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# Appendix D

Option appraisal

## **Appendix D    Option appraisal**

### **D.1    Introduction**

As introduced in the main body of the report the option appraisal process has been divided into three phases:

- i)    Initial screening of options – “long listing”
- ii)   Qualitative consideration of options – “short listing”
- iii)   Quantitative assessment of options – “ranking”

### **D.2    Initial screening of options – “long listing”**

Full details of the initial screening process are provided within the main body of the report.

### **D.3 Qualitative consideration – “short listing”**

The Appraisal Summary Tables (ASTs) used in the “short listing” assessment of the options are provided on the following pages.

Option	1. Moorland restoration to Muckle headwaters		
Overview	<ul style="list-style-type: none"> <li>-Reducing runoff rates by blocking grips and drains</li> <li>-Reducing stocking density and introduction of heterogeneous grazing</li> <li>-Encouragement of upland woodland away from topographic ridge</li> <li>-Riparian planting</li> </ul>		
BCR overview	- Estimated as GOOD	PROGRESS	
Health & safety	-Blocking of grips and fencing will require remote working by contractor		
Uncertainties	<ul style="list-style-type: none"> <li>-Acceptance by landowner</li> <li>-Unproven approach to assessing hydrological benefits</li> <li>-Funding</li> </ul>		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Small scale works to block grips and install new fencing	Low	To be valued during next stage
Maintenance costs (PV)	Maintenance of fencing	negligible	
	<b>Description and quantification</b>	<b>Value</b>	<b>Assumptions</b>
<b>Economic</b>			
Flood risk to properties	Site contributes ~7% to flood peak in Bridge of Allan ~234 properties downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Reduced intensity landuse will decrease runoff
<b>Environment</b>			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Would reduce soil erosion from site	Small benefit	
Water	-No change to WFD status -Could improve drought resilience for water user	Small benefit	
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit	
Landscape	Increased naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Reduced stocking would impact on farm incomes	Small disbenefit	Could be partly offset by SRDP funding
Culture		No impact	
Community	Fencing could form a barrier to ramblers reducing accessibility	Small disbenefit	Gates and styles could acceptably mitigate
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	2. Moorland restoration to Danny Burn headwaters		
Overview	<ul style="list-style-type: none"> <li>-Predominant exclusion of grazing livestock from Danny catchment by new fences</li> <li>-Blocking of existing drains</li> <li>-Encouragement of the regeneration of upland woodland</li> <li>-Localised riparian planting</li> </ul>		
BCR overview	- Estimated as MARGINAL	PROGRESS	
Health & safety	-Blocking of grips and fencing will require remote working by contractor		
Uncertainties	<ul style="list-style-type: none"> <li>-Acceptance by landowner</li> <li>-Unproven approach to assessing hydrological benefits</li> </ul>		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Small scale works to block grips and install new fencing	Low	To be valued during next stage
Maintenance costs (PV)	Maintenance of fencing	negligible	
	Description and quantification	Value	Assumptions
<b>Economic</b>			
Flood risk to properties	Site contributes ~4% to flood peak in Bridge of Allan ~263 properties downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Reduced intensity landuse will decrease runoff
<b>Environment</b>			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Would reduce peat/soil erosion from the site	Small benefit	
Water	<ul style="list-style-type: none"> <li>-No change to WFD status</li> <li>-Could reduce the amount of treatment required by water users</li> <li>-Could improve drought resilience for water users</li> </ul>	Small benefit	
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit	
Landscape	New fence will be an unsightly intervention on the landscape particularly it is along the catchment boundary	Small disbenefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Would reduce the area of land available for farming, hence reducing local income. (Note existing un-intensive landuse)	Small disbenefit	To be investigated in more detail
Culture		No impact	
Community	Fencing could form a barrier to ramblers reducing accessibility	Small disbenefit	Gates and styles could acceptably mitigate
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	3. Naturalise lower Keir Burn plan form		
Overview	-Manually move the watercourse into a constructed channel away from the road -Create more natural riparian corridor fenced from livestock		
BCR overview	- Estimated as POOR	NOT PROGRESSED	
Health & safety	-Normal construction risks associated with heavy earth works -Buried and overhead services		
Uncertainties	-Acceptance by landowner -Option may result in the marginal increase of flood risk to properties at Keirallan		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Hydrological benefits would be realised on completion. A majority of ecological benefits would be realised within a couple of years.		
Capital costs (PV)	-Relatively large scale engineering works to create new river channel -Land purchase or compensation -Installing fences and tree planting	Medium - high	To be valued during next stage
Maintenance costs (PV)	Maintenance of fencing	negligible	Insignificant against capital
	Description and quantification	Value	Assumptions
Economic			
Flood risk to properties	-Keir Burn contributes to ~10% of the flood peak at Bridge of Allan -Potential increase at Keirallan ~234 properties downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Decanalisation will improve flow attenuation
Environment			
Flora and fauna	Could improve the ecological value of the currently modified watercourse by providing additional spawning and feeding habitat	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Infrequent flooding may supply rich silts	Low-negligible	
Water	May improve the WFD status of the watercourse	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Air	Heavy earthworks could result in creation of significant dust which may impact nearby properties	Small disbenefit	Limited number of properties nearby
Use of natural resources	Relatively heavy earth works to create new channel	Small disbenefit	No need to import or export material from site
Landscape	The naturalised channel would be an improvement to the local landscape which is visible from the A822	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
Social			
Way of life	Would reduce the area of land available for farming, hence reducing local income	Small disbenefit	Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	5. Naturalise the lower reaches of the Muckle Burn		
Overview	-Manually move the watercourse into a constructed channel away from the road -Create more natural riparian corridor fenced from livestock		
BCR overview	- Estimated as POOR	NOT PROGRESSED	
Health & safety	-Normal construction risks associated with heavy earth works -Buried and overhead services		
Uncertainties	-Acceptance by landowner -The existing flood embankments along the Muckle Burn create a construction on the floodplain of the Allan. This construction may cause backing up of flow. Flow on the Allan is more significant than the Muckle, hence removing the embankments may reduce attenuation.		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Hydrological benefits would be realised on completion. A majority of ecological benefits would be realised within a couple of years.		
Capital costs (PV)	-Relatively large scale engineering works to create new river channel -Land purchase or compensation -Installing fences and tree planting	Medium - high	To be valued during next stage
Maintenance costs (PV)	Maintenance of fencing	negligible	Insignificant against capital
	<b>Description and quantification</b>	<b>Value</b>	<b>Assumptions</b>
<b>Economic</b>			
Flood risk to properties	-Muckle Burn contributes to ~13% of the flood peak at Bridge of Allan ~234 properties downstream which might benefit during 200yr event channel	Small benefit	To be estimated at next stage Decanalisation will improve flow attenuation
<b>Environment</b>			
Flora and fauna	Could improve the ecological value of the currently modified watercourse by providing additional spawning and feeding habitat	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Infrequent flooding may supply rich silts	Low-negligible	
Water	May improve the WFD status of the watercourse	Small benefit	Significance could be assessed using WAT-SG-67
Air	Heavy earthworks could result in creation of significant dust which may impact nearby properties	Small disbenefit	Limited number of properties nearby
Use of natural resources	Relatively heavy earth works to create new channel	Small disbenefit	No need to import or export material from site
Landscape	The naturalised channel would be an improvement to the local landscape which is visible from the B8033	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Would reduce the area of land available for farming, hence reducing local income	Small disbenefit	Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	6. Moorland improvements in Keir Burn headwaters		
Overview	-Reducing runoff rates by blocking grips and drains -Reducing stocking density and introduction of heterogeneous grazing -Encouragement of upland woodland		
BCR overview	- Estimated as POOR	NOT PROGRESSED	
Health & safety	-Blocking of grips will require remote working by contractor		
Uncertainties	-Acceptance by landowner -Unproven approach to assessing hydrological benefits -Funding		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Small scale works to block grips and install new fencing	Low	To be valued during next stage
Maintenance costs (PV)	Maintenance of fencing	Negligible	
	Description and quantification	Value	Assumptions
<b>Economic</b>			
Flood risk to properties	-The site contributes ~5% of the flood peak at Bridge of Allan ~310 properties downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Reduced intensity landuse will decrease runoff
<b>Environment</b>			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Reduction in erosion of soil	Small benefit	
Water	May improve the WFD status of the Keir Burn	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit	
Landscape	Increased naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Reduced stocking would impact on farm incomes and shooting industry	Major disbenefit	Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	



Option	7. Moorland improvements on Meall a' Choire Odhair		
Overview	-Reducing runoff rates by blocking grips and drains -Reducing stocking density and introduction of heterogeneous grazing -Encouragement of upland woodland		
BCR overview	- Estimated as MARGINAL	NOT PROGRESSED	
Health & safety	-Blocking of grips will require remote working by contractor		
Uncertainties	-Acceptance by landowner -Unproven approach to assessing hydrological benefits -Funding		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Small scale works to block grips and install new fencing	Low	To be valued during next stage
Maintenance costs (PV)	Maintenance of fencing	Negligible	
	Description and quantification	Value	Assumptions
Economic			
Flood risk to properties	-The site contributes ~2% of the flood peak at Bridge of Allan ~310 properties downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Reduced intensity landuse will decrease runoff
Environment			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Reduction in erosion of soil	Small benefit	
Water	No impact to WFD status	No impact	
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit	
Landscape	Increased naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
Social			
Way of life	Reduced stocking would impact on farm incomes and shooting industry	Major disbenefit	Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		Small disbenefit	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	8. Improved riparian corridor on River Knaik		
Overview	-Installing riparian fencing -Riparian planting -Reduction in riparian woodland management in lower reaches		
BCR overview	- Estimated as GOOD	PROGRESSED	
Health & safety	-Comparatively low risk		
Uncertainties	-Acceptance by landowner -Unproven approach to assessing hydrological benefits		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Limited immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Installing riparian fencing and riparian planting	Low	To be valued during next stage
Maintenance costs (PV)	Maintenance of fencing	Negligible	
	<b>Description and quantification</b>	<b>Value</b>	<b>Assumptions</b>
<b>Economic</b>			
Flood risk to properties	The Knaik at the site contributes to ~23% of the flood peak at Bridge of Allan ~310 properties downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Riparian planting will slow the progression of floodwater moving through catchment
<b>Environment</b>			
Flora and fauna	Could supply LWD and shade improving aquatic habitats. Benefits to bird populations.	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil		No impact	
Water	Will not improve WFD status but likely to have ecological benefits	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Air		No impact	
Use of natural resources		No impact	
Landscape	Increased naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Would reduce the area of land available for farming, hence reducing local income	Small disbenefit	Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	9. Moorland improvements in Knaik headwaters		
Overview	<ul style="list-style-type: none"> <li>-Reducing stocking density and introduction of heterogeneous grazing</li> <li>-Blocking of drains and grips</li> <li>-Encouraging the recolonisation of upland woodland</li> </ul>		
BCR overview	- Estimated as POOR	NOT PROGRESSED	
Health & safety	-Remote working required if blocking of drains undertaken		
Uncertainties	<ul style="list-style-type: none"> <li>-Acceptance by landowner</li> <li>-Unproven approach to assessing hydrological benefits</li> <li>-Funding</li> </ul>		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Compensation of land owner	Low	To be valued during next stage
Maintenance costs (PV)		Negligible	
	Description and quantification	Value	Assumptions
Economic			
Flood risk to properties	The restoration site contributes ~10% to flood peak in Bridge of Allan ~310 properties at downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Reduced intensity landuse will decrease runoff
Environment			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Reduction in erosion of soil	Small benefit	
Water	No impact to WFD status	No impact	
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit	
Landscape	Increased naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
Social			
Way of life	Reduced stocking would impact on farm incomes and shooting industry	Major disbenefit	Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	10. Moorland improvements in MOD area		
Overview	<ul style="list-style-type: none"> <li>-Reducing stocking density and introduction of heterogeneous grazing</li> <li>-Blocking of drains and grips</li> <li>-Encouraging the recolonisation of upland woodland</li> <li>-Localised riparian planting</li> </ul>		
BCR overview	- Estimated as POOR	NOT PROGRESSED	
Health & safety	-Remote working required if blocking drains		
Uncertainties	<ul style="list-style-type: none"> <li>-Acceptance by landowner</li> <li>-Unproven approach to assessing hydrological benefits</li> <li>-Funding</li> </ul>		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Compensation of land owner	Low	To be valued during next stage
Maintenance costs (PV)		Negligible	
	Description and quantification	Value	Assumptions
<b>Economic</b>			
Flood risk to properties	The restoration site contributes ~7% to flood peak in Bridge of Allan ~310 properties at downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Reduced intensity landuse will decrease runoff
<b>Environment</b>			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Reduction in erosion of soil	Small benefit	
Water	No impact to WFD status	No impact	
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit	
Landscape	Increased naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Reduced stocking would impact on farm incomes and shooting industry	Major disbenefit	Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	11. Moorland improvements Allan headwaters		
Overview	-Reducing stocking density and introduction of heterogeneous grazing -Blocking of drains and grips -Encouraging the recolonisation of upland woodland		
BCR overview	- Estimated as POOR	NOT PROGRESSED	
Health & safety	-Remote working required if blocking drains		
Uncertainties	-Acceptance by landowner -Unproven approach to assessing hydrological benefits -Funding		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Compensation of landowner	Low	To be valued during next stage
Maintenance costs (PV)		Negligible	
	Description and quantification	Value	Assumptions
<b>Economic</b>			
Flood risk to properties	The restoration site contributes ~3% to flood peak in Bridge of Allan ~263 properties at downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Reduced intensity landuse will decrease runoff
<b>Environment</b>			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Reduction in erosion of soil	Small benefit	
Water	No impact to WFD status	No impact	
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit	
Landscape	Increased naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Reduced stocking would impact on farm incomes	Major disbenefit	Could be partly offset by SRDP funding
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	17. Manually create a restored channel for Allan Water near Carsebreck		
Overview	-Manually create restored channel into which the Allan can be diverted through heavy earthworks over approximately a 1-2km reach depending on constraints		
BCR overview	- Estimated as MARGINAL	NOT PROGRESSED (in favour of next option)	
Health & safety	-Remote working required		
Uncertainties	-Acceptance by landowner -Unproven approach to assessing hydrological benefits		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Hydrological benefits would be immediate, ecological benefits would take a couple of seasons		
Capital costs (PV)	Relatively intensive earthworks	High	To be valued during next stage
Maintenance costs (PV)	Proximity to railway and SAC would require good quality post construction monitoring	Low	To be valued during next stage
	Description and quantification	Value	Assumptions
<b>Economic</b>			
Flood risk to properties	The Allan at this reach contributes ~21% to flood peak in Bridge of Allan ~234 properties at downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Restored channel would slow the movement of floodwater through the catchment
<b>Environment</b>			
Flora and fauna	Could improve the ecological value of the currently modified watercourse by providing additional spawning and feeding habitat	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Reduction in erosion on reach	Small benefit	
Water	Could result in an improvement in the WFD status of the reach	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Air	The earthworks could generate large amounts of dust, but limited impact due absence of receptors	Negligible	
Use of natural resources	The heavy earthworks would require the use of large plant with resulting release of carbon	Small disbenefit	The works would not require the bulk import or export of materials
Landscape	The reach is very visible from the railway line and the restoration would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Could result in improved sport fishing in the area by improving fish stocks	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Culture		No impact	
Community	(Opportunity to improve access for walkers as part of the project)	Not included	Could be valued using DfT willingness to pay guidance
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit	

Option	19. Cease maintenance of the straightened Allan Water channel		
Overview	<ul style="list-style-type: none"> <li>-Cease all intensive maintenance of reach</li> <li>-Undertake strategic roughening using riparian planting, boulder placements and possibly the placement of large woody debris</li> <li>-Continue low intensity use of surrounding land</li> </ul>		
BCR overview	- Estimated as GOOD	PROGRESSSED	
Health & safety	-Comparatively low risk		
Uncertainties	<ul style="list-style-type: none"> <li>-Acceptance by landowner and rail track</li> <li>-Unproven approach to assessing hydrological benefits</li> <li>-Channel may have insufficient energy to bring about the changes in an acceptable time period</li> <li>-A large flood event could result in the deposition of significant quantities of material downstream which could exacerbate flooding or cause environmental damage</li> </ul>		
Future adaptation	<ul style="list-style-type: none"> <li>-Does not eliminate the implementation of any FRM option in the future</li> <li>-Partially prohibits the return of the surrounding land to agricultural production</li> </ul>		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a number of decades		
Capital costs (PV)	Small scale works to undertake strategic roughening Compensation of landowner	Low	To be valued during next stage
Maintenance costs (PV)	Large scale monitoring and with potential for large scale intervention if things go wrong	Low-medium	To be valued during next stage
	<b>Description and quantification</b>	<b>Value</b>	<b>Assumptions</b>
<b>Economic</b>			
Flood risk to properties	The Allan at this reach conveys ~27% of flood peak in Bridge of Allan ~234 properties at downstream which might benefit during 200yr event	Small benefit	To be estimated at next stage Restored channel would slow the movement of floodwater through the catchment
<b>Environment</b>			
Flora and fauna	Could improve the ecological value of the currently modified watercourse by providing additional spawning and feeding habitat	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Soil	Reduction in erosion on reach	Small benefit	
Water	Could result in an improvement in the WFD status of the reach	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Air		No impact	
Use of natural resources		No impact	
Landscape	The reach is very visible from the railway line and the eventual naturalisation would be an improvement	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Could result in improved sport fishing in the area by improving fish stocks	Small benefit	Significance could be assessed using WAT-SG-67 at next stage
Culture		No impact	
Community	The local community will be alarmed to see what may be perceived as the neglect of the watercourse	Small disbenefit	
Fears and aspirations	The option may be perceived as nothing being done to manage flood risk	Small disbenefit	





## D.4 Quantitative assessment of options – “ranking”

### D.4.1 Assessment to change in flood risk

The methodology used to make a quantified estimate of the reduction in flood risk as a consequence of implementing the four natural flood management options is presented in Section 4 of the main report body. The estimated impacts of these changes to the catchment on flood flows are presented in Table D-1, Table D-2, Table D-3, Table D-4, Table D-5, Table D-6 and Table D-7.

Option	2yr	10yr	50yr	100yr	200yr	500yr
<b>Muckle Burn headwaters</b>	98.4%	98.9%	99.2%	99.3%	99.4%	99.5%
<b>Danny Burn headwaters</b>	98.4%	98.5%	98.7%	98.8%	98.9%	99.0%
<b>River Knaik riparian corridor</b>	99.4%	99.4%	99.4%	99.4%	99.4%	99.5%
<b>Allan Water decanalisation</b>	99.6%	99.6%	99.5%	99.5%	99.5%	99.5%

Table D-1: Estimated percentage change in flood flows on the Allan Water at Bridge of Allan for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr	500yr
<b>Muckle Burn headwaters</b>	98.3%	98.9%	99.2%	99.3%	99.4%	99.5%
<b>Danny Burn headwaters</b>	98.4%	98.4%	98.7%	98.8%	98.9%	99.0%
<b>River Knaik riparian corridor</b>	99.4%	99.4%	99.4%	99.4%	99.4%	99.4%
<b>Allan Water decanalisation</b>	99.6%	99.5%	99.5%	99.5%	99.5%	99.5%

Table D-2: Estimated percentage change in flood flows on the Allan Water at Dunblane for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr	500yr
<b>Muckle Burn headwaters</b>	98.2%	98.8%	99.2%	99.3%	99.4%	98.6%
<b>Danny Burn headwaters</b>	98.3%	98.4%	98.6%	98.7%	98.8%	99.0%
<b>River Knaik riparian corridor</b>	99.4%	99.4%	99.4%	99.4%	99.4%	98.5%
<b>Allan Water decanalisation</b>	99.6%	99.5%	99.5%	99.5%	99.5%	98.6%

Table D-3: Estimated percentage change in flood flows on the Allan Water at Kinbuck for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr	500yr
<b>Muckle Burn headwaters</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Danny Burn headwaters</b>	97.7%	97.8%	98.1%	98.3%	98.4%	98.6%
<b>River Knaik riparian corridor</b>	99.1%	99.1%	99.1%	99.2%	99.2%	99.2%
<b>Allan Water decanalisation</b>	99.4%	99.3%	99.3%	99.3%	99.3%	99.3%

Table D-4: Estimated percentage change in flood flows on the Allan Water downstream of the Keir Burn confluence for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr	500yr
<b>Muckle Burn headwaters</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Danny Burn headwaters</b>	89.7%	92.2%	94.1%	94.7%	95.3%	96.0%
<b>River Knaik riparian corridor</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Allan Water decanalisation</b>	98.3%	98.2%	98.2%	98.2%	98.2%	98.2%

Table D-5: Estimated percentage change in flood flows on the Allan Water upstream of the River Knaik confluence for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr	500yr
<b>Muckle Burn headwaters</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Danny Burn headwaters</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>River Knaik riparian corridor</b>	97.9%	97.9%	98.0%	98.0%	98.0%	98.0%
<b>Allan Water decanalisation</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table D-6: Estimated percentage change in flood flows on the River Knaik at Braco for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr	500yr
<b>Muckle Burn headwaters</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Danny Burn headwaters</b>	73.4%	75.1%	78.7%	80.4%	81.9%	83.9%
<b>River Knaik riparian corridor</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Allan Water decanalisation</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table D-7: Estimated percentage change in flood flows on the Danny Water at Blackford each of the assessed natural flood management options

The estimated reduced flood event return period as a consequence of the implementation of each of the quantitatively considered natural flood management measures are presented in Table D-8, Table D-9, Table D-10, Table D-11, Table D-12, Table D-13 and Table D-14.

Option	2yr	10yr	50yr	100yr	200yr
<b>Muckle Burn headwaters</b>	2.0	10.3	51.2	102.1	203.9
<b>Danny Burn headwaters</b>	2.0	10.4	52.0	103.9	207.5
<b>River Knaik riparian corridor</b>	2.0	10.2	50.9	101.8	203.8
<b>Allan Water decanalisation</b>	2.0	10.1	50.7	101.5	203.3

Table D-8: Estimated reduced flood return periods for events on the Allan Water at Bridge of Allan for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr
<b>Muckle Burn headwaters</b>	2.0	10.3	51.3	102.2	204.0
<b>Danny Burn headwaters</b>	2.0	10.5	52.1	104.0	207.7
<b>River Knaik riparian corridor</b>	2.0	10.2	50.9	101.9	203.9
<b>Allan Water decanalisation</b>	2.0	10.1	50.8	101.6	203.4

Table D-9: Estimated reduced flood return periods for events on the Allan Water at Dunblane for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr
<b>Muckle Burn headwaters</b>	2.0	10.4	51.3	102.3	204.2
<b>Danny Burn headwaters</b>	2.0	10.5	52.2	104.2	208.0
<b>River Knaik riparian corridor</b>	2.0	10.2	51.0	102.0	204.2
<b>Allan Water decanalisation</b>	2.0	10.1	50.8	101.7	203.6

Table D-10: Estimated reduced flood return periods for events on the Allan Water at Kinbuck for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr
<b>Muckle Burn headwaters</b>	2.0	10.0	50.0	100.0	200.0
<b>Danny Burn headwaters</b>	2.0	10.7	53.0	105.6	211.0
<b>River Knaik riparian corridor</b>	2.0	10.3	51.3	102.7	205.6
<b>Allan Water decanalisation</b>	2.0	10.2	51.1	102.3	204.9

Table D-11: Estimated reduced flood return periods for events on the Allan Water downstream of the Keir Burn confluence for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr
<b>Muckle Burn headwaters</b>	2	10	50	100	200
<b>Danny Burn headwaters</b>	2.0	10.0	50.0	100.0	200.0
<b>River Knaik riparian corridor</b>	2.2	12.3	59.4	117.1	232.5
<b>Allan Water decanalisation</b>	2.0	10.0	50.0	100.0	200.0

Table D-12: Estimated reduced flood return periods for events on the Allan Water upstream of the River Knaik confluence for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr
<b>Muckle Burn headwaters</b>	2.0	10.0	50.0	100.0	200.0
<b>Danny Burn headwaters</b>	2.0	10.0	50.0	100.0	200.0
<b>River Knaik riparian corridor</b>	2.0	10.6	53.3	106.8	214.3
<b>Allan Water decanalisation</b>	2.0	10.0	50.0	100.0	200.0

Table D-13: Estimated reduced flood return periods for events on the River Knaik at Braco for each of the assessed natural flood management options

Option	2yr	10yr	50yr	100yr	200yr
<b>Muckle Burn headwaters</b>	2.0	10.0	50.0	100.0	200.0
<b>Danny Burn headwaters</b>	3.1	20.3	97.9	190.2	373.0
<b>River Knaik riparian corridor</b>	2.0	10.0	50.0	100.0	200.0
<b>Allan Water decanalisation</b>	2.0	10.0	50.0	100.0	200.0

Table D-14: Estimated reduced flood return periods for events on the Danny Water at Blackford each of the assessed natural flood management options

The appraisal summary tables developed as part of the ranking process are supplied on the following pages.

Option	1. Moorland restoration to Muckle headwaters		
Overview	<ul style="list-style-type: none"> <li>-Reducing runoff rates by blocking grips and drains</li> <li>-Reducing stocking density and introduction of heterogeneous grazing</li> <li>-Encouragement of upland woodland away from topographic ridge</li> <li>-Riparian planting</li> </ul>		
BCR overview	0.14	<b>RANK: 4</b>	
Health & safety	-Blocking of grips and fencing will require remote working by contractor		
Uncertainties	<ul style="list-style-type: none"> <li>-Acceptance by landowner</li> <li>-Unproven approach to assessing hydrological benefits</li> <li>-Funding</li> </ul>		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Small scale works to block grips, tree planting and install new fencing	£142k PV	Estimated using unit rate date (includes OB)
Maintenance costs (PV)	Maintenance of fencing and establishment of trees	£45k PV	Estimated using unit rate date (includes OB)
	<b>Description and quantification</b>	<b>Value</b>	<b>Assumptions</b>
<b>Economic</b>			
Flood risk to properties	Site contributes ~7% to flood peak in Bridge of Allan ~234 properties downstream which might benefit during 200yr event	£31k PV	Evaluated using a simplified MCM procedure Reduced intensity landuse will decrease runoff
<b>Environment</b>			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit of very low significance	Significance assessed using WAT-SG-67
Soil	Would reduce soil erosion from site	Small benefit, of negligible significance	
Water	-No change to WFD status -Could improve drought resilience for water user	Small benefit of negligible significance	Significance assessed using WAT-SG-67
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit of negligible significance	
Landscape	Increased naturalisation would be an improvement	Small benefit of low significance	Significance assessed using WAT-SG-67
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Reduced stocking would impact on farm incomes	Small disbenefit of low significance	Could be partly offset by SRDP funding Significance assessed using WAT-SG-67
Culture		No impact	
Community	Fencing could form a barrier to ramblers reducing accessibility	Small disbenefit of very low significance	Gates and styles could acceptably mitigate Significance assessed using WAT-SG-67
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit of negligible significance	

Option	2. Further reduction of sheep/deer from Danny Burn catchment		
Overview	<ul style="list-style-type: none"> <li>-Predominant exclusion of grazing livestock from Danny catchment by new fences</li> <li>-Blocking of existing drains</li> <li>-Encouragement of the regeneration of upland woodland</li> <li>-Localised riparian planting</li> </ul>		
BCR overview	0.21	<b>RANK: 3</b>	
Health & safety	-Blocking of grips and fencing will require remote working by contractor		
Uncertainties	-Acceptance by landowner    -Unproven approach to assessing hydrological benefits		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Small scale works to block grips, tree planting and install new fencing	£183k PV	Estimated using unit rate date (includes OB)
Maintenance costs (PV)	Maintenance of fencing and establishment of trees	£56k PV	Estimated using unit rate date (includes OB)
	<b>Description and quantification</b>	<b>Value</b>	<b>Assumptions</b>
<b>Economic</b>			
Flood risk to properties	Site contributes ~4% to flood peak in Bridge of Allan ~263 properties downstream which might benefit during 200yr event	£56k PV	Evaluated using a simplified MCM procedure Reduced intensity landuse will decrease runoff
<b>Environment</b>			
Flora and fauna	Improvement in habitat for ground nesting birds	Small benefit of very low significance	Significance assessed using WAT-SG-67
Soil	Would reduce peat/soil erosion from the site	Small benefit	Not valued
Water	<ul style="list-style-type: none"> <li>-No change to WFD status</li> <li>-Could reduce the amount of treatment required by water users</li> <li>-Could improve drought resilience for water users</li> </ul>	Small benefit of negligible significance	Significance assessed using WAT-SG-67
Air		No impact	
Use of natural resources	Improve moorland's ability to act as a carbon sink	Small benefit of negligible significance	Significance assessed using WAT-SG-67
Landscape	New fence may be an unsightly intervention on the landscape particularly if it is along the catchment boundary. Regeneration of woodland will only be visible from within the localised area	Small disbenefit of negligible significance	Significance assessed using WAT-SG-67
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Would reduce the area of land available for farming, hence reducing local income. (Note existing un-intensive landuse within Highland Springs area)	Small disbenefit of low significance	Significance assessed using WAT-SG-67
Culture		No impact	
Community	Fencing could form a barrier to ramblers reducing accessibility	Small disbenefit of very low significance	Significance assessed using WAT-SG-67 Gates and styles could acceptably mitigate



Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit, negligible significance	
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Option	8. Improved riparian corridor on River Knaik		
Overview	-Installing riparian fencing -Riparian planting -Reduction in riparian woodland management in lower reaches		
BCR overview	0.18	<b>RANK: 2</b>	
Health & safety	-Comparatively low risk		
Uncertainties	-Acceptance by landowner -Unproven approach to assessing hydrological benefits		
Future adaptation	-Does not eliminate the implementation of any FRM option in the future		
Fruition timescale	Limited immediate benefits, a majority of benefits realised within a decade		
Capital costs (PV)	Small scale works to block grips, tree planting and install new fencing	£138k PV	Estimated using unit rate date (includes OB)
Maintenance costs (PV)	Maintenance of fencing and establishment of trees	£46k PV	Estimated using unit rate date (includes OB)
	Description and quantification	Value	Assumptions
Economic			
Flood risk to properties	The Knaik at the site contributes to ~23% of the flood peak at Bridge of Allan ~310 properties downstream which might benefit during 200yr event	£41k PV	Evaluated using a simplified MCM procedure Riparian planting will slow the progression of floodwater moving through catchment
Environment			
Flora and fauna	Could supply LWD and shade improving aquatic habitats. Benefits to bird and other terrestrial populations	Small benefit of very low significance	Significance assessed using WAT-SG-67
Soil		No impact	Not valued
Water	Will not improve WFD status but likely to have ecological benefits	Small benefit of negligible significance	Significance assessed using WAT-SG-67
Air		No impact	
Use of natural resources		No impact	
Landscape	Increased naturalisation would be an improvement and would be visible from the nearby road	Small benefit or low significance	Significance assessed using WAT-SG-67
Cultural heritage		No impact	
Social			
Way of life	Would reduce the area of land available for farming, hence reducing local income	Small disbenefit of low significance	Significance assessed using WAT-SG-67 Could be partly offset by SRDP funding. To be investigated in more detail
Culture		No impact	
Community		No impact	
Fears and aspirations	Works could be viewed locally as being too little and ineffective. Thus turning opinions away from NFM	Small disbenefit, of negligible significance	Significance assessed using WAT-SG-67

Option	19. Cease maintenance of the straightened Allan Water channel		
Overview	<ul style="list-style-type: none"> <li>-Cease all intensive maintenance of reach</li> <li>-Undertake strategic roughening using riparian planting, boulder placements and possibly the placement of large woody debris</li> <li>-Continue low intensity use of surrounding land</li> </ul>		
BCR overview	0.14	<b>RANK: 1</b>	
Health & safety	-Comparatively low risk		
Uncertainties	<ul style="list-style-type: none"> <li>-Acceptance by landowner and rail track</li> <li>-Unproven approach to assessing hydrological benefits</li> <li>-Channel may have insufficient energy to bring about the changes in an acceptable time period</li> <li>-A large flood event could result in the deposition of significant quantities of material downstream which could exacerbate flooding or cause environmental damage</li> </ul>		
Future adaptation	<ul style="list-style-type: none"> <li>-Does not eliminate the implementation of any FRM option in the future</li> <li>-Partially prohibits the return of the surrounding land to agricultural production</li> </ul>		
Fruition timescale	Some immediate benefits, a majority of benefits realised within a number of decades		
Capital costs (PV)	Small scale works to undertake localised riparian planting, boulder placements and placement of large woody debris	£26k PV	Estimated using unit rate date (includes OB)
Maintenance costs (PV)	Post implementation monitoring	£71k PV	Estimated using unit rate date (includes OB)
	<b>Description and quantification</b>	<b>Value</b>	<b>Assumptions</b>
<b>Economic</b>			
Flood risk to properties	The Allan at this reach conveys ~27% of flood peak in Bridge of Allan ~234 properties at downstream which might benefit during 200yr event	£19k PV	Evaluated using a simplified MCM procedure Restored channel would slow the movement of floodwater through the catchment
<b>Environment</b>			
Flora and fauna	Could improve the ecological value of the currently modified watercourse by providing additional spawning and feeding habitat	Small benefit of low significance	Significance assessed using WAT-SG-67
Soil	Reduction in erosion on reach	Small benefit	Not valued
Water	Could result in an improvement in the WFD status of the reach	Small benefit of medium significance	Significance assessed using WAT-SG-67
Air		No impact	
Use of natural resources		No impact	
Landscape	The reach is very visible from the railway line and the eventual naturalisation would be an improvement	Small benefit of medium significance	Significance assessed using WAT-SG-67
Cultural heritage		No impact	
<b>Social</b>			
Way of life	Could result in improved sport fishing in the area by improving fish stocks.	Small benefit of low significance	Significance assessed using WAT-SG-67
Culture		No impact	
Community	The local community will be alarmed to see what may be perceived as the neglect of the watercourse. Could offer improved recreational facility for walkers.	Small disbenefit of negligible significance	
Fears and aspirations	The option may be perceived as nothing being done to manage flood risk	Small disbenefit of negligible significance	



## Allan Water - Natural Flood Management - Muckle headwaters

COST SUMMARY		2011 Q1	
1.2m high stock proof fencing (reduced stocking)	4050 m	£	28,500
1.2m high stock proof fencing (riparian planting)	3085 m	£	21,700
Provision of gates, stiles and crossing points (1/km)	7 nr	£	1,700
Riparian tree planting (300-600mm whips)	9375 nr	£	8,900
Supply and install tree protector tube	9375 nr	£	14,100
<b>DIRECT COST</b>		<b>£</b>	<b>75,000</b>
Contractor's preliminaries	15%	£	11,300
Contractor's head office overheads	6%	£	4,500
Contractor's profit	5%	£	3,800
Maintenance of loans	2%	£	1,500
<b>TENDER SUM (ESTIMATED)</b>		<b>£</b>	<b>97,000</b>
Optimism bias	60%	£	45,000
<b>TOTAL CONSTRUCTION COST (INCLUDING OB)</b>		<b>£</b>	<b>142,000</b>
Estimated maintenance & monitoring cost (PV, without OB)		£	45,000
<b>Notes:</b>			
1. All prices relevant to the stated period and are exclusive of VAT.			
2. Cost estimate does not include the purchase and rental or negotiations for land or access associated with the works.			
3. Costing assumes that works are undertaken through a single contract over a reasonable timescale.			
4. It has been assumed that the works will not require planning consent.			
5. No allowance has been made for delays due to unfavourable weather.			
6. The estimate is based on the assumption that there is no requirement to divert or protect services.			
7. It has been assumed that all excavated ground will be free from contamination, buried archaeology, above the water table and generally easily worked.			
8. It is assumed that specific mitigation measures for protected or invasive species will not be required.			
9. It is assumed that the landowner will be supportive of the adopted measures.			

## Allan Water - Natural Flood Management - Danny headwaters

COST SUMMARY		2011 Q1	
1.2m high stock proof fencing (50% of perimeter)	8750 m	£	61,600
Provision of gates, stiles and crossing points	18 nr	£	4,400
Riparian tree planting (300-600mm whips)	18125 nr	£	17,200
Supply and install spiral tree protectors	18125 nr	£	13,600
<b>DIRECT COST</b>		<b>£</b>	<b>97,000</b>
Contractor's preliminaries	15%	£	14,600
Contractor's head office overheads	6%	£	5,900
Contractor's profit	5%	£	4,900
Maintenance of loans	2%	£	2,000
<b>TENDER SUM (ESTIMATED)</b>		<b>£</b>	<b>125,000</b>
Optimism bias	60%	£	58,200
<b>TOTAL CONSTRUCTION COST (INCLUDING OB)</b>		<b>£</b>	<b>183,200</b>
Estimated maintenance & monitoring cost (PV, without OB)		£	56,000
<b>Notes:</b>			
<ol style="list-style-type: none"> <li>1. All prices relevant to the stated period and are exclusive of VAT.</li> <li>2. Cost estimate does not include the purchase and rental or negotiations for land or access associated with the works.</li> <li>3. Costing assumes that works are undertaken through a single contract over a reasonable timescale.</li> <li>4. It has been assumed that the works will not require planning consent.</li> <li>5. No allowance has been made for delays due to unfavourable weather.</li> <li>6. The estimate is based on the assumption that there is no requirement to divert or protect services.</li> <li>7. It has been assumed that all excavated ground will be free from contamination, buried archaeology, above the water table and generally easily worked.</li> <li>8. It is assumed that specific mitigation measures for protected or invasive species will not be required.</li> <li>9. It is assumed that the landowner will be supportive of the adopted measures.</li> </ol>			

## Allan Water - Natural Flood Management - Knaik Riparian Corridor

COST SUMMARY		2011 Q1	
1.2m high stock proof fencing (75% new riparian planting)	4350 m	£	30,600
1.2m high stock proof fencing (25% of existing riparian)	2618.75 m	£	18,400
Provision of gates, stiles and crossing points (2/km)	14 nr	£	3,400
Riparian tree planting (300-600mm whips)	11625 nr	£	11,000
Supply and install spiral tree protectors	11625 nr	£	8,700
<b>DIRECT COST</b>		<b>£</b>	<b>73,000</b>
Contractor's preliminaries	15%	£	11,000
Contractor's head office overheads	6%	£	4,400
Contractor's profit	5%	£	3,700
Maintenance of loans	2%	£	1,500
<b>TENDER SUM (ESTIMATED)</b>		<b>£</b>	<b>94,000</b>
Optimism bias	60%	£	43,800
<b>TOTAL CONSTRUCTION COST (INCLUDING OB)</b>		<b>£</b>	<b>137,800</b>
Estimated maintenance & monitoring cost (PV, without OB)		£	46,000
<b>Notes:</b>			
<ol style="list-style-type: none"> <li>1. All prices relevant to the stated period and are exclusive of VAT.</li> <li>2. Cost estimate does not include the purchase and rental or negotiations for land or access associated with the works.</li> <li>3. Costing assumes that works are undertaken through a single contract over a reasonable timescale.</li> <li>4. It has been assumed that the works will not require planning consent.</li> <li>5. No allowance has been made for delays due to unfavourable weather.</li> <li>6. The estimate is based on the assumption that there is no requirement to divert or protect services.</li> <li>7. It has been assumed that all excavated ground will be free from contamination, buried archaeology, above the water table and generally easily worked.</li> <li>8. It is assumed that specific mitigation measures for protected or invasive species will not be required.</li> <li>9. It is assumed that the landowner will be supportive of the adopted measures.</li> </ol>			

## Allan Water - Natural Flood Management - Allan Water Naturalisation

COST SUMMARY		2011 Q1	
1.2m high set back stock proof fencing	1500 m	£	10,600
Provision of gates, stiles and crossing points (1/km)	2 nr	£	500
Riparian tree planting (300-600mm whips)	1250 nr	£	1,200
Supply and install spiral tree protectors	1250 nr	£	900
<b>DIRECT COST</b>		<b>£</b>	<b>14,000</b>
Contractor's preliminaries	15%	£	2,100
Contractor's head office overheads	6%	£	900
Contractor's profit	5%	£	700
Maintenance of loans	2%	£	300
<b>TENDER SUM (ESTIMATED)</b>		<b>£</b>	<b>18,000</b>
Optimism bias	60%	£	8,400
<b>TOTAL CONSTRUCTION COST (INCLUDING OB)</b>		<b>£</b>	<b>26,400</b>
Estimated maintenance & monitoring cost (PV, without OB)		£	71,000
<b>Notes:</b>			
<ol style="list-style-type: none"> <li>1. All prices relevant to the stated period and are exclusive of VAT.</li> <li>2. Cost estimate does not include the purchase and rental or negotiations for land or access associated with the works.</li> <li>3. Costing assumes that works are undertaken through a single contract over a reasonable timescale.</li> <li>4. It has been assumed that the works will not require planning consent.</li> <li>5. No allowance has been made for delays due to unfavourable weather.</li> <li>6. The estimate is based on the assumption that there is no requirement to divert or protect services.</li> <li>7. It has been assumed that all excavated ground will be free from contamination, buried archaeology, above the water table and generally easily worked.</li> <li>8. It is assumed that specific mitigation measures for protected or invasive species will not be required.</li> <li>9. It is assumed that the landowner will be supportive of the adopted measures.</li> </ol>			

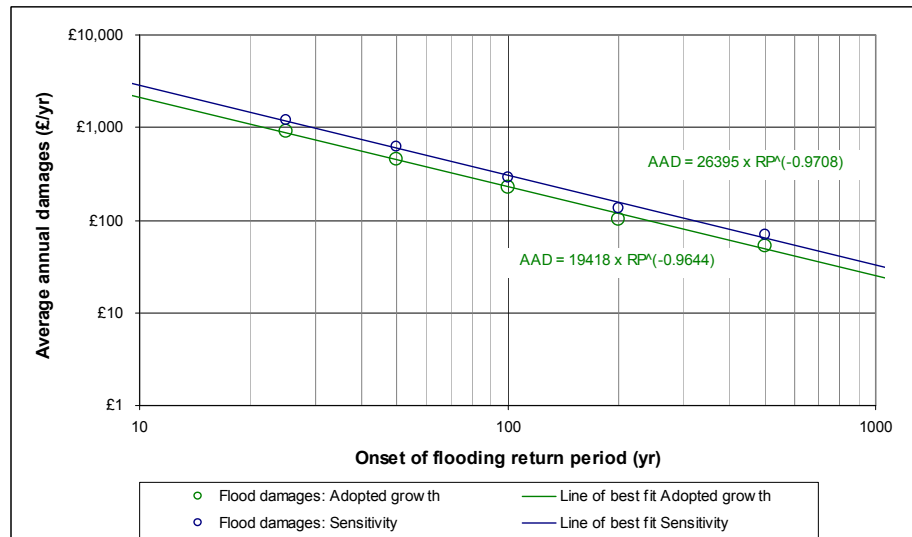


## D.4.2 Economic benefits sensitivity

It is accepted that the method used to the damage assessment has a number of shortcomings and is likely to give a significant underestimation of the benefits. For this reason a sensitivity test has been conducted to enable a better understanding of the magnitude of the error. The following changes were made to the original damage assessment:

- The flood depth curve was increased by 25%
- Where the 100yr flood map was the lowest available return period, 10% of properties identified as being at risk during the 100yr event were assumed to flood during the 50yr event
- A DEFRA social class weighting factor of 1.12 was applied to all damages

The following average annual damages against standard of protection curve was generated.



The average annual damages for the sensitivity case are presented in the table below. This demonstrates approximately a 20% increase in damages over those adopted by the study.

Option	Average annual damages in baseline	Average annual damages (after full realisation)	Average annual economic benefits (damages avoided)
1. Muckle Burn headwaters	£126,121/yr	£124,409/yr	£1,712/yr
2. Danny Burn headwaters	£126,121/yr	£123,002/yr	£3,119/yr
8. River Knaik riparian corridor	£126,121/yr	£123,529/yr	£2,592/yr
17. Allan reduced maintenance	£126,121/yr	£124,949/yr	£1,172/yr