Bristol Avon Flood Strategy

Cost / Methodology review 2023

Introduction

BAM Nuttall have been asked by Arup to review four parts of the Bristol Avon Flood strategy and to provide advice on indicative costs for the structures.

Due to the constraints of our appointment to review these works, the costs provided are based on the limited information issued.

The structures are:

- Entrance Lock gates (outer)
- Netham lock gates
- Brunel Dam
- Bathurst Dam

Current design/scheme notes

The outline / concept has been completed for whole scheme

- Cost consultant (Arcadis) have been building up cost of the scheme with “standard market rates” and included for temporary works, risk pot (substantial) and also provided an optimum bias.
- Time frames
  - OBC is required to be submitted to Bristol City Council by the end of 2023
  - FBC to follow
  - Construction estimated start date is 2027
  - Duration approximately 7/8 years
- Required – Transport and Works Act order

Summary

All options presented below would benefit greatly from a full contractor ECI process to bring expertise into the design phase at the earliest opportunity. We would propose to have technical experts, specifically with maritime knowledge, estimating resource and project management. BAM would also draw on functional support within the business to provide a thorough assessment and appraisal of existing designs and cost evaluation. The contracts most effective could be NEC4 Option C (2 stage) with X22 included.

The outputs and costs must only be considered as indicative, and have not allowed for site specific risks or unknowns. As stated above further work will need to be carried out to establish the baseline of design and work up appropriate costs from there.

Entrance Lock Gates

Description

- Full replacement of the outer lock gates at the entrance to the Bristol floating harbour. These are to be increased in height to allow for the flood events and will be tied in with the raised walls either side
- The design of hinges will require bi-directional loading to enable the gates to withstand the standard lock water levels and any tidal surges, or flood waters.

Fig 1 : Bristol harbour entrance (outer) lock gates

Constraints

- Quay walls are grade II listed
- Full closure will be limited
- Environmental constraints
- Access restrictions
- Programme / timings and permissible closures
- Detailed navigational or traffic constraints.

Initial budget – provided by ARUP (Arcadis)

	Contractor estimates SOC	Arup proposed costs	Contractor estimates SOC
Lock gates design, fabrication, delivery, installation including electric and mechanical systems	£3,000,000 *(for 22m x 7m gate)*	£1,950,000 *£1,250,000 (quote requested in 2020 for design, fabrication and supply of a 12m x 10m gate)* *£500,000 (estimated for electrical and mechanical systems)* *£200,000 (estimated for installation)*	
Temporary works – Removal of old gates, cofferdam installation and removal, dewatering and silt removal	£500,000	£510,000 *(including removal of old gates, silt removal, cofferdam, dewatering and removal of cofferdam)*	
Associated civils – sills and walls	£750,000	£750,000 *(assumed from contractor information)*	
Total	£4,250,000	**£3,210,000**	**£4,301,400**

Proposed method

The methodology is only briefly detailed within the indicative cost below. Any further work on methodology would require all current design details and further time to develop. Particular areas of focus would be around the constraints and permitted timings of "full closures" (see below) as well as access to the site works to the lock gate hinges.

Programme

The programme will need to be developed with further input from the current design and will need to focus on the following items:

- Long lead in items / Off site fabrication
- Mobilisation - timings from tender procurement process through contract award and contract start
- Hinge works (Possession of lock barrel required likely 26 weeks)
- Gate installation
- M&E works - including testing, commissioning and final handover

Assumptions

- No inflation has been applied (priced at 2023 rates)
- The outputs must only be considered as indicative, with limited opportunity to include for site specific risks or unknowns. Before these outputs are used for budget or other purposes, further work will need to be carried out
- We have assumed this is a build only project
- No allowance for
  - Management of Grade II listed status
  - Contaminated materials
  - UXO's - surveys or removal
  - Service diversions / management

Outline construction budget

Item	Description	No	Rate	Extension
1	Design and surveys (including UXO's)			By others
2	Set up site			£200,000
3	Traffic management			£200,000
4	Access for craneage - possibly on jack up			£150,000
5	Temporary works (2 x diaphragm cofferdam) and enabling			£1,500,000
6	Modify existing lock barrel and quoins for new gates			£750,000
7	Fabricate and transport new gates (12W x 10H = say 60t equivalent) to site and install	120t	£10,000/t	£1,200,000
8	Install Gates on site	2	£100,000	£200,000
9	MEICA	sum	£750,000	£750,000
				£4,950,000
	Risk		20%	£990,000
	Direct Costs			£5,940,000
	Prelims (inclusive of fee)		40%	£2,376,000
	Indicative Construction Cost			£8,316,000

With the information provided there could be range applied to the overall indicative costs from minus 20% to plus 50%. This range would then be between approximately £6.6m to £12.5m

Other options ideas

- Flap flood gate between existing inner and outer lock gates
- Reposition gates to enable lock to have limited but not restricted use
- Full, extended closure to allow more efficient programme
- Design and build contract (ECI)

Netham Lock Gates

Description

- Installation of a new flood gate at the 'high point' of feeder road – as identified below in fig 2. This will then tie into additional flood walls located along Feeder Road running from west to east
- The high point is also position of existing historic lock gates and bridge structure running south.

Fig 2 : Netham lock gates

Constraints

- Construction Access and Compounds
- Traffic Management
- Maintaining navigation / operation capability
- Eel pass to be incorporated into design/works
- Navigational access to be maintained
- Existing Netham and Lock Keeper's House locks are Grade II listed
- Existing walls - condition and structural make up along Feeder Road are unknown

Initial budget – provided by ARUP (Arcadis)

- None provided

Proposed method

The methodology is only briefly detailed within the indicative cost below. Any further work on methodology would require all current design details and further time to develop. Particular areas of focus would be around the constraints and permitted timings of "full closures" (see below) as well as access to the site works and the configuration around the existing bridge/lock gates at the proposed

location and the narrow of the channel to accommodate the new flood gate.

Programme

The programme will need to be developed with further input from the current design status and will need to focus on the following items:

- Long lead in items / Off site fabrication
- Mobilisation - timings from tender procurement process through contract award and contract start
- Narrowing works for the channel
- Gate installation
- M&E works - including testing, commissioning and final handover

Assumptions

- No inflation has been applied (priced at today's rates)
- The outputs must only be considered as indicative, with limited opportunity to include for site specific risks or unknowns. Before these outputs are used for budget or other purposes, further work will need to be carried out
- We have assumed this is a build only project
- No allowance for
    - Management of Grade II listed status
    - Contaminated materials
    - UXO's - surveys or removal
    - Existing statutory undertakers and drainage

Outline construction budget

Item	Description	No	Rate	Extension
1	Design and surveys (including UXO's)			By others
2	Set up site			£200,000
3	Traffic management	2nr	£900,000	£200,000
4	Access for craneage - at least partial road closure		£400,000	£150,000
5	Drive sheet pile abutments incl cut off wall and backfill			£1,800,000
6	Temporary works - continuation of abutment piles to form closure. Subsequently burnt down	20t	£15,000/t	£400,000
7	Construction lock barrel for new flap gate	1	£125,000	£300,000
8	Fabricate and transport new gate (6W x 6H = say 20t equivalent) to site and install	sum	£400,000	£300,000
9	Install Gate on site	2nr	£900,000	£125,000

				£3,875,000
	Risk		20%	£775,000
	Direct Costs			£4,650,000
	Prelims (inclusive of fee)		40%	£1,860,000
	Indicative Construction Cost			£6,510,000

With the information provided there could be range applied to the overall indicative costs from minus 20% to plus 50%. This range would then be between approximately £5.2m to £9.8m

Other options ideas

- Full, canal/road extended closure to allow for more efficient programme
- Design and build contract

Brunel Dam raising

Description

- Installation of concrete dam/plug beneath existing bridge structure – as identified below in fig 3
- Concrete dam as fig 4
- Concrete dam with props as fig 5

Note: our team believe the current design of the mass concrete dam is the least efficient solution, most unsustainability and also extremely costly.

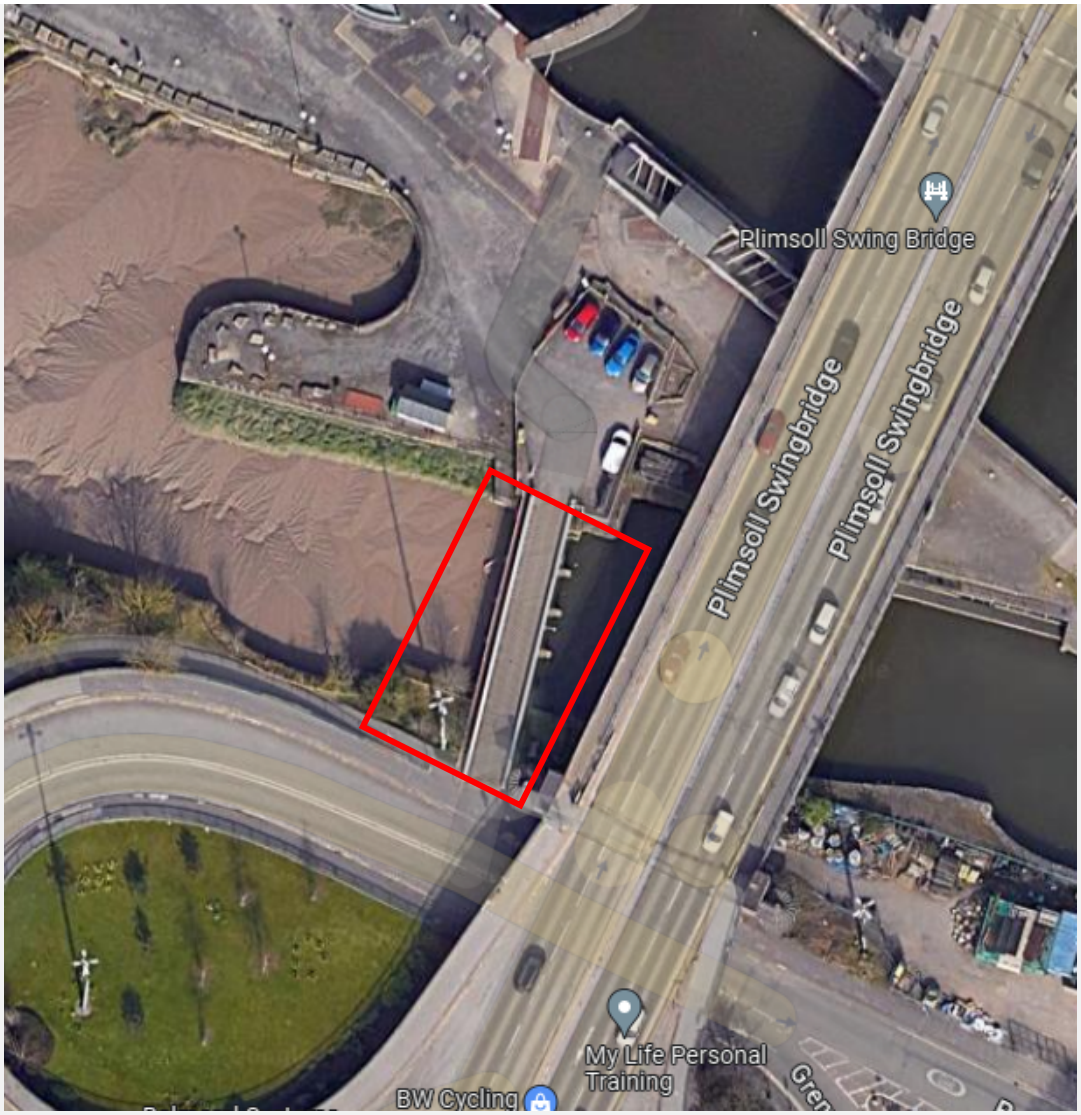

Fig 3 : Brunel Dam

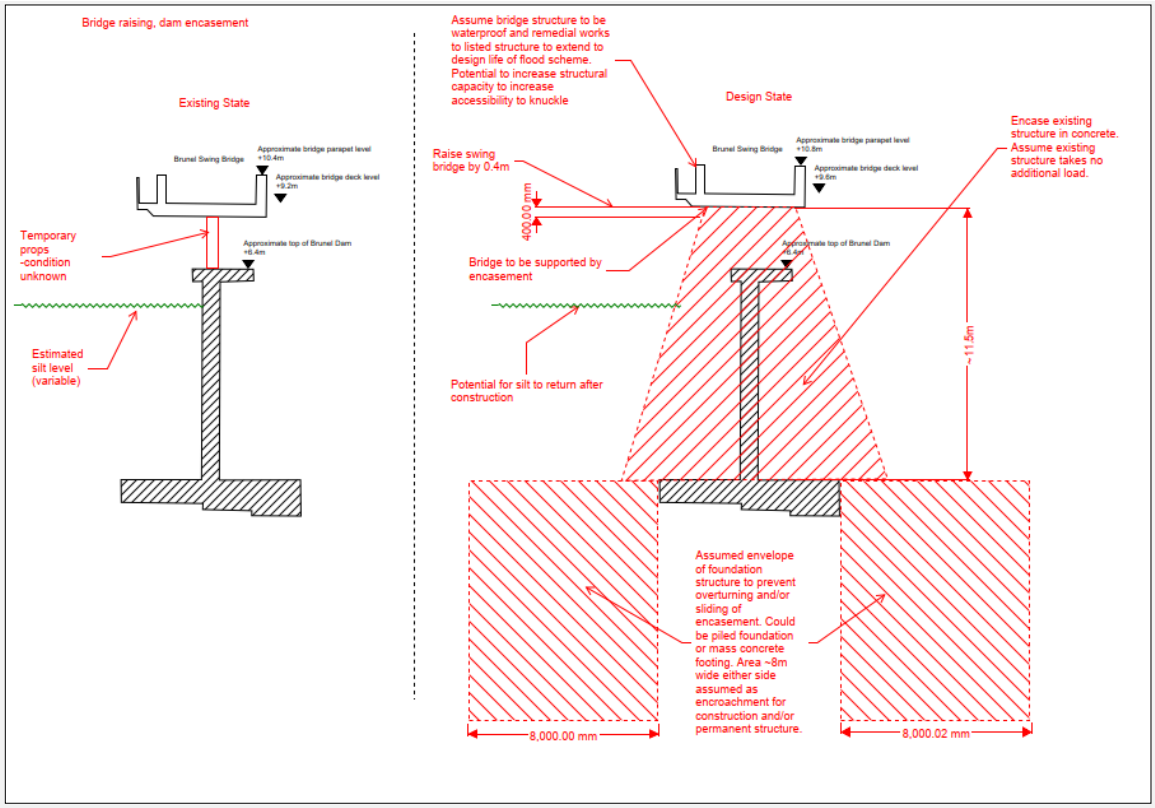

Fig 4: Concrete Dam with props removed

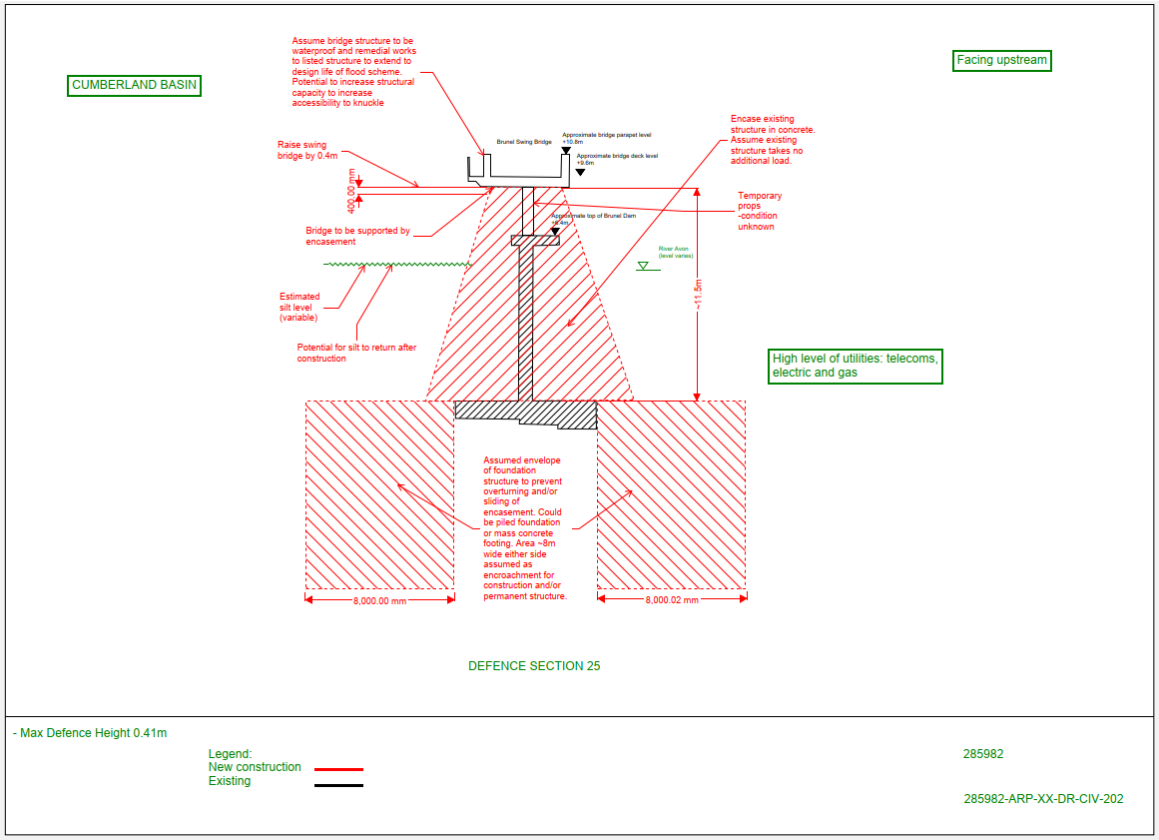

Fig 5: Concrete Dam with props to remain insitu

Constraints

- Existing bridge Grade II listed structure and surrounding street furniture (lamp posts)
- Intertidal mudflats include protected species
- Construction Access and Compounds may be limited

Initial budget – provided by ARUP (Arcadis)

- Costs: SOC: £1,757,317
- OBC Uplifted: £2,354, 805

Proposed method

The methodology is only briefly detailed within the indicative cost below. Any further work on methodology would require all current design details and further time to develop. Particular areas of focus would be around the constraints and access, working areas access to the site works. Brief stages of works would comprise the following:

- Undertake temporary works
- Excavate bed under bridge to create foundation
- Backfill excavation with concrete to bridge soffit level to close gap
- Raise swing bridge (no future movement required)

Programme

The programme will need to be developed with further input from the current design and will need to focus on the following items:

- Mobilisation - timings from tender procurement process through contract award and contract start
- Temporary works installation
- Concrete dam
- Removal/refurbishment/replacement of existing bridge (not allowed for)

Assumptions

- No inflation has been applied (priced at today's rates)
- The outputs must only be considered as indicative, with limited opportunity to include for site specific risks or unknowns. Before these outputs are used for budget or other purposes, further work will need to be carried out
- We have assumed this is a build only project
- No allowance for
    - Management of Grade II listed status structures
    - Contaminated materials
    - UXO's - surveys or removal

Outline construction budget

Item	Description	No	Rate	Extension
1	Design and surveys (including UXO's)			By others
2	Set up site			£200,000
3	Traffic management			£300,000
4	Lift up bridge			£250,000
5	Special measures to protect existing structure			£300,000
6	"Drive sheet piles - diaphragm wall (w=30m) river side and backfill and single sheet pile wall harbour side"	1nr	£2,000,000	£2,000,000
7	Access for craneage across diaphragm wall			£150,000
8	Construction concrete foundation and fill to soffit. Including excavation, silt disposal plain formwork	5000m3	£700/m3	£3,500,000
9	Temporary works - Subsequently remove fill and burnt down sheet piles to bed level		£200,000	£200,000
				£6,900,000
	Risk		20%	£1,380,000
	Direct Costs			£8,280,000
	Prelims (inclusive of fee)		40%	£3,312,000
	Indicative Construction Cost			£11,592,000

With the information provided there could be range applied to the overall indicative costs from minus 20% to plus 50%. This range would then be between approximately £9.3m to £17.4m

Other options

As stated above BAM believe that the better solution would be to incorporate temporary works sheet piles / dams as permanent works. This could provide a potential saving for item 8 of around £2m, reducing the overall cost to approximately to approximately £8.3m

Bathurst Dam raising

Description

- Installation of concrete dam/plug beneath existing bridge structure – as identified below in fig 6
- Concrete dam as fig 7

Note: our team believe the current design of the mass concrete dam is the least efficient solution, most unsustainability and also extremely costly.

Fig 6 : Bathurst Dam

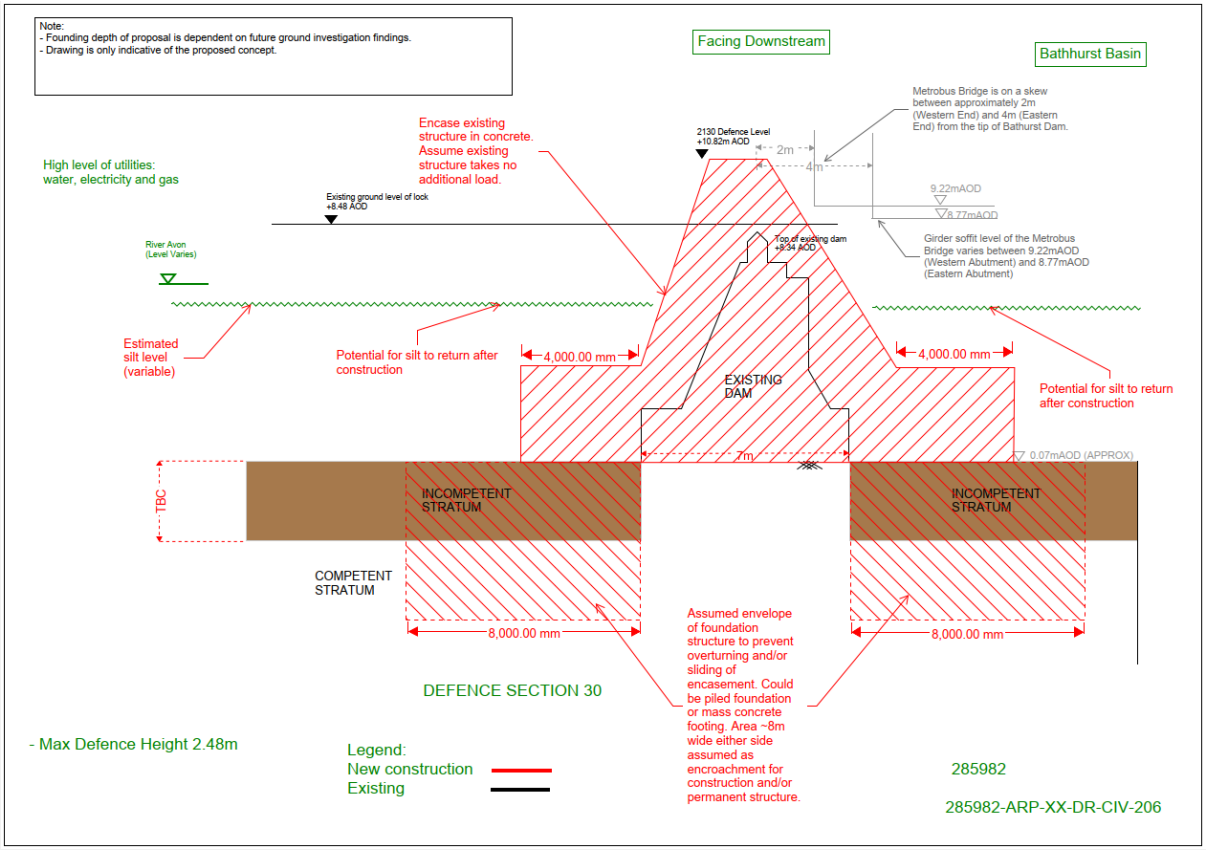

Fig 7: Concrete Dam

Constraints

- Existing bridge Grade II listed structure adjacent to work site
- New Metrobus Bridge partly over existing dam construction
- Intertidal mudflats including protected species
- Construction Access and Compounds may be limited (private land adjacent to site)
- Existing boat yard - relationships are not favourable to using this land

Initial budget – provided by ARUP (Arcadis)

- SOC: £601,500
- OBC Uplifted: £806,010 (only concrete works)

Proposed method

The methodology is only briefly detailed within the indicative cost below. Any further work on methodology would require all current design details and further time to develop. Particular areas of focus would be around the constraints and access, working areas access to the site works. Brief stages of works would comprise the following:

- Undertake temporary works
- Excavate bed under bridge to create foundation
- Backfill excavation with concrete to bridge soffit level to close gap

Programme

The programme will need to be developed with further input from the current design and will need to focus on the following items:

- Mobilisation - timings from tender procurement process through contract award and contract start
- Temporary works installation
- Concrete dam

Assumptions

- No inflation has been applied (priced at today's rates)
- The outputs must only be considered as indicative, with limited opportunity to include for site specific risks or unknowns. Before these outputs are used for budget or other purposes, further work will need to be carried out
- We have assumed this is a build only project
- No allowance for
    - Management of Grade II listed status structures
    - Contaminated materials
    - UXO's - surveys or removal

Outline construction budget

Item	Description	No	Rate	Extension
1	Design and surveys (including UXO's)			By Others
2	Set up site			£200,000
3	Traffic management			£500,000
4	Special measures to protect existing structure			£200,000
5	"Drive sheet piles - diaphragm wall (w=13m) river side and backfill and single sheet pile wall harbour side beyond bridge"	1nr	£1,000,000	£1,000,000
6	Temporary works access for craneage to site			
7	Construction concrete foundation and dam wall. Including excavation, silt disposal plain formwork (Specialist facing to new concrete not included)	2140m3	£700/m3	£1,498,000
8	Temporary works - Subsequently remove fill and burnt down sheet piles to bed level		£150,000	£150,000
				£3,698,000
	Risk		20%	£739,600

	Direct Costs			£4,437,600
	Prelims (inclusive of fee)		40%	£1,775,040
	Indicative Construction Cost			£6,212,640

With the information provided there could be range applied to the overall indicative costs from minus 20% to plus 50%. This range would then be between approximately £5m to £9.3m

Other options ideas etc

As stated above BAM believe that the better solution would be to incorporate temporary works sheet piles dams as permanent works. This could provide a potential saving for item 7 of around £1.2m, reducing the overall cost to approximately to approximately £5.2m