

SRN-DDR-035: Reservoir Safety Enhancement Cost Evidence Case

28th August 2024
Version 1.0



from
**Southern
Water** 

Contents

1.	Introduction	3
1.1.	What has changed since October?	3
2.	Ofwat's Draft Determination	4
3.	Our response	4
3.1	Need for enhancement investment	4
3.1	Best option for customers	7
3.1.1.	Spillways	7
3.1.2.	Drawdown	10
3.2	Cost efficiency	11
3.2.1.	Spillways	11
3.2.2.	Drawdown	11
3.3	Customer protection	13
4.	Business Plan Dependencies	13
5.	Appendix A	14
6.	Appendix B	15
7.	Appendix C	16
	Table 1: Weirwood	5
	Table 2: Darwell	6
	Table 3: Cost Summary for Darwell and Weirwood Safety Enhancements	6
	Table 4: Spillway Options for Weirwood	7
	Table 5: Spillway Options for Weirwood	11
	Table 6: Breakdown of Uplift for Bewl Reservoir Costs	12
	Table 7: Drawdown costs for Weirwood and Darwell	12

1. Introduction

This document follows on from our **Reservoir Safety** enhancement business case (**SRN32**), and outlines changes since our October submission as well as responding to Ofwat's challenges as part of the Draft Determination we received in July 24. This document addresses Ofwat's deep dive on the allocated allowance of **£9m** vs originally requested **£24.86m** (noting Ofwat assessed **£21.2m**).

1.1. What has changed since October?

Since our October business plan submission, we have made several updates to our draft plan which means we are requesting an allowance of **£30.91m**.

These changes include:

1) Change in Scope

We now have **greater scope certainty** from the **All Reservoirs Panel (S10 report)** which includes minor changes to mandatory scope. The All Reservoir Panel Engineer (ARPE) for our Weir Wood Surface Water Reservoir (SWR) has issued the s10 inspection report to us. The report has recommended an **auxiliary spillway** to reduce the risk of failure associated with flood and wave overtopping of the crest, which will be formed close to the left abutment to augment overflow capacity. This auxiliary spillway will be applied to **both Weir Wood and Darwell**. Ofwat identified **£2.425m** related to general maintenance or with an unknown driver as part of Draft Determination. We believe the **£2.425m** Ofwat identified relates to the valve actuation and piezometer works and we have **excluded** these as part of our revised submission as we have identified these activities as being part of maintenance activity.

2) Updated cost estimates

Weir Wood and **Darwell** cost estimates have changed (Oct Submitted **£24.86m** vs July 24 **£30.91m**). We have undertaken a re-assessment of our siphon costs at both sites and now that design and implementation has progressed at our **Bewl** site, we have benchmarked our new costs to reflect the anticipated expenditure more accurately. The updated costs also include the additional spillway as instructed by the S10 report. Both the scope and the cost changes are presented in this response document.

3) Updated CW3 data table

The requested allowance of **£30.908m** is shown below:

2025-26	2026-27	2027-28	2028-29	2029-30
6.227	12.408	10.751	1.523	0.000

CW3.134 values exclude the South East Water, 3rd party cost element of these schemes, which is included in CW11.27 (Third party capex-bulk supplies).

2. Ofwat's Draft Determination

Below is a summary of Ofwat's deep dive on Reservoir safety at Draft Determination. This document will respond to each of the 4 areas along with further evidence if required.

Need for enhancement investment

- We outlined we believed the actual cost required will likely to be **£24.86m** but understand Ofwat has based the allowance on the **£21.85m** in the data table provided which as noted above was incorrect.
- Ofwat has identified **£2.45m** related to general maintenance or with an unknown driver.

Best option for customers

- Ofwat believes there is limited range of alternative options that have been considered and whether the proposal is best value for money including cost benefit analysis.

Cost efficiency

- Ofwat states there is insufficient evidence that the proposed costs are efficient including benchmarking and assurance.

Customer protection

- Ofwat deems the proposal sufficient in protecting customers from under or non-delivery.

3. Our response

3.1 Need for enhancement investment

Following submission of our PR24 Business Plan in October 2023, we have received the **Weir Wood s10 inspection report** from the ARPE (report dated 15th March 2024) which requires statutory works as "Measures in the Interests of Safety" (MIOS), namely drawdown improvements (previously anticipated), auxiliary spillway improvements (added since Oct 23) and anti-leakage work to the overflow tunnel, all complete by 30 Sep 2027. The anti-leakage work is excluded from the application (see Table 1). Darwell s10 inspection is due by Oct 24. That reservoir is comparable in terms of construction date, type, and spillway arrangements. It is reasonably anticipated that similar improvements will be required. The deadline is shown in Table 2 as Sep-27, roughly 3yr after the inspection, and so appears reasonable.

Drawdown

The main item of work (emergency drawdown rate enhancement) **remains unchanged** in the final report, however some of the auxiliary items have been removed and others have been added. The required completion date for the work at Weir Wood has also changed from **March 2027 to September 2027**. Due to the similarities in age, size and design of the Weir Wood and Darwell dams and having discussed this with the ARPE, we expect that when the Darwell dam is inspected in October 2024, that the same scope will be mandated at Darwell. Therefore, not including this as part of the scope at Darwell would assume non-compliance with the Reservoir act.

Addition of spillways

The main change in scope is due to the **inclusion of an additional spillway** at both Weir Wood and Darwell. This has been recommended by the ARPE and have undertaken a cost estimate which is provided in table 3. This auxiliary spillway has been included which is a separate **enhancement requirement**

stemming from the 10 yearly inspections under Section 10 of the Reservoirs Act 1975. This is **not considered** to be part of general BAU maintenance where supervisions are undertaken at regular intervals.

Base overlap

Ofwat identified **£2.425m** related to general maintenance or with an unknown driver. We believe the £2.425m Ofwat identified relates to the 2 items below.

In our original enhancement case, we had included:

- 1) Actuation of scour valves (**£0.683m** Weir Wood and **£0.6m** for Darwell)
- 2) Piezometers (**£0.712m** Weir Wood and **£0.85m** for Darwell)

These 2 items were originally advised by the ARPE during the site inspection to be included as part of the scope. However, once the report was issued to Southern Water they were removed from the scope. The only additional items to be included as enhancement are the **auxiliary spillways** which have been described in this document. Southern Water has assessed the culvert anti-leakage work and deemed them as being **maintenance**, therefore have **removed this cost** from the requested allowance. The new emergency drawdowns and spillways at both Weir Wood and Darwell will **remain** as part of the enhancement business case.

The tables below outline what would be covered in **capital maintenance vs in the enhancement case**:

Table 1: Weirwood

Weir Wood	PR24 Submission (SRN32)		S10 Inspection (S10 report)	
	Oct 23 Scope	Oct 23 Cost (£m)	July 24 Scope	July 24 Cost (£m)
Emergency Drawdown rate	Drawdown to 5m below full supply level (m) within a period of 5 days. <i>(Pro-rated from Bewl Reservoir scheme)</i>	13.312	3 x 1000m Diameter 95m Length Culvert 80m Long Priming and discharge chambers	12.931
Actuation of scour valves	Included for 5no draw off valves	0.683	Not required by S10	Removed
Middle offtake guard valve	Not included	Not included	Repair of valve required	Works completed Maintenance not enhancement
Installation of Piezometers	Included for c18no piezometers	0.712	Not required by S10	Removed
Provision of additional overflow spillway	Not included	Not included	Auxiliary spillway to be formed, close to left abutment , to pass a 1 in 10,000 year flood event without the dam overtopping	2.748 New enhancement
Tunnel leak repairs	Not included	Not included	Hydrophilic grout injection and banding repair in tunnel	Not included Maintenance not enhancement
Total costs		£14.708m		£15.679m
Completion date		Mar-27		Sep-27

Table 2: Darwell

Darwell	PR24 Submission (SRN32)		S10 Inspection (S10 report)	
	Oct 23 Scope	Oct 23 Cost (£m)	July 24 Scope	July 24 Cost (£m)
Emergency Drawdown rate	Drawdown to 5m below full supply level (m) within a period of 5 days.	8.704	3 x 800m Diameter 90m Length	12.481
			Culvert 100m Long	
Actuation of scour valves	Included for 5no draw off valves	0.6	Not required	Removed
Middle offtake guard valve	Not included	Not included	Repair of valve required	Works completed Maintenance not enhancement
Installation of Piezometers	Included for c18no piezometers	0.85	Not required	Removed
Provision of additional overflow spillway	Not included	Not included	Auxiliary spillway to be formed, close to left abutment , to pass a 1 in 10,000 year flood event without the dam overtopping	2.748 New enhancement
Tunnel leak repairs	Not included	Not included	Hydrophilic grout injection and banding repair in tunnel	Not included Maintenance not enhancement
Total costs		£10.154m		£15.229m
Completion date		Mar-27		Sep-27

Table 3: Cost Summary for Darwell and Weirwood Safety Enhancements

Summary		Oct 23 Cost (£m)	July 24 Cost (£m)	
Weir Wood	Emergency Drawdown capacity increase	14.708	12.931	15.679
	Provision of additional overflow spillway	Not included	2.748 New enhancement	
Darwell	Emergency Drawdown capacity increase	10.154	12.481	15.229
	Provision of additional overflow spillway	Not included	2.748 New enhancement	
Total costs (£m)		£24.862m	£30.908m	

3.1 Best option for customers

3.1.1. Spillways

In addition to the above cost changes, some additional scope has been added to these schemes (as outlined above). The main item of additional scope is an overflow spillway. We have used the flood report for the Weir Wood reservoir which included analysis and an option appraisal for size, location, and design of the emergency overflow spillway.

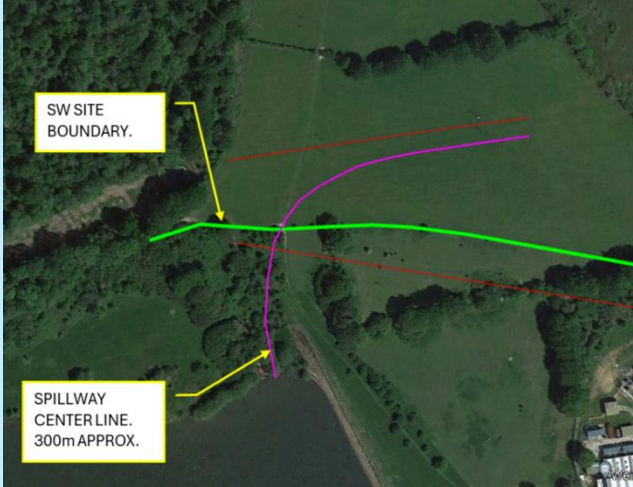
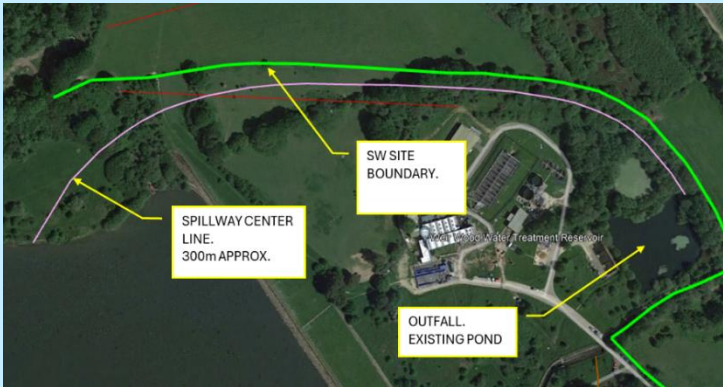
The options were based on the location stated in the recommendations in the report and the flows the spillway must be designed for. For Weir Wood, the recommendation is clear and must be carried out as described in the S10 Report; *“The bellmouth overflow not only has limited capacity but is also vulnerable to blockages. The safety of the reservoir at present is wholly reliant upon freeboard and associated temporary flood storage. In order to reduce the risk of failure associated with flood and wave overtopping of the crest, an auxiliary spillway shall be formed close to the left abutment to augment overflow capacity. The structure shall be set to operate in the event of a 1 in 10,000-year flood, or other threshold deemed to be appropriate by the QCE overseeing implementation of this measure. Floodwaters passing down the auxiliary channel shall be conveyed sufficiently far downstream so as to prevent erosion of the dam embankment. The alignment of the channel and its mode of protection shall be to the approval of the QCE”*.

For Darwell, the recommended solution will be identical, and we have replicated the Weir Wood design in our submission.

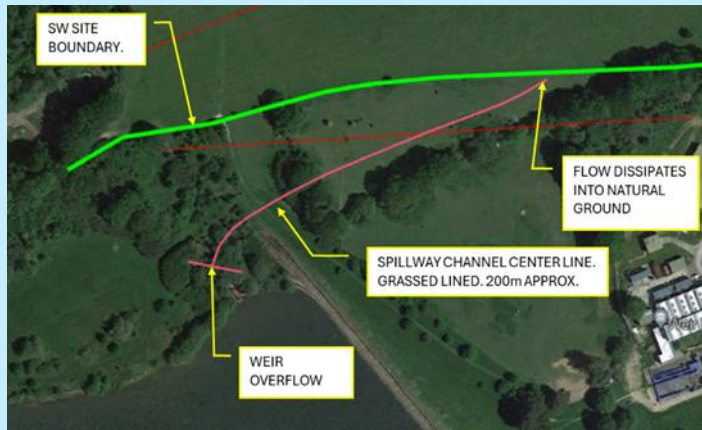
We have developed designs and costings for three of the main options from that report. The options and cost estimates for these three options at Weir Wood are as follows:

Table 4: Spillway Options for Weirwood

Option ref	Option description	Scope	Cost (£m)
A	Discharge via grass channel to land outside of site boundary	<ul style="list-style-type: none"> Auxiliary Spillway located on the left hand side of the dam embankment as per 'Weir Wood Reservoir Auxiliary Spillway Optioneering Report' from Stantec Auxiliary Spillway cross section assumed to be trapezoidal with 1 in 5 side slopes. Spillway lining grass only. Works potentially can be undertaken above water level but temporary works have been assumed for this scope Requires undertaking the works outside Southern Water Site Boundary. Therefore, Permission will be required from the landowner or land acquisition may be required. The current stated cost does not include land acquisition. There is no certainty of securing land which would mean potential delays could be incurred Only to operate in a 1 in 10,000 storm and soil erosion away from the dam crest is not expected to be an issue 	2.697

			
<p>B</p>	<p>Discharge via concrete channel to existing pond</p>	<ul style="list-style-type: none"> • Auxiliary Spillway located on the left hand side of the dam embankment as per 'Weir Wood Reservoir Auxiliary Spillway Optioneering Report' Stantec (Appendix C) • Auxiliary Spillway cross section assumed to be trapezoidal with 1 in 5 side slopes • Works potentially can be undertaken above water level but temporary works have been assumed for this scope • Energy dissipation channel assumed to be 50m in length. A detailed design analysis must be done to specify exact length and type • Excavation for RC channel construction assumed to be 1 in 2 side slopes. After RC channel lay down refill of batter up to 200mm below top of channel wall is assumed 	<p>6.802</p>
<p>C</p>	<p>Discharge via reinforced grass channel inside of site boundary</p>	<ul style="list-style-type: none"> • Auxiliary Spillway located on the left hand side of the dam embankment as per 'Weir Wood Reservoir Auxiliary Spillway Optioneering Report' from Stantec • Auxiliary Spillway cross section assumed to be trapezoidal with 1 in 5 side slopes utilising reinforced grass • Works potentially can be undertaken above water level but temporary works have been assumed for this scope 	<p>2.748</p>

		<ul style="list-style-type: none"> • Assume that 30m of channel excavation cuts through dam's left abutment and may encounter Armorflex mats and dam fill. Refer to Detail of Left Abutment with Armorflex after modification on the right for details • Aerial map shows a shed building on the left embankment and through the proposed spillway channel. This must be confirmed. If building shed exist, the auxiliary weir could be set back at the crest, as long as the approach "channel" is not higher than the weir • Assumed that flow from Auxiliary Spillway will discharge into existing ground and dissipate within SW site boundary 	
--	--	---	--



Preferred option

Option C with a cost estimate of **£2.739m** is the best option because:

- The construction area is contained within the Southern Water site boundary; therefore, no land acquisition is required and there is no impact on the public right of way.
- The use of a reinforced grass channel provides better protection for the dam during discharge events.
- Greater cost efficiency and certainty than the alternative options because:
 - **Option A (£2.4m)** – Net cost could be higher if land needs to be acquired. Land purchase also reduces delivery certainty. Spillway does not include reinforced grass, inclusion of reinforcement to the grass would increase costs further.
 - **Option B (£6.2m)** – >60% higher in cost with no additional functionality or benefit to our customers. This is also the most carbon intensive option due to the additional concrete required.

3.1.2. Drawdown

We outlined in our original enhancement case (**SRN32**), our approach to the optioneering process we undertook. The optioneering undertaken was of a strategic nature as per table 7 from SRN32 below.

Table 7: Options for increasing emergency drawdown at Weir Wood and Darwell

Option ref	Description	Details	Capex (£m)	Pros	Cons
1	Do nothing		0	Zero capex	Does not meet statutory obligation. No reduction in risk of dam failure
2	Modify overflow structure	Reduce level in reservoir and install penstocks in existing overflow structure	11.0	Lower capex than siphons and new tower	Does not meet statutory obligation, insufficient capacity to meet 5m in 5day requirement. Reduced reservoir capacity during installation, or sustained underwater installation. Structural risk to overflow structure.
3	Install siphons	Install siphons over dam wall to rapidly drain top 5m of reservoir	25.0	Meets regulatory requirement for capacity. Lower capex than new draw-off tower.	Higher capex than overflow modification
4	Install additional draw-off tower	Installation of a new draw-off tower and tunnel through existing dam wall.	60.0	Meets regulatory requirement for capacity.	Higher capex than siphons. Reservoir unusable during construction. Potential compromise of dam integrity.

Rejected options

- **Option 1** was rejected because it **does not meet the statutory obligation** to provide the 5m in 5 day requirement as per the recommendation of the S10 report. This option does not reduce the risk of catastrophic dam failure and is therefore not acceptable.
- **Option 2** was rejected because it **does not meet the statutory obligation** to provide the 5m in 5 day requirement as per the recommendation of the S10 report. Although this option could be adapted to meet the 5m in 5 day requirement, it would still be rejected because of the need to reduce the level (and hence storage) in the reservoir for an extended period of time. This would have an unacceptable impact on our raw water resources and would reduce our ability to maintain water supplies to our customers. There are also deliverability risks associated with this option due to the need to modify existing old submerged concrete structures which weren't originally designed to take the loads required by this solution. This option would however be the least carbon intensive of the viable options.
- **Option 4** was rejected because it is the most expensive option (+£60m) without providing any additional benefits relative to alternative option. In addition it is more intrusive to the Dam and has a much longer construction timeline. It is also likely to make it impossible to maintain water supplies during the construction period. There are also risks to reservoir integrity both during and after construction which are not present for either of the alternative options. Additionally this is a much more carbon intensive solution.

Preferred option

- **Option 3** was deemed to be the **most efficient** option due to meeting statutory obligations whilst being a more cost efficient solution. This option allows us to reduce the risk of catastrophic dam failure without impacting the security of our supplies to our customers. The deliverability of this

option is good, because we have recently delivered a similar larger version of this solution at our Bewl reservoir.

3.2 Cost efficiency

3.2.1. Spillways

As outlined in the best option for customers section, the 3 spillway options have been costed by our cost intelligence team and are based on Mott MacDonald's industry benchmarks.

Across the 3 options, the components of the Blended Total Project Estimated Cost include uplifts from the Net Direct Works Costs are as follows:

- Corporate overhead
- Blended Total Project estimated cost (Exc Corporate overheads)
- Total In-Direct Costs
- Contractor and client Indirects
- Site specifics and TtOR

Table 5: Spillway Options for Weirwood

Spillway Option	Description	Net Direct (£m)	July 24 Cost (£m)
A	Discharge via grass channel to land outside of site boundary	1.256	2.697
B	Discharge via concrete channel to existing pond	3.168	6.802
C	Discharge via reinforced grass channel inside of site boundary	1.280	2.748

3.2.2. Drawdown

Context

We are challenging the Ofwat allowance at Draft Determination as since Oct 23, we have further developed the scope and re-assessed cost estimates based on bill of quantities for the Drawdown at Weir Wood and Darwell. This provides an **updated July 24 cost of £25.41m for the drawdown elements of this scheme**. This new cost is based on further design work which we have carried out. This has allowed us to produce an accurate list of scope which has been costed by our cost estimating team. We have also used costs from our Bewl scheme to benchmark our costs. The Bewl scheme benefits from actual contractor quotes, so gives real costs.

The costs that were developed for the Emergency drawdown works in Oct 23 at **Weir Wood** and **Darwell** were based on work that we have been carrying out on our **Bewl** reservoir. Since October 2023, when our PR24 plans were submitted, the costs for our Bewl scheme have changed. We have analysed these changes and where applicable have removed the inefficiencies from our estimates for Weir Wood and Darwell. These re-estimates are shown below in table 6 alongside our bottom-up cost estimates for Weir Wood and Darwell.

Bewl Costs increase

The total Bewl reservoir cost has increased (**Approx. £38.583m**) which represents a **25% increase** on the costs which we used as the basis for our October 2023 submission. The breakdown of the uplift is summarised in the below table.

Table 6: Breakdown of Uplift for Bewl Reservoir Costs

Cost	% Uplift
Civils	38%
Indirect (inc Risk)	17%
Total cost	25%

The main area of cost increase in the Net cost is attributed to increase in the Civil Sub-Contractor quotation. There has also been a significant increase due to additional DP labour and preliminary costs. This rise is primarily due to the adjustments in Civil Works, Stage 2 PRC's, and other significant cost factors such as:

- Lessons learned & solution improvements:
- Civil sub-contractor quotations
- DP Labour and preliminary costs
- Inflation
- Fee Increase
- Design modifications, and re-evaluated risk and management costs

We have analysed these costs and where appropriate removed them from our latest Weir Wood and Darwell estimates, because the learnings from our Bewl scheme will ensure works can be completed more efficiently in subsequent projects.

Updated Drawdown Costs

Our July 24 cost (£25.412m) was benchmarked against the updated Bewl costs, as described above, to determine the efficiency in our cost. Our latest estimate, based on site specific design requirements and scope, is efficient relative to the Bewl project as shown in Table 6 below.

Table 7: Drawdown costs for Weirwood and Darwell

Drawdown	Oct 23 Cost based on Bewl estimate (£m)	Benchmarking cost based on Bewl out-turn (£m)	Benchmarking cost based on Bewl out-turn minus efficiency (£m)	July 24 Cost based on site specific bottom-up design and scope (£m)
Weir Wood	14.708	18.385	16.852	12.931
Darwell	10.154	12.6925	11.635	12.481*
Total costs (£m)	£24.862m	£31.078m	£28.487m	£25.412m

*Site specific design for Darwell required longer concrete discharge channel than anticipated through scaling of the original Bewl design.

3.3 Customer protection

Ofwat deemed our proposal sufficiently protects customers from under or non-delivery although it did not consider that the Reservoir Act inspection regime (which although monitors compliance to the Act) will necessarily ensure that the activities as funded by customers will be delivered. **The expenditure in this area is not material and so Ofwat do not consider a PCD is required.**

4. Business Plan Dependencies

This document is linked with our SRN32 Reservoir Safety October 2023 business plan submission.

Data Tables impacted by the representation:

Table/s Impacted	Data Lines Impacted
CW3	134 - Additional Line 3; Reservoir safety water Capex

All documents and tables referenced above can be found on our website here: [Business Plan 2025-30 - Southern Water](#)

5. Appendix A

Drawdown Estimate Review

Weir Wood

Scope Area	Nett Direct Costs
Total	£ 6,023,026.75
Additional Project Related CapEx Costs	£ 1,062,358.00
Weirwood Drawdown	£ -
Siphon	£ 1,594,132.48
Priming chamber	£ 521,397.25
Discharge chamber	£ 914,696.56
Culvert	£ 809,644.81
New washouts on supply mains	£ 107,881.99
Siphon test-water retention facility	£ 18,026.66
Site wide works	£ 994,889.00

Darwell

Scope Area	Nett Direct Costs
Total	£ 5,813,526.78
Additional Project Related CapEx Costs	£ 1,062,358.00
Darwell Drawdown	£ -
Siphon	£ 1,268,312.39
Priming chamber	£ 507,520.35
Discharge chamber	£ 881,396.01
Culvert	£ 973,142.38
New washouts on supply mains	£ 107,881.99
Siphon test-water retention facility	£ 18,026.66
Site wide works	£ 994,889.00

6. Appendix B

Spillway Estimate Options

Option A - Discharge via grass channel to land outside of site boundary

Scope Area	Nett Direct Costs
Total	£ 1,256,039.56
Additional Project Related CapEx Costs	£ -
CIVILS	£ 1,256,039.56

Option B - Discharge via concrete channel to existing pond

Scope Area	Nett Direct Costs
Total	£ 3,167,646.10
Additional Project Related CapEx Costs	£ -
CIVILS	£ 3,167,646.10

Option C - Discharge via reinforced grass channel inside of site boundary

Scope Area	Nett Direct Costs
Total	£ 1,280,053.80
Additional Project Related CapEx Costs	£ -
CIVILS	£ 1,280,053.80

7. Appendix C

See submitted appendix: SRN-DDR-035 - Appendix A - Weir Wood Reservoir Auxiliary Spillway
Optioneering Report