS AND PROPERTIES ARE TO BE REINSTATED TO EXISTING CONDITION.
7. FOR SECTIONS C-C, D-D, E-E, F-F & G-G SEE DRAWING 2745-GA-003.
8. FOR TREE CLEARANCE PLAN REFER TO DRAWING 2745-XS-001.

LEGEND

- LIMITS OF LAND AFFECTED BY OPERATIONS AND OF LAND UPON WHICH ENTRY IS REQUIRED
- RIVER
- EXISTING BUILDINGS
- EXISTING CARRIAGEWAY
- PROPOSED NEW BUILDING
- 2017 (CBEC) TOPO SURVEY EXTENT
- 2017 (WSP) TOPO SURVEY EXTENT
- WALLS
- FENCELINE
- ROCK ARMOUR

OVERHEAD BT — BT

SCOTTISH WATER - COMBINED — SW-C

SCOTTISH WATER - WATER SUPPLY — SW-MAIN

SSE - 11kv POWER

SSE - LOW POWER

N

A82 DRUMNADROCHIT BRIDGE

PROPOSED FLOOD WALL TIE-IN ARRANGEMENT TO EXISTING WINGWALL/TRAINING WALL TO BE CONFIRMED DURING DETAILED DESIGN STAGE

EXISTING OUTBUILDINGS TO BE DEMOLISHED. FLOOD WALL FOUNDATIONS TO BE CAST AS ONE WITH NEW OUTBUILDINGS FOUNDATIONS. SEE NOTE 4.

BOUNDARY WALLS, FENCES & HEDGES TO BE LOCALLY TEMPORARILY DISMANTLED AND REINSTATED TO TIE-IN WITH PROPOSED FLOOD WALL, SUBJECT TO AGREEMENT WITH AFFECTED LANDOWNERS.

DECKING AREA AND HOT TUB TO BE TEMPORARILY DISMANTLED AND REINSTATED FOLLOWING CONSTRUCTION

RIVER ENRICK

FLOW DIRECTION

BOUNDARY WALL TO BE LOCALLY TEMPORARILY DISMANTLED AND REINSTATED TO TIE-IN WITH PROPOSED FLOOD WALL, SUBJECT TO AGREEMENT WITH AFFECTED LANDOWNERS.

STEP IN WALL CREST LEVEL AT THIS POINT FOR DOWNSTREAM FLOOD LEVEL

EXISTING WALL

EXISTING OUTBUILDING TO REMAIN

EXISTING TREE TO REMAIN

EXISTING GAS TANK TO REMAIN

TIMBER HUTCH TO BE TEMPORARILY RELOCATED WITHIN GARDEN DURING CONSTRUCTION

EXISTING SCOTTISH WATER SEWER OVERFLOW. OVERFLOW PIPE TO BE LOCATED. NON-RETURN VALVE ADDED TO OUTLET.

BRIDGEND HOUSE

GREENLEA

GREENGATE COTTAGE

EASTLEA

HEDGE ALONG BOUNDARY IN THIS AREA TO REMAIN

EXISTING SHED TO REMAIN

LIMITS OF LAND AFFECTED BY OPERATIONS AND OF LAND UPON WHICH ENTRY IS REQUIRED FOR THE PURPOSES OF CARRYING OUT THE OPERATIONS

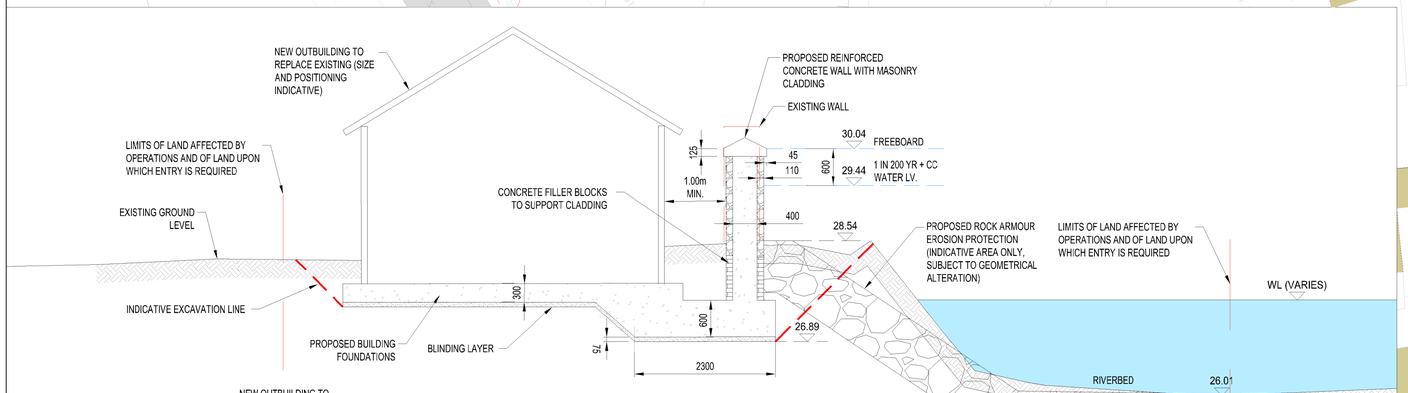
EXISTING SEWER TO BE PROTECTED/RELOCATED

PROPOSED FLOOD WALL TIE-IN ARRANGEMENT TO EXISTING LANDSCAPE

PROPOSED ACCESS ROUTE FROM A82. SUBJECT TO AGREEMENT WITH LAND OWNER

Glen Cafe

PLAN VIEW SHOWING FLOOD WALL EXTENT
SCALE 1:250



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P03	05/11/2018	ds	DRAWING AMENDED TO HIGHLAND COUNCIL COMMENTS	DS	DS
P02	08/08/2018	CW	GENERAL FORMATTING, ADDITIONAL INFORMATION, EROSION PROTECTION ADDED	PMB	AC
P01	02/07/2018	JR	FIRST ISSUE.	DKP	IB

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CLIENT: The Highland Council / Comhairle na Gàidhealtachd

SITE/PROJECT: DRUMNADROCHIT FLOOD PROTECTION SCHEME

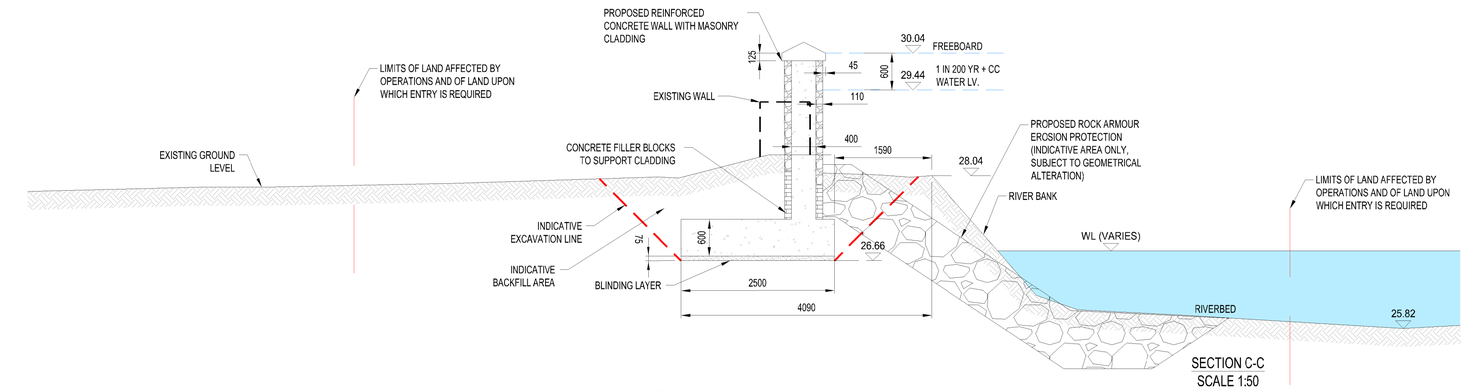
TITLE: DRUMNADROCHIT FLOOD WALL GENERAL ARRANGEMENT

SHEET 1 OF 2

SCALE @ A1:	CHECKED:	APPROVED:
AS SHOWN@A1	DKP	IB

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70022745	DKP	JR	January 19

DRAWING No: 2745-GA-002 REV: P04



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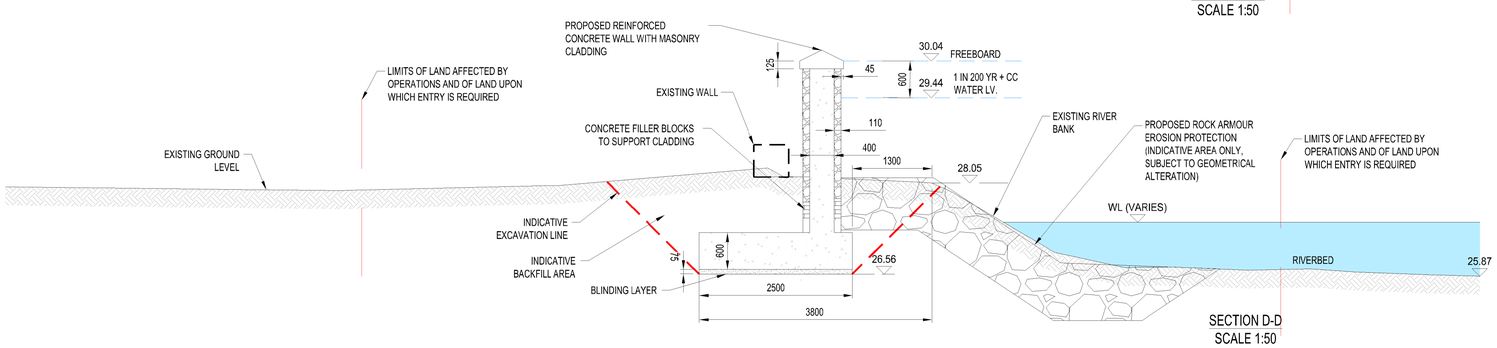

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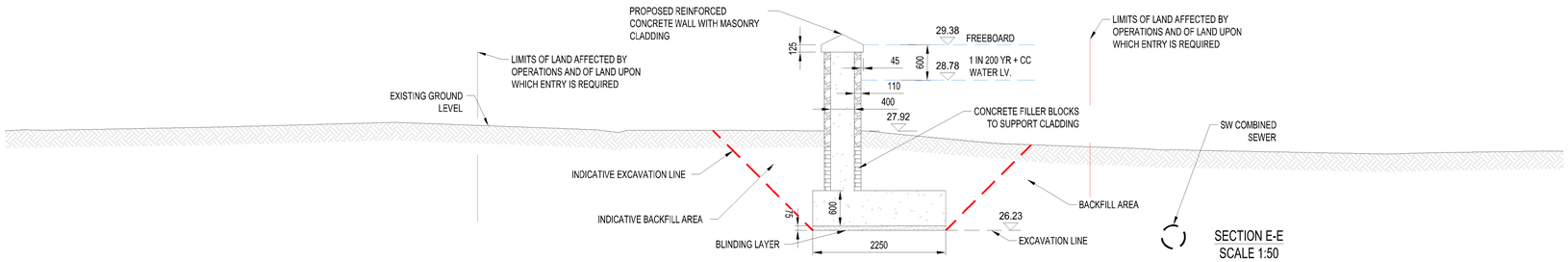

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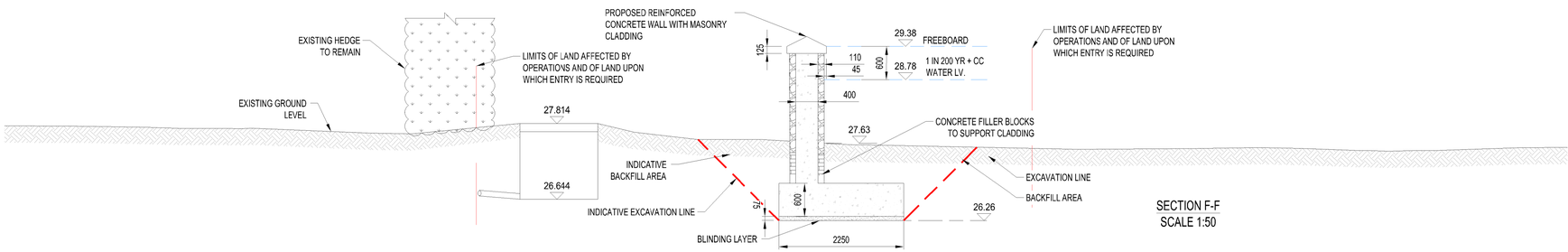

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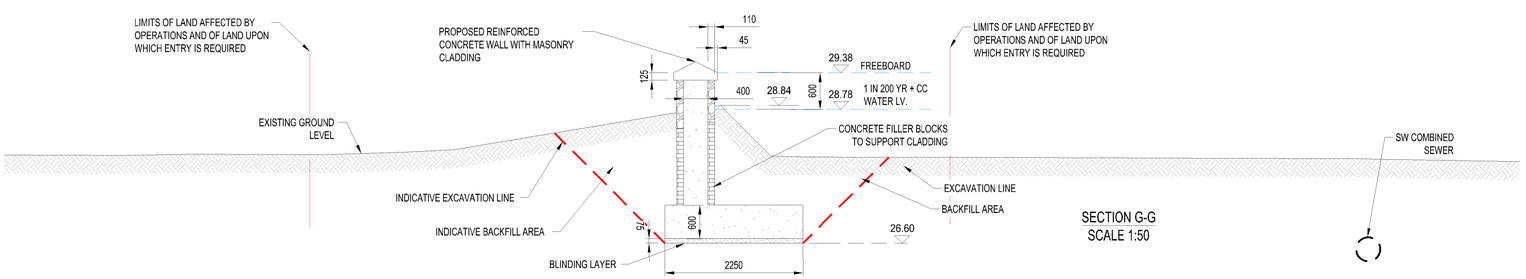

SECTION G-G
SCALE 1:50

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LEGEND

LIMITS OF LAND AFFECTED BY OPERATIONS AND OF LAND UPON WHICH ENTRY IS REQUIRED

RIVER

WALLS

P04	21/11/2018	MM	DRAWING AMENDED TO HIGHLAND COUNCIL COMMENTS	DS	DS
P03	05/11/2018	DS	DRAWING AMENDED TO HIGHLAND COUNCIL COMMENTS	DS	DS
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REV	DATE	BY	DESCRIPTION	CHK	APP

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SITE/PROJECT: DRUMNADROCHIT FLOOD PROTECTION SCHEME

TITLE: DRUMNADROCHIT FLOOD WALL GENERAL ARRANAGEMENT

SHEET 2 OF 2

SCALE @ A1:	CHECKED:		APPROVED:
AS SHOWN@A1	DKP		IB
PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70022745	DKP	JR	January 19

DRAWING No: 2745-GA-003 REV: P04

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5. TOPOGRAPHICAL SURVEY PRODUCED BY A THIRD PARTY.
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RIVER ENRICK FLOW DIRECTION

EXISTING SSE 11KV OVERHEAD LINE

VEHICLE ACCESS LOCATED TO AVOID LAND RAISING IN VICINITY OF SSE APPARATUS

RELOCATION OF EXISTING SSE 11KV OVERHEAD LINE WITH 3m STANDOFF TO BE PROVIDED

PROPOSED ELECTRICITY DIVERSION. LAYOUT TO BE CONFIRMED BY SSE.

4m GATE

MAIN EMBANKMENT

PROPOSED VEHICLE ACCESS

EXISTING FARMERS ACCESS FROM A82 ROAD

TEMPORARY PROTECTION OF SCOTTISH WATER MAIN TO BE AGREED WITH SCOTTISH WATER

PROPOSED VEHICLE ACCESS

TEMPORARY ACCESS TRACK TO BE 5m WIDE (4m TRACK WITH 0.5m VERGES)

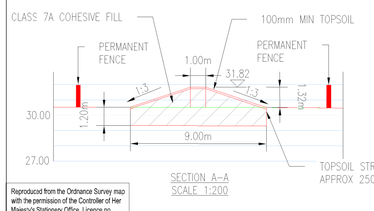
EXISTING FIELD GATE

A82

PLAN VIEW
SCALE 1:500

LEGEND

- OVERHEAD BT
- SCOTTISH WATER – COMBINED
- SCOTTISH WATER – WATER SUPPLY
- SSE – 11kv POWER
- SSE – LOW POWER
- CONSTRUCTION AND MAINTENANCE ACCESS
- EXISTING HOUSES
- EXISTING CARRIAGEWAY
- PROPOSED CLAY BLANKET
- RELOCATION OF EXISTING SSE 11KV OVERHEAD LINE
- EXISTING GROUND PROFILE
- PROPOSED GROUND PROFILE
- PERMANENT FENCELINE
- TEMPORARY FENCELINE



SECTION A–A
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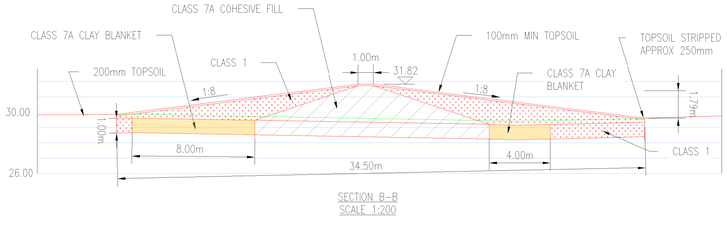

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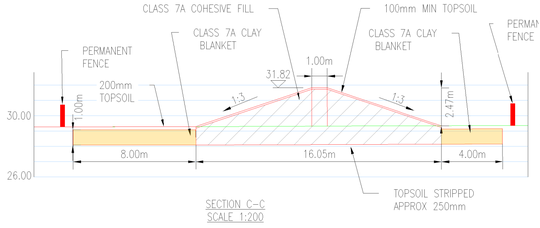

SECTION C–C
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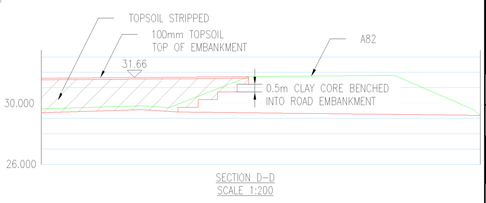

SECTION D–D
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REV	DATE	BY	DESCRIPTION	CHK	APP
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D	21/11/18	MM	DRAWING AMENDED TO HIGHLAND COUNCIL COMMENTS	JS	FM
C	05/11/18	GS	DRAWING AMENDED TO HIGHLAND COUNCIL COMMENTS	JS	FM
B	26/09/18	JN	DRAWING UPDATE	FM	FM
A	07/12/17	JR	FIRST ISSUE	FM	FM

DRAWING STATUS:
S2 - FOR INFORMATION

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CLIENT:
THE HIGHLAND COUNCIL

ARCHITECT:
-

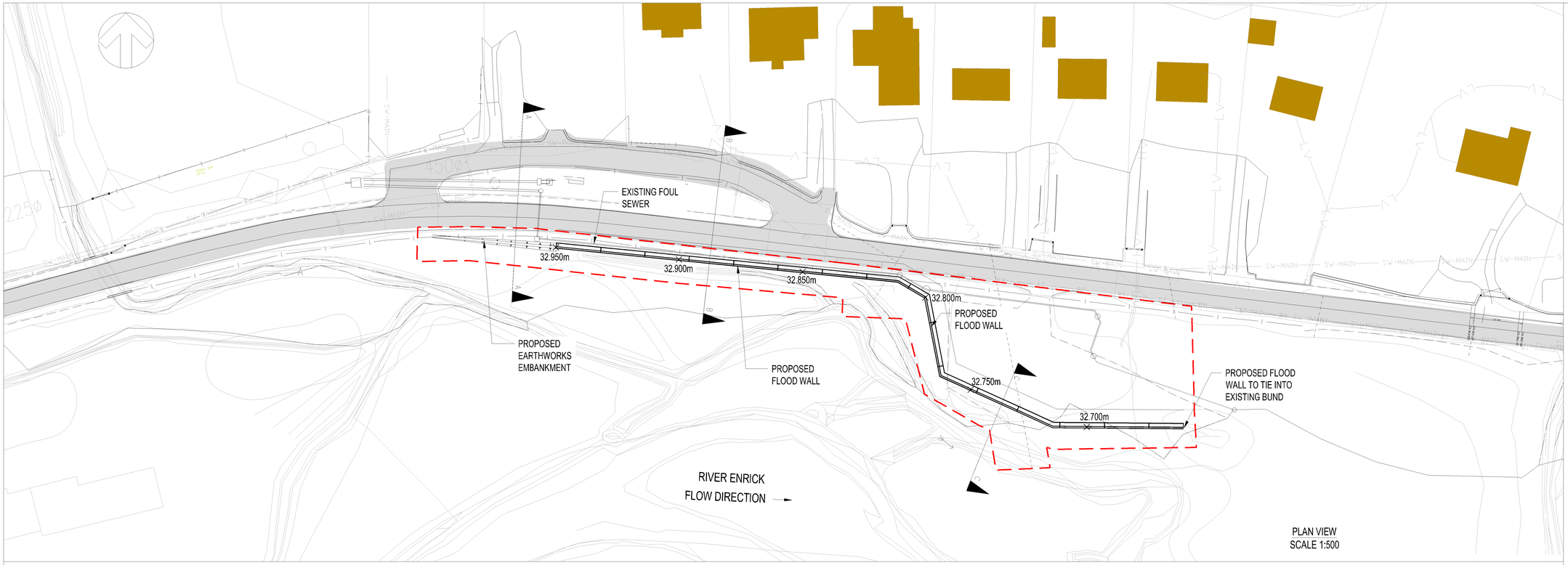
SITE/PROJECT:
DRUMNADROCHIT
FLOOD PROTECTION SCHEME

TITLE:
MAIN EMBANKMENT PLAN

SCALE @ A1:	CHECKED:	APPROVED:
AS SHOWN	PM	PM

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70022745	GK	JN	September 2018

DRAWING No: 2745-GA-004 REV: E



PLAN VIEW
SCALE 1:500

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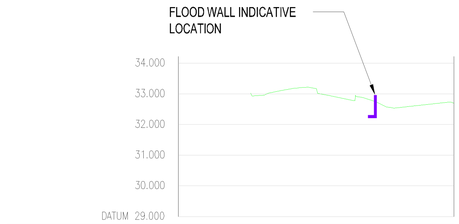
6. ALL EXPLORATORY POSITIONS ARE TO BE MICRO-SITED DURING GI WORKS SUBJECT TO ACCESS + SERVICE CLEARANCE.
8. FOR TREE CLEARANCE PLAN REFER TO DRAWING 2745-XS-001.

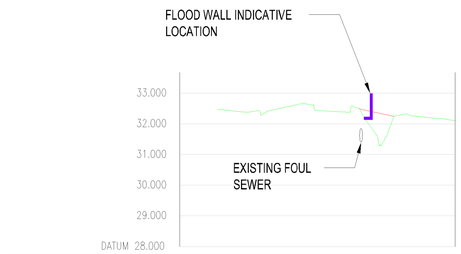
LEGEND

- EXISTING GROUND PROFILE
- LEVEL OF PROPOSED FLOOD WALL
- PROPOSED GROUND LEVEL
- PROPOSED FLOOD WALL
- LIMITS OF LAND AFFECTED BY OPERATIONS AND OF LAND UPON WHICH ENTRY IS REQUIRED



CHAINAGE	0.000	5.000	10.000	11.821	15.000	20.000	25.000	30.000	35.000	40.000	45.000
180501 COMPOSITE SURFA				33.024	33.038	33.206	32.930	32.888	32.546	32.643	32.693

SECTION A-A
SCALE: H: 1:500, V 1:100



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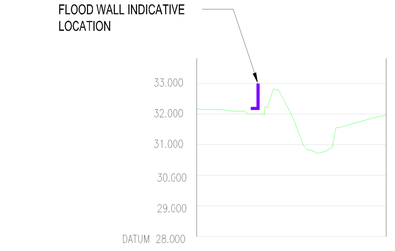

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SECTION C-C
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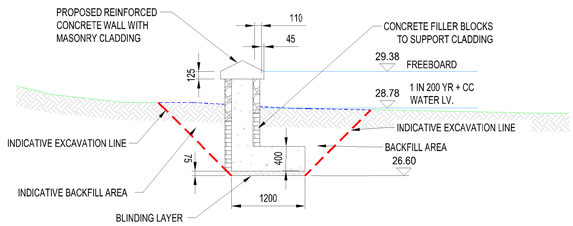

TYPICAL REINFORCED CAST INSITU CONCRETE FLOOD WALL SECTION
SCALE 1:50

CHAINAGE	0.000	5.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000	55.000	60.000	65.000	70.000	75.000	80.000	85.000	90.000	95.000	100.000	105.000	110.000	115.000	120.000	125.000	130.000	135.000	140.000	145.000	150.000	155.000	160.000	165.000	170.000	175.000	180.000	185.000	187.216
18C501 COMPOSITE SURFA	33.063	33.015	32.934	32.906	32.884	32.838	32.764	32.706	32.734	32.662	32.586	32.557	32.516	32.389	32.396	32.346	32.364	32.394	32.413	32.370	32.511	32.512	32.145	32.976	32.252	32.303	32.304	32.177	32.109	31.976	32.162	32.171	32.210	32.195	32.190	32.205	32.220	32.000	34.000

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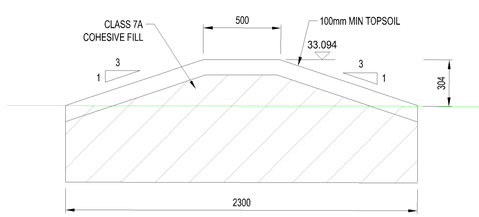

TYPICAL EARTHWORKS EMBANKMENT DETAIL
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E	09/01/2019	BD	DRAWING UPDATE	DS	PM
D	21/11/2018	MM	DRAWING AMENDED TO HIGHLAND COUNCIL COMMENTS	DS	PM
C	05/11/2018	DS	DRAWING AMENDED TO HIGHLAND COUNCIL COMMENTS	DS	PM
B	26/09/2018	JR	DRAWING UPDATE	PM	PM
A	31/08/2018	JR	FIRST ISSUE	PM	PM

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wsp.com

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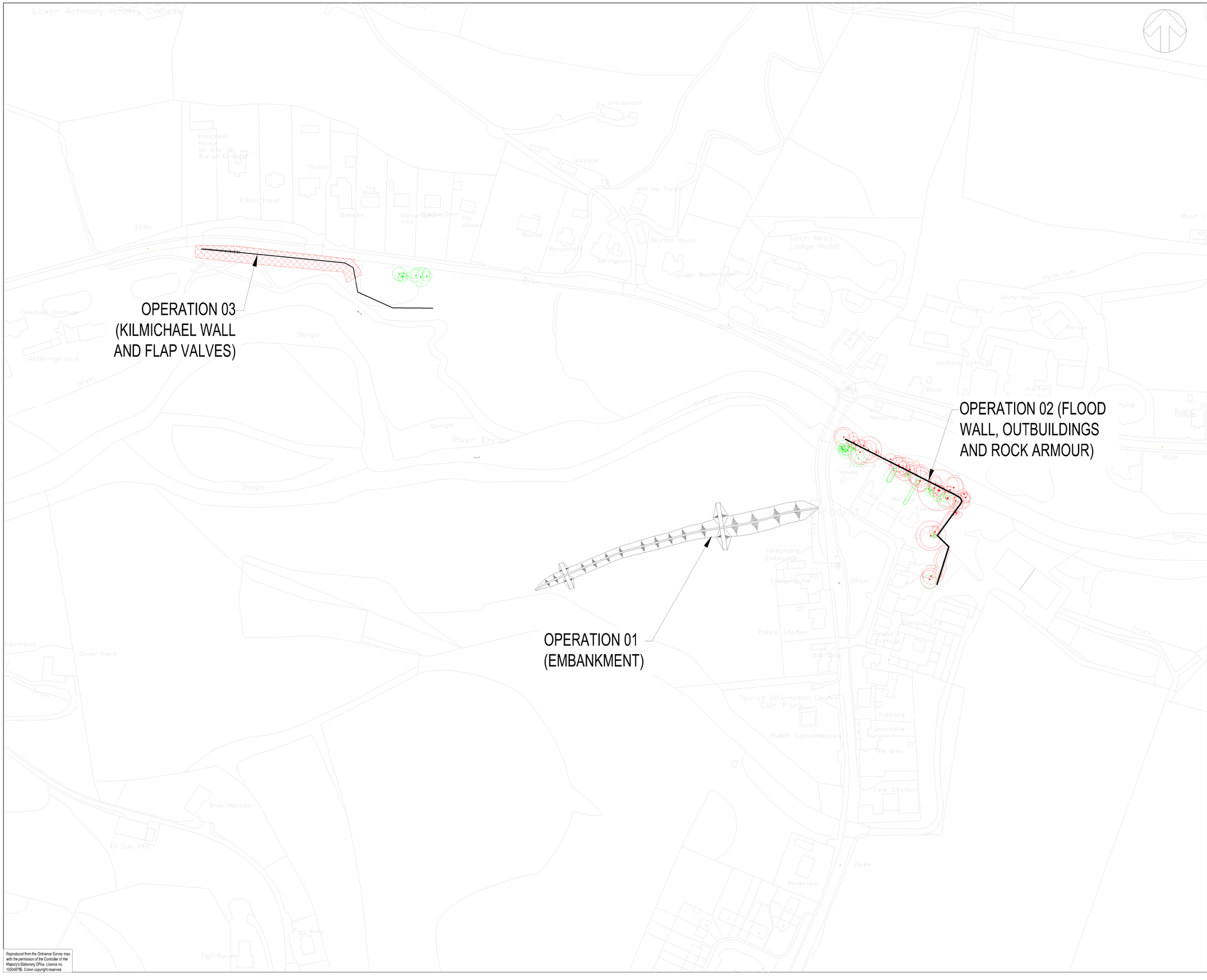
ARCHITECT: -

PROJECT: DRUMNADROCHIT FLOOD PROTECTION SCHEME

TITLE: KILMICHAEL WALL SECTIONS

SCALE @ A1:	CHECKED:	APPROVED:
AS SHOWN	PM	PM
CAD FILE: 2745-GA-005	DESIGN DRAWN: JN	DATE: January 2019

PROJECT No:	DRAWING No:	REV:
70022745	2745-GA-005	E



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4. ALL EXPLORATORY POSITIONS ARE TO BE MICRO-SITED DURING GI WORKS SUBJECT TO ACCESS + SERVICE CLEARANCE.
5. TREE SURVEY UNDERTAKEN BY SCOTTISH ARBORICULTURAL SERVICES ON 15/09/2017.
6. FOR TREE SURVEY SCHEDULE SEE DRAWING 2745-XS-002.

LEGEND

EXISTING TREE TO BE RETAINED

EXISTING TREE TO BE REMOVED

EXISTING GROUP OF TREES TO BE REMOVED

EXISTING HEDGE TO BE RETAINED

EXISTING HEDGE TO BE REMOVED

PROPOSED FLOOD WALL

PROPOSED EMBANKMENT

REV	DATE	BY	DESCRIPTION	CHK	APP
A	08/01/19	BD	FIRST ISSUE	DS	DS

DRAWING STATUS:
S2 - FOR INFORMATION

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ARCHITECT:
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SITE/PROJECT:
DRUMNADROCHIT
FLOOD PREVENTION SCHEME

TITLE:
TREE CLEARANCE PLAN
SHEET 1 OF 2

SCALE @ A1:	CHECKED:		APPROVED:
1:1250	DS		PM
PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70022745	-	BD	January 19

DRAWING No: 2745-XS-001
REV: A

Header

Surveyed Trees

Reference	Species	Height	Stem Diameter	Canopy NESW	Crown Clearance Height	Age Class	Physiological Condition	Structural Condition	Notes	Recommendations	Est. Remaining Contribution	RPA Radius	Category
5007	Malus	4m	0.27m	0.1N 2E 4S 3W	3m	Over-Mature	Fair	Poor	Basal decay evident.		10-20 Years	3.3m	C2
5008	Fraxinus excelsior	16m	0.56m	3N 5E 7S 5W	3m	Mature	Fair	Fair	Trifurcated at 1.7m. Stem and scaffold limbs covered with ivy to 9m height.	Remove ivy to facilitate future assessment of structural condition.	20-40 Years	6.6m	B2
5009	Fagus sylvatica	16m	0.5m	8N 8E 1S 6.5W	4m	EM	Fair	Fair	Asymmetric crown and natural lean weighted north. Stem and scaffold limbs covered with ivy to 8m.	Remove ivy to facilitate future assessment of structural condition.	20-40 Years	6m	B2
5010	Fraxinus excelsior	9m	0.17m	1N 4E 4S 2.5W	2m	Young	Good	Good	No significant defects visible		40+ Years	2.1m	B2
5011	Acer pseudoplatanus	10m	0.15m	1N 1E 2S 5W	2m	Young	Good	Fair	Self-seeded tree with heavily swept bole.	Remove to favour 5010.	10-20 Years	1.8m	C2
5012	Alnus glutinosa	10m	0.350; 0.320; 0.120m	0.1N 5E 5S 0.1W	5m	Mature	Poor	Poor	Significant decay evident. Bat roost potential.	Coppice	Years	6m	U
5013	Acer pseudoplatanus	14m	0.3m	4N 3E 4S 4W	3m	SM	Good	Good	No significant defects visible.		20-40 Years	3.6m	B2
5014	Fraxinus excelsior	12m	0.140; 0.140m	4N 2E 2S 3W	9m	SM	Fair	Fair	Bifurcated at 1m. Root system undermined by river.		10-20 Years	2.4m	C2
5015	Fagus sylvatica	17m	0.600; 0.470; 0.470m	7N 7E 9S 8W	2.5m	Mature	Fair	Fair	Swept bole. Tight forks and crossed and rubbing branches present.	Crown clean removing deadwood, crossed and rubbing branches.	10-20 Years	10.8m	C2
5016	Cupressocyparis leylandii	8m	0.16m	2N 2E 1S 1.5W	2m	SM	Fair	Good	Codominant forx at 5m		10-20 Years	1.8m	C2
5017	Betula pendula	9.5m	0.36m	5N 3E 2S 2W	5m	EM	Fair	Poor	Tree topped at current height.		10-20 Years	4.2m	C2
5018	Pinus contorta	19m	0.45m	3N 6E 7S 2W	3m	EM	Fair	Fair	Large old scar ts stem with decay evident. Fence wire embedded in stem.		10-20 Years	5.4m	C2
5019	Fraxinus excelsior	19m	0.44m	3N 7E 6S 7W	6m	EM	Good	Good	No significant defects visible.		40+ Years	5.4m	A2
5020	Fraxinus excelsior	17m	0.68m	4N 5E 1S 3W	6m	EM	Fair	Fair	No significant defects visible.		20-40 Years	8.1m	B2
5021	Fraxinus excelsior	19m	0.3m	3N 1E 3S 5W	6m	EM	Fair	Fair			20-40 Years	3.6m	B2
5022	Alnus glutinosa	16m	0.440; 0.300; 0.240; 0.220m	9N 6.5E 3S 5W	4m	Mature	Fair	Fair	Multiple-stemmed tree.		20-40 Years	7.5m	B2
5023	Fraxinus excelsior	13m	0.23m	3N 1E 1S 6W	10m	SM	Fair	Poor	Etiolated tree with heavy natural lean and asymmetric crown weighted northwest		10-20 Years	2.7m	C2
5024	Fraxinus excelsior	14m	0.32m	4N 4E 6S 5W	9m	SM	Fair	Fair	Bifurcated at 2m. Fence wire embedded in stem.		10-20 Years	3.9m	C2
5025	Crataegus monogyna	5m	0.140; 8.000; 0.070m	4N 3E 3S 4W	2m	EM	Fair	Fair	Ivy present to 4m height.		20-40 Years	15m	B2
5026	Fraxinus excelsior	14m	0.230; 0.220m	5N 3E 6S 4W	9m	SM	Fair	Fair	Bifurcated at 0.4m.		20-40 Years	3.9m	B2
5027	Fraxinus excelsior	14m	0.230; 0.220; 0.200; 0.160; 0.150m	6.5N 4E 4S 4W	9m	EM	Fair	Fair	Multi-stemmed tree with minor deadwood.		20-40 Years	5.1m	B2
5028	Sorbus aucuparia	10m	0.120; 0.100; 0.090; 0.070m	0.1N 2E 5S 1W	3m	Over-Mature	Poor	Fair	Asymmetric crown and heavy lean weighted south.		<10 Years	2.4m	U
5029	Sorbus aucuparia	10m	0.190; 0.090m	0.5N 1E 5S 3W	3m	OM	Poor	Poor	asymmetric crown and lean weighted south. Basal decay evident.		<10 Years	2.4m	U
5030	Fraxinus excelsior	14m	0.540; 0.330m	0.5N 6E 8S 3W	5m	M	Fair	Poor	Tws stems. Heavily asymmetric crown and lean weighted south. Fence wire embedded in stem.		10-20 Years	7.5m	C2
5031	Ulmus glabra	18m	0.480; 0.280; 0.240; 0.140m	9N 7E 6S 3W	10m	Mature	Fair	Fair	Minor deadwood present.		20-40 Years	7.5m	B2
5032	Acer pseudoplatanus	19m	0.58m	10N 3E 8S 6W	4m	M	Fair	Fair		Fence wire embedded in stem.	20-40 Years	6.9m	B2
5033	Fraxinus excelsior	12m	0.14m	0.1N 1E 7S 2W	8m	Young	Fair	Poor	Etiolated tree growing out of stone dyke. Heavily asymmetric crown and lean weighted south.		<10 Years	1.8m	C2
5034	Acer pseudoplatanus	17m	0.31m	6N 3E 3S 3W	7m	SM	Fair	Fair	Swept bole. Bifurcated at 2m. Root system undermined by river.		10-20 Years	3.6m	C2
5035	Acer pseudoplatanus	19m	0.7m	1N 3E 6S 1W	10m	SM	Fair	Fair	Swept bole. Root system undermined by river.		10-20 Years	8.4m	C2
5036	Acer pseudoplatanus	18m	0.4m	5N 3E 6S 3W	11m	SM	Fair	Fair		Swept bole. Root system undermined by river.	20-40 Years	4.8m	B2
5037	Ulmus glabra	15m	0.450; 0.340; 0.250m	1N 6E 6S 5W	3m	Mature	Fair	Fair	Rot holes present. At roost potential.		20-40 Years	7.5m	B2
5038	Acer pseudoplatanus	17m	0.44m	7N 3E 5S 6W	9m	SM	Fair	Fair	Bifurcated at4m height.		10-20 Years	5.4m	C2
5039	Alnus glutinosa	6m	0.35m	0N 0E 0S 0W	6m	OM	Dead	Decaying	Standing deadwood.		Years	4.2m	U
5040	Fraxinus excelsior	6m	0.16m	1N 2E 3S 0.2W	3m	Young	Poor	Poor	Poor quality stemss arising from old stump.	Remove	<10 Years	1.8m	U
5041	Acer pseudoplatanus	18m	0.430; 0.390; 0.390; 0.370; 0.021m	7N 6E 7S 4W	6m	SM	Good	Fair	Multiple-stemmed tree.		20-40 Years	9.6m	B2
5042	Alnus glutinosa	14m	0.21m	4N 1E 2S 4W	11m	EM	Fair	Fair	Etiolated tree		10-20 Years	2.4m	C2
5043	Alnus glutinosa	9m	0.3m	0N 0E 0S 0W	9m	Over-Mature	Dead	Decaying	Standing deadwood.	Remove	<10 Years	3.6m	U
5044	Fraxinus excelsior	14m	0.240; 0.270m	7N 3E 2S 5W	10m	EM	Fair	Poor	Bifurcated at 1m and 4m.		10-20 Years	4.2m	C2
5045	Ulmus glabra	15m	0.600; 0.120m	6N 4E 5S 6W	7m	M	Poor	Fair	Evidence of ealy onset of Dutch Elm Disease	Remove	<10 Years	7.2m	U
5046	Ulmus glabra	18m	0.74m	5N 7E 8S 7W	8m	OM	Dead	Poor	Tree has recently died (Dutch Elm Disease)	Remove	<10 Years	9m	U
5047	Chamaecyparis lawsoniana	18m	0.400; 0.320m	3N 4E 4.5S 2.5W	2.5m	EM	Good	Fair	Dual stemmed tree.		20-40 Years	6m	B2
5048	Chamaecyparis lawsoniana	6.5m	0.09m	3N 1.5E 1.5S 1.5W	1m	Young	Fair	Fair	Supportive ties are restricting stem.	Remove stake and ties.	20-40 Years	1.2m	B2
5049	Chamaecyparis lawsoniana	20m	0.27m	2N 1.5E 1S 1.5W	15m	SM	Good	Good	Fencing rails attached to stem.		20-40 Years	3.3m	B2
5050	Chamaecyparis lawsoniana	20m	0.29m	1N 2E 1S 2W	14m	SM	Good	Fair	Bifurcated at 4m. Fencing rails attached to stem.		10-20 Years	3.6m	C2
5051	Chamaecyparis lawsoniana	20m	0.39m	1N 3E 3S 2W	7m	SM	Good	Fair	Asymmetric crown.		20-40 Years	4.8m	B2
5052	Chamaecyparis lawsoniana	20m	0.31m	1N 1E 1S 1.5W	14m	SM	Good	Poor	Codominant fork at 4m.		10-20 Years	3.6m	C2
5053	Chamaecyparis lawsoniana	16m	0.2m	1N 1E 1S 1W	11m	SM	Poor	Poor	Suppressed.		<10 Years	2.4m	U
5054	Chamaecyparis lawsoniana	19m	0.24m	1N 1E 1S 2W	12m	SM	Fair	Fair	Etiolated.		10-20 Years	3m	C2
5055	Chamaecyparis lawsoniana	20m	0.4m	2N 2E 2S 2W	9m	SM	Fair	Fair	Ivy growing up stem to 4m height.		20-40 Years	4.8m	B2
5056	Prunus avium	15m	0.98m	4N 4E 4S 2W	11m	Over-Mature	Poor	Decaying	significant internal decay evident. Fruiting bodies present (Ganoderma spp.)	Remove	<10 Years	11.7m	U
5057	Prunus avium	11m	0.39m	5.5N 5E 6.5S 4.5W	2m	SM	Good	Good	Low branches encroach on field access.		40+ Years	4.8m	A2
5058	Alnus glutinosa	12m	0.220; 0.200; 0.140; 0.160; 0.150; 0.120; 0.100; 0.100m	5N 3E 5S 5W	4m	EM	Fair	Fair	Multiple-stemmed tree with some dead stems.	Reove dead stems.	20-40 Years	5.1m	B2
5059	Alnus glutinosa	10m	0.27m	3N 4E 4S 3W	4m	EM	Good	Good	No significant defects visible.		40+ Years	3.3m	A2
5060	Alnus glutinosa	10m	0.14m	2N 3E 0.5S 1W	7m	SM	Fair	Poor	Etiolated.		10-20 Years	1.8m	C2
5061	Alnus glutinosa	12m	0.290, 0.200; 0.180m	5N 2E 2S 6W	4m	Mature	Fair	Fair		Asymmetric crown and natural lean weighted towards road.	10-20 Years	4.8m	C2
5062	Alnus glutinosa	14m	0.350; 0.340; 0.290m	6N 2E 5S 3W	10m	Mature	Fair	Fair	Slight evidence of dieback.		Years	6.9m	C2
5063	Alnus glutinosa	11m	0.33m	6N 2E 1S 3W	10m	Mature	Fair	Fair	Natural lean weighted towards road. Becoming suppressed. Deadwood present.		10-20 Years	3.9m	C2
5064	Acer pseudoplatanus	14m	0.9m	5N 5E 5S 3W	3m	SM	Good	Fair	Bifurcated at 2.5m		20-40 Years	10.8m	B2
5065	Fraxinus excelsior	14m	0.280; 0.220; 0.200; 0.200; 0.160; 0.140; 0.170; 0.130; 0.210m	5N 4E 5S 3W	4m	SM	Good	Fair	Multiple stems arising from old stump.		20-40 Years	6.9m	B2
5066	Acer pseudoplatanus	11m	0.31m	6N 0.1E 2S 6W	3m	SM	Fair	Poor	Heavily asymmetric crown and natural lean weighted northwest.		Years	3.6m	C2
5067	Acer pseudoplatanus	13m	0.65m	3N 6E 7.5S 6.5W	3m	Mature	Good	Good	No significant defects visible.		40+ Years	7.8m	A2
5068	Fraxinus excelsior	12m	0.360; 0.240m	4N 5.5E 4.5S 5W	2m	SM	Good	Fair	Fence wire embedded in stem.		10-20 Years	5.1m	C2
5069	Fraxinus excelsior	10m	0.21m	4N 4E 3.5S 4.5W	2m	SM	Good	Good	No significant defects visible.		40+ Years	2.4m	A2
5070	Chamaecyparis lawsoniana	12m	0.47m	2N 2E 2S 2W	1m	EM	Fair	Poor	Codominant stems with bark inclusions.		10-20 Years	5.7m	C2

Surveyed Tree Group

Reference	Species	Height	Stem Diameter	Canopy NESW	Crown Clearance Height	Age Class	Physiological Condition	Structural Condition	Notes	Recommendations	Est. Remaining Contribution	RPA Radius	Category
Hedge 1	Fagus sylvatica								Beech hedging 9m height and 8m spread _ management lapsed.	Reduce height and spread to 3m	Years		C2
Hedge 2	Cupressocyparis leylandii								Managed hedge 2.5m height and 2m spread.	Maintain at current dimensions	Years		B2
Hedge 3	Chamaecyparis lawsoniana								Lawson cypress hedge topped at current height		Years		C2
Hedge 4	Chamaecyparis lawsoniana									Lawson cypress hedge topped at 2m	Years		C2
Hedge 5	Prunus spp.								Prunus spinosa hedge - unmanaged		Years		C2
W1	Mixed Broadleaves								Mixed broadleaf riparian woodland predominated by alder and goat willow but including ash sycamore and elm. Many trees are mature/over mature and some are in a state of collapse. Rot holes and cracks offering potential bat roosts.		Years		C2
W2	Alnus glutinosa								Wooded strip of mature Alder		Years		B2

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5. TREE SURVEY UNDERTAKEN BY SCOTTISH ARBORICULTURAL SERVICES ON 15/09/2017.

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A	08/01/19	BD	FIRST ISSUE	JS	JS

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SITE/PROJECT: DRUMNADROCHIT FLOOD PREVENTION SCHEME

TITLE: TREE CLEARANCE PLAN SHEET 2 OF 2

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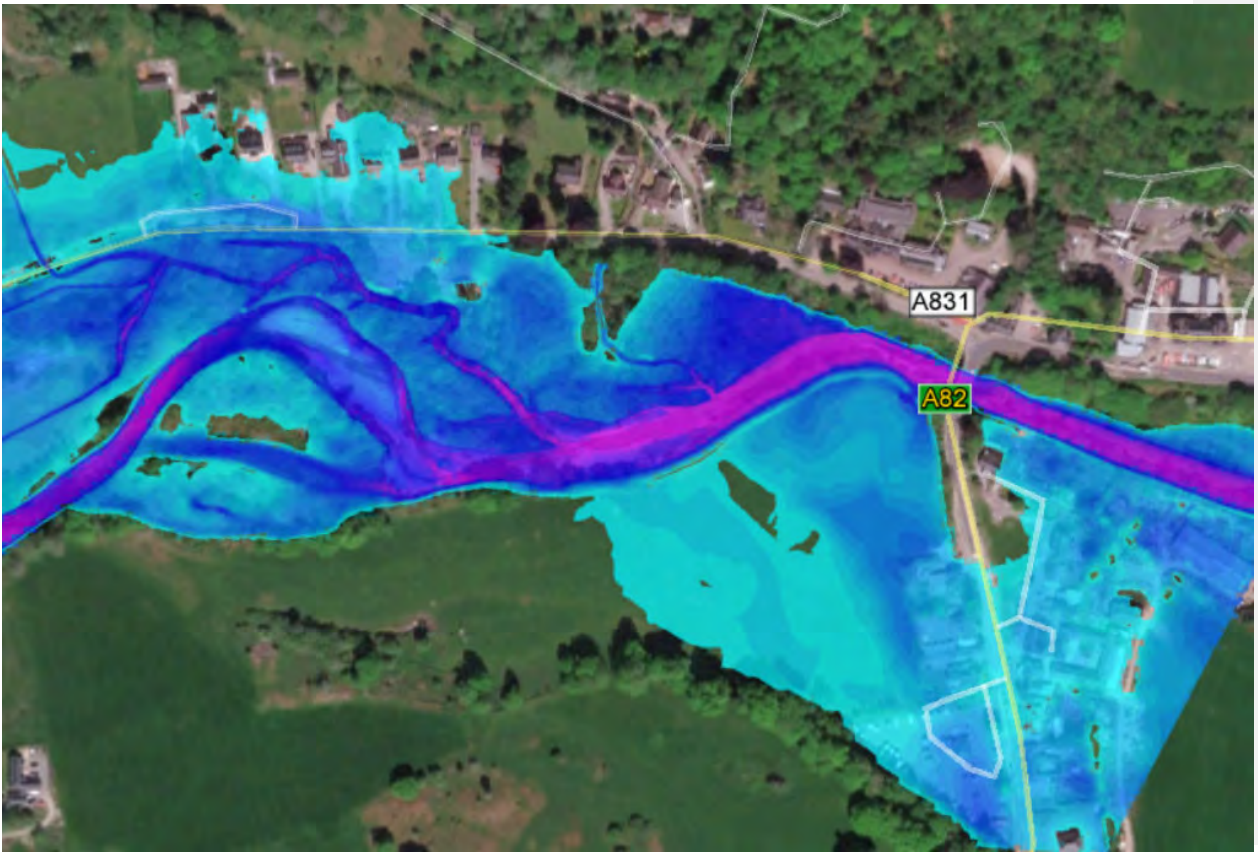
PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70022745	-	MM	January 19

DRAWING No: 2745-XS-002 REV: A

The Highland Council

DRUMNADROCHIT FLOOD PREVENTION SCHEME

Design Justification Report



The Highland **Council**

DRUMNADROCHIT FLOOD PREVENTION SCHEME

Design Justification Report

TYPE OF DOCUMENT (VERSION) CHOOSE AN ITEM.

PROJECT NO. 70022745

OUR REF. NO. DJR01

DATE: JANUARY 2019

The Highland **Council**

DRUMNADROCHIT FLOOD PREVENTION SCHEME

Design Justification Report

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QUALITY CONTROL

Issue/revision	First issue	Revision 1
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Prepared by	Nick Burke	
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Checked by	Duncan Shaw	
Signature		
Authorised by	Paul Mankey	
Signature		
Project number	70022745	
Report number	DJR01	
File reference	70022745 DJR01	

CONTENTS

TABLES

FIGURES

APPENDICES

No table of contents entries found.

EXECUTIVE SUMMARY

WSP were commissioned by The Highland Council for the

Executive summary content goes here

Contact name Paul Mankey

1. INTRODUCTION

1.1. BACKGROUND TO THE SCHEME

1.1.1. WSP and CBEC were commissioned by The Highland Council to provide guidance in the development of a Flood Protection Scheme (FPS) under the Flood Risk Management (Scotland) Act 2009.

1.1.2. The FPS will focus mainly on the protection of the village of Drumnadrochit and the A82, but will also provide some relief from flooding to the small village of Kilmichael approximately 0.5 km to the west, and its main access route, the A831.

1.1.3. The area was identified as being at risk during SEPA's first National Flood Risk Assessment (NFRA) in 2011, and was included in the Inverness and the Great Glen Potentially Vulnerable Area (PVA).

1.1.4. WSP undertook this work with CBEC as sub-consultants. The division of labour for this project was as follows:

WSP

- Project Management
- Geotechnical engineering
- Structural engineering
- Environmental and ecological assessment

CBEC

- Geomorphological modelling
- Hydrology
- Hydraulic modelling

WSP also sub-consulted work to Scottish Arboricultural Services (SAS) for the arboricultural survey.

1.2. STUDY AREA

1.2.1. The location of the study area is shown in Figure 1-1 overleaf, and the study boundary is also shown in Figure 1-2.

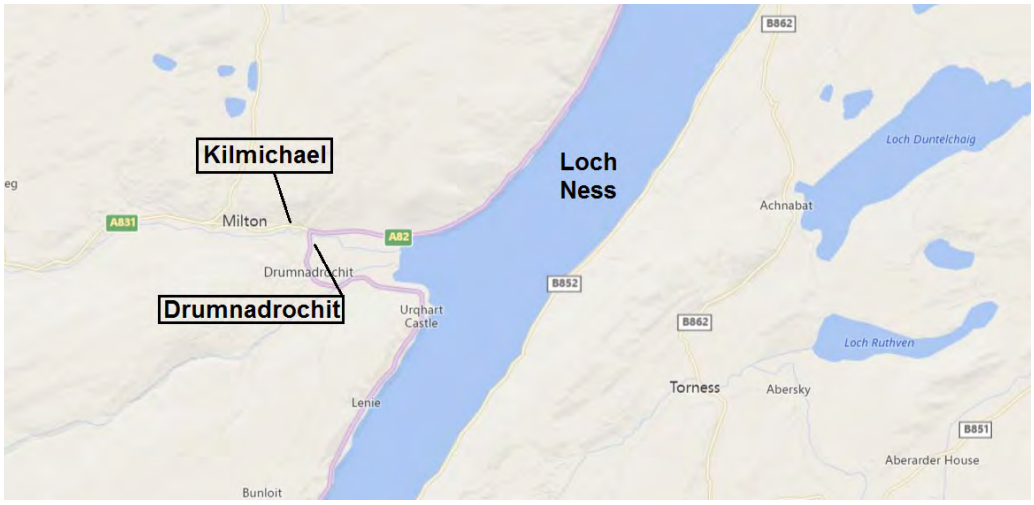

Figure 1-1 - Drumnadrochit and Kilmichael location plan

Figure 1-2 - Study area (in red)

Comment [MP1]: Add red line

1.3. LEGISLATIVE FRAMEWORK

1.3.1. The Flood Risk Management (Scotland) Act 2009provides THC with general power to manage flood risk in its area and to carry out flood protection work.

1.3.2. The Drumnadrochit FPS is being promoted under Part 4 of the Act.

1.3.3. The scheme forms part of SEPA's Flood Risk Management Strategy for Potentially Vulnerable Area 01/21 (Inverness and the Great Glen).

1.4. REPORT AIMS AND OBJECTIVES

1.4.1. The aim of this report is to describe the development of the scheme origins and to provide a description of the extent and scale of the FPS. This report will also assess the impact of the scheme on the local residents and to the surrounding environment.

This report is intended to:

- Support the notification and confirmation of the FPS as per the Flood Risk Management (Scotland) Act 2009, Schedule 2
- Support the promotion of the Drumnadrochit FPS to Scottish Ministers in the event of Ministerial call-in as per Flood Risk Management (Scotland) Act 2009, Schedule 2.

1.5. PREVIOUS WORK

1.5.1. A number of previous reports exist concerning flood risk at Drumnadrochit. Reports that were considered as part of this work are listed below in Table 1-1.

Table 1-1 – Previous Studies

Title, Author and Date	Description
SAFER – Flood Risk Assessment and Survey of the River Enrick (Jacobs May 2006)	Report produced for Forestry Commission / Highland Council
Drumnadrochit Flood Appraisal Report (JBA Consulting, May 2016)	Initial flood appraisal carried out for The Highland Council that forms the basis of the options brought forward.
Drumnadrochit Flood Protection – Geomorphological Appraisal (JBA Consulting, May 2016)	Assessment of geomorphological impacts of the proposals

2. FLOODING ISSUES

2.1. FLOODING BACKGROUND

2.1.1. Drumnadrochit has a long history of flooding, with events being recorded as far back as 1818. Some of the known results are summarised in Table 2-1 below.

Table 2-1 – River Enrick Flooding History

Date of Flood	Source	Comment
1818	SEPA	River Enrick in Glen Urquhart flooded in 1818 destroying three bridges
1829	SEPA and SAFER	Similar in magnitude to 1818 flood. Torrential rain caused the River Enrick to threaten the churchyard of Glen Urquhart. Bank on north side of Drumnadrochit Bridge torn away.
1892	SEPA	A flood in 1892 destroyed five bridges on the River Enrick.
26th January 1892	SAFER	3 foot of snow fell followed 3 weeks later by heavy thaw and rain. In Strathglass 7 of 5 bridges swept away.
28th March 1908	SAFER	Highest flood for many years
17th January 1909	SAFER	Heavy rain caused a great deal of damage to roads, banks and houses in Drumnadrochit
1910, 1913, 1920	SEPA	Flood on the River Enrick
15th January 1932	Inverness Courier	Overflowed at Drumnadrochit Bridge flooded houses by the roadside - "unprecedented"
3rd November 1932	Inverness Courier	Flooding of flat land from Oakland to Drumnadrochit. Houses flooded at Drumnadrochit with long stretches of road impassable
16th February 1950	Inverness courier	Drumnadrochit/Lewiston - houses threatened
1950's	SEPA	Four bridges were lost in the 1950s
1956	SEPA	Flood on the River Enrick
February 1989	SAFER	Drumnadrochit/Lewiston - houses threatened
4th February 1990	SAFER	Members of local community noted that flooding occurred at various locations throughout Glen Urquhart and particularly severe around Kilmichael and Drumnadrochit. Considerable damage to property occurred, flood banks were breached, fields were scoured
17th January 1993	THC	Photographs show roads flooded and impassable.
1st March 1997	THC	A member of the local community recalls water reaching alarming levels inside Glen Guest House rising to approx. 2ft. Other members of local community noted flood waters reaching to a height of 2ft at back of Post Office.
13th August 1997	THC	Flash flood following heavy overnight rain. Garden to rear of Mingulay eroded by force of water. Garden shed lost. Approximately 3.5 metres of garden left between house and straight vertical face of 2.1m forming river bank.
24th December 1999	SAFER	Limited details
1st June 2000	SAFER	Limited details
1st December 2006	THC	A831 Road flooded with a flood level of around 32.75 mAOD.

4th July 2007	THC	Flooding from River Enrick on road and garden of property

2.2. FLOOD IMPACTS

2.2.1. Flooding from the Enrick reached properties in Drumnadrochit during the 1980s, 1997, and 2016, causing serious damage and risk to properties and infrastructure.

2.2.2. The March 1997 flood is estimated to have a 25 year return period. Images captured by SEPA indicate the path and extent of the flood that affected a number of properties, including the Post Office, Police Station and (anecdotally) the Fire Station.

Upstream of A82 Bridge showing flooding pattern in field.

Upstream of A82 Bridge showing flooding pattern in field.

Fiddlers Cafe and public car park

Flooding to Post Office

Upstream of A82 Bridge

Flooding to rear of Post Office.

Figure 2-1 – 1997 flood event images supplied by SEPA.

2.2.3. Kilmichael was also reported to be affected by flooding in 2010, 2013, 2015 and 2016. The reported extent of flooding did not appear to reach occupied properties, however there was hazard and disruption to the A831 which is deemed nuisance flooding.

2.2.4. Images of the 2016 event are shown in Figure 2-2 below.

Figure 2-2 - Flooding at Kilmichael, 2016[1]

2.3. CURRENT FLOOD MANAGEMENT MEASURES

2.3.1. At present flood management is restricted to intermittent dredging within the River Enrick to reduce river bed levels and remove accumulated deposits of gravel and small boulders. The Highland Council carried out dredging works in 2016, removing 1450m^3 of material to reduce flooding frequency to the A831.

2.3.2. Such dredging is known to have been undertaken historically, although the locations, dates and quantities are unknown.

2.3.3. It appears that recurrence of the nuisance flooding has reduced since the works were carried out, however they are not proposed as a sustainable solution to the problem.

[1] Glenurquhart Community Council facebook page

Figure 2-3 - Dredging Works to River Enrick, 2016

2.4. FLOOD IMPACTS FOR DO-NOTHING SCENARIO

2.4.1. Detailed flood modelling exercises have been carried out by JBA, supplemented by WSP, with calibration against the known flood extents described in Section 2.2 above. This has allowed an assessment of the properties potentially at risk for a range of return periods, and these are summarised in Table 2-2 below.

Table 2-2 – Properties at risk in "do nothing" scenario.

Return Period (years)	2	10	25	50	100	200
Properties at risk	0	0	9	26	29	31

2.4.2. An image of the most extreme flood event analysed, for the 200 year return period event with climate change allowance, is shown in Figure 2-4 overleaf.

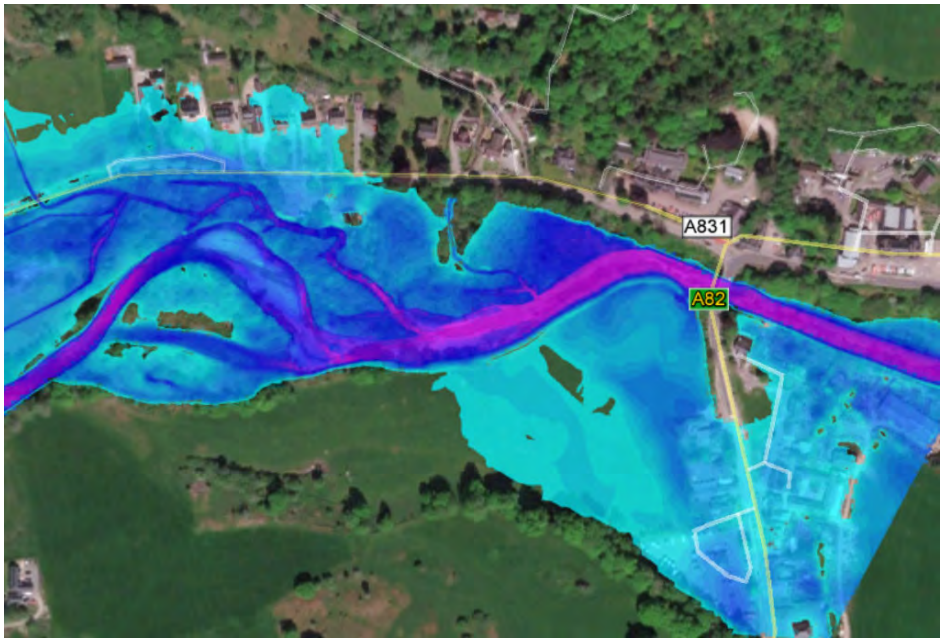

Figure 2-4 - Predicted flood extents for 200 year return period

2.5. FLOOD SOURCES AND MECHANISMS

2.5.1. Fluvial

The main source of fluvial flooding to Drumnadrochit is from the River Enrick, and this forms the bilk of the hydrological modelling works .

Frequent flooding also occurs at Kilmichael over the A831 that is contributed to by nearby small watercourses and these are included in the extended model.

2.5.2. Groundwater

The soils and geology at Drumnadrochit are such that shallow groundwater flooding may occur in the low lying fields to the east of the A82. There is a minor risk that this may be exacerbated by the presence of a flood embankment, due to the increase in head at the protected face of the embankment. This shall taken into account in the design, and geotechnical studies and the production of a geotechnical report will simulate the effects of the embankment on groundwater flow in the area. This report also describes any other groundwater flood mitigation steps that are to be taken.

2.5.3. Drainage systems

There is considered a risk of flooding to properties due to back flow of drains during high river events that coincide with high rainfall on the site. The study shall consider installing flap-valves at surface water drainage outfalls to the River Enrick.. This means that no flow would be allowed through the pipes during such times, therefore surface water flow paths are to be determined. This analysis shall be undertaken by WSP through the use of InfoWorks Integrated Catchment Modelling (ICM) software, which is an accepted tool for modelling the integration of drainage systems with river systems.

2.6. GEOMORPHOLOGICAL CONSIDERATIONS

2.6.1. The River Enrick is geomorphologically active in this area, mostly because of the nature of the geology and soils in the area, and also due to high velocities during peak storm events. This has led to transportation of gravels and boulders downstream that deposit in the lower meanders of the river within the study area.

2.6.2. Natural Flood Management (NFM) techniques involve holding back water in upper catchments in natural floodplains to control flows in the downstream event. These have been the subject of several studies.

2.6.3. The act of channelling the river through floodwalls may lead to a nincrease in velocities during peak events. These shall be assessed, particularly in the area of the A82 road bridge, to determine if additional erisn protection is required.

2.7. CLIMATE CHANGE

There are many potential impacts of the climate changes underway as identified by the Intergovernmental Panel on Climate Change (IPCC) which include:

- Rising temperatures.
- Rising sea levels.
- An increase in storm severity as rainfall events are more concentrated.
- An increase in flooding risk due to alterations to catchment characteristics.

In order to allow for such changes at this location, an additional 20% flow has been added to peak runoffs in accordance with current guidance.

2.8. POST-SCHEME FLOOD RISK

Following assessment of the flood risk, a number of measures were examined to reduce flood risk to properties and infrastructure. These included:

- An earthworks flood embankment along the southern bank of the Enrick upstream of the A82 to protect properties to the west of the A82.

- An alternative earthworks flood embankment set back from the southern bank of the Enrick upstream of the A82.
- A solid protection wall downstream of the A82 on the southern bank of the Enrick to protect properties to the east of the A82.
- A solid/earthwork wall on the north bank of the Enrick to reduce carriageway flooding on the A831.
- Natural Flood Management mitigation measures consisting of excavation/dredging of historical channels in the upstream meanders of the Enrick.
- Installation of valves to drainage to prevent back flooding through pipework.

The selected scheme is further described in Section 4. Following installation of the scheme the aims of the project shall be achieved, namely:

- Protection of properties for events up to a 200 year return period (with climate change allowance)
- Reduction of nuisance flooding to the A831 for events up to a 10 year return period.

3. HYDROLOGICAL/HYDRAULIC MODELLING AND ANALYSIS

The following chapter describes the hydraulic modelling method adopted by CBEC as part of this study, and how information from these models was derived and interpreted.

3.1. DESIGN FLOOD ESTIMATION

3.1.1. Statistical Method for the River Enrick

Flood Estimation Handbook version 13 (FEH13) parameters were used in the analysis, in accordance with national guidelines. The method of flood estimation used was also based upon national guidelines, with the Statistical Method of flow estimation being used for the main component of flow, i.e. the River Enrick, and the Revitalised Flood Hydrograph 2 (ReFH2) method used for the smaller catchments that contributed to flooding on the A82 by Kilmichael.

JBA Consulting's 2016 report was consulted during this analysis. This study used the single-site analysis method to predict extreme flows in the River Enrick, whereas the CBEC analysis looked at the pooling-group method. Other deviations from JBA's approach related to the FEH parameters used – JBA used 1999 FEH parameters, whereas this approach used FEH 2013 parameters. AMAX series were also updated to 2013 as part of CBEC's approach.

Design flows using the Statistical Method are shown in Table 3-1**Error! Reference source not found.** below, and a hydrograph showing the variation in flow over time for the 200 year event is shown I n overleaf.

Table 3-1 - River Enrick Design flows used in the analysis

Return Period (years)	Flows (m^3/s)
2	63.03
5	84.44
10	99.57
30	125.55
50	139.02
100	159.13
200	181.69
200+ cc	218.03
1000	245.61

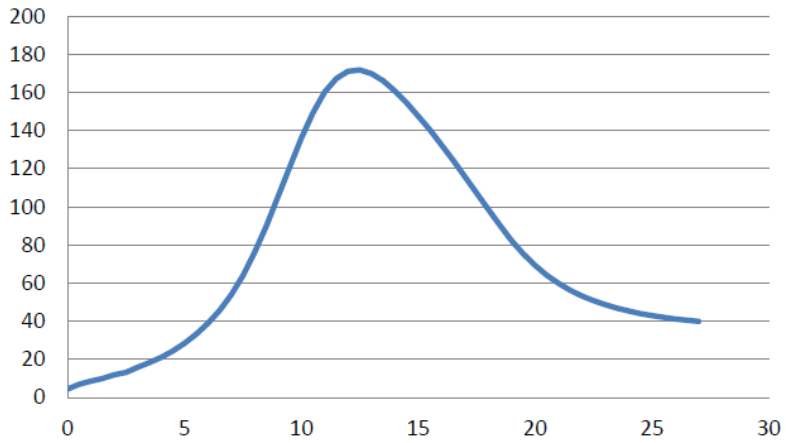

Figure 3-1 - Hydrograph for 200 year event for River Enrick

3.1.2. ReFH2 Method for Kilmichael area

The ReFH2 method was used to estimate design flows for the watercourses in the Kilmichael area, i.e. the Culnakirk and Balchraggan Burns. These are summarised in Table 3-2 below.

Table 3-2 - Derived flows for the Culnakirk and Balchraggan Burns

	Flows (m^3/s)	
Return Period (years)	**Culnakirk Burn**	**Balchraggan Burn**
2	0.85	0.94
5	1.35	1.50
10	1.73	1.92
30	2.36	2.62
50	2.67	2.97
100	3.11	3.46
200	3.57	3.97
200+ cc	4.29	4.76
1000	4.73	5.25

3.2. HYDRAULIC MODELLING

3.2.1. General

The hydraulic modelling component of the work was carried out by CBEC using SRH software. This complements and adds to the work carried out by JBA previously that forms the basis of the scheme, and also is more suited to assessment of Natural Flood Management techniques. It was, however, necessary to make some updates to the JBA methodology based on the time elapsed since the last study and changes to practice and available data sets. The changes are described below.

3.2.2. Topographical Survey

A topographic survey was conducted to collect cross-sectional and detailed grid data at specified locations of the River Enrick within the design area. The survey extended to 1.3 km of the River Enrick (upstream extent: NH 49833 30113, downstream extent: NH 50997 30040).

Surveying was undertaken with Leica RTK GPS (Leica GS14 and GS08) and Leica GS14 base-station equipment to survey the required reach. A Trimble S6 'robotic' optical ('total station') instrument was used to collect data where GPS signal was unavailable. The Trimble S6 was also used to collect reflector-less points where additional information around the A82 road bridge was obtained. All points were surveyed in the OSGB36 datum coordinate system.

The survey was conducted in such a way that allowed characterization of the physical form/ hydraulic function of all bedforms, while avoiding superfluous detail that would add to cost. All channel structures (e.g. bridges, culverts and embankments, etc.) were captured in sufficient detail as required.

The surveys representatively characterised variation in the horizontal (i.e. channel planform) and vertical (i.e. relative topographic highs, bars, riffle crests/ hydraulic controls, and lows, pool centres).

Cross sections were extended to a maximum of 30 m from 'top of bank' to allow for tie in with existing LiDAR data. Within the middle section of the reach (~NH 50409 30188) a complex bar feature and several small channels exist. Data was collected from this area in a non-uniform gridded format (i.e. not cross-section based), allowing for greater point density around areas of highest elevation variability. Such a 'point scatter' approach is essential to capture the salient aspects of morphology in more complex topographic areas (e.g. at complex alluvial bar features and other hydraulic structures).

The topographic survey was carried out by CBEC survey staff in January and February 2016. Data processing was then conducted using AutoCAD Civil 3D 2016, in which a detailed 3D triangulated and breaklined digital elevation surface was built. The floodplains in the surface were further extended by LiDAR data. The surface was meshed for hydraulic computations using Aquavaeo SMS 11.1.

3.2.3. Structures

The A82 bridge is a large structure spanning the Enrick in Drumnadrochit village itself. Flows do not reach the bridge soffit, and so, to model this bridge and the transfer of momentum through it accurately, the bridge was modelled fully in 2D. This required that the bridge deck be 'daylighted' using Computer Aided Design (CAD). The bridge was therefore represented by the surveyed channel bed through the bridge and the bridge abutments on each bank. The bridge is shown in Figure 2.4. The model results were carefully compared with the JBA model, where this bridge was represented by a 1D unit, and no significant differences were found in water levels upstream of the bridge.

Figure 3-2 - A82 Bridge

Two minor tributaries, the Culnakirk Burn and the Allt Tarbh/Balchraggan burn enter the Enrick through culverts through the A831. There is also a culvert/drain through the embankment at Aldergrove. Each of these culverts were surveyed and opened in the 2D model. The Culnakirk Burn and the Allt Tarbh only account for 2% and 2.2% of the total Enrick flow respectively at the 1:200/year flow peak and so the functional floodplain is not significantly affected by the choice to model these by daylighted flow routes. The daylighted culvert through the embankment at Aldergrove carries around 2.4% the total Enrick and floodplain flow at the 1:10/year flow peak and so while the culvert is necessary for an accurate representation of floodplain flow routes (see the Calibration section), it accounts for only a small amount of the total flow and so representing the culvert by a daylighted notch does not compromise overall model accuracy.

In addition to these topographic adjustments, the entire LiDAR surface was adjusted in AutoCAD Civil 3D to accurately represent properties by their surveyed finished floor level.

This approach was considered acceptable by SEPA .

3.3. MODEL BOUNDARIES

3.3.1. The model was set up so that it contained the entire functional floodplain for the 1:200/year +20% climate change allowance event. Therefore, there were no 'glass walls' in the model and water could run off both the floodplain and channel at the downstream end.

3.3.2. The water surface elevation (either as a function of time, or of discharge) must be supplied at the downstream end of any 1D or 2D hydraulic model. Typically, when the downstream water elevation is not known a normal depth assumption is used, where water elevation is computed as a function of discharge using bed slope, bed friction, bed cross sectional area and hydraulic radius. If there is any downstream backwater effect, then the actual water surface elevation may be higher than normal depth. To take account of downstream backwater effects, and to be conservative in terms of flood risk, CBEC used a different, more accurate, approach.

3.3.3. Two other larger models were available for the study that contained estimates of water surface elevation at the downstream end of the 2D model. These two models were the SEPA commissioned flood model, which extended approximately 2km downstream of CBEC model boundary, and the recent JBA 1D/2D flood model, which extended 680m beyond the CBEC model boundary. The SEPA model has the advantage that its downstream boundary is Loch Ness, with a relatively constant, well known elevation. The JBA downstream boundary was itself normal depth, but this model is relatively detailed and calibrated against flood photos.

Figure 3-3 shows each model domain. The CBEC 2D model is a black polygon, with the downstream boundary at the right. The JBA normal depth boundary is at the right of the red 200yr flood outline, and is 680m downstream of the CBEC model boundary. The SEPA flood model boundary is 2km downstream. The water elevation and discharge through CBEC model boundary line was extracted from both of these larger models, and a best-fit rating curve extracted, which was supplied as the downstream rating for the 2D model. This rating is included in the figure.

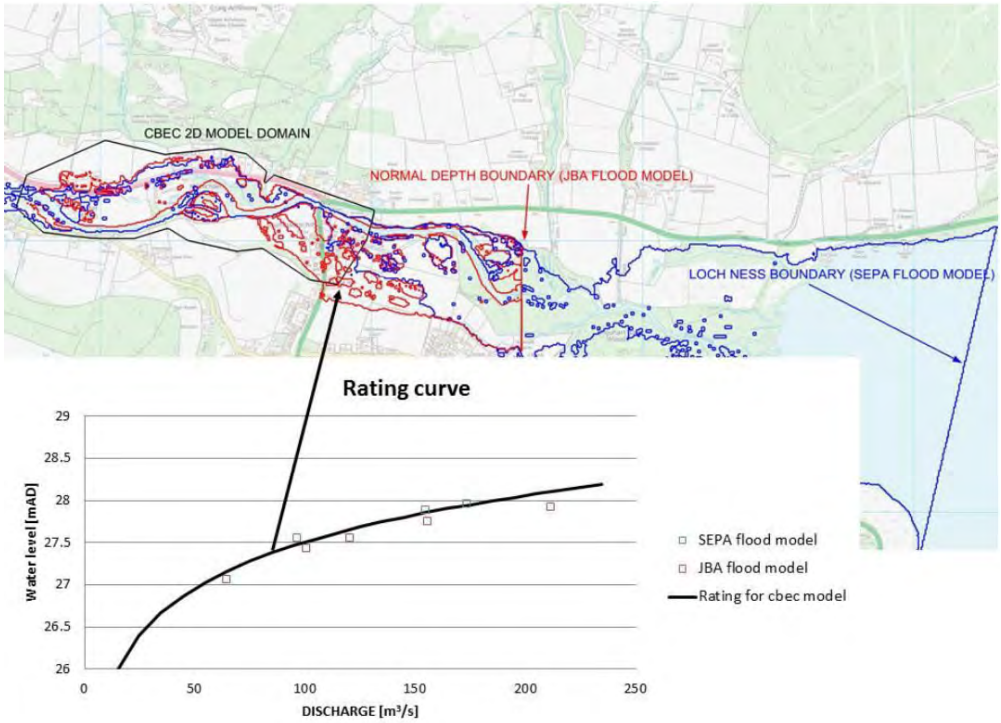

Figure 3-3 - Model boundaries and rating curve

4. DEVELOPMENT OF THE SCHEME

4.1. STANDARD OF FLOOD PROTECTION OBJECTIVE

4.1.1. The FPS is designed to protect existing properties to a 0.5% Annual Exceedance Probability (200-year return period) with climate change allowance.

4.1.2. The FPS is also designed to reduce the frequency of flooding on the A831 to events exceeding a 10% AEP (10-year return period).

4.2. KEY SCHEME OBJECTIVES

4.2.1. The first element of the flood protection scheme is intended to protect properties within the village of Drumnadrochit. The area at risk of flooding from the River Enrick has been identified by flood modelling. A direct defence is proposed to provide a 1 in 200 year level of protection including climate change. Two options for the line of the defence have been identified in the Flood Appraisal Report by JBA. The proposals will also have to address local drainage issues.

4.2.2. The second element of the flood protection scheme is intended to protect the A831 Drumnadrochit to Cannich road in the locality of Kilmichael. The road is currently susceptible to regular flooding, primarily from the adjacent River Enrick. This element of the scheme comprises up to two lengths of new roadside defence in order to provide a 1 in 10 year level of protection from the River Enrick. The proposals will also have to address local drainage issues, in particular the possibility that flooding may arise due to runoff from land to the north of the road. An initial line and crest level of the defence has already been proposed following a Flood Appraisal Report by JBA.

4.2.3. A Natural Flood Management Study is proposed to look at the Natural Flood Management options for the full catchment of the River Enrick. The need for the study has been identified in SEPA's national flood risk management strategy and the study will be undertaken under the framework of the Flood Risk Management Act. The study is intended to coordinate and complement the proposed flood scheme and has the objective of reducing flood risk in Drumnadrochit. The study shall take into account, and build upon, the previous studies.

4.3. GEOTECHNICAL REVIEW

Comment [MP2]: GDR due Monday am

4.4. EROSION

Comment [MP3]: PDM to add in erosion protection data and image

4.5. NATURAL FLOOD MANAGEMENT

Comment [MP4]: PDM to add in why NFM discounted

5. SOCIAL AND ENVIRONMENTAL IMPACT

5.1. ENVIRONMENTAL IMPACT ASSESSMENT

5.1.1. A Screening Opinion from the planning authority confirmed that an Environmental Impact Assessment would not be required.

Although an Environmental Impact Assessment is not required, the potential environmental impacts mentioned in the opinion have been considered in developing the scheme. The screening opinion called, mainly, for the following environmental aspects to be considered:

• Characteristics of the development. This included items such as physical size, cumulation with other development, use of natural resources, production of waste, pollution and nuisances, risk of accidents with impacts on people or environment and other impacts.

• Location of the development and including items such as existing land use, status of natural resources in the area and absorption capacity of the natural environment,

• Significance of environmental effects. The main considerations are; extent of impact, probability of impact, duration, frequency and reversibility of impact and magnitude and complexity of the impacts.

Pre-design surveys were done to establish baselines and this work is described below.

5.1.2. Ecological Survey

A Phase 1 habitat survey was carried out by an experienced ecologist in WSP, and a number of potential ecological constraints were identified.

- **Bats:** All of the flood protection locations that require the felling of trees will also require dedicated tree assessments in search of potential roosting opportunities for bats. Some items are already identified to be retained if possible. The bat habitat suitability assessment of trees can be undertaken at any time of year and involves a ground-based inspection in search of features with the potential to support roosting bats.
- **Nesting Birds:** It is recommended that any vegetation removal/tree felling works are undertaken outwith the nesting bird season (recognised as March to August inclusive
- **Badgers:** It will be necessary to undertake a dedicated badger survey, as the presence of active badger setts, west of the main embankment, indicates that a clan is active in the area.
- **Otters:** The River Enrick provides good habitat to support otter and evidence of otter was recorded along the southern bank of the river during the survey effort comprising a holt, sprainting activity and further potential resting spots identified. Given the presence of otter activity/evidence upstream, this has implications for the Drumnadrochit defence wall, given the potentially disruptive method of works proposed (rock armour) to the southern bank. It is recommended that a dedicated otter survey along the river be undertaken to ascertain the extent of otter activity along the water channel.

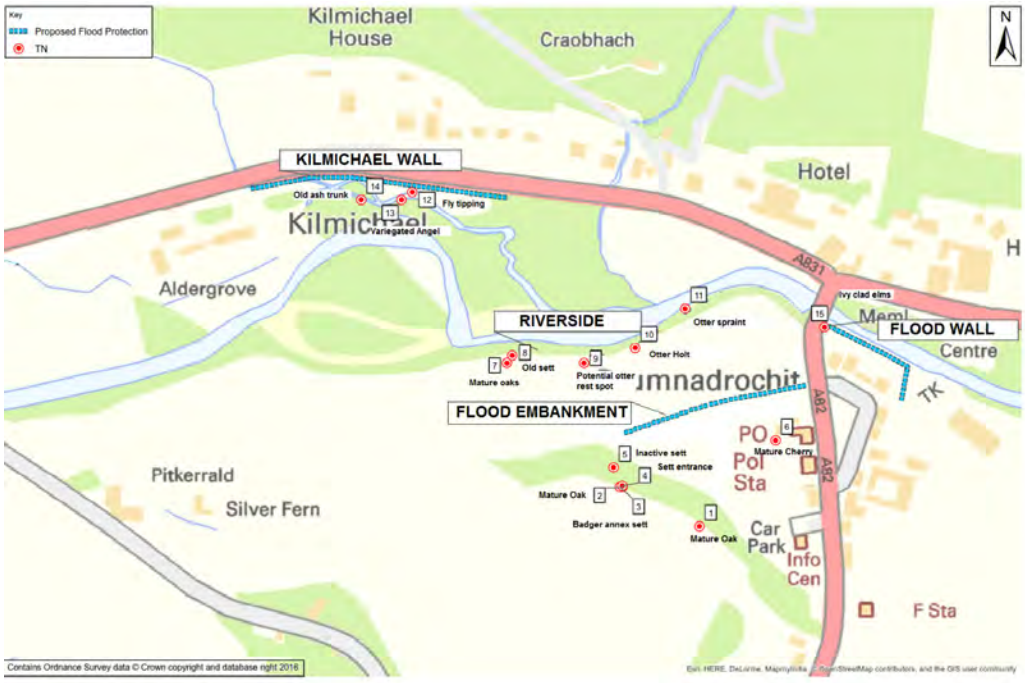

Figure 5-1 - 2016 Ecological Survey noted items

5.1.3. Tree Survey

Comment [MP5]: Add reference to tree clearance plan in Appendix

Comment [MP6]: Add in SAS text

5.2. PUBLIC CONSULTATION

5.2.1. A public consultation meeting was held at Glen Urquhart High School, Drumnadrochit, on Wednesday 16th December 2015 attended by THC that presented the work carried by JBA at that stage. The meeting was advertised by posters. No specific feedback was received that altered the direction of the study.

5.2.2. Once the scheme was further advanced a further Public Meeting was held 8th November 2017 at the same venue. Three members of the public submitted comment forms, all of which were supportive of the proposals.

5.2.3. Following the second public consultation, a short presentation was made to the Glen Urquhart Community Council Meeting on 23rd October 2017.

5.3. STATUTORY CONSULTATION

5.3.1. EIA Screening Opinion

A screening opinion was requested to establish the scope or need for an Environmental Impact Assessment (EIA). It was concluded that no EIA was required in this instance. Responses from statutory consultees are summarised below.

5.3.2. SEPA

SEPA gave detailed comments on the Screening Opinion Plan (29th January 2017), that covered the form and extent of additional information that may be required to close consultations. Key highlights are as follows:

- Further details to be provided on site layout, flood risk, (including freeboard allowances, residual risk, and wider impacts), structural design, (including overtopping considerations)
- Impacts on the water environment – a stated preference for setback embankments where possible, or assessment of impact where not possible due to land availability.
- Mitigations for pollution prevention and environmental management
- Details of borrow pits if required

5.3.3. RSPB

The RSPB gave the following general comments on the Screening Opinion Plan (30th January 2017)

- Preference for set back earthwork embankment option rather than river edge
- Possible provision of shallow scrapes to create suitable feeding areas for young wading birds.
- sharp faced earth banks would also provide nesting sites for sand martin and kingfisher.
- any trees felled along the river bank with natural cavities in them could be left to provide nesting habitat for tree nesting ducks, alternatively provision of nest boxes is provided.
- If extensive tree removal is undertaken then artificial otter Holts should be considered
- cold searching to be carried out before clear felling or thinning operations to avoid any nest sites of protected species are avoided, with felling operations outside of the main bird breeding season.
- Consideration of other protected species including red squirrel, salmon, sea trout, freshwater mussels, and black grouse.

5.3.4. Transport Scotland

The A82 is a trunk road owned by Transport Scotland. WSP met with BEAR Scotland, the network operators of the A82 on behalf of Transport Scotland. They raised no major objection to the scheme, and requested additional information on the following points:

- Clarification of velocities to the upstream face of the A82 embankment
- Assessment of impacts on the drainage from the A82, as this was perceived a s potential source of historical flooding
- Noted that HGV access points may lie in the 30mph zone of the A82.

- Noted that there is increased traffic in the holiday period which time should be avoided if possible.

5.4. STATUTORY CONSENT

5.4.1. CAR License

Proposed engineering works within the water environment will require authorisation under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended). Management of surplus peat or soils may require an exemption under The Waste Management Licensing (Scotland) Regulations 2011. Proposed crushing or screening will require a permit under The Pollution Prevention and Control (Scotland) Regulations 2012.

5.4.2. Waste Management Licence

A waste management licence is normally required for movement and disposal of waste material including excess soils from construction sites under the Waste Management Licencing (Scotland)

Regulations 2011. SEPA has adopted a regulatory position where it will not require a licence or exemption for the reuse of greenfield soils within the site boundary under their guidance 'Promoting the sustainable reuse of Greenfield soils in construction'.

In this instance it shall be necessary to import fill materials to form embankments, and it is expected that all stripped topsoil shall be replaced on completion of the filling works. There may, however, be a surplus of materials from the excavation for the rock armour works.

5.5. SOCIAL BENEFITS

On completion of the scheme the following benefits shall be experienced:

- Reduced risk of flooding of property in Drumnadrochit
- Reduced risk of flooding to public services including the Police and Fire Station, car parks and telephone exchange.
- A more secure access route along the A82.
- Greater security of access along the A831.

6. SELECTED SCHEME DESCRIPTION

6.1. DRUMNADROCHIT FLOOD DEFENCE EMBANKMENT

6.1.1. Purpose

The purpose of this set of works is to form a primary defence to the properties at risk of flooding.

6.1.2. Description

OP-01 Construction of an earth embankment approximately 200m long, from the A82 adjacent to the existing bus stop across the field to the west. The embankment shall have maximum side slopes of 1:2.5, a 1m crest width at a level of 31.82m AOD that includes a freeboard of 600mm. The embankment shall be constructed at ground level at the western end to a maximum height of c2.6m above the existing ground level at the eastern end. Two grassed ramps of 4m width will provide landowner access across the embankment.

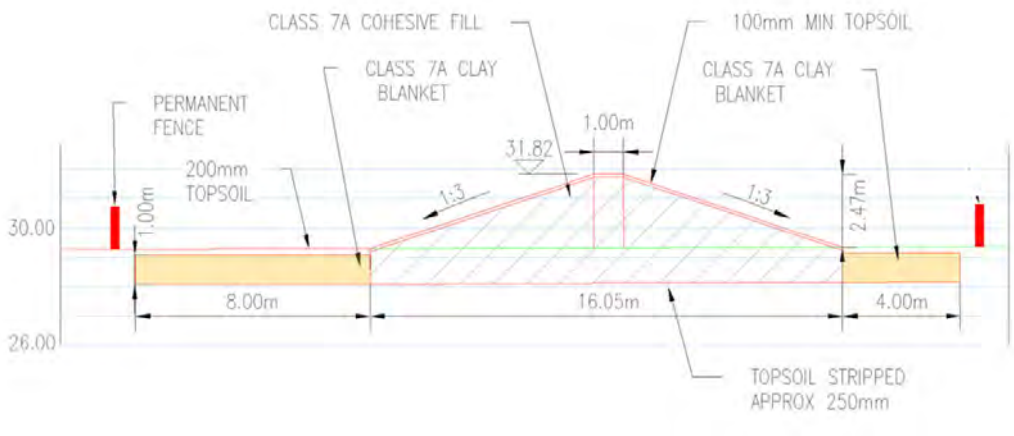

Figure 6-1 - Section through higher part of flood embankment

6.1.3. Construction Process

A possible construction sequence is outlined below. This sequence is illustrative only and does not pre-empt how a contractor might set-up and carry out the works.

- Temporary fencing to the perimeter of the site
- Construction of a temporary access track c4m wide from the car park to the south
- Diversion of the SSE 11kV power poles and transformer for safety reasons.

- Stripping of topsoil and storage at an appropriate location,
- Placement of clay and clay liner to form the embankment.
- Replacement and seeding of topsoil.
- Installation of fencing and gates to allow landowners access and maintenance access.

6.1.4. Maintenance and operation

- The embankment sides are set at a gradient to allow grass cutting or grazing by sheep.
- Gates/fences may require replacement approximately every 20 years

6.2. DRUMNADROCHIT FLOOD DEFENCE WALL

6.2.1. Purpose

The purpose of this set of works is to form a primary defence to the properties at risk of flooding.

6.2.2. Description

OP-02 Construction of a concrete wall between the A82 bridge over the River Enrick and Morlea. The flood wall will be 173m long, and shall be faced with a natural stone façade and concrete coping stones. The defence level shall be 30.04m above ordnance datum (mAOD) that includes a 600mm freeboard, and shall be constructed an average of 1.7m above the existing ground level. A rock armour erosion protection layer shall be placed on the southern bank of the river of 105m length or thereby, with a maximum rock size of 600mm. Existing surface water drains will pass under the flood defence wall, and these shall be closed with a non-return valve at the water's edge. Two outbuildings shall be removed and rebuilt after construction of the flood defence wall.

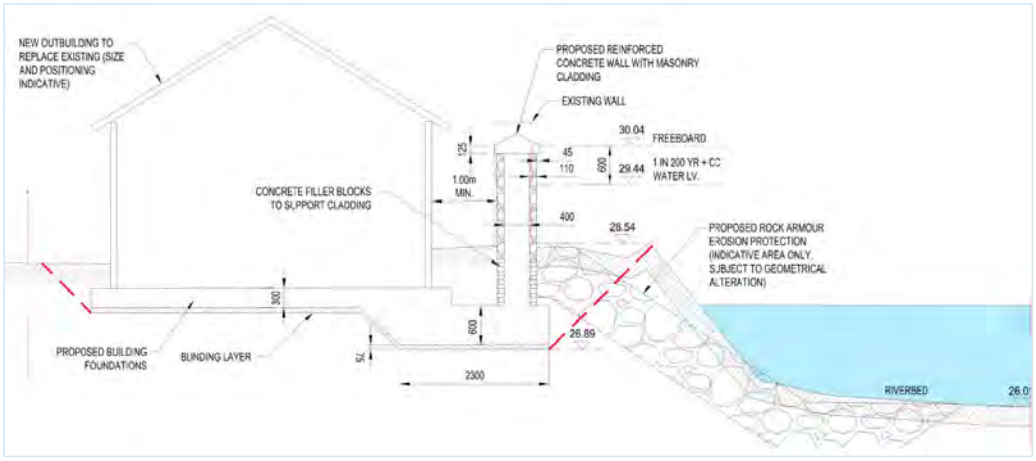

Figure 6-2 - Section through flood defence wall at outbuilding

6.2.3. Construction Process

- Construct temporary access route to the site
- Erect temporary fencing around the perimeter of the site.
- Site clearance of trees on the southern bank of the Enrick, grubbing up roots, and removal of two outbuildings and upper layers of bankside.
- Excavation to a firm bearing level and removal of unsuitable material.
- Placement of blinding concrete and erection of formwork.
- Installation of reinforcement steel cages and placement of concrete.
- Stripping of formwork.
- Backfilling of the wall with suitable material.
- Place facing stonework and coping stones.
- Place erosion protection stone and soil/seed.
- Re-erect boundary fencing.
- Remove temporary fencing and reinstate gardens.
- Install flap valves where required to prevent back flow of flood waters.
- Build two new outbuildings to the agreed specification.

6.2.4. Maintenance and operation

- The wall is constructed of reinforced concrete and stone façade that requires minimal maintenance.
- Inspection and occasional replacement of joint seals and pointing of stonework may be required every 10 years.
- Maintenance of outbuildings shall be the responsibility of the landowners.

6.3. KILMICHAEL WALL

6.3.1. Purpose

The purpose of this set of works is reduce the frequency of flooding to the A831 to a 10 year return period.

6.3.2. Description

OP-03 Construction of a concrete flood wall approximately 158m long between the Enrick and the southern verge of the A831. The wall will be on average 0.5m above the existing ground and will have a defence level of 33.00mAOD at its western extent running to 27.50mAOD at its eastern extent, that includes a freeboard of 300mm. The existing surface water outfalls shall have non-return valves fitted to reduce the risk of flooding during high river levels.

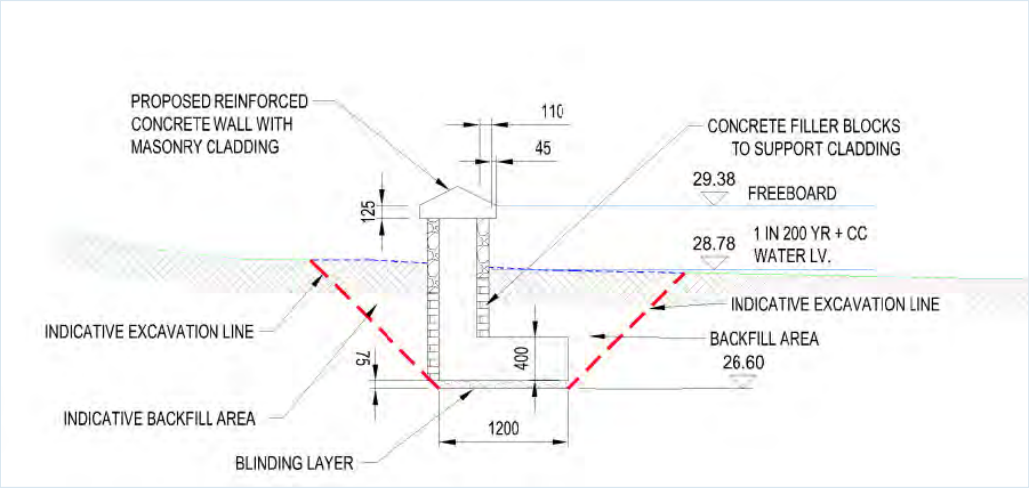

Figure 6-3 - Typical section through Kilmichael wall

6.3.3. Construction Process

- Erect temporary fencing around the southern perimeter of the site.
- Traffic management works as appropriate to each operation.
- Site clearance of trees on the southern side of the A831 and grubbing up roots
- Removal of topsoil from the wall base and the ditch to the south.
- Excavation to a firm bearing level and removal of unsuitable material.
- Infill of the ditch with suitable engineering fill.

- Placement of blinding concrete and erection of formwork, or placement of precast elements.
- Installation of reinforcement steel cages and placement of concrete if not precast.
- Backfilling of the wall with suitable material.
- Install flap valves where required to prevent back flow of flood waters.
- Remove temporary fencing, traffic management, and reinstate soil.

6.3.4. Maintenance and operation

- The wall is constructed of reinforced concrete requiring minimal maintenance.
- Occasional inspection of pipework shall be carried out by Scottish Water of the Highland Council as appropriate in line with normal duties.

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FLOOD RISK MANAGEMENT (SCOTLAND) ACT 2009

THE HIGHLAND COUNCIL

DRUMNADROCHIT FLOOD PROTECTION SCHEME 2019 DESCRIPTION

1. General

In exercise of the powers conferred upon them by the Flood Risk Management (Scotland) Act 2009 (hereinafter referred to as “the Act”) The Highland Council, established under the Local Government etc (Scotland) Act 1994 (hereinafter referred to as “the Council”) have prepared the following Flood Protection Scheme (hereinafter referred to as “the Scheme”) the purpose of which is to reduce the risk of flooding of residential and commercial properties within the village of Drumnadrochit near the west bank of Loch Ness arising from flows within the River Enrick.

The National Flood Risk Management Strategy was published by the Scottish Environmental Protection Agency in December 2015 and the Local Flood Risk Management Plan was published by the Council in April 2016. Both identify the need for the Scheme as a recommended measure to alleviate flooding in the Inverness and the Great Glen Potentially Vulnerable Area (PVA) 01/21 in the first Flood Risk Management Cycle from 2016 – 2022. The implementation of the Scheme will address that need.

2. Terms of the Scheme

The terms of the Scheme are as detailed in Sections 3 to 5 hereunder.

3. Description of the Operations

The Operations to be carried out in terms of the Scheme are as shown on the drawings marked, annexed and executed as relative hereto, and are as follows:

Drawing Number	Title	Revision
Scheme Plans		
2745-GA-001	Scheme Layout Plan	F
2745-GA-002	Drumnadrochit Flood Wall General Arrangement Sheet 1 of 2	P04
2745-GA-003	Drumnadrochit Flood Wall General Arrangement Sheet 2 of 2	P04
2745-GA-004	Drumnadrochit Flood Embankment General Arrangement	E
2745-GA-005	Kilmichael Wall Sections	E
2745-XS-001	Tree clearance plan (Sheet 1 of 2)	A
2745-XS-002	Tree clearance plan (Sheet 2 of 2)	A

Drumnadrochit Flood Defence Embankment

OP-01 Construction of an earth embankment 200m long, or thereby, from the A82 adjacent to the existing bus stop across the field to the west. The embankment shall have maximum side slopes of 1:2.5, a 1m crest width at a level of 31.82m Above Ordnance Datum (AOD) that includes a freeboard of 600mm. The embankment shall be constructed at ground level at the western end to a maximum height of 2.6m or thereby above the existing ground level at the eastern end. Two grassed ramps of 4m width or thereby, will provide landowner access across the embankment.

Drumnadrochit Flood Defence Wall

OP-02 Construction of a concrete wall between the A82 bridge over the River Enrick and Morlea. The flood wall will be 173m long, or thereby, and shall be faced with a natural stone façade and concrete coping stones. The defence level shall be 30.04m above ordnance datum (AOD) that includes a 600mm freeboard, and shall be constructed an average of 1.7m above the existing ground level, or thereby. A rock armour erosion protection layer shall be placed on the southern bank of the river of 105m length or thereby, with a rock size of 600mm or thereby. Existing surface water

drains will pass under the flood defence wall, and these shall be closed with a non-return valve at the water's edge. Two outbuildings shall be removed and rebuilt after construction of the flood defence wall.

Kilmichael Wall

OP-03 Construction of a concrete flood wall 158m long or thereby between the Enrick and the southern verge of the A831. The wall will be on average 0.5m above the existing ground with a maximum height of 900mm. It will have a defence level of 32.95m AOD at its western extent running to 32.70m AOD at its eastern extent, that includes a freeboard of 300mm. The existing surface water outfalls shall have non-return valves fitted to reduce the risk of flooding during high river levels

4. Land

The land which is affected by the operations and land where entry is required for the purposes of carrying out the operations are identified within the red boundary on the scheme plan 2745-GA-004.

5. Cost

The estimated cost for the Operations is £1,550,000 (February 2019), one million, five hundred and fifty thousand pounds sterling.

Made by The Highland Council on the ……. day of…….2019.

……Proper Officer of the Council