



GRUGGIES BURN FLOOD ALLEVIATION SCHEME

Options Report



IBE1560
Options Report
D03
5th August 2021

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
D01	Draft for review / comment	NB	SP	AJ	15/06/21
D02	Draft for review / comment	NB	SP	AJ	04/08/21
D03	Draft for review / comment	NB	SP	AJ	05/08/21

Approval for issue

Andrew Jackson

5 August 2021

© Copyright RPS Group Plc. All rights reserved.

The report has been prepared for the exclusive use of our client and unless otherwise agreed in writing by RPS Group Plc, any of its subsidiaries, or a related entity (collectively 'RPS'), no other party may use, make use of, or rely on the contents of this report. The report has been compiled using the resources agreed with the client and in accordance with the scope of work agreed with the client. No liability is accepted by RPS for any use of this report, other than the purpose for which it was prepared. The report does not account for any changes relating to the subject matter of the report, or any legislative or regulatory changes that have occurred since the report was produced and that may affect the report. RPS does not accept any responsibility or liability for loss whatsoever to any third party caused by, related to or arising out of any use or reliance on the report.

RPS accepts no responsibility for any documents or information supplied to RPS by others and no legal liability arising from the use by others of opinions or data contained in this report. It is expressly stated that no independent verification of any documents or information supplied by others has been made. RPS has used reasonable skill, care and diligence in compiling this report and no warranty is provided as to the report's accuracy. No part of this report may be copied or reproduced, by any means, without the prior written consent of RPS.

Prepared by:

RPS

Stephen Patterson
Senior Associate - Water Environment and Flood Risk
Management

Elmwood House
74 Boucher Road, Belfast
Co. Antrim BT12 6RZ

T +44 2890 667 914
E stephen.patterson@rpsgroup.com

Prepared for:

West Dunbartonshire Council

West Dunbartonshire Council
Clydebank Town Centre
16 Church Street

Dumbarton
Scotland
G82 QL

T
E

Contents

1	INTRODUCTION	5
1.1	Background	5
1.2	Purpose of this Report	5
2	OPTIONS IDENTIFIED	6
2.1	Long-list of Options	6
2.1.1	Option 1 – Do Minimum	6
2.1.2	Option 2 – Gruggies Burn Hard Defences	6
2.1.3	Option 3 – Flood Storage.....	6
2.1.4	Option 4 – Hard Defences and Flood Relief Culvert (Route 1)	7
2.1.5	Option 5 - Hard Defences and Flood Relief Culvert (Route 2)	8
2.2	Short-List of Options	9
2.2.1	Option 2 – Gruggies Burn Hard Defences	9
2.2.2	Option 4 – Hard Defences and Flood Relief Culvert (Route 1)	11
2.2.3	Option 5 – Hard Defences and Flood Relief Culvert (Route 2)	11
3	SELECTION OF PREFERRED OPTION.....	12
4	RECOMMENDATIONS AND CONCLUSIONS	13

Tables

Table 2-1	Defence Wall and Embankment Height and Length	10
Table 2-2	Dimensions of Bypass Culverts.....	11
Table 2-3	Defence Wall and Embankment Height and Length	11
Table 2-4	Dimensions of Bypass Culverts.....	11
Table 2-5	Dimensions of Bypass Culverts.....	11
Table 3-1:	Advantages and Disadvantages of Options	12

Figures

Figure 1-1	Location of Gruggies Burn with 0.5% AEP modelled fluvial flood extents.....	5
Figure 2-1	Hard defences for Option 2	6
Figure 2-2	Storage Locations for Option 3	7
Figure 2-3	Location of Option 4 Hard Defences and Flood Relief Culvert Route 1	8
Figure 2-4	Location of Option 5 Hard Defences and Flood Relief Culvert Route 2	9
Figure 2-5	Defence Wall Locations	10

LIST OF ACRONYMS

AEP – Annual Exceedance Probability

FAS – Flood Alleviation Scheme

SoP – Standard of Protection

WDC – West Dunbartonshire Council

1 INTRODUCTION

1.1 Background

The Gruggies Burn is one of the principle rivers which runs through the town of Dumbarton, West Dunbartonshire (Figure 1-1). It flows in a southerly direction from its source in the Kilpatrick Hills, through the steep surrounding catchment, towards its confluence with the Clyde Estuary. Despite the rural nature of this catchment, its steepness dictates that rainfall is often directed rapidly towards the burn. This results in a limited potential for water to infiltrate into the soil, resulting in fluvial flood events which are flashy in nature. At the downstream extent of the burn, this is made worse by the highly urbanised character of the surrounding area.

In addition to the inundation of assets as a result of fluvial sources, flooding due to coastal mechanisms, such as high tides, storm surges and wave-overtopping, also occurs along the downstream extent of the Gruggies Burn. Here, coastal mechanisms contribute towards the inundation of properties and infrastructure as far from the Clyde Estuary as Glasgow Road.

Whilst the impact of flooding from each of these mechanisms is severe, the further interaction of fluvial and coastal sources provides for a highly significant degree of flood risk within the town of Dumbarton. In order to mitigate the risk of coastal and fluvial flooding to the area surrounding the Gruggies Burn, West Dunbartonshire Council is developing the Gruggies Burn Flood Alleviation Scheme in preparation for submission to Scottish ministers.

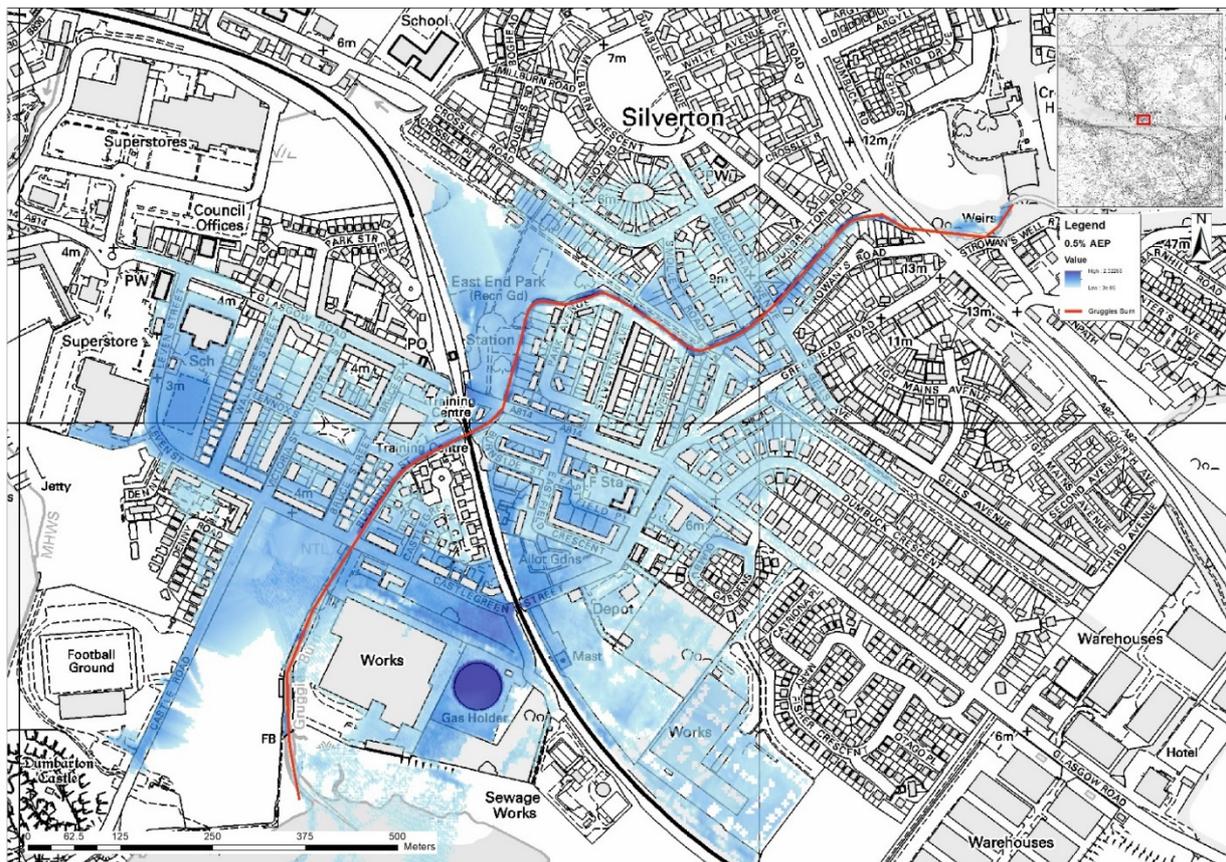


Figure 1-1 Location of Gruggies Burn with 0.5% AEP modelled fluvial flood extents

1.2 Purpose of this Report

In order to support the development of the Gruggies Burn Flood Alleviation Scheme, and its submission to Scottish Ministers, WDC have commissioned RPS to identify a preferred option which can be progressed through detailed design and construction. In order to fulfil this aim, RPS procured topographical survey information, undertook hydrological and hydraulic modelling analyses prior to completing an optioneering assessment. This report provides a summary of this assessment, including information on all of the options identified and justification of the selection of the preferred option.

2 OPTIONS IDENTIFIED

2.1 Long-list of Options

2.1.1 Option 1 – Do Minimum

This option involves maintaining the existing maintenance regime on the Gruggies Burn, with no changes to existing infrastructure. As this option did not meet the objectives of the study, it was not progressed to the short-list of options (Section 2.2).

2.1.2 Option 2 – Gruggies Burn Hard Defences

This option is designed to provide a 0.5% Annual Exceedance Probability (AEP) Standard of Protection (SoP) and involves the construction of flood walls along the Gruggies Burn, as shown in Figure 2-1, from Stirling Road to the Firth of Clyde. Where the burn crosses Alclutha Avenue, Glasgow Road and Castlegreen Street, bypass culverts would be installed at each location to prevent overspill onto the road network. The option also includes the construction of a coastal embankment south of the gas and sewage works at the Firth of Clyde. This option was considered to potentially provide a technically and economically viable scheme and was progressed to the short-list of options (Section 2.2)

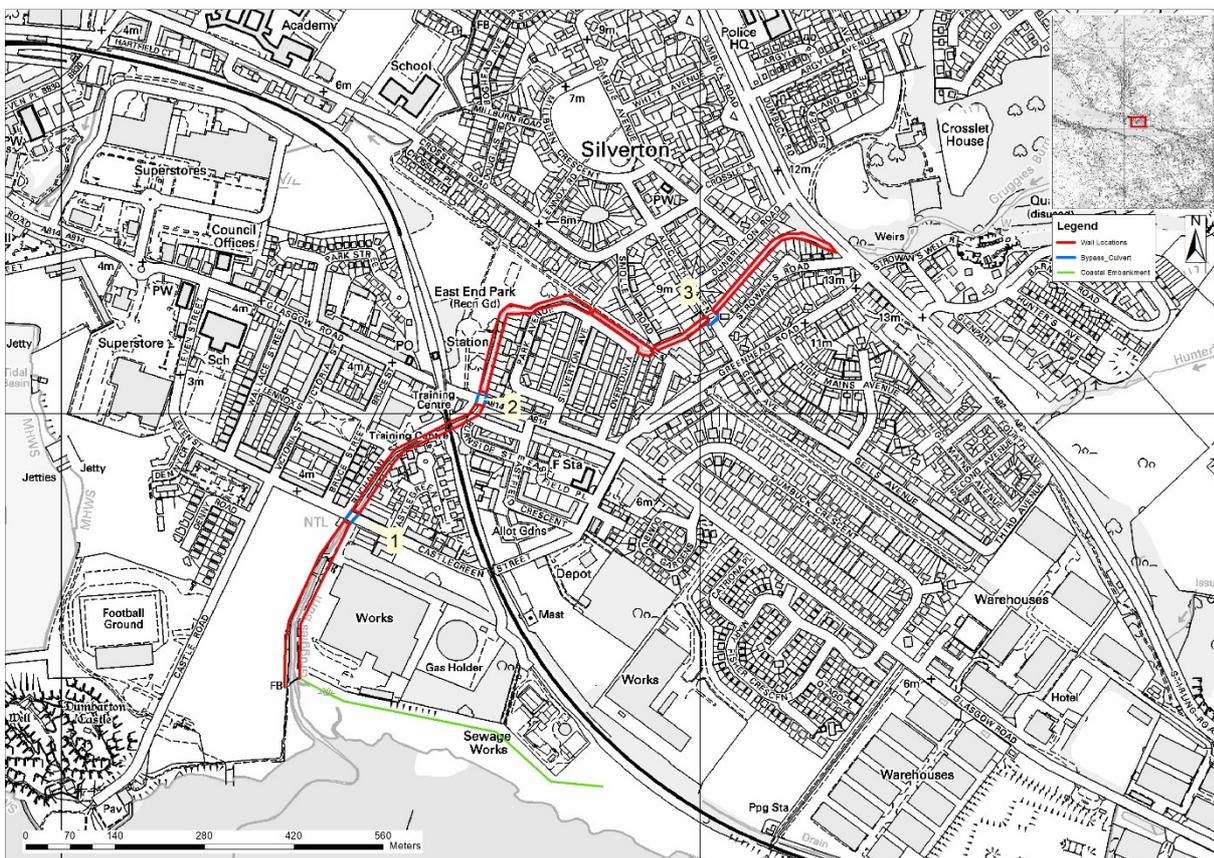


Figure 2-1 Hard defences for Option 2

2.1.3 Option 3 – Flood Storage

This option incorporates NTL in the upper catchment which would store flood water, and allow a controlled release of flow into the burn to achieve a 0.5% AEP SoP. The areas identified for storage are shown in Figure 2-2, and are located in the area near Overtoun House. Option 3 was screened out due to multiple reasons including the cost of constructing the large scale structures required to provide the storage, and the licensing requirements needed to be sought under the Reservoirs Act.

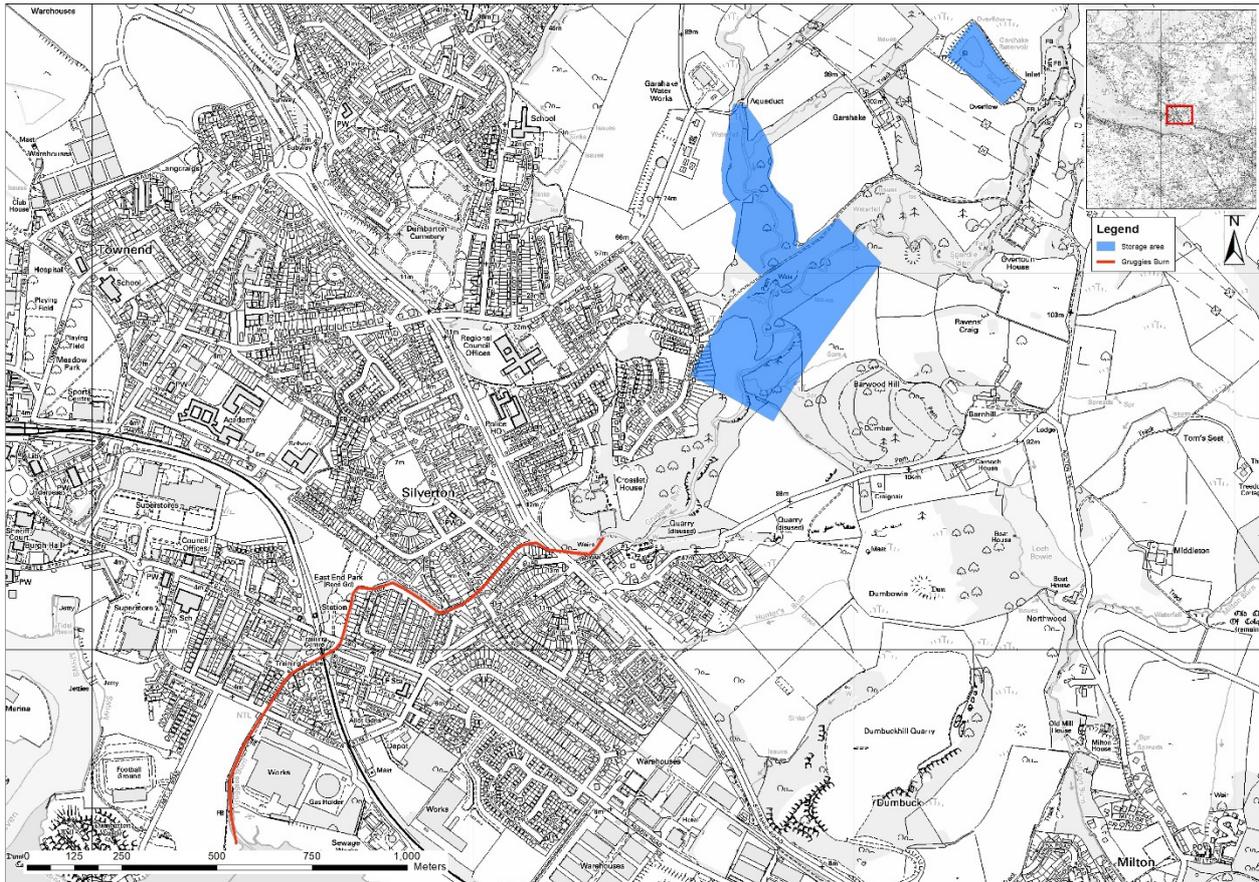


Figure 2-2 Storage Locations for Option 3

2.1.4 Option 4 – Hard Defences and Flood Relief Culvert (Route 1)

This option incorporates hard defences in the same locations as Option 2, from Glasgow Road to the Firth of Clyde. In contrast to Option 2, there are no hard defences upstream of Glasgow Road as these are replaced with a flood relief culvert (Figure 2-3). The culvert diversion route crosses Stirling Road to Greenhead Road continuing on Greenhead Road to the path south of Geils Avenue. The culvert follows this path east then south along Oaktree Gardens across Glasgow Road and then into the Clyde. This option is designed to provide a 0.5% AEP SoP. This option was considered to potentially provide a technically and economically viable scheme and was progressed to the short-list of options (Section 2.2).

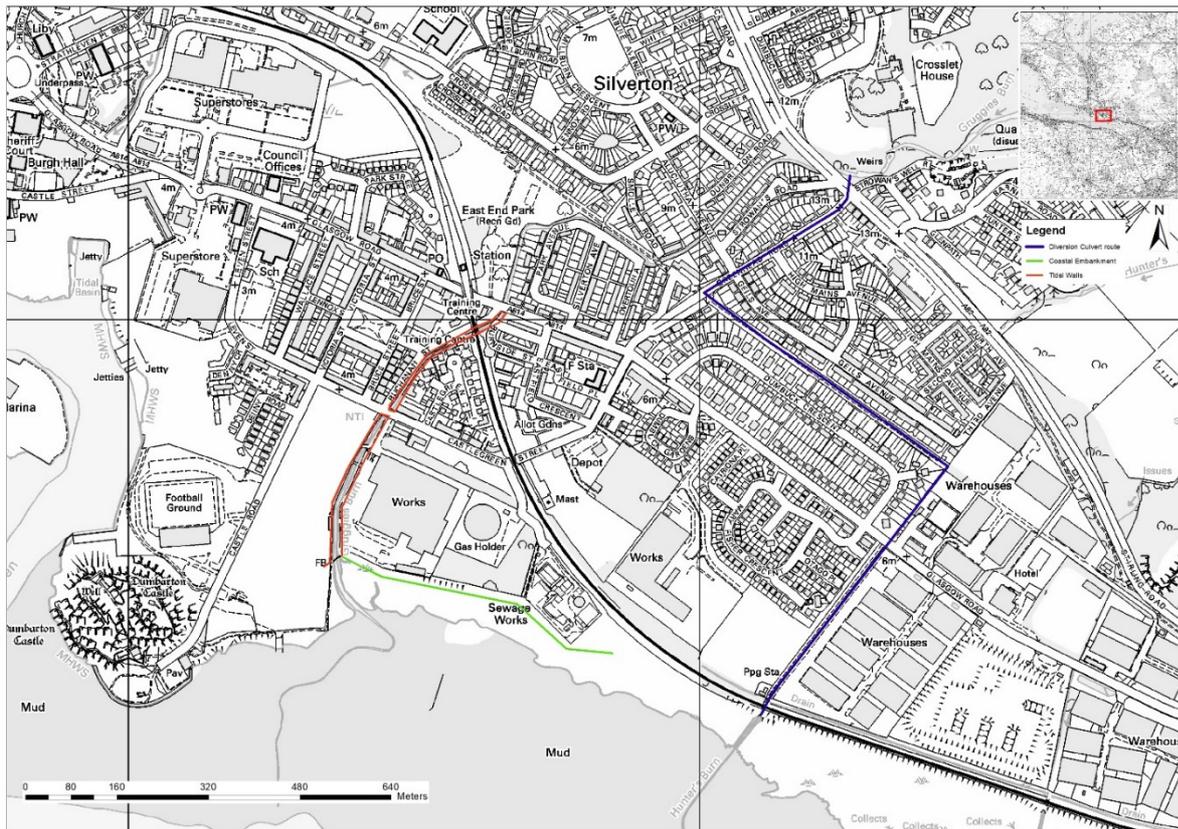


Figure 2-3 Location of Option 4 Hard Defences and Flood Relief Culvert Route 1

2.1.5 Option 5 - Hard Defences and Flood Relief Culvert (Route 2)

This option incorporates hard defences in the same locations as Option 2, from Glasgow Road to the Firth of Clyde. In contrast to Option 2, there are no hard defences upstream of Glasgow Road as these are replaced with a flood relief culvert (Figure 2-4), following a different route to that chosen for Option 4. The flood relief culvert route commences from Gruggies Burn following Glenpath then under Stirling Road to Third Avenue. The culvert then crosses Glasgow Road before discharging to the Clyde. This option is designed to provide a 0.5% AEP SoP. This option was considered to potentially provide a technically and economically viable scheme and was progressed to the short-list of options (Section 2.2).

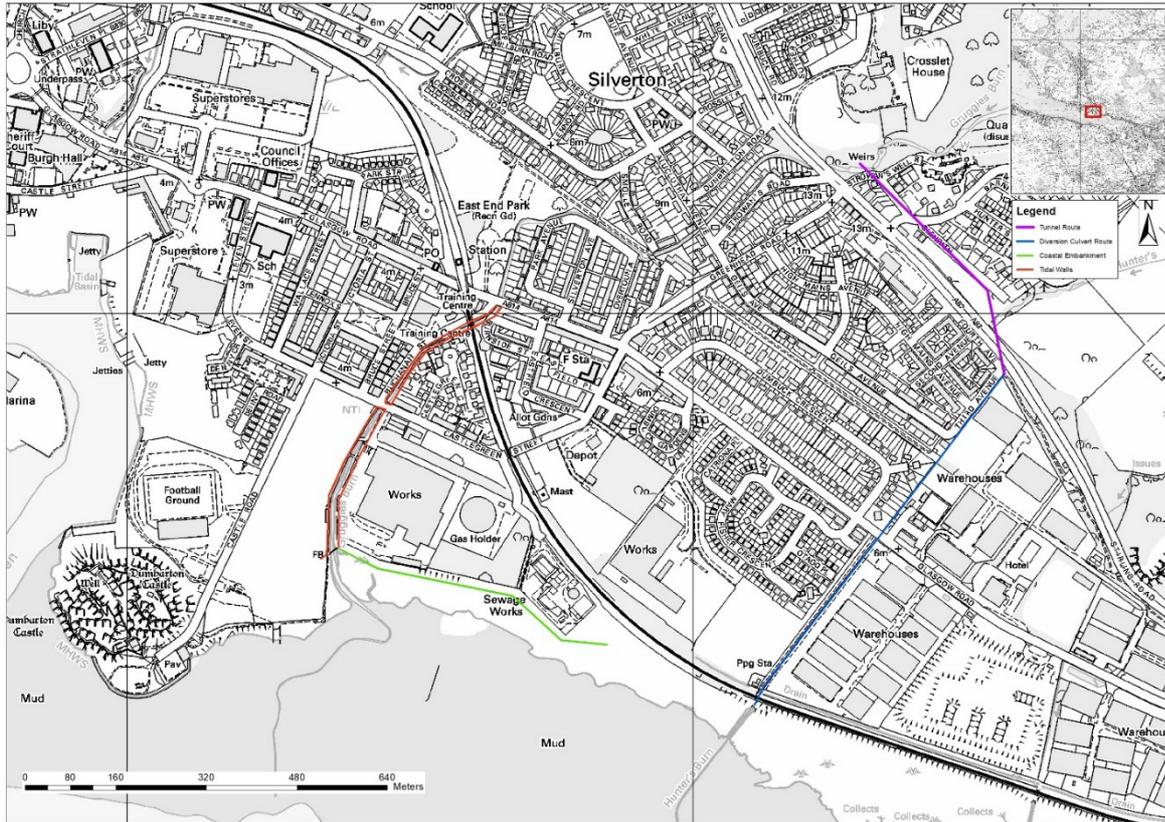


Figure 2-4 Location of Option 5 Hard Defences and Flood Relief Culvert Route 2

2.2 Short-List of Options

2.2.1 Option 2 – Gruggies Burn Hard Defences

As shown in Figure 2-1, Option 2 incorporates flood defence walls along Gruggies Burn, bypass culverts and a flood defence embankment to reduce the risk of tidal inundation. The estimated length and height of the walls and embankments (above ground level), and bypass culvert dimensions, are provided in Table 2-1 and

Table 2-2, with reference to the location of each reach identified in Figure 2-5. The height of each flood defence makes an allowance for freeboard of 600mm.

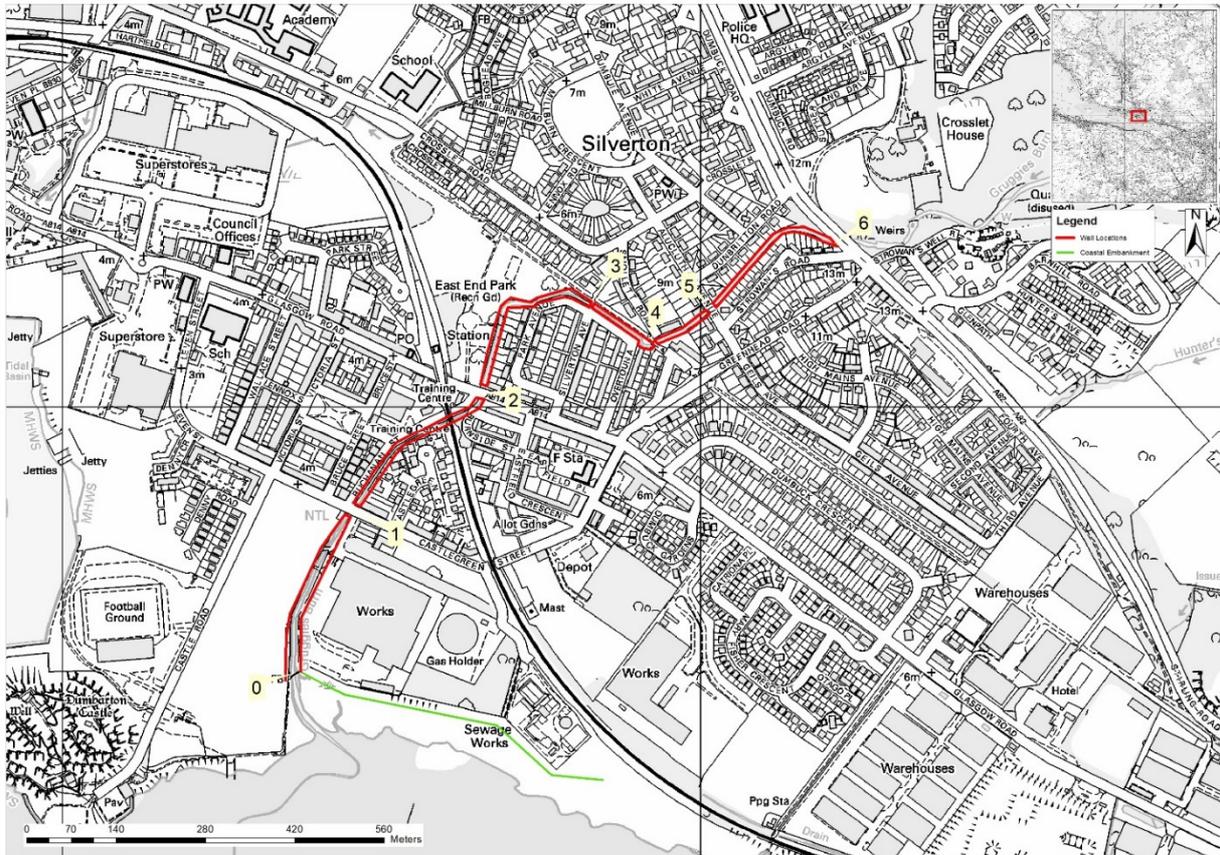


Figure 2-5 Defence Wall Locations

Table 2-1 Defence Wall and Embankment Height and Length

Location	Height (m)	Length (m)
1-0 Right bank (looking downstream)	1.945	260
1-0 Left bank (looking downstream)	1.945	290
2-1 RB	2.991	265
2-1 LB	2.991	265
3-2 LB	2.626	265
3-2 RB	2.626	290
4-3 LB	1.803	135
4-3 RB	1.803	115
5-4 LB	1.9	100
5-4 RB	1.9	100
6-5 RB	2.47	260
6-5 LB	2.47	250
Coastal Embankment	3.85	519

Table 2-2 Dimensions of Bypass Culverts

Location	Dimensions (m)	Length (m)
1 RB	5 x 0.8	23
5 RB	3 x 1.3	39
2 LB	2 x 0.9	23
1 LB	2 x 0.8	23
2 RB	2 x 0.9	23

2.2.2 Option 4 – Hard Defences and Flood Relief Culvert (Route 1)

As shown in **Figure 2-3**, Option 4 incorporates flood defence walls along Gruggies Burn from Geils Avenue to the Firth of Clyde, bypass culverts, a flood defence embankment to reduce the risk of tidal inundation and a flow diversion culvert. The estimated length and height of the walls and embankments, and bypass culvert dimensions, are provided in Table 2-3 and Table 2-4, with reference to the location of each reach identified in Figure 2-5. The height of each flood defence makes an allowance for freeboard of 600mm.

Table 2-3 Defence Wall and Embankment Height and Length

Location	Height (m)	Length (m)
1-0 Right bank (looking downstream)	1.945	260
1-0 Left bank (looking downstream)	1.945	290
2-1 RB	2.991	265
2-1 LB	2.991	265
Coastal Embankment	3.85	519

Table 2-4 Dimensions of Bypass Culverts

Location	Dimensions (m)	Length (m)
1 RB	5 x 0.8	23
2 LB	2 x 0.9	23
1 LB	2 x 0.8	23
2 RB	2 x 0.9	23
Flow Diversion Culvert	4 x 2	1059

2.2.3 Option 5 – Hard Defences and Flood Relief Culvert (Route 2)

As shown in Figure 2-4, Option 5 incorporates flood defence walls along Gruggies Burn from Geils Avenue to the Firth of Clyde, bypass culverts, a flood defence embankment to reduce the risk of tidal inundation and a flow diversion culvert. The estimated length and height of the walls and embankments are provided in Table 2-3 (as they are the same as Option 4), with reference to the location of each reach identified in Figure 2-5. The dimensions of the bypass culverts and the flow diversion culvert are provided in Table 2-5. The height of each flood defence makes an allowance for freeboard of 600mm.

Table 2-5 Dimensions of Bypass Culverts

Location	Dimensions (m)	Length (m)
1 RB	5 x 0.8	23
2 LB	2 x 0.9	23
1 LB	2 x 0.8	23
2 RB	2 x 0.9	23
Flow Diversion Culvert	4 x 2	1215

3 SELECTION OF PREFERRED OPTION

RPS consulted with Balfour Beatty, in order to request information on the constructability of each of the short-listed options from an experienced Contractor. Balfour Beatty provided a report (April 2021) which included the advantages and disadvantages as outlined in Table 3-1.

Table 3-1: Advantages and Disadvantages of Options

Option	Advantages	Disadvantages
Option 2	No diversion of water route required. Minimal road closures (Alclutha Avenue, Glasgow Road and Castlegreen Street) for bypass culverts. Relatively simply design.	Multiple interactions with private properties. Limited access to sections of the burn bank. Gas main at Castlegreen Street. Working on or over water for the whole route.
Option 4	Few interactions with private property. Good access to most work sites. Main Road closures are limited (Mainly Greenhead Road). Culverts are less expensive than tunnelling.	Greenhead Road closed or partially closed for an extended period. Stirling Road and Glasgow Road contraflow required for culvert installation. Gas main at Castlegreen Street. New culvert ends at railway line. Sections of the wall are in private property.
Option 5	Few interactions with private properties. Direct route for diversion. Mostly unused or rarely used land along the diversion route.	Tunnelling is expensive. Tunnelling under Stirling Road would result in a major road closure (A82) with lengthy diversion routes. New culvert ends at railway line. Gas main at Castlegreen Street. Sections of the wall are in private property.

The Balfour Beatty report provided the following recommendation:

Based on the information available and the options currently on the table, Balfour Beatty would recommend Option 4. We feel this would offer the best product in terms of buildability, cost, safety, access, and long-term benefits to the community of Dumbarton.

At a meeting with WDC, Balfour Beatty and RPS (21/04/21), it was concluded that Option 4 was the preferred option.

RPS recommend that the ground investigation data and waste classification report, provided to Balfour Beatty on 19/01/21 and 31/03/21 respectively, should be considered when providing the cost estimates for each option. In addition to the points made in Table 3-1, RPS would note that a further disadvantage with Option 4 is that a section of the flow diversion route follows the Greenhead Road, which is a primary route used by the Fire Brigade and lorries travelling to and from local industrial units.

4 RECOMMENDATIONS AND CONCLUSIONS

The Gruggies Burn has been subject to previous studies by Scott Wilson, Jacobs and Mott MacDonald dating as far back as September 2004 which have assessed the flood potential, geotechnical information, hydrology and hydraulic modelling, utilities, cost and offered options for potential flood alleviation schemes. Subsequently, RPS have procured topographical survey information, undertook hydrological and hydraulic modelling analyses prior to completing an optioneering assessment and undertaking site investigations works.

This report provides a summary of the optioneering assessment, including information on all of the options identified and justification of the selection of the preferred option. RPS recommend that consideration should be given to confirming that the SEPA guidance on options appraisal has been followed including their aims to find sustainable solutions, make the best use of public money, have accountability and be robust. This would require an assessment of the costs of each option and a damage assessment to ensure that the scheme is economically viable.

Prior to progressing to the outline design phase, RPS recommend a detailed analysis using the hydraulic model to confirm the design requirements. This may include determining how flood flows will be conveyed from the Gruggies Burn into the flow diversion culvert (as part of the preferred option). It is considered that a significant inlet structure will be required upstream of Stirling Road in order to facilitate this mechanism.

It is recommended that further consultation is undertaken between WDC, RPS and Balfour Beatty prior to finalisation of this report and progressing to the next stages of the scheme.