MOTT MACDONALD

Inchgarth Road Flood Study

Cost Benefit Analysis

May 2017

Aberdeen City Council
383682-001-A

Moray House
16-18 Bank Street
Inverness IV1 1QY
United Kingdom

T +44 (0)1463 239323

mottmac.com

Marischal College
Broad Street
Aberdeen
AB10 1AB

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	11/05/17	D Morrison M Nekula	L Cload	S Robertson	First Draft
B	22/05/17	M Nekula	L Cload	P Whitefoot	Final Issue (following Client's comments)

Information class: Standard

Contents

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1 Introduction

1.1 Background

Inchgarth Road is located in close proximity to the River Dee and is separated from the river by an area of vegetated grassland, and riverside bund. Scottish Water's Inchgarth reservoir is located immediately downstream of the bund.

The Inchgarth Road area has a history of flooding, most recently in winter 2015/16 the river bund was breached resulting in the flooding of the grassland, Inchgarth Road and neighbouring properties. Given the flood history Aberdeen City Council decided to carry out further flood study and investigate potential solutions to address the flood issue at Inchgarth Road.

Mott MacDonald was commissioned by Aberdeen City Council to undertake the flood study in March 2017. The study is carried out under the Scotland Excel Framework for Engineering and Technical Consultancy.

1.2 Purpose of this study

This report summarises the flood mitigation options identified for the area, presents their economic appraisal and draws conclusion and further recommendations.

1.3 Methodology

1.3.1 Flood mitigation option development

The development of flood mitigation options has been based on the data provided by Aberdeen City Council (ACC) and information collected during the initial site visit. Further consultation with the engineering team of ACC was carried out to agree the three leading options for the economic appraisal.

The 1 in 30 year, 100year and 200 year flood maps (with blocked and unblocked culvert scenario) have been supplied by ACC for this assessment. Therefore, no hydraulic modelling has been carried out as part of this study.

1.3.2 Economic appraisal

The process for undertaking the benefit-cost analysis is defined by the "Flooding and Coastal Defence Erosion Risk Management – Handbook for Economic Appraisal"[1] and the Treasury Green Book[2]. The Handbook is complemented by the "Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal" [3] (MCM), which provides further details and the rationale behind the approaches described in the Handbook.

[1] Flooding and Coastal Defence Erosion Risk Management – Handbook for Economic Appraisal, Flood Hazard Research Centre at Middlesex University, 2016

[2] The Green Book – Appraisal and Evaluation in Central Government, 2011

[3] Flood and Coastal Erosion Risk Management – A Manual for Economic Appraisal', Flood Hazard Research Centre at Middlesex University, 2016. Also known as the Multi-Coloured Manual (MCM).

The Benefit-Cost Analysis for the Inchgarth Road area has been undertaken in accordance with the above guidance. This consists of the following major steps to determine the:

- flood extent – based on the provided flood maps (Appendix B)
- property damage – as described in Section 3
- costs to build the flood protection scheme – as described in Section 4
- benefit-cost ratio and hence assess the economic viability of the options – as described in Section 5.

All damages in the benefit-cost analysis are assessed as the national economic losses caused by floods and their indirect consequence.

1.4 Site Visit

A site visit was carried out by Mott MacDonald engineers on 6th April 2017. The purpose of this site visit was to visually survey the subject site, watercourses, nearby properties at risk, potential flood paths and technical feasibility of the identified new flood mitigation options.

Photographs from the site visit are in Appendix A.

1.5 Available data

ACC provided the following data:

- ESRI shapefiles for the 1 in 30, 1in 100 and 1 in 200 flood extents (blocked / unblocked burn culvert) scenario;
- Address points for the Inchgarth Road;
- OS Master Map;
- Information on the observed flood mechanism from the last flood event.

SEPA provided the hydrograph shape from the latest flood event in winter 2015/16 and information on the existing flood warning scheme at the River Dee.

Further information was collected during the site visit on 6th April 2017.

2 Identified Flood Mitigation Measures

2.1 Flood Mechanisms

Two principal flood mechanisms were defined through analysis of data and through a site visit carried out on Thursday 6th April 2017.

Namely:

- **Mechanism 1 –** Fluvial flooding of the River Dee and Burn of Cults during high flood events can cause both watercourses to come out of bank. This leads to the flooding of the Den of Cults and Inchgarth Road, affecting properties in the vicinity. The fluvial flooding at the River Dee also leads to flow backing up the Burn of Cults culvert at the confluence with the River Dee.
- **Mechanism 2 –** The circa 1200mm diameter culvert for the Burn of Cults underneath Inchgarth Road could become blocked. There has been a history of blockage in this culvert, causing the water to back up the Burn of Cults and overtop its banks affecting properties in close proximity. Higher flow in the watercourse will, as expected, exacerbate the flooding issue should a blockage occur, and the culvert could be of insufficient capacity. It is noted that the existing roadside wall, until its collapse, had the potential to trap water overtopping the culvert, further exacerbating flood risk.

2.2 Selected Options

Based on the supplied information, outline mitigation options were selected. From carrying out the site visit, these options were further developed and three options were selected for detailed assessment. Some of the mitigation measures were combined in order to form an option that would address and alleviate both flooding mechanisms aforementioned.

These are:

- Option 1 – Bund improvement and culvert extension
- Option 2 – Reinforced concrete sheet piled flood wall
- Option 3 – Property level protection

2.2.1 Option 1 – Bund Improvement and Culvert Extension

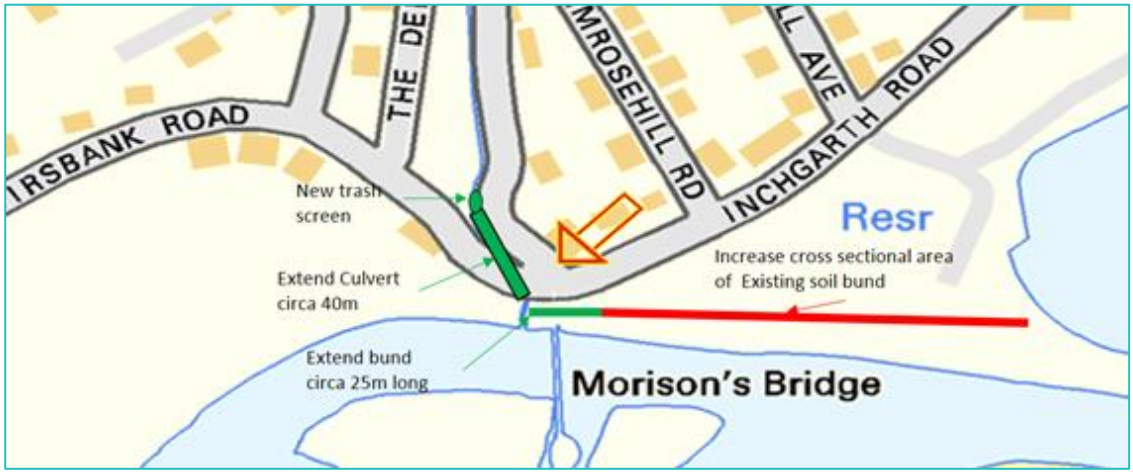
Option 1 is to replace the existing bund with a formal flood bund and extend the culvert as shown in Figure 1.

It was noted in the scoping document for this project that the bund parallel to the River Dee was breached during the 2015 winter flood event from Storm Frank. ACC have stated that the bund was not designed as a flood defence. During the site visit, it was noted that the bund was steep and is considered not suitable in its present state to form a flood defence. The bund crest is also lower at the Morison's Bridge end, requiring any new bund to be extended past the bridge to high ground on the other side.

To mitigate the backing up of the Burn of Cults from the River Dee, it is proposed that the existing culvert is extended up the watercourse to an invert level that matches the flood level of the River Dee. This would include the provision of a suitably designed trash screen at the

upstream end of the culvert inlet to alleviate culvert blockage, provided it is cleared and inspected at regular intervals.

Figure 1: Option 1 Sketch



Source: OS Streetview map available under OS OpenData

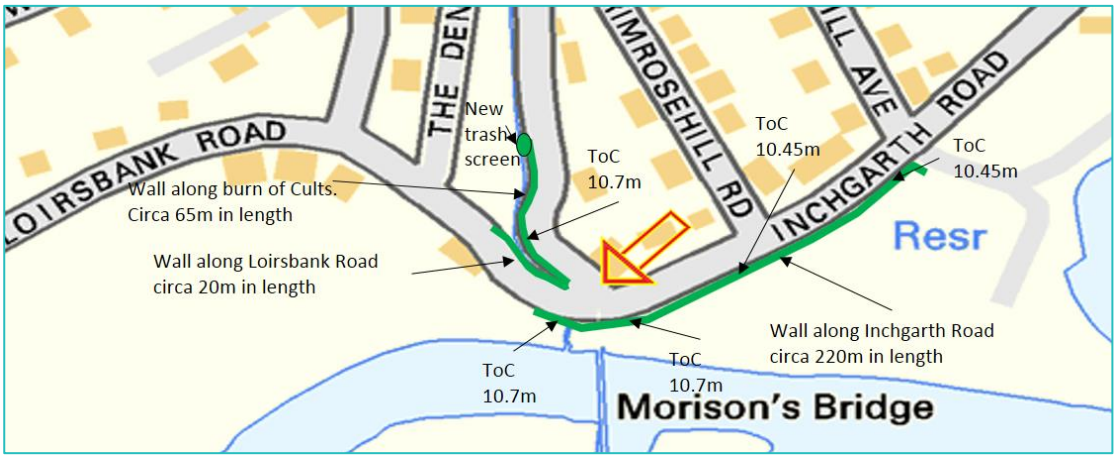
2.2.2 Option 2 – Reinforced Concrete Sheet Piled Flood Wall

Option 2 is the provision of a flood wall and trash screen as shown in Figure 2. It is proposed that to address the flooding problem from Mechanism 1 that flood walls should follow the south side of Inchgarth Road, running for circa 225m spanning between high ground. The backing up problem up the Burn of Cults would be alleviated by the provision of a Reinforced Concrete Flood Wall along the east bank of the Burn of Cults. Initial flood wall heights were calculated from flood levels plus an additional freeboard of 0.6m has been added.

The risk of blockage would be alleviated by the provision of a suitably designed trash screen at the upstream end of the culvert inlet to alleviate culvert blockage, provided it is cleared and inspected at regular intervals.

It is noted that the existing wall along Inchgarth Road caused ponding of flood water on its landward side during the latest flood event. Therefore to mitigate this risk, it is proposed that new discharge pipes, equipped with flap valves, will be installed under the wall leading back toward the River Dee.

Figure 2: Option 2 Sketch



Source: OS Streetview map available under OS OpenData

2.2.3 Option 3 – Property Level Protection

Option 3 is the provision of property level protection to the individual properties affected. Mott MacDonald contacted an external supplier, UK Flood Barriers, to ascertain information on products that could be supplied to mitigate and alleviate damages to at risk properties. It was determined that protection would need to be provided for 5 individual residential properties including flood doors, airbrick covers and non-return valves. A flood door would also be required for the Scottish Water pumping station.

While not necessary under this option it is advised that the trash screen is improved to reduce the risk of future culvert blockage and improve accessibility for clearing during a flood.

Figure 3: Option 3 Sketch – Residential in Green, Non-residential in purple

Source: OS Streetview map available under OS OpenData

3 Potential benefits of flood mitigation

3.1 Introduction

Benefits for the identified flood mitigations have been determined using the methodology outlined in the MCM. The level of protection of the identified flood mitigations is up to 0.5% annual exceedance probability (or 1 in 200 year) flood event.

The benefits are the economic costs avoided by the scheme which include both direct and indirect impacts of flooding. The direct impacts result from the physical contact of flood water with damageable property and their contents. These damages are primarily a function of the nature and extent of the flooding including its duration, velocity and any contamination of the flood water. Indirect damages include disruption of the traffic networks and social activities.

The MCM gives recommendations on when different types of benefits should be assessed, as does Making Space for Water[4]. Using these recommendations, the following benefits have been examined:

1. Direct tangible impacts of flooding on residential properties (including domestic vehicles).
2. Direct tangible impact of flooding on non-residential properties.
3. Indirect tangible impacts of flooding on residential properties.
4. Human-related intangible impacts of flooding.
5. Costs to emergency services as a result of flooding

3.2 Principal exclusions

There are a number of benefits that have not been included, for example because they are disproportionately difficult to estimate. These exclusions imply that the calculations of benefits presented in this report are a conservative estimate. The principle exclusions are:

1. Road traffic disruption.
2. Indirect non-residential benefits.
3. Weighting based on scale of industry and the number of independent companies affected.
4. Flood damage to underground utilities.
5. Environmental gains and losses.
6. Agricultural benefits and impacts.
7. VAT and other indirect taxes, because they are money transfers within the economy rather than real losses or gains.

[4] Making space for water – a consultation exercise, by DEFRA, July 2004

3.3 Direct benefits

3.3.1 Overview

The MCM provide standard direct damage data for residential and non-residential property data which has been used to estimate the direct benefits of construction of flood defences. A more detailed breakdown of the analysis is included in Appendix C.

Based on the available flood hydrograph of the River Dee during the winter 2015/16 flood event[5], the duration of flooding for the River Dee fluvial flood event has been assessed as more than 12 hours. SEPA also advised that for the given area SEPA aim to issue flood warning between 3 and 6 hours before the onset of flooding (although in practice they are often much earlier). Therefore, the long duration MCM direct damage data with <8hr warning have been applied.

No additional cost associated with damage by saltwater or other contaminants has been included in the damage assessment.

The MCM depth/damage data is based on 2016 -17 price base.

3.3.2 Direct tangible impacts of flooding on residential properties

The damage to a residential property is calculated in the MCM as a function of the age and the type of the building, the social class of the occupants, depth of flooding and flood duration. The damages to domestic vehicles have also been included.

Individual properties were identified using address point data provided by Aberdeen City Council. A threshold level of 0.3m has been assumed for each property, although the site visit observation confirmed that some properties are likely to have a higher difference between the external ground level and internal floor level. Therefore, this assumption is likely to provide a conservative damage estimate, i.e. higher damages.

The site visit was used to identify the house type and building age. The social class of occupants was based on the type of the property and council tax band; all identified properties were classified as AB social group.

For the domestic vehicle damages the recommended average loss value of £3,600 per residential property in the area has been applied for the flood depths greater than 0.35m.

3.4 Indirect benefits

3.4.1 Indirect tangible impacts of flooding on residential properties

Indirect flood impacts can be more significant to householders than property damage itself and tends to affect a wider area. These impacts encompass increased stress, health problems, loss of memorabilia and displacement from their homes. There is currently no agreed comprehensive methodology for assessing these costs in monetary terms. However, MCM suggests, as a partial measure, the use of surrogate values for assessing tangible indirect losses.

For overview appraisals, the MCM recommends using the total average cost of evacuation per household (based on an average evacuation of 23 weeks) to be in the range of £2,856 and

[5] The River Dee Flood hydrographs supplied by SEPA on 01/05/2017

£6,816. An average cost of £4,121 has been applied to the properties flooded at Inchgarth Road.

3.4.2 Intangible impacts of flooding on residential properties

The MCM shows that intangible benefits can be expressed as the relationship between the value of avoiding the impacts of flooding and the reduction in the probability of being flooded. Intangible health benefits have been estimated as being, on average for the UK, £290 per year per household (MCM). As no further details on the current standard of protection of the properties has been available the average figure was used in the assessment.

3.4.3 Costs to emergency services as a result of flooding

Emergency services can be involved in both emergency works before and during the flood event, and in the clean up after the event. Actual data for the costs to emergency services is difficult to obtain. However, the MCM recommends that on the basis of flood events in autumn 2000 and summer 2007, the total property damage calculated in project appraisals of flood alleviation schemed should be multiplied by a factor ranging between 1.107 and 1.056 to allow for the emergency and recovery costs. In the absence of better data the factor of 1.107 has been used.

3.5 Annual average benefit calculation

3.5.1 Methodology

The benefits of a flood scheme are expressed as the difference between the average annual flood damages before and after constructing a flood protection scheme. This is based on the probability of a flood event occurring in any given year, and the damage that would have been caused by that event.

For the Inchgarth Road area the 1 in 10, 30, 50, 100 and 200 year return period events were used to construct the loss-probability curves for each of the flood protection options considered. It is noted that only the 1 in 30, 100 and 200 year flood depth/extent maps were available for the area, therefore, the damage figures for the remaining return period are based on the interpolation/extrapolation of the generated curve, except for the 1 in 10 year flood return period, where no damages were assumed.

Damage figures were assessed for the Burn of Cults culvert being “blocked” and “unblocked” as shown in Tables 1 and 2.

The overall average annual damages are discounted over the 100 year design life of the proposed flood mitigations to give net present value of benefits as calculated using the FCDPAG3[6] spreadsheets published by DEFRA. The FCDPAG3 spreadsheets summarising the whole Inchgarth Road area are included in Appendix D of this report.

The benefits are calculated for the area as a whole. The number of properties affected by flooding is identified along with a summary of the calculated damage values based on the existing conditions (i.e. the ‘do nothing’ scenario) for various return periods.

The proposed flood mitigation intends to reduce flooding up to and including the 1 in 200 year flood level. Therefore, the damages with the scheme in place have been calculated on this basis.

[6] Flood and Coastal Defence Project Appraisal Guidance, Handbook for Economic Appraisal, DEFRA, 2015

3.5.2 Summary of benefits for the Inchgarth Road area

Table 1: Number of properties affected by flooding

Return Period (years)	30year unblocked	100year unblocked	200year unblocked	30year blocked	100year blocked	200year blocked
Residential	2	2	3	2	3	5
Non-Residential	0	0	0	0	0	1

Table 2: Damage Frequency Values (£)

Return Period (years)	30year unblocked	100year unblocked	200year unblocked	30year blocked	100year blocked	200year blocked
Residential property (including domestic vehicles)	2,693	2,693	27,667	37,750	38,918	71,231
Ind/commercial (direct)	0	0	37,607	0	0	59,425
Residential Indirect Tangible	0	0	8,242	8,242	8,242	8,242
Residential Intangible	580	580	870	580	870	1,450
Emergency services	350	350	7,959	4,983	5,139	15,017
Other	0	0	0	0	0	0
TOTAL	3,623	3,623	82,345	51,555	53,169	155,365

Figure 4: Damage frequency curve – unblocked culvert scenario

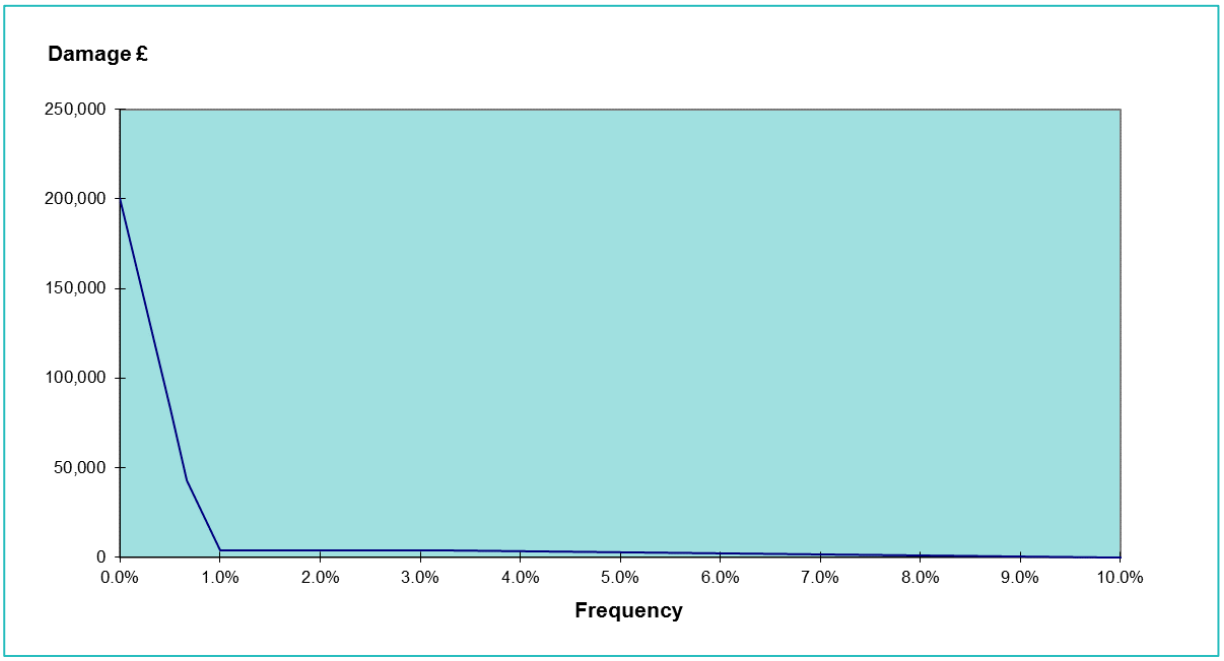
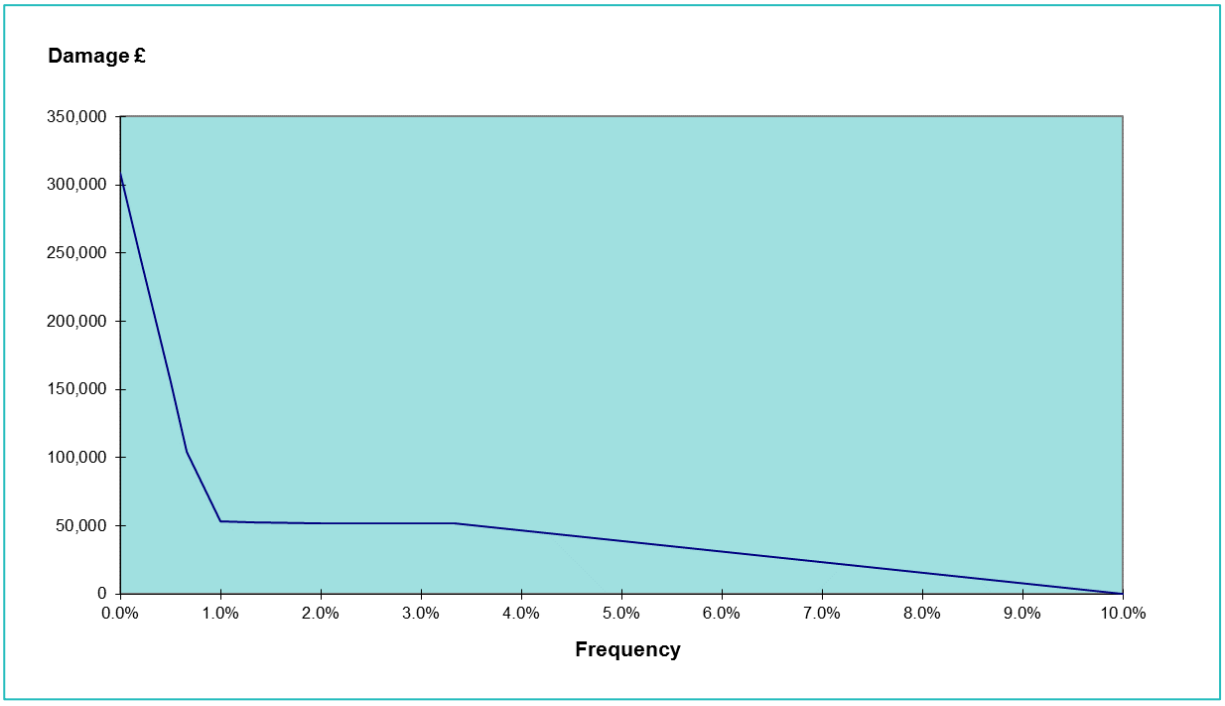


Figure 5: Damage frequency curve – blocked culvert scenario



4 Cost of flood mitigation options

4.1 Capital costs

Various sources were used to calculate initial capital costs for the 3 mitigation options considered. It should be noted an optimism bias (OB) factor is not added to the initial capital costs calculated and this is added separately in the FCDPAG3 spreadsheet.

Table 3 shows the calculated capital costs:

Table 3: Capital costs

Option	*Component*	*Area*	*Capital Cost*	*OB Applied*	*Source*
1	Embankment	River Dee	£350,119	£560,190	SPON'S 2017 Price Book
	Culvert	Burn of Cults	£187,500	£300,000	Estimate
	Trash Screen	Burn of Cults	£18,000	£28,800	Environment Agency: Cost estimation for culverts
	Total		**£555,619**	**£888,990**	
2	Flood Wall	Inchgarth Road	£480,567	£768,907	SPON'S 2017 Price Book
		Den of Cults	£142,003	£227,204	SPON'S 2017 Price Book
		Misc.	£10,089	£16,143	SPON'S 2017 Price Book
	Trash Screen	Burn of Cults	£18,000	£28,800	Environment Agency: Cost estimation for culverts
	Total		**£650,659**	**£1,041,054**	
3	Property Level Protection	Various properties	£22,190	£35,504	UK Flood Barriers
	Trash Screen	Burn of Cults	£18,000	£28,800	Environment Agency: Cost estimation for culverts
	Total		**£40,190**	**£64,304**	

4.2 Maintenance costs

Maintenance costs associated with the proposed flood mitigation measures have been estimated as summarised in Table 4. This includes grass cutting, regular inspection of the culvert and upstream trash screen, occasional maintenance to the walls and embankments and flap gate clearance. The table assumes minimal maintenance will be required as aesthetics are not a key consideration of the area.

Table 4: Maintenance costs

Option	*Component*	*Area*	*Unit maintenance cost (£/km/year)*	*Maintenance cost total / year*	*Source*
1	Embankment	River Dee	£2,000	£500	Environment Agency: Cost estimation for fluvial defences
	Culvert + trash screen	Burn of Cults		£600	Estimate
	Total			**£1,100**	
2	Flood Wall	Inchgarth Road + Den of Cults	£500	£150	Environment Agency: Cost estimation for fluvial defences + River Ness FAS cost benefit analysis
	Trash Screen	Burn of Cults		£500	Estimate
	Total			**£650**	
3	Property Level Protection	Various properties	n/a	n/a	UK Flood Barriers
	Trash Screen	Burn of Cults		£500	Estimate
	Total			**£500**	

4.3 Total cost

The total costs are presented in Table 5. These costs have been discounted over the 100-year life of the project to provide a present value cost.

Table 5: Present value costs by option (£)

	Option 0: Do Nothing	Option 1:	Option 2:	Option 3:
Whole life present value cost	0	622,178	713,692	30,119
Optimism bias adjustment (60%)	0	373,307	428,215	18,071
Total Present Value Costs for appraisal (PVc)	0	995,484	1,141,907	48,190

5 Cost Benefit Analysis of Options

Comparison of the benefits and costs of the scheme has been undertaken using DEFRA's FCDPAG3 economic appraisal spreadsheets, which calculate the average annual damages for 'Do Nothing' option and compare this with the proposed scheme costs over a 100-year period. The costs are adjusted using the government's published variable discount rates[7] as shown in Table 6.

Both flood scenarios, i.e. unblocked and blocked culvert at the Burn of Cults, have been assessed and the benefit-cost analysis results are presented for each scenario in Table 7 and Table 8.

Table 6: Variable Discount Rates

Years	0 - 30	31-75	76-100
Discount Rate	3.5%	3.0%	2.5%

Table 7: Benefit -Cost Analysis Results for Inchgarth Road area – unblocked culvert

	Option 0	Option 1	Option 2	Option 3
Annual Average Damage	£1,094	£583	£583	£583
Present Value Benefits (PVb)	£0	£15,259	£15,259	£15,259
Present Value Cost (PVc)	£0	£995,484	£1,141,907	£48,190
Average benefit/cost ratio		0.02	0.01	0.32

Note: It is assumed that the existing defences will not require cost to maintain.
Option 0 refers to Do Nothing

Table 8: Benefit -Cost Analysis Results for Inchgarth Road area – blocked culvert

	Option 0	Option 1	Option 2	Option 3
Annual Average Damage	£4,573	£927	£927	£927
Present Value Benefits (PVb)	£0	£108,874	£108,874	£108,874
Present Value Cost (PVc)	£0	£995,484	£1,141,907	£48,190
Average benefit/cost ratio		0.11	0.10	2.26

Note: It is assumed that the existing defences will not require cost to maintain.
Option 0 refers to Do Nothing

[7] 'http://data.gov.uk/sib_knowledge_box/discount-rates-and-net-present-value – April 2013.

6 Conclusions and Recommendations

This report summarises the assessment of options to mitigate fluvial flood risk at Inchgarth Road. Three selected options have been assessed in more detail:

- Option 1: Bund improvement and culvert extension
- Option 2: Reinforced concrete sheet piled flood wall
- Option 3: Property level protection

The report summarises the economic analysis for the three selected options. The benefits and costs of the options have been assessed in accordance with the “Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal” (MCM) and the Green Book.

The option development and consequent economic appraisal are based on flood extent maps provided by Aberdeen City Council, which considered the 1 in 30yr, 100yr and 200yr fluvial flood event at the River Dee and Burn of Cults, including the unblocked/blocked culvert scenarios.

The new defences will be for a 200 year return period design flood event, which has been used in the analysis.

The cost has been derived using relevant Environment Agency guidance, SPONS price data to derive an estimate at 2017 prices and examples of previous Mott MacDonald projects related to the fluvial flood defence construction.

Using the FADPAG3 spreadsheets, the estimated present values of damages avoided by the proposed flood defences are estimated as £15,259 and £108,874 for the unblocked culvert scenario and blocked culvert scenario respectively.

The estimated present value cost of the proposed flood defences (including 60% optimism bias) are following:

- Option 1: £995,484
- Option 2: £1,141,907
- Option 3: £48,190

Option 3 of the blocked culvert scenario has the highest benefit / cost ratio of 2.26 and is the only one with a ratio above 1. The other options have the benefit / cost ratio significantly lower, i.e. ranging from 0.01 to 0.32.

Regardless of options chosen moving forward, Mott MacDonald recommends that the existing trash screen is improved to reduce the risk of blockage and facilitate safe access for clearing. It is also advised that the culvert outlet is regularly cleared, including at the downstream end, to prevent blockage (see appendix A for photograph).

Appendices

A. Photographs

Figure 6: Burn of Cults Culvert Inlet

Source: Site Visit

Figure 7: Inchgarth Road looking west

Source: Site Visit

Figure 8: At-Risk properties on the corner of Den of Cults and Inchgarth Road

Source: Site Visit

Figure 9: Vicinity around old Morison's Bridge entrance

Source: Site Visit

Figure 10: Scottish Water Pumping Station

Source: Site Visit

Figure 11: Burn of Cults Culvert Outlet (Vegetation clearance recommended)

Source: Site Visit

Figure 12: Looking over flood plain and Inchgarth Road from crest of bund

Source: Site Visit

Figure 13: Burn of Cults Open Channel

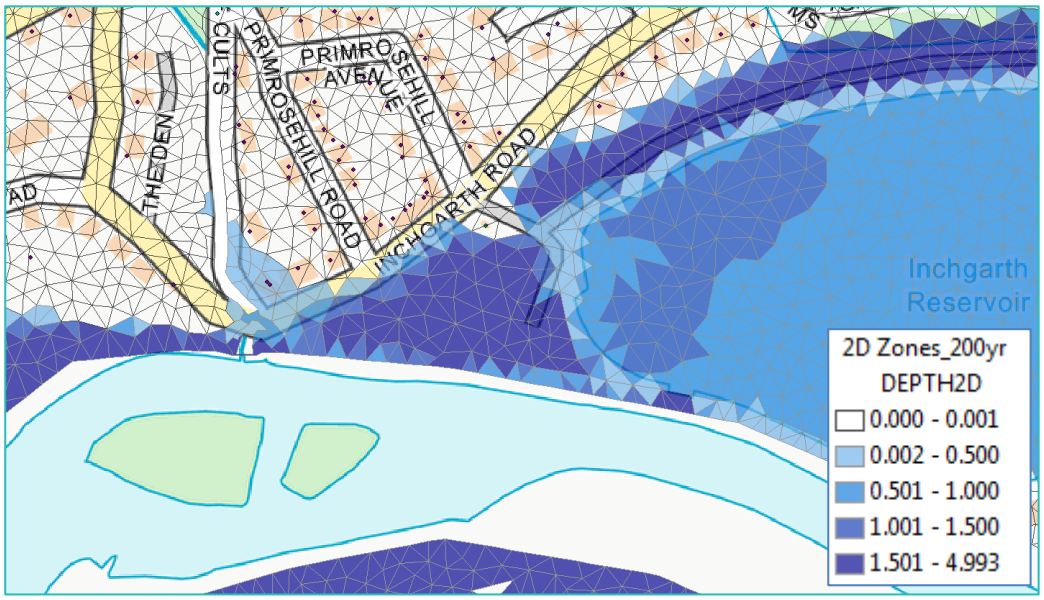
Source: Site Visit

Figure 14: Bund from Inchgarth Road

Source: Site Visit

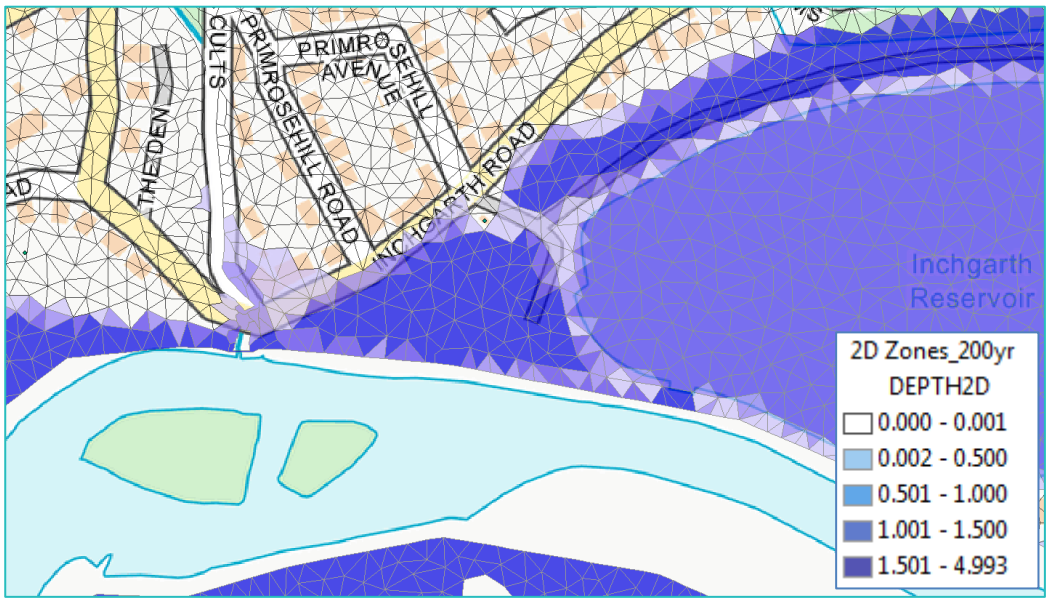
B. Flood Maps

Figure 15: 1 in 200 year flood extent (unblocked culvert scenario)



Source: OS OpenData + Aberdeen City Council

Figure 16: 1 in 200 year flood extent (blocked culvert scenario)



Source: OS OpenData + Aberdeen City Council

C. 1 in 200 year Damage Tables

Table 9: Residential damages (1 in 200 year return period flood event)

Address	Building Type	Building Age	Social Class	Flood Depth	Total Damage (£)	Evacuation cost (£)	Intangible benefits (£)
[redacted]	Detached	1965	AB	-0.078	1168.50	0	290
[redacted]	Semi	1900	AB	0.224	34656.66	4121	290
[redacted]	Semi	1965	AB	0.286	33174.23	4121	290
[redacted]	Detached	1965	AB	-0.117	1168.50	0	290
[redacted]	Detached	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Detached	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Detached	1965	AB	0	0.00	0	0
[redacted]	Semi	1965	AB	0	0.00	0	0
[redacted]	Detached	1985	AB	-0.239	1063.18	0	290
[redacted]	Detached	1965	AB	0	0.00	0	0
[redacted]	Detached	1965	AB	0	0.00	0	0
[redacted]	Detached	1965	AB	0	0.00	0	0
[redacted]	Detached	1965	AB	0	0.00	0	0
[redacted]	Detached	1965	AB	0	0.00	0	0

Table 10: Non-residential damages (1 in 200 year return period flood event)

Property Desc	Easting	Northing	Approx Area (m²)	MCM Name	Flood Depth	Total Damage (£)
Electricity Substation	389,912	802,750	26.02	SubStation	0.331	59,425

D. FCDPAG3 Spreadsheets

D.1 Unblocked culvert scenario

Figure 17: Summary sheet – unblocked culvert scenario

Project Summary Sheet

Client/Authority		Prepared (date)	26/04/2017
Aberdeen City Council		Printed	10/05/2017
Project name		Prepared by	MN
Inchgarth Road		Checked by	LC
Project reference	383682	Checked date	10/05/2017
Base date for estimates (year 0)	Apr-2017		
Scaling factor (e.g. £m, £k, £)	£	(used for all costs, losses and benefits)	
Principle land use band	A	(A to E)	
Initial Discount Rate	3.5%		
Optimism bias adjustment factor	60.0%		

Costs and benefits of options

	Costs and benefits £			
	No Project	Option 1	Option 2	Option 3
PV costs from estimates	-	622,178	713,692	30,119
Optimism bias adjustment	-	373,307	428,215	18,071
Total PV Costs for appraisal PVc	-	995,484	1,141,907	48,190
PV damage PVd	32,682	17,423	17,423	17,423
PV damage avoided		15,259	15,259	15,259
PV assets Pva				
PV asset protection benefits		-	-	-
Total PV benefits PVb		15,259	15,259	15,259
Net Present Value NPV		- 980,226	- 1,126,648	- 32,931
Average benefit/cost ratio		0.02	0.01	0.32
Incremental benefit/cost ratio				-
		-	-	Highest b/c

Brief description of options:

Option 0: Maintain existing	No project
Option 1: Bund improvement and extended culve	Bund improvement an extended culvert - flood defences up to 1 in 200yr flood event
Option 2: Reinforcement concrete sheet piled floc	Reinforcement concrete sheet piled flood wall - flood defences up to 1 in 200yr flood event
Option 3: Property level protection	Property level protection - flood defences up to 1 in 200yr flood event

Special note to revised version:

This version of the original FCDPAG3 example 2 has been produced to illustrate the changes introduced in the March 2003 guidance on the HMT new Green Book, published in January 2003.

Original Notes:

1) Benefits will normally be expressed either in terms of damage avoided or asset values protected. Care is needed to avoid double counting

2) PV damage avoided is calculated as PV damage (No Project) - PV damage (Option)
PV asset protection benefits are calculated as PVa (Option) - PVa (No Project)
PV benefits calculated as PV damage avoided + PV asset protection benefits

3) Incremental benefit/cost ratio is calculated as:
(PVb(current option) - PVb(previous option))/(PVc(current option) - PVc(previous option))

Figure 18: Present Value Costs for all options (both unblocked/blocked culvert scenario)

Present Value Costs for all options

Sheet Nr. 10

Client/Authority: Aberdeen City Council
Project name: Inchgarth Road
Project reference: 383682
Base date for estimates (year 0): Apr-2017
Scaling factor (e.g. £m, £k, £): £
Initial discount rate: 3.5%

Results £

	Option 1	Option 2	Option 3	Option 4
	0	ded culvert - flood defencelled flood wall - flood defetion - flood defences up to		
PV total costs	0	623278	714342	30119

Prepared (date): 27/08/2008
Printed: 11/05/2017
Prepared by: MN
Checked by: LC
Checked date: 11/05/2017

	Option 0: Ma			TOTALS:		Option 1	Bund improvement an ext		TOTALS:		Option 2	Reinforcement concrete s		TOTALS:		Option 3	Property level protection -		TOTALS:	
	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV
cash sum	0	0	0	0.00	0.00	537,619	378,810	-	916429	623278	632658.99	381329.495	0	1013988	714342	22190	33285	0	55475.00	30118.75
year	Discount Factor																			
0	1.000			0.00	0.00	537,619	1,100	-	538719.00	538719.00	632,659	650		633308.99	633308.99	22,190			22190.00	22190.00
1	0.966			0.00	0.00		1,100	-	1100.00	1062.80		650		650.00	628.02				0.00	0.00
2	0.934			0.00	0.00		1,100	-	1100.00	1026.86		650		650.00	606.78				0.00	0.00
3	0.902			0.00	0.00		1,100	-	1100.00	992.14		650		650.00	586.26				0.00	0.00
4	0.871			0.00	0.00		1,100	-	1100.00	958.59		650		650.00	566.44				0.00	0.00
5	0.842			0.00	0.00		1,100	-	1100.00	926.17		650		650.00	547.28				0.00	0.00
6	0.814			0.00	0.00		1,100	-	1100.00	894.85		650		650.00	528.78				0.00	0.00
7	0.786			0.00	0.00		1,100	-	1100.00	864.59		650		650.00	510.89				0.00	0.00
8	0.759			0.00	0.00		1,100	-	1100.00	835.35		650		650.00	493.62				0.00	0.00
9	0.734			0.00	0.00		1,100	-	1100.00	807.10		650		650.00	476.93				0.00	0.00
10	0.709			0.00	0.00		1,100	-	1100.00	779.81		650		650.00	460.80				0.00	0.00
11	0.685			0.00	0.00		1,100	-	1100.00	753.44		650		650.00	445.21				0.00	0.00
12	0.662			0.00	0.00		1,100	-	1100.00	727.96		650		650.00	430.15				0.00	0.00
13	0.639			0.00	0.00		1,100	-	1100.00	703.34		650		650.00	415.61				0.00	0.00
14	0.618			0.00	0.00		1,100	-	1100.00	679.56		650		650.00	401.56				0.00	0.00
15	0.597			0.00	0.00		1,100	-	1100.00	656.58		650		650.00	387.98				0.00	0.00
16	0.577			0.00	0.00		1,100	-	1100.00	634.38		650		650.00	374.86				0.00	0.00
17	0.557			0.00	0.00		1,100	-	1100.00	612.92		650		650.00	362.18				0.00	0.00
18	0.538			0.00	0.00		1,100	-	1100.00	592.20		650		650.00	349.93				0.00	0.00
19	0.520			0.00	0.00		1,100	-	1100.00	572.17		650		650.00	338.10				0.00	0.00
20	0.503			0.00	0.00		1,100	-	1100.00	552.82		650		650.00	326.67				0.00	0.00
21	0.486			0.00	0.00		1,100	-	1100.00	534.13		650		650.00	315.62				0.00	0.00
22	0.469			0.00	0.00		1,100	-	1100.00	516.07		650		650.00	304.95				0.00	0.00
23	0.453			0.00	0.00		1,100	-	1100.00	498.61		650		650.00	294.64				0.00	0.00
24	0.438			0.00	0.00		1,100	-	1100.00	481.75		650		650.00	284.67				0.00	0.00
25	0.423			0.00	0.00		1,100	-	1100.00	465.46		650		650.00	275.05		11,095		11095.00	4694.82
26	0.409			0.00	0.00		1,100	-	1100.00	449.72		650		650.00	265.74				0.00	0.00
27	0.395			0.00	0.00		1,100	-	1100.00	434.51		650		650.00	256.76				0.00	0.00
28	0.382			0.00	0.00		1,100	-	1100.00	419.82		650		650.00	248.08				0.00	0.00
29	0.369			0.00	0.00		1,100	-	1100.00	405.62		650		650.00	239.69				0.00	0.00
30	0.356			0.00	0.00		1,100	-	1100.00	391.91		650		650.00	231.58				0.00	0.00
31	0.346			0.00	0.00		1,100	-	1100.00	380.49		650		650.00	224.84				0.00	0.00
32	0.336			0.00	0.00		1,100	-	1100.00	369.41		650		650.00	218.29				0.00	0.00
33	0.326			0.00	0.00		1,100	-	1100.00	358.65		650		650.00	211.93				0.00	0.00
34	0.317			0.00	0.00		1,100	-	1100.00	348.20		650		650.00	205.76				0.00	0.00
35	0.307			0.00	0.00		1,100	-	1100.00	338.06		650		650.00	199.76				0.00	0.00
36	0.298			0.00	0.00		1,100	-	1100.00	328.22		650		650.00	193.95				0.00	0.00
37	0.290			0.00	0.00		1,100	-	1100.00	318.66		650		650.00	188.30				0.00	0.00
38	0.281			0.00	0.00		1,100	-	1100.00	309.37		650		650.00	182.81				0.00	0.00
39	0.273			0.00	0.00		1,100	-	1100.00	300.36		650		650.00	177.49				0.00	0.00
40	0.265			0.00	0.00		1,100	-	1100.00	291.62		650		650.00	172.32				0.00	0.00
41	0.257			0.00	0.00		1,100	-	1100.00	283.12		650		650.00	167.30				0.00	0.00
42	0.250			0.00	0.00		1,100	-	1100.00	274.88		650		650.00	162.43				0.00	0.00
43	0.243			0.00	0.00		1,100	-	1100.00	266.87		650		650.00	157.70				0.00	0.00
44	0.236			0.00	0.00		1,100	-	1100.00	259.10		650		650.00	153.10				0.00	0.00
45	0.229			0.00	0.00		1,100	-	1100.00	251.55		650		650.00	148.64				0.00	0.00
46	0.222			0.00	0.00		1,100	-	1100.00	244.22		650		650.00	144.31				0.00	0.00
47	0.216			0.00	0.00		1,100	-	1100.00	237.11		650		650.00	140.11				0.00	0.00
48	0.209			0.00	0.00		1,100	-	1100.00	230.20		650		650.00	136.03				0.00	0.00
49	0.203			0.00	0.00		1,100	-	1100.00	223.50		650		650.00	132.07				0.00	0.00
50	0.197			0.00	0.00	268,810		-	268809.50	53026.09	316,329			316329.50	62400.02		11,095		11095.00	2188.63
51	0.192			0.00	0.00		1,100	-	1100.00	210.67		650		650.00	124.49				0.00	0.00
52	0.186			0.00	0.00		1,100	-	1100.00	204.53		650		650.00	120.86				0.00	0.00
53	0.181			0.00	0.00		1,100	-	1100.00	198.58		650		650.00	117.34				0.00	0.00
54	0.175			0.00	0.00		1,100	-	1100.00	192.79		650		650.00	113.92				0.00	0.00
55	0.170			0.00	0.00		1,100	-	1100.00	187.18		650		650.00	110.60				0.00	0.00
56	0.165			0.00	0.00		1,100	-	1100.00	181.72		650		650.00	107.38				0.00	0.00
57	0.160			0.00	0.00		1,100	-	1100.00	176.43		650		650.00	104.26				0.00	0.00
58	0.156			0.00	0.00		1,100	-	1100.00	171.29		650		650.00	101.22				0.00	0.00
59	0.151			0.00	0.00		1,100	-	1100.00	166.30		650		650.00	98.27				0.00	0.00
60	0.147			0.00	0.00		1,100	-	1100.00	161.46		650		650.00	95.41				0.00	0.00
61	0.143			0.00	0.00		1,100	-	1100.00	156.76		650		650.00	92.63				0.00	0.00
62	0.138			0.00	0.00		1,100	-	1100.00	152.19		650		650.00	89.93				0.00	0.00
63	0.134			0.00	0.00		1,100	-	1100.00	147.75		650		650.00	87.31				0.00	0.00
64	0.130			0.00	0.00		1,100	-	1100.00	143.46		650		650.00	84.77				0.00	0.00
65	0.127			0.00	0.00		1,100	-	1100.00	139.28		650		650.00	82.30				0.00	0.00
66	0.123			0.00	0.00		1,100	-	1100.00	135.22		650		650.00	79.90				0.00	0.00
67	0.119			0.00	0.00		1,100	-	1100.00	131.28		650		650.00	77.58				0.00	0.00
68	0.116			0.00	0.00		1,100	-	1100.00	127.46		650		650.00	75.32				0.00	0.00
69	0.112			0.00	0.00		1,100	-	1100.00	123.75		650		650.00	73.12				0.00	0.00
70	0.109			0.00	0.00		1,100	-	1100.00	120.14		650		650.00	70.99				0.00	0.00
71	0.106			0.00	0.00		1,100	-	1100.00	116.64		650		650.00	68.92				0.00	0.00
72	0.103			0.00	0.00		1,100	-	1100.00	113.24		650		650.00	66.92				0.00	0.00
73	0.100			0.00	0.00		1,100	-	1100.00	109.95		650		650.00	64.97				0.00	0.00
74	0.097			0.00	0.00		1,100	-	1100.00	106.74		650		650.00	63.08				0.00	0.00
75	0.094			0.00	0.00		1,100	-	1100.00	103.64		650		650.00	61.24		11,095		11095.00	1045.30
76	0.092			0.00	0.00		1,100	-	1100.00	101.11		650		650.00	59.75				0.00	0.00
77	0.090			0.00	0.00		1,100	-	1100.00	98.64		650		650.00	58.29				0.00	0.00
78	0.087			0.00	0.00		1,100	-	1100.00	96.24		650		650.00	56.87				0.00	0.00
79	0.085			0.00	0.00		1,100	-	1100.00	93.89		650		650.00	55.48				0.00	0.00
80	0.083			0.00	0.00		1,100	-	1100.00	91.60		650		650.00	54.13				0.00	0.00
81	0.081			0.00	0.00		1,100	-	1100.00	89.36		650		650.00	52.81				0.00	0.00
82	0.079			0.00	0.00		1,100	-	1100.00	87.18		650		650.00	51.52				0.00	0.00
83	0.077			0.00	0.00		1,100	-	1100.00	85.06		650		650.00	50.26				0.00	0.00
84	0.075			0.00	0.00		1,100	-	1100.00	82.98		650		650.00	49.04				0.00	0.00
85	0.074			0.00	0.00		1,100	-	1100.00	80.96		650		650.00	47.84				0.00	0.00
86	0.072			0.00	0.00		1,100	-	1100.00	78.98		650		650.00	46.67				0.00	0.00
87	0.070			0.00	0.00		1,100	-	1100.00	77.06		650		650.00	45.53				0.00	0.00
88	0.068			0.00	0.00		1,100	-	1100.00	75.18		650		650.00	44.42				0.00	0.00
89	0.067			0.00	0.00		1,100	-	1100.00	73.35		650		650.00	43.34				0.00	0.00
90	0.065			0.00	0.00		1,100	-	1100.00	71.56		650		650.00	42.28				0.00	0.00
91	0.063			0.00	0.00		1,100	-	1100.00	69.81		650		650.00	41.25				0.00	0.00
92	0.062			0.00	0.00		1,100	-	1100.00	68.11		650		650.00	40.25				0.00	0.00
93	0.060			0.00	0.00		1,100	-	1100.00	66.45		650		650.00	39.26				0.00	0.00
94	0.059			0.00	0.00		1,100	-	1100.00	64.83		650		650.00	38.31				0.00	0.00
95	0.057			0.00	0.00		1,100	-	1100.00	63.25		650		650.00	37.37				0.00	0.00
96	0.056			0.00	0.00		1,100	-	1100.00	61.70		650		650.00	36.46				0.00	0.00
97	0.055			0.00	0.00		1,100	-	1100.00	60.20		650		650.00	35.57				0.00	0.00
98	0.053			0.00	0.00		1,100	-	1100.00	58.73		650		650.00	34.70				0.00	0.00
99	0.052			0.00	0.00		1,100	-	1100.00	57.30		650		650.00	33.86				0.00	0.00
100	0.051			0.00	0.00		1,100	-	1100.00	55.90		650		650.00	33.03				0.00	0.00

Figure 19: Annual Average Damages – do nothing (unblocked culvert scenario)

Summary Annual Average Damage

Sheet Nr.

Client/Authority						
Aberdeen City Council						
Project name		**Option:**				
Inchgarth Road		Option 0: Maintain existing				
Project reference	383682					
Base date for estimates (year 0)	Apr-2017	First mid-year of damage:	0	Prepared (date)		26/04/2017
Scaling factor (e.g. £m, £k, £)	£	Last mid-year of period:	100	Printed		10/05/2017
Discount rate	3.5%	PV factor for mid-year 0:	29.863	Prepared by		MN
				Checked by		LC
Applicable year (if time varying)				Checked date		10/05/2017

	Average waiting time (yrs) between events/frequency per year									Total PV
	10	**30**	50	75	**100**	150	**200**	500	Infinity	£
	0.100	0.033	0.020	0.013	0.010	0.007	0.005	0.002	0	
Damage category	Damage £									
Residential property	0	**2,693**	2,693	2,693	**2,693**	15,180	**27,667**	50,144	65,128	13,441.05
Ind/commercial (direct)	0	**0**	0	0	**0**	18,804	**37,607**	71,453	94,018	12,166.61
Residential Indirect Tangibl	0	**0**	0	0	**0**	4,121	**8,242**	15,660	20,605	2,666.45
Residential Intangible	0	**580**	580	580	**580**	725	**870**	1,131	1,305	1,248.54
Emergency services	0	**350**	350	350	**350**	4,155	**7,959**	14,807	19,373	3,158.92
Other	0	0	0	0	0	0	0	0	0	0.00
									0	0.00
									0	0.00
Total damage £	0	3,623	3,623	3,623	3,623	42,984	82,345	153,195	200,428	
Area (damagexfrequency)		121	48	24	12	78	104	353	354	

Total area, as above	1,094	
PV Factor, as above	29.863	
Present value (assuming no change in damage or event frequency)	32,682	32,681.57

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

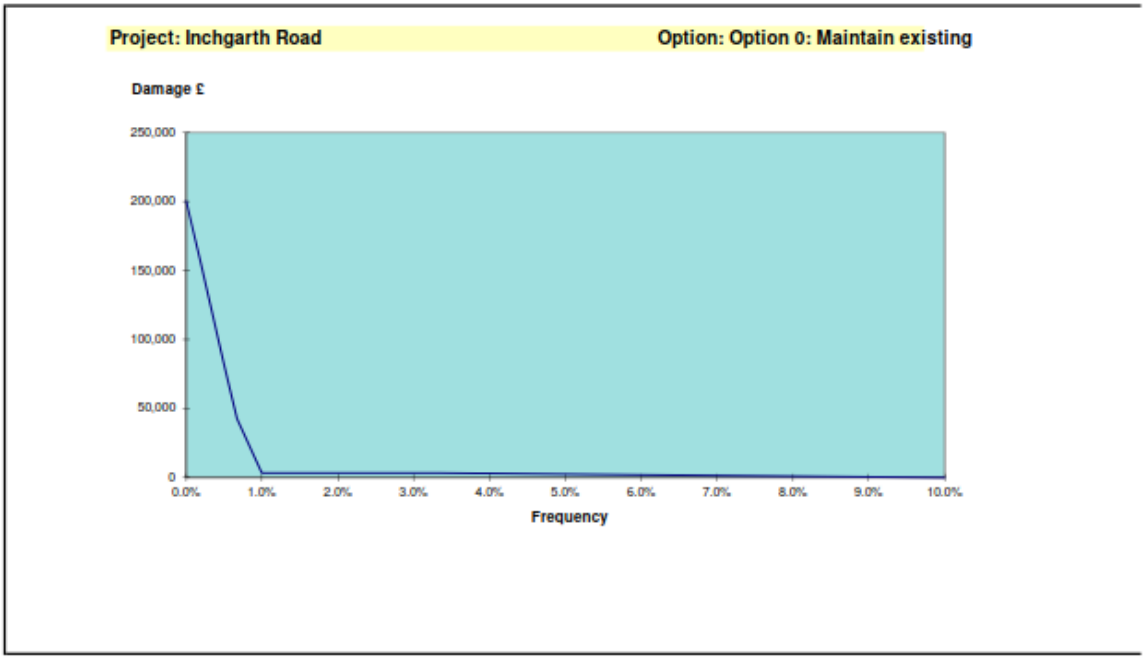


Figure 20: Annual Average Damages – do something (unblocked culvert scenario)

Summary Annual Average Damage

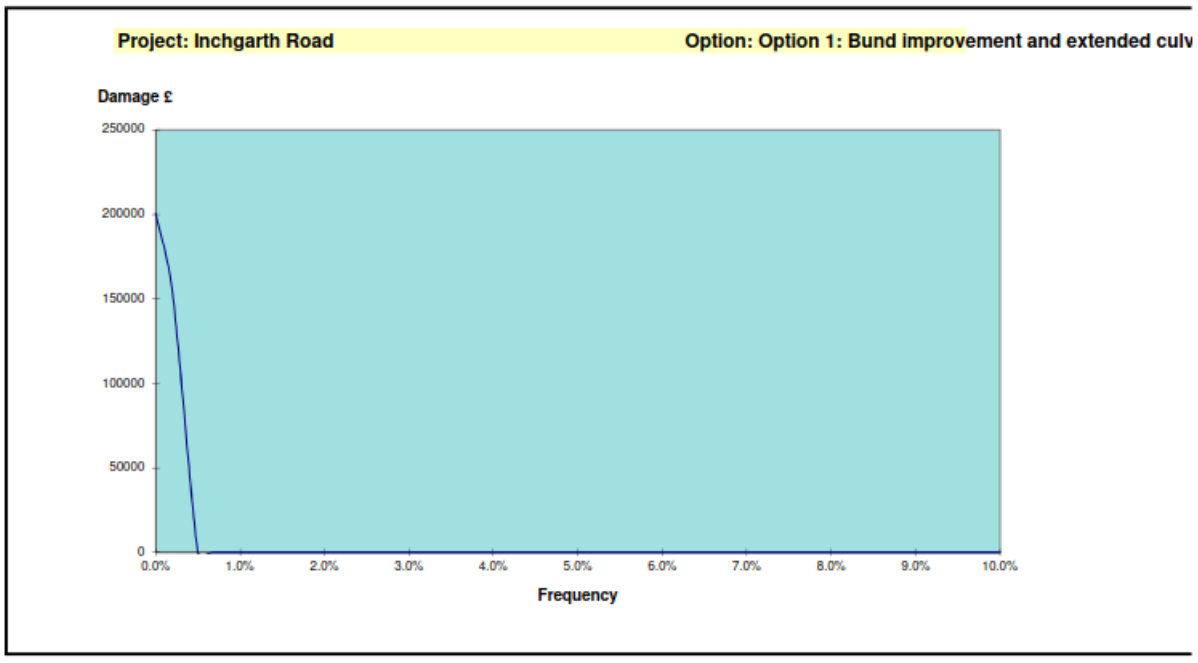
Sheet Nr.

Client/Authority					
Aberdeen City Council					
Project name		**Option:**			
Inchgarth Road		Option 1: Bund improvement and extended culvert			
Project reference	383682				
Base date for estimates (year 0)	Apr-2017	First mid-year of damage:	0	Prepared (date)	26/04/2017
Scaling factor (e.g. £m, £k, £)	£	Last mid-year of period:	100	Printed	10/05/2017
Discount rate	3.5%	PV factor for mid-year 0:	29.863	Prepared by	MN
				Checked by	LC
Applicable year (if time varying)				Checked date	10/05/2017

	Average waiting time (yrs) between events/frequency per year									Total PV
	10	25	50	75	100	150	200	500	Infinity	£
	0.100	0.040	0.020	0.013	0.010	0.007	0.005	0.002	0	
Damage category	Damage £									
Residential property								50144	65128	5,688.58
Ind/commercial (direct)								71453	94018	8,142.27
Residential Indirect Tangible								15660	20605	1,784.47
Residential Intangible								1131	1305	123.41
Emergency services								14807	19373	1,684.04
Other										0.00
										0.00
									0	0.00
Total damage £	0	0	0	0	0	0	0	153,195	200,428	
Area (damagexfrequency)		0	0	0	0	0	0	230	354	

Total area, as above	583	
PV Factor, as above	29.863	
Present value (assuming no change in damage or event frequency)	17,423	17,422.78

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet



D.2 Blocked culvert scenario

Figure 21: Summary sheet – blocked culvert scenario

Project Summary Sheet

Client/Authority		Prepared (date)	26/04/2017
Aberdeen City Council		Printed	10/05/2017
Project name		Prepared by	MN
Inchgarth Road		Checked by	LC
Project reference	383682	Checked date	
Base date for estimates (year 0)	Apr-2017		
Scaling factor (e.g. £m, £k, £)	£	(used for all costs, losses and benefits)	
Principle land use band	A	(A to E)	
Initial Discount Rate	3.5%		
Optimism bias adjustment factor	60.0%		

Costs and benefits of options

	Costs and benefits £				
	No Project	Option 1	Option 2	Option 3	
PV costs from estimates	-	622,178	713,692	30,119	
Optimism bias adjustment	-	373,307	428,215	18,071	
Total PV Costs for appraisal PVc	-	995,484	1,141,907	48,190	
PV damage PVd	136,558	27,684	27,684	27,684	
PV damage avoided		108,874	108,874	108,874	
PV assets Pva					
PV asset protection benefits		-	-	-	
Total PV benefits PVb		108,874	108,874	108,874	
Net Present Value NPV		- 886,610	- 1,033,033	60,684	
Average benefit/cost ratio		0.11	0.10	2.26	
Incremental benefit/cost ratio				-	
		-	-	Highest b/c	

Brief description of options:

Option 0: Maintain existing	No project
Option 1: Bund improvement and extended culver	Bund improvement an extended culvert - flood defences up to 1 in 200yr flood event
Option 2: Reinforcement concrete sheet piled floo	Reinforcement concrete sheet piled flood wall - flood defences up to 1 in 200yr flood event
Option 3: Property level protection	Property level protection - flood defences up to 1 in 200yr flood event

Special note to revised version:

This version of the original FCDPAG3 example 2 has been produced to illustrate the changes introduced in the March 2003 guidance on the HMT new Green Book, published in January 2003.

Original Notes:

1) Benefits will normally be expressed either in terms of damage avoided or asset values protected. Care is needed to avoid double counting

2) PV damage avoided is calculated as PV damage (No Project) - PV damage (Option)
PV asset protection benefits are calculated as PVa (Option) - PVa (No Project)
PV benefits calculated as PV damage avoided + PV asset protection benefits

3) Incremental benefit/cost ratio is calculated as:
(PVb(current option) - PVb(previous option))/(PVc(current option) - PVc(previous option))

Figure 22: Annual Average Damages – do nothing (blocked culvert scenario)

Summary Annual Average Damage

Sheet Nr.

Client/Authority										
Aberdeen City Council										
Project name				**Option:**						
Inchgarth Road				Option 0: Maintain existing						
Project reference	383682									
Base date for estimates (year 0)	Apr-2017			First mid-year of damage:	0	Prepared (date)				26/04/2017
Scaling factor (e.g. £m, £k, £)	£			Last mid-year of period:	100	Printed				10/05/2017
Discount rate	3.5%			PV factor for mid-year 0:	29.863	Prepared by				MN
						Checked by				LC
Applicable year (if time varying)						Checked date				00/01/1900

	Average waiting time (yrs) between events/frequency per year									Total PV
	10	**30**	50	75	**100**	150	**200**	500	Infinity	£
	0.100	0.033	0.020	0.013	0.010	0.007	0.005	0.002	0	
Damage category	Damage £									
Residential property	0	**37,750**	38,084	38,501	**38,918**	55,075	**71,231**	100,313	119,701	86,228.74
Ind/commercial (direct)	0	**0**	0	0	**0**	29,713	**59,425**	112,908	148,563	19,225.16
Residential Indirect Tangibl	0	**8,242**	8,242	8,242	**8,242**	8,242	**8,242**	8,242	8,242	16,408.92
Residential Intangible	0	**580**	663	766	**870**	1,160	**1,450**	1,972	2,320	1,495.98
Emergency services	0	**4,983**	5,028	5,083	**5,139**	10,078	**15,017**	23,907	29,834	13,199.39
Other	0	0	0	0	0	0	0	0	0	0.00
									0	0.00
									0	0.00
Total damage £	0	51,555	52,016	52,593	53,169	104,267	155,365	247,342	308,659	
Area (damagexfrequency)		1,719	690	349	176	262	216	604	556	
Total area, as above					4,573					
PV Factor, as above					29.863					
Present value (assuming no change in damage or event frequency)					136,558					136,558.19

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

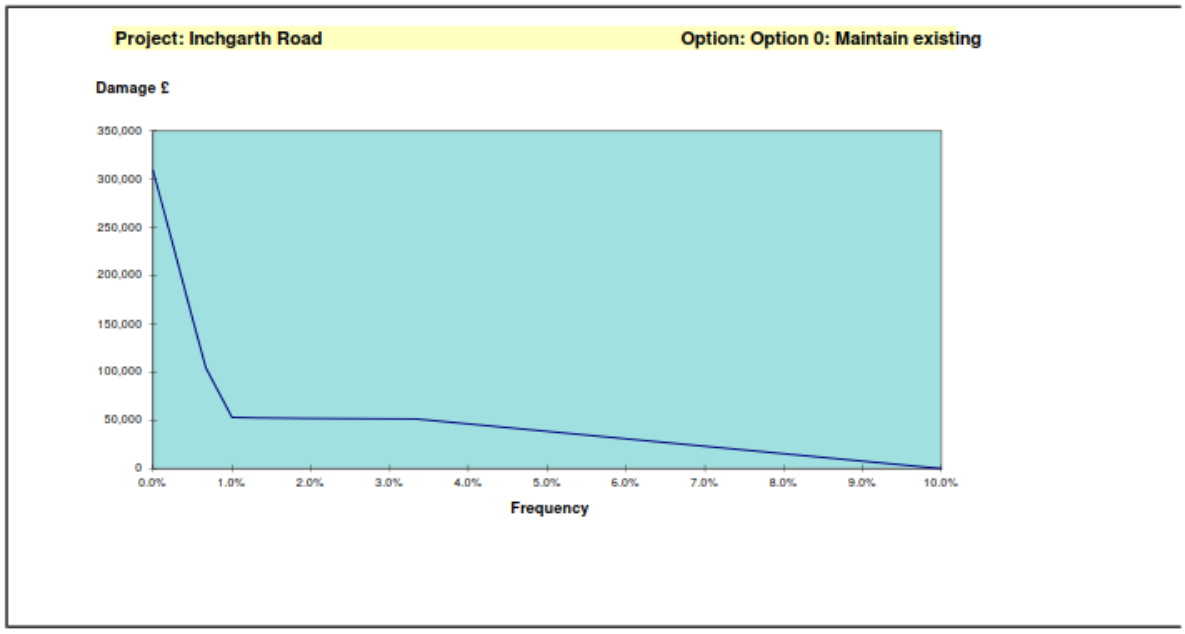


Figure 23: Annual Average Damages – do something (blocked culvert scenario)

Summary Annual Average Damage

Sheet Nr.

Client/Authority										
Aberdeen City Council										
Project name				**Option:**						
Inchgarth Road				Option 1: Bund improvement and extended culvert						
Project reference	383682									
Base date for estimates (year 0)	Apr-2017			First mid-year of damage:	0			Prepared (date)		26/04/2017
Scaling factor (e.g. £m, £k, £)	£			Last mid-year of period:	100			Printed		10/05/2017
Discount rate	3.5%			PV factor for mid-year 0:	29.863			Prepared by		MN
								Checked by		LC
Applicable year (if time varying)								Checked date		00/01/1900

	Average waiting time (yrs) between events/frequency per year									Total PV
	10	25	50	75	100	150	**200**	500	Infinity	£
	0.100	0.040	0.020	0.013	0.010	0.007	**0.005**	0.002	0	
Damage category	Damage £									
Residential property								100313	119701	11,063.85
Ind/commercial (direct)								112908	148563	12,866.07
Residential Indirect Tangible								8242	8242	861.47
Residential Intangible								1972	2320	216.51
Emergency services								23907	29834	2,675.84
Other										0.00
										0.00
									0	0.00
Total damage £	0	0	0	0	0	0	0	247,342	308,659	
Area (damagexfrequency)		0	0	0	0	0	0	371	556	

Total area, as above	927	
PV Factor, as above	29.863	
Present value (assuming no change in damage or event frequency)	27,684	27,683.74

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet