LOWER SEVERN (2005) INTERNAL DRAINAGE BOARD

Engineering Meeting

Wednesday 16th December 2020

Virtual Meeting
10.30am

Please note due to the sensitive nature of some of the information in these papers ,some pages have been removed and some information has been redacted.

LOWER SEVERN (2005) INTERNAL DRAINAGE BOARD

TERMS OF REFERENCE
OF THE ENGINEERING COMMITTEE
Approved 5th Feb 2020 Minute 3002

MATTERS FOR DETERMINATION BY THE COMMITTEE

1. Small engineering schemes or works up to £30,000.
2. Machinery replacement in accordance with the pre-approved programme.
3. The adoption or declassification of watercourses in the context of an approved policy framework and the regimes of other statutory authorities in this regard.
4. To assess, agree and monitor works for the Capital Programme.

MATTERS FOR RECOMMENDATION BY THE COMMITTEE TO THE BOARD

5. To review the Board's rhine maintenance priorities.
6. To review future maintenance liabilities of assets e.g. Environment Agency, outfalls and main river
7. To review Avonmouth and Severnside developments commuted sums, infrastructure charges and modelling.
8. To review pumping station maintenance and repair.

Signed:…… (Chairman)

Minute 3002
05 February 2020

Minutes of the Engineering Committee
of the Lower Severn (2005) Internal Drainage Board
Meeting held Wednesday 2nd September 2020 at 10.00 am
Zoom Virtual Meeting

Present:

Mr Barnes	Chairman	
Mr W J Cornock		Cllr J Jones
Miss R Hewlett		Cllr M Williams

Staff:

Martin Dear	Accounts Officer	AO
James Druett	Land Drainage Engineer	LDE
James Thomas	Civil Engineer	CE
Kieran Warren	Principal Officer	PO
Louise Reading	Minutes	

3082	**Appointment of Engineering Committee Chairman** **Resolved that:** **Mr Barnes be appointed Committee Chairman for the ensuing year.**	
3083	**Apologies** Apologies were received from Tom Cullimore, Ian Ratcliffe, Roger Godwin, Robert Hyslop, Robert Thatcher and Geoff Simms.	
3084	**Declarations of Interest** No interests were declared.	
3085	**Minutes of Previous Engineering Committee Meeting** **It was resolved that:** • **The minutes of the meeting held on 24th October 2019 be approved as a correct record.**	
3086	**Capital Programme Progress Report** The PO advised Members that the Quantity Surveyor's report for Elmore Back had been recently received; this meant that more detailed costings were available for consideration. The LDE updated Members on Elmore Back Pump Station replacement as follows: • The Board were still awaiting 1 consent from the EA for the fish pass. • The pump station sump had been drained fully to allow for further concrete testing and; • Research into whether retaining the pump station building or demolishing the pump station had begun. Demolishing the building to allow easier pump access in the future seemed preferable. Pre planning talks were being arranged with the local authority. The LDE advised Members that there had been an estimated increase of £80,000 in expenditure. This increase might require savings to be found elsewhere, e.g. from the £50,000 provision for an access road and the £25,000 for electrical installations and over-pumping. Members noted that tenders would be invited on the basis of the original specification with costed alternatives for some of the works. Ms Hewlett asked where the medical and health and safety supplies would be stored if the building were to be demolished. The LDE advised there would be a metal unit to house such items and the pump would be protected by a security fence around its perimeter.	

Unapproved

	In response to Cllr Jones, the LDE indicated that all the components were waterproof. Ms Hewlett asked if the fish pass consent was likely to hold up progress as it had done at Saul. The LDE confirmed that Motion, as the Project Manager, were chasing the EA for this. Mr Goodey asked if the weather would cause a problem as works were being completed over the winter months. The LDE advised that this shouldn't cause any issues. Provisions are in place and the majority of the works would be above ground. The LDE informed the Committee that the tenders for Elmore Back were due to be returned by the end of October. The Engineers and Motion would then be responsible for assessing all the bids and selecting a contractor to complete the works. The CE added that the selection process was rigorous and many factors were taken into consideration as well as the price. The Chair expressed his confidence in Motion as the Board had worked with them for many years and impressed Members over this time. At the request of Mr Simms, Members then went on to discuss the effectiveness of the reporting mechanism and liaison between the Finance and General Purposes Committee and Engineering Committee in respect of the Capital Programme. He proposed an additional Term of Reference for the Engineering Committee, viz: *"To validate, agree and monitor the financial expenditure and deliverables of the Capital Programme, within the financial constraints of the agreed budget."* Mr Simms suggested that greater communication between the two Committees would be beneficial and proposed that more Engineering meetings be held and an annual joint meeting for both Finance and General Purposes and Engineering Committees. Members generally welcomed these proposals but felt that it would be unnecessary to have more meetings scheduled as additional meetings could always be arranged at relatively short notice as and when required. The PO reminded members that Engineering Committee meetings were arranged prior to Finance and General Purposes Committee meetings so that up to date information could be passed on. Items referred from any Committee to another were reported as they arose and Members were supplied with relevant extracts from minutes to aid their discussions. **It was resolved that:** • **The report be noted; and** • **The views of this Committee be referred to the F & GP Committee for consideration at the meeting scheduled for 9 September 2020.** **It was recommended that:** • **The Term of Reference highlighted above be added to this Committee's existing Terms of Reference.**	
3087	**M49 Junction Drainage Arrangements** The CE provided an update on the M49 Junction drainage works. Works had been completed and the Culvert provided additional water diversion from the Pilning and Severn Beach areas.	

Unapproved

	Mr Cornock asked about the impact of the bank being raised along the Avonmouth to Aust section of the riverbank. The CE advised that this was a positive action lowering the risk of tidal inundation and that Bristol City Council were creating wetlands in the area. Mr Goodey added that around 80acres of land would be become wetlands and this would reduce water into the rhines and water excess in those areas. The bank walls would reduce tidal inundation and improvement in outfalls provided efficiently and easier maintenance. **It was resolved that:** • **The report to be noted**	
3088	**Date of Next Meeting** Members noted that the next Engineering meeting would be rescheduled from 21st October 2020 to allow time for the Elmore Back Pump Station tenders to be considered. The PO and Chair would discuss and confirm as soon as possible.	
	The meeting closed at 15.00pm	

Un-approved

MEETING: ENGINEERING **MEETING DATE: 16/12/20**

REF: JT **REPORT BY: Civil Engineer**

CIVIL ENGINEER'S COMMITTEE REPORT

Introduction

Below is a report compiled by the Civil Engineer.

Elmore Back Pumping Station Update

Tender Process

Four regional scale contractors with suitable experience were approached however, only 2 decided to return tenders. The contractors costs are above what was expected which along with other project delays and unforeseen events has led to significant cost increases overall. The tender appraisal (draft in appendix 12) process is underway at the time of writing of the report and further information will be made available to members along with a recommendation on the day of the meeting.

Delays and additional costs

Lack of adequate original drawings for the site with those that were available being inaccurate and requiring additional survey and drawing production.

Planning consent has now been identified as no longer required for the removal of the building. This took 3 months to confirm rather that the promised 6 weeks.

The Environment Agency as of the 2nd of December 2020 have not issued the Fisheries Consent for the proposal despite the formal application being made in August 2020 and with extensive consultation prior to this.

Unforeseen electrical network improvements were required to provide and upgraded power supply to the site. The process has been delayed by Western Power with Covid-19 given as the reason for this.

There have been extensive additional consultant costs arising out of the above delays.

The construction costs received back from the prospective tenderers are far higher than was expected.

The project is now expected to require an additional £200k raising the total budget to £700k.

Proposals

Given the Board commitment to the continued use of pumping arrangements there is no alternative course of action than to continue with the proposed Capital Programme albeit in a slightly modified manner.

It is proposed to continue with the construction of the project however, in order to ensure the projected cashflows of the Board are not impacted too significantly the future capital programme should be pushed back by an initial period of 1 year for all pumping stations yet to be renewed. This would result in no new pumping stations next year because the work at Lapperditch pumping station would commence in financial year 2022/23. This will allow for a period to reassess the cost of future schemes with fully costed Quantity Surveyor reports.

The new buildings and pumps, including, Elmore Back Pumping Station, should be depreciated at a straight line rate of 20 years for the buildings and 15 years for the pumps and electrical equipment.

In order to comply with the Boards standing orders it is proposed to hold a single item Board meeting on Wednesday the 23rd of December 2020 to approve the changes to the capital programme.

Recommendations

- A Board meeting is held on the Wednesday the 23rd of December 2020 to approve the alterations to the capital programme.
- The Committee recommends to the Board that the above changes be accepted by the Board.
- The Committee recommends that the Board approve the increase in budget of Elmore Back Pumping Station to £700k
- The depreciation for the pumping stations in set at a straight line for 20 years for buildings and 15 years for the pumps and electrical equipment.

James Thomas

Civil Engineer

MEETING: ENGINEERING **MEETING DATE: 16/12/20**

REF: JD **REPORT BY: Land Drainage Engineer**

LAND DRAINAGE ENGINEER'S ENGINEERING COMMITTEE REPORT

Machinery Replacement Programme 2021/2022

Introduction

The Land Drainage Engineer has reviewed the machinery replacement programme as agreed by the Board at the Engineering Committee dated 21st November 2018. The replacement programme was extended to 7 years which equates to a machine undertaking approximately 7000hrs.

The machinery which is due for replacement is a Tractor and mower combination and one hydraulic tracked excavator.

Tractor and Mower combination

The existing Claas 650 Tractor (6800hrs) and Bomford Eagle mower are now due for replacement. However, the usual practice is to retain one tractor/mowing unit as a spare which is needed to keep downtime to a minimum in the event of a breakdown, therefore the LDE recommends that this unit should be retained for a spare and the existing spare Claas 697 (8950hrs) and Noremat Magistra mower should be sold.

Tractor

After researching the Tractor market again there are two manufacturers which the LDE decided to follow up and obtain quotations. The makes and models were chosen for several reasons including operator visibility, gearbox, gross vehicle weight to stay road legal, required H.P, previous service experience, mower manufacturers advice and within the same market category.

Quotations as follows

1 x Claas 650 = [redacted] (see appendix 1) part ex Claas 697 = [redacted].

1 x Case Puma150 = [redacted] (see appendix 2) part ex Claas 697 = [redacted]

Mower

The LDE has again researched the flail mower market and obtained quotations from several manufacturers which have the required reach and specifications.

Quotations as follows

1 x new Bomford Eagle = [redacted] (see appendix 3)

1 x new Noremat Magistra = [redacted] (see appendix 4)

1 x new Herder Cavalier (side mounted) = [redacted] (see appendix 5)

1 x new Spearhead Orbital = [redacted] (see appendix 6)

Estimated value 1 x second hand Noremat Magistra Mower = [redacted] possible to sell via Ebay.

Recommendations:

The LDE recommends the purchase of -

1 x new Claas tractor due to lowest quotation combined with a longer standard warranty of 5 years.

1 x New Bomford mower due to the fact that it was the lowest quotation. It also means we only need to keep Bomford spares rather than additional mower parts. The problems which we experienced during the early stages of ownership with the existing Bomford have been rectified/modified and the improvements have been incorporated in the new model.

Excavator

The Kobelco SK135srlc (8650hrs) with extending dipper arm is due for replacement. The extending dipper arm was originally purchased in 2001 by the LDE. It was fabricated by Kobelco as a 'one off' and they have never been interested in supplying another. However, the dipper arm has been reconditioned twice and been used throughout the life of 3 excavators!!

After market telescopic dipper arms have been purchased in the past but are not strong enough. We have had to carry out major welding repairs which are expensive and lead to long periods of downtime.

Normally, the spare Hyundai tracked excavator (which is used mainly in the winter months when ground conditions become too wet to use the Boards wheeled excavator) would be traded in and the Kobelco would be kept for the spare. However, the Hyundai has less hours (5800hrs) than the Kobelco so it is advisable to retain this machine as its currently in good working order.

The LDE has researched various options again from different manufacturers which would give us the required reach (modified dipper arm or top boom) and other specifications that we require.

New Kobelco SK140SRLC + Existing sliding dipper reconditioned (see appendix 7) = [redacted]

New Kobelco SK140SRLC + Modified top boom & counterweight by Kocurek (appendix 8) = [redacted]

New Hyundai HX145LCR + Modified top boom & counterweight by Kocurek (appendix 8) = [redacted]

New Hitachi ZX135 Factory production extending dipper machine (appendix 9) = [redacted]

New JCB 150X standard machine + Mastenbroek dipper extension (appendix 10) = [redacted]

Trade in existing machine = approx. [redacted]

Recommendations:

After careful consideration and discussing the options the LDE has concerns about reconditioning the 20 year old dipper arm for another 7 years use especially as it has already been welded and is obviously becoming fatigued.

Top boom modifications by Kocurek are very well fabricated and we have had no problem to date with the product. The top boom modification has its advantages in certain locations, however operationally there have been issues such as an inability to reduce the height enough when working under electric cables. Also, the bucket has to be removed when transporting on a low loader. Due to the angle of the boom there is also a lack of power when it comes to pushing piling or gate posts into the ground.

The LDE is still awaiting a quotation for the total cost of the JCB option but after seeing a photograph of the Mastenbroek dipper, it is an internal sliding arm which will not last and cause problems exactly as the Ulrich arms have in the past. The excavator is heavier and not a zero tail swing so not suitable.

Taking the above into consideration The LDE would recommend further investigation into the purchase of a factory-built Hitachi zx135 which would be a standard machine without a modification to the arm or counterweight which means it would be a true zero tail swing. The fuel tank has an additional 50 litre capacity than the others. No DPF filter which has caused problems and considerable cost to replace on some our existing machines.

Frampton On Severn surface water drainage modelling.

The water from the village of Frampton on Severn currently drains via 2 main routes into the Severn Estuary. The northern end of the village drains via Hock Ditch into the Severn Estuary via an outfall controlled by the E.A.

The remainder of the village and surface water from the surrounding catchment area has to drain under the canal via the Buckholt syphon. Once on the west (estuary)side of the Canal, water has to flow via a drainage channel in a southerly direction which belongs to the Canals and Rivers trust, through several old structures, through the wharf and then eventually discharging into the estuary.

This drainage route has been problematic in the past due to debris and estuarine mud being deposited into the outfall channel at high tides. The outfall channel in the Wharf and old structure is under the control of the Environment Agency.

However, problems are being compounded by the constant erosion of the foreshore and the old flood defence. Unfortunately, the flood defence has now been breached in several places and regularly high tides cover the wharf and the Canal bank is acting as the tidal flood defence.

Whilst not an immediate problem, it will become more difficult in the future for the Board to physically maintain the outfall and keep flooding to a minimum in the village. If the outfall became completely blocked there could possibly be residential property at risk.

The ground conditions on the warth will deteriorate with more frequent tidal inundation, the outfall will require more regular cleansing. The speed at which the warth will erode also increases as the ground level decreases towards the canal.

Please see attached a briefing report which we have given to various other bodies including Gloucestershire County Council which was mainly put together by Rose Hewlett. This explains the issue in far more detail with some excellent plans and photos. (see appendix 11)

Rose Hewlett has been very involved with the monitoring of the Warth erosion for many years.

Possible solution :

Divert Framptons surface water drainage on the landward side of the canal in a southerly direction using an existing watercourse utilizing a different culvert under the canal at Brickpits so that it can discharge into the Estuary via a modern E.A flapped outfall.

The LDE is keen to carry out some hydraulic modelling of the catchment to ensure that the Brickpits culvert and drainage channel layout has the required capacity without having a detrimental effect to any property in the Boards area.

Gloucestershire county council have indicated that they maybe in a position to fund this work but if funding is not forthcoming due to budget restraints the LDE would like to be in a position to add these works to the Boards capital programme.

If the results of hydraulic model concluded that the surface water diversion was possible the site work would be relatively straight forward with maybe some culvert upgrades and minor channel diversion/reprofiling and this could also be added to the capital programme.

James Druett

Land Drainage Engineer

FRAMPTON FLOOD RESILIENCE – BRIEFING NOTE 1 – 25 MARCH 2020

The purpose of this briefing note is to replace the presentation that was to be given at a meeting on 18 March 2020 by Rose Hewlett, Advance the Line (ATL), and James Druett, Lower Severn Internal Drainage Board (LSIDB). It provides factual information from on-site observations and monitoring. This should help inform discussions on how to maintain Frampton on Severn's flood resilience in the light increasing frequency and duration of tidal inundation. There are two main issues:

- the discharge of Frampton's surface water trapped landward of the Gloucester and Sharpness Canal
- the integrity of the canal's western embankment in the light of prolonged periods of saturation

Supporting written evidence

ATL's *Gauging the tide* (2013) http://gloucestershirehousehistories.co.uk/gauging-the-tide.pdf
Severn Lands Monitoring Reports 1-6 (2015-19)
Severn Lands Monitoring Protocol v3

Quick overview

The study area runs from Hock Ditch to Frampton Pill and is known as the Severn Lands and is highly designated.[1] The outer warth has been rapidly eroding since the demise of the railway bridge between Lydney and Sharpness (1960s).[2] Land loss has been noted through mapping, aerial and ground photography and satellite imagery.[3] A protocol for ATL to measure erosion of the outer warth on a quarterly basis was formally established in 2014: reports are issued annually to all organisations associated with the Frampton Flood Resilience (FFR) group. ATL also undertakes monthly bird surveys and periodic botanical surveys which are similarly reported annually.

The outer warth (outside the old sea wall) generally lies 0.75m higher than the inner warth (inside the old sea wall). ATL predicted that erosion of the outer warth and breaches in the old sea wall would enable a regular direct connection between the tides and the canal embankment before 2023.[4] The topography of the outer warth has changed since 2014 with the development of two major embayments, and tidal ingress via these has locally lowered the level of the land.[5] The big spring tides of March 2020 brought prolonged tidal inundation, and the outer warth 'broke through' close to a large breach in the old sea wall. Spring tides of the same height are predicted for April, September, October and November 2020. Direct exposure of the inner warth to the sea will mean that many more tides will have the potential to reach the canal bank. The rate of erosion suggests that large parts of the outer warth between Frampton Pill and Hock Ditch will have been lost by 2028.[6] The Shoreline Management Plan Review (SMP2) predicted that the shoreline defence (i.e. the embanked section of the Gloucester and Sharpness Canal) would fail between 2030 and 2060 without significant action.[7] There is an urgent need to address the two key issues listed above.

[1] *Gauging the tide*, pp. 10-11.
[2] *Gauging the tide*, pp. 23-24.
[3] *Gauging the tide*, pp. 28-33.
[4] *Gauging the tide*, pp. 33, 46-49.
[5] Severn Lands Monitoring Reports 1-6.
[6] Severn Lands Monitoring Report 5.
[7] *Gauging the tide*, pp. 13, 54-55.

Mapping of the warth edge

ATL maps a line 1m from the edge of the warth periodically. The erosion noted between 2014 and 2020 can be extrapolated to suggest where the warth edge might be in 2028.

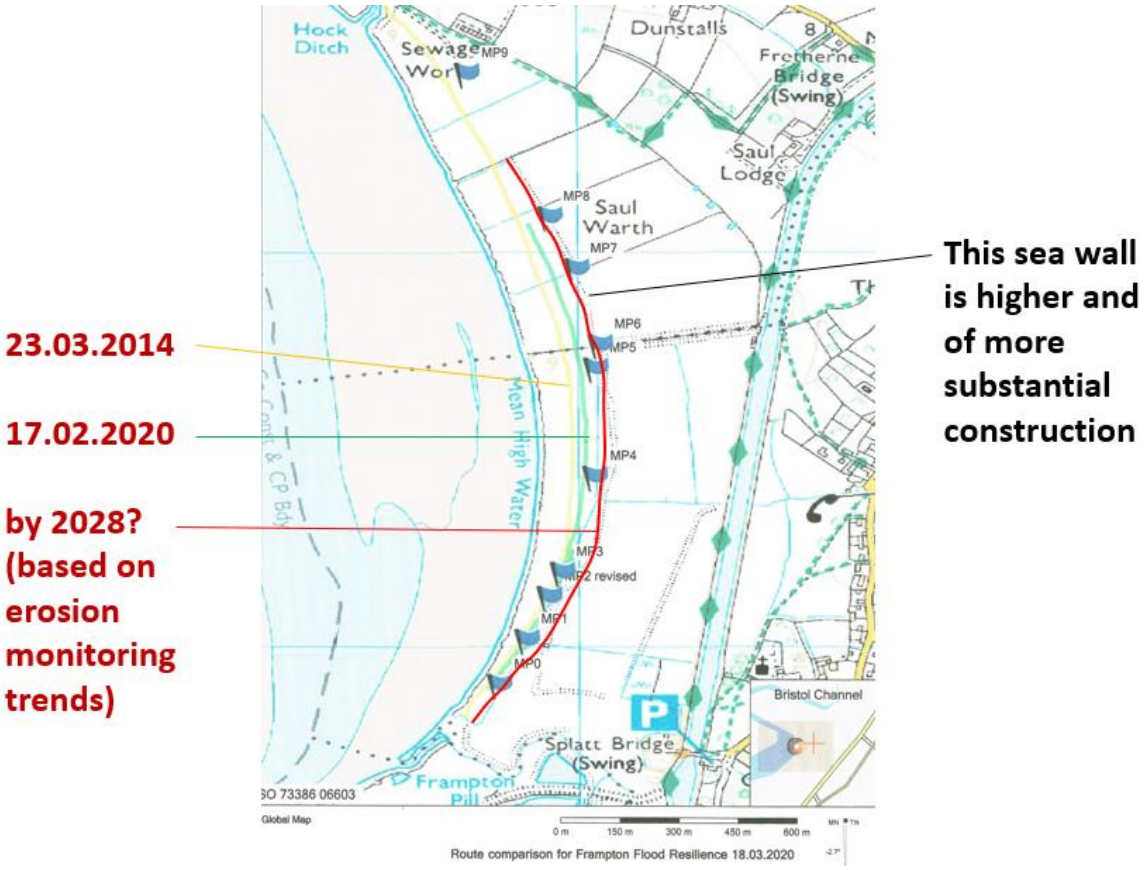


Fig. 1 – Warth edge mapping

Although the formal erosion monitoring protocol started in 2014, some information is available from informal monitoring at the same points from 2011. The most recent monitoring was undertaken on 17 February 2020.

Marker Post[8]	Date first measured	Original distance	Distance at 17.02.2020	Distance lost against time	Percentage lost since date first measured
0	18.11.2018	22.8m	21.4m	1.4m in 1 year 3 months	6%
1	03.11.2011	19.0m	2.5m	16.5m in 8 years 3 months	87%
2	03.11.2011	15.0m	1.5m*	13.5m in 8 years 3 months	90%
3	05.11.2012	11.2m	2.6m	8.6m in 7 years 3 months	77%
4	01.03.2013	58.3m	22.9m	35.4m in 6 years 11 months	61%
5	05.11.2012	69.0m	30.3m	38.7m in 7 years 3 months	56%
6	05.01.2014	72.5m	46.7m	25.8m in 6 years 1 month	36%
7	05.11.2012	77.0m	47.3m	29.7m in 7 years 3 months	39%
8	04.12.2013	56.3m	41.2m	15.1m in 5 years 2 months	27%
9	16.11.2014	33.0m	not recorded	2.7m in 5 years 3 months	9%

Table 1 – Land lost including historic informal monitoring

* This marker post was moved approximately one metre seawards following its loss during the EA's operations to extract a stranded excavator in December 2019.

[8] See Fig. 1 or Severn Lands Monitoring Protocol v3 for the position of the Marker Posts.

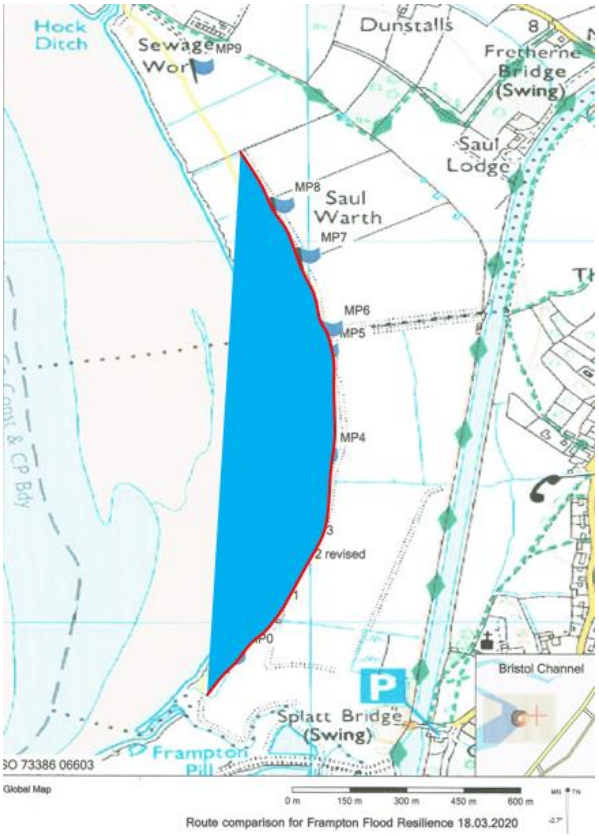


Fig. 2 – Projected position of the edge of the warth by 2028

Height of the tides and timing of high water at Frampton

The nearest tidal gauges are at Sharpness. Datum for the Gloucester Harbour Trustees (GHT) is the sill of harbour. Sill Datum is 0.5m above Chart Datum. ATL liaises with GHT and therefore uses Sill Datum. GHT's electronic system does not function above 9.99m above Sill Datum. At that point, GHT rely on their physical gauge. The EA also have a gauge at Sharpness, apparently also using Sill Datum, but GHT have questioned its accuracy as it has often been seen to vary from both the electronic and physical gauges of the GHT.[9] Can the EA confirm the Datum please?

Personal observation and conversation regarding several large tides suggests that high water at Splatt Bridge, Frampton, is probably about 15 minutes after Sharpness.[10] The actual height of the tides at Frampton is uncertain due to the shape of the Severn Estuary and the fact that above Shepperdine, spring tides do not fully ebb and thus retain some of their waters.[11]

The big spring tides of 11-12 March 2020 were predicted to be over 10.0m to Sharpness Sill.[12] There was a substantial surge on the evening tide of 11 March.[13] Although not observed in real time, the strand line was certainly seen to be higher than that of 3 January 2014 (morning) which was also influenced by a similar storm surge, albeit on a predicted 0.3m lower tide.[14]

[9] Rose Hewlett, pers. comm. Mike Johnson, harbourmaster.
[10] Rose Hewlett, pers. comm. Mike Johnson, harbourmaster.
[11] *Gauging the tide*, p. 22.
[12] England – Sharpness Dock: Times and Heights of High and Low Waters, 2020.
[13] RH's understanding is this was 0.65m at Avonmouth – EA please confirm the surge at Sharpness.
[14] England – Sharpness Dock: Times and Heights of High and Low Waters, 2014. RH's understanding is that this was 0.8m at Sharpness – EA please confirm.

The influence of the 18.6-year lunar cycle should not be underestimated when considering sea level rise and climate change.[15]

Observation of tidal inundation

ATL observes the impact of tidal inundation from a number of Observation Points (OP) on the canal towpath between Splatt Bridge and the Buckholdt siphon.

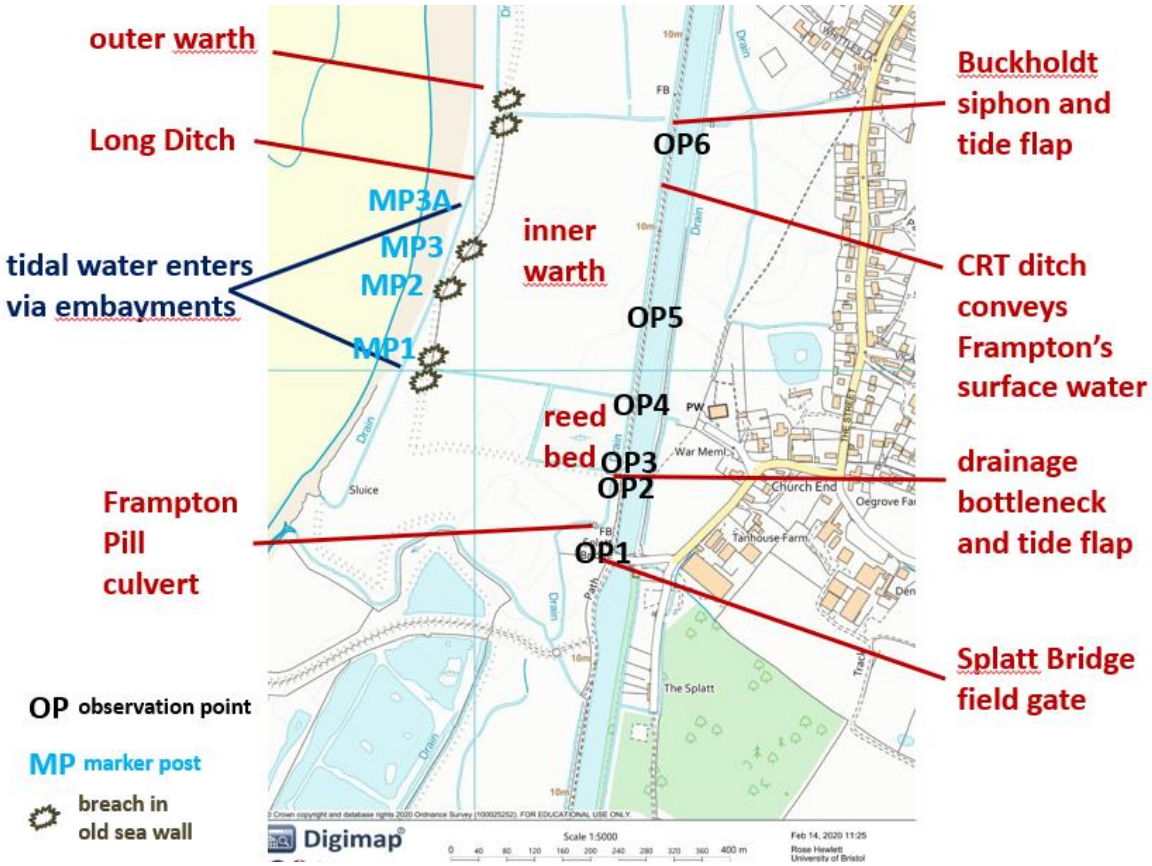


Fig. 3 – Site map between Buckholdt siphon and Frampton Pill

The tide height can be roughly gauged visually in a number of ways. These are against physical objects, none of which have been measured for height in relation to Ordnance Datum Newlyn.

Fig. 4 – Strand line at OP5 after the evening tide of 11 March 2020

The strand line at OP5 (indicated by the bottom of the stick) was 20cm vertical height below the top of the towpath edge after the evening tide of 11 March 2020. Note that the towpath then slopes upwards towards the canal edge.

[15] *Gauging the tide*, p. 22 including footnote 2.

Fig. 5 – High water at OP5 on the morning of 11 March 2020.

Visual estimates suggest that high water came within 1m vertical height from the top of the towpath edge on the previous tide. The EA's recent coastal defence projects in the south west have been based on designs assuming a 1.1m rise in sea level by 2100.[16] It follows that the canal embankment will not only be subject to more and more tidal action and saturation, but will likely be overtopped by the end of this century.

Fig. 6 – Just after high water at OP4 on the morning of 12 March 2020

The height of the tide can be seen on the fence posts.

Fig. 7 – Marker Post (MP) 2 on the outer warth is 65cm in height

The top of MP2 was just visible from the towpath during high water on the morning tide of 12 March 2020.

Fig. 8 – High water at the Buckholdt siphon (OP6) on 11 March 2020

The Buckholdt siphon takes a substantial percentage of Frampton's surface water under the canal.

[16] This accords with the range predicted in Jonathan L. Bamber *et al*, 'Ice sheet contributions to future sea-level rise from structured expert judgment', *Proceedings of the National Academy of Sciences*, 116/23 (4 June 2019), 11195-11200 <https://www.pnas.org/content/pnas/116/23/11195.full.pdf> [accessed 24 March 2020]

Draining the warths

Fig. 9 – 23 January 2019 at high water

On 23 January 2019, water came through a breach in the old sea wall at MP2 on an observed tide of 9.64m at Sharpness (to Sill Datum). Since then, erosion has lowered parts of the warth, particularly around the two main embayments, and ATL have studied the flows of tidal water into the inner warth.[17] Extraction of the excavator in December 2019 caused further localised lowering at MP2.[18]

Fig. 10 – 12 March 2020, shortly after the outer warth broke near MP2 'the new embayment'

The outer warth broke through just before this photograph was taken as the cascading water was much less than this upon arrival. This is just south of the main breach at MP2.

Embayments such as this quickly enlarge when supplied by draining water, and the incoming tide. They wear away and allow access for lower tides onto the warth. This action has been observed at MP1 and MP3A during the last five years, both of which help to drain water during the ebb tides.[19] There is no reason to suppose that anything different will happen here.

Fig. 11 – 14 March 2020 – debris lying in 'the new embayment'

The warth is likely to break through adjacent to this point within a short space of time. The loss of the outer warth in this way facilitates a more rapid draining of the inner warths, but this draining stops once the floodwater reaches a certain level.

Although not currently monitored, ATL considers it probable that tides of 9.4m are now accessing the inner warth via the embayment at MP1 and possibly MP3, primarily using the Long Ditch as a conduit. It is recognised and accepted that the deterioration of the outer warth will lead to direct exposure of the inner water to tidal water on a more regular basis. As the old sea wall loses its integrity (but noting that it still holds up well to repeated overtopping and tidal action), it should become easier to drain some of the inundated land.

[17] Severn Lands Monitoring Report 5.
[18] Severn Lands Monitoring Report 6.
[19] Severn Lands Monitoring Reports 3 and 4. Both have opened up a great deal since.

LiDAR between Buckholdt siphon (at OP6) and Frampton Pill demonstrates the low spots

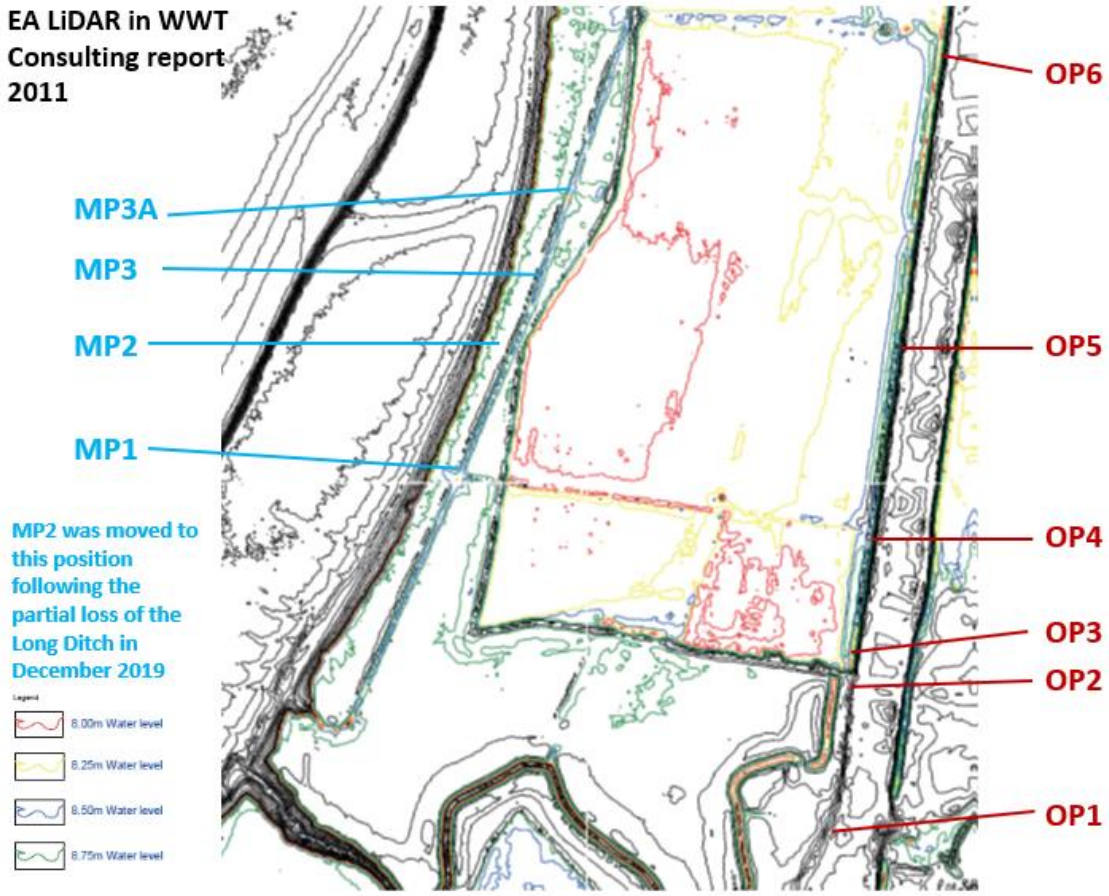
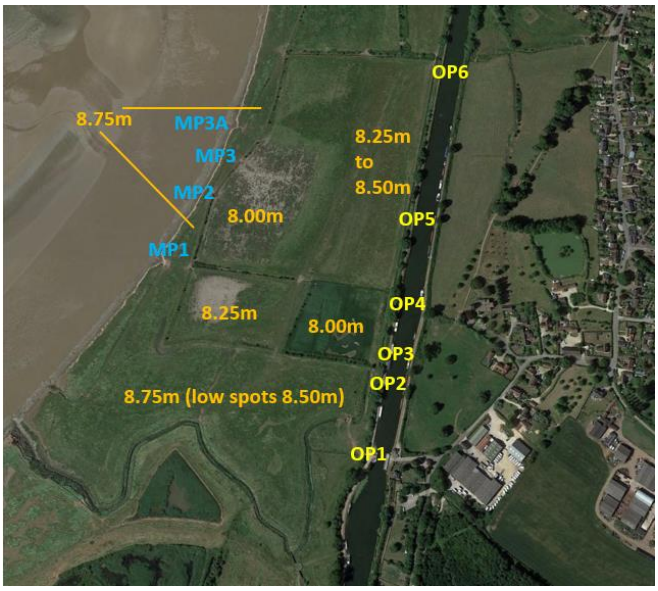


Fig. 12 – LiDAR from Buckholdt siphon to Frampton Pill



ATL and the LSIDB have observed the draining of the warths in 2020. It is apparent that a substantial amount of water from these warths initially drains into the canal-side ditch (which was primarily designed to take Frampton's surface water from the Buckholdt siphon to Frampton Pill). Frampton was therefore effectively tide-locked for the best part of a week in March even when the warths adjacent to the ditch were not inundated and the tide was out. The satellite imagery at Fig. 13 shows where the water settles for long periods of time. The rest currently disperses within days.

Fig. 13 – Ground heights from Buckholdt siphon to Frampton Pill

In order to understand why Frampton's surface water is held back for so long at the Buckholdt siphon, it is necessary to look at the whole area from Hock Ditch to Frampton Pill.

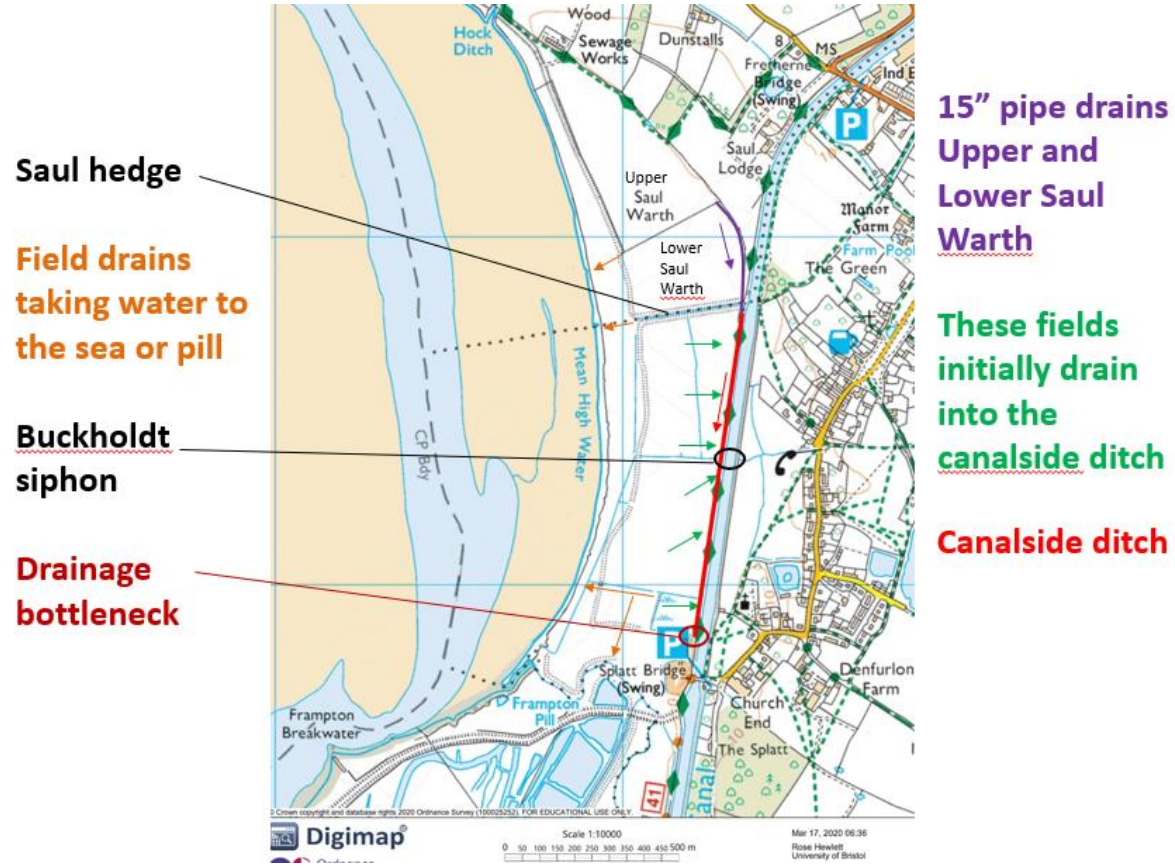


Fig. 14 – Main lines of drainage

Figure 14 shows some main lines of drainage. Victorian field drains are presumed to have mostly silted up, but a few still operate well and take water out to sea. Modern field drains (some also probably silted up) direct water to main ditches or Frampton Pill. This system works reasonably effectively until repeated inundations from big spring tides. Clearly, with greater tidal inundation expected, this situation will extend to a far greater number of tides.

Fig. 15 – Damaged sea wall beside Upper Saul Warth

Upper and Lower Saul Warths retain water behind a sea wall that is no longer regularly mown or cleared of wrack by the EA.[20] Heavy plant tracking along this wall in December (first the EA's excavator and then the attempts to recover it) has reduced its crest. On big spring tides, this sea wall is overtopped at the southern end of Lower Saul Warth (near the Saul hedge). Much of the water retained here is fresh and results from the high water table and local land drainage.

A 38cm (15 inch) pipe is located at the eastern edge of Lower Saul Warth (purple in Fig. 14). This discharges southwards and effectively empties into the canal-side ditch.

[20] That's personal observation. RH believes George Tomlin said at a GlosSES meeting that the EA were no longer maintaining the wall below the sewage works, but cannot currently find that information! EA – please confirm.

The fields immediately to the south of the Saul hedge also drain some of their initial water into the canal-side ditch, as do the fields between the Buckholdt siphon and the drainage bottleneck, including the particularly low-lying reed bed. All of this keeps the water level in the canal-side ditch high, sometimes for several days, as witnessed between at least 10 March (but probably from 9 March) until at least 16 March when the apparatus above the tide flap on the Buckholdt siphon finally became visible.

Fig. 16 – The Buckholdt siphon at 9am on 16 March 2020

ATL has witnessed the siphon staying shut for many hours after high water on a number of occasions when the tides were well under 10.0m.

What happens at the drainage bottleneck?

Fig. 17 – The drainage bottleneck

At the south end of the canal-side ditch, the water takes a 90º turn through a narrow, twisty part-open, part-culverted section.

The water is impeded through another 90º turn before being culverted through a bank and emerging through the EA's tide flap whereupon it flows into Frampton Pill.

Fig. 18 – The wooden tide flap at Frampton's outfall

The tide flap is of uncertain age. It was still not visible on 16 March 2020, but flow could be detected as a disturbance in the water.

As the water was drawing down from the warths during the previous week, it was also seeping through the bank.

The canal-side ditch is owned by the Canal and River Trust (CRT) and maintained by the LSIDB on a rechargeable basis. CRT's responsibility stems from the making of this new canal-side ditch when the canal was built, and is covered by *The Gloucester and Berkeley Canal Act, 1870.*[21] Although the EA's responsibilities and powers start at the tide flap, in practice, the

[21] This act brought together all previous legislation.

LSIDB generally maintain the ditch between the tide flap and the culvert over Frampton Pill, and also assist with the removal of wrack at either place when they have machinery on site for the canal-side ditch maintenance.

Fig. 19 – Frampton Pill culvert

Wrack frequently accumulates here and impedes the flow of drainage water through the small arched culvert. It also regularly accumulates about 85m downstream which can reduce outflow even more.

Under flood conditions, this drainage bottleneck, together with the sea wall immediately to the south of the reed bed and the higher level of the warth beside Frampton Pill hold the water in a cell against the canal bank.

Fig. 20 – Five hours after high water, 3 January 2014

This scenario has been repeatedly observed.

<u>The western embankment of the Gloucester and Sharpness Canal</u>

The western embankment of the Gloucester and Sharpness Canal is the de facto shoreline tidal defence.[22] In the light of BWB Consulting's 'Embankment Inspection Report' (July 2006), and localised slips and slumps seen following prolonged saturation of the embankment during the first three months of 2014 and at other times, ATL have repeatedly questioned the embankment's integrity and poor management of its vegetation which often hinders thorough visual inspections.[23] As a result, the EA compiled a technical note (presented at the last FFR meeting) and subsequently circulated additional supporting documentation regarding the composition of the embankment.[24] When the technical note was presented at the last FFR meeting, ATL was concerned that no account had been taken of the effects on the embankment of the drainage bottleneck at the southern end of the canal-side ditch. ATL considered this to be a key factor because of how long the embankment could and does remain under water, and an action was made on the EA to include a note about it.

[22] *Gauging the tide*, pp. 64-67.
[23] *Gauging the tide*, pp. 43-45, 54-55 and during various site visits and meetings.
[24] EA, Gloucester and Sharpness Canal Bank Technical Note (Version 1) (10 April 2019); Parkman Consulting Engineers, River Severn Tidal Defences Frampton Breakwater to Hock Ditch: Site Investigation Interpretative Report (March 1992, extracts).

Following a site visit on 8 March 2019, CRT suggested that they compile an Embankment Management Plan. They agreed to develop this within six months of the last FFR meeting (i.e. by the end of 2019) and implement it over a three-year period. As of March 2020, the cordwood and chippings resulting from pollarding in the winter of 2018-19 remain on site, although much of it has been washed around by the recent tides. It is likely that the large piles of cordwood stacked behind some trees have exerted pressure on them while the bank remained under water.

Fig. 21 – Scenes like this in March 2019 prompted CRT to confirm that an Embankment Management Plan was needed

Brambles still cover the embankment, and one tree with spindly bare branches has become so heavy with ivy and mistletoe that it slipped during the recent prolonged saturation period. This is not an isolated case; other similar trees are in danger of becoming overladen in the same way.

Fig. 22 – Ivy and mistletoe overwhelm the bare branches of spindly trees making them unstable, 12 March 2020

Virtually all the cordwood was under water on at least three of the March spring tides, and quite a lot was dislodged. Most remained somewhere on the bank, some of it has entered the canal-side ditch and is impeding drainage, and other lengths have found their way to the Buckholdt siphon.

Fig. 23 – Lengths of cordwood and other wrack at the Buckholdt siphon, 12 March 2020, almost six hours after high water

On 16 March 2020, it was still not possible to see the toe of the embankment, nor much of the embankment itself. It was not only covered in brambles, but also a large amount of straw-like wrack and other debris from the tides. However, where the earth was visible, it is clear that the wave-like action of water had weakened the topsoil and subsoil layers leaving loose material behind. This soil is vulnerable to being washed away during the next period of heavy rainfall or tidal saturation.

Fig. 24 – Localised erosion, 16 March 2020

Of greater concern is this section of bank about 100m to the south of Buckholdt siphon where the mooring bollard has slipped and the embankment seems to have a strange hollowed shape and then a near vertical drop.

Fig. 25 – 100m south of the Buckholdt siphon the embankment appears to be slipping, 16 March 2020

Fig. 26 - This is especially obvious in a close-up of the mooring bollard, 16 March 2020

This slippage is also visually evident from the towpath and on Google Earth.

13.07.2013 27.06.2018

Fig. 27 – The mooring bollard (ringed in yellow) has slipped towards the canal-side ditch

Fig. 28 – The same slipped mooring bollard from the opposite direction, 14 March 2020

Either side of the mooring bollard, from the towpath downwards initially there is firm, sloping ground. This then gives way to a what appears to be small vertical drop and a more hollowed out section, before another vertical drop towards the toe. (The toe is not yet visible due to the water level.) This embankment profile appears to be replicated elsewhere.

Fig. 29 – Another location where the bank appears to have a similar hollowed out profile, especially behind the tree, 14 March 2020

It is not unreasonable to assume that the original profile of the embankment was consistent and more akin to the one in this photograph (i.e. no short vertical drop or hollows, just a uniform slope to the ditch).

Fig. 30 – Some sections display a more engineered profile, 14 March 2020

The action of the water against the embankment, even for short periods of time, should not be overlooked. Holding the camera still in a strong wind to take photographs from the particularly exposed OP5 can be difficult. Waves on the canal are replicated on the tidal waters over the inner warth, in the canal-side ditch and against the canal bank. This can happen for several hours, saturating the lower part of the bank making it susceptible to collapse, particularly given the lack of support at the toe. Annual maintenance of the drainage ditch for decades has significantly adjusted profile at the toe, and this tidal action is making it weaker every time this area is flooded.

Fig. 31 – Waves near the Buckholdt siphon and also on the canal from the same place, six hours after high water on 11 March 2020

Ironically, the straw-like wrack has (perhaps) served to protect parts of the bank from this type of action, although (one imagines) it is also preventing the saturated ground from drying out.

Concerns about the EA's technical note

While compilation of the technical note about the condition of the canal embankment as a tidal flood defence was welcomed by ATL, it fell short of expectations. ATL has considerable local knowledge, data and technical expertise and could have worked alongside the EA to produce something more accurate and rigorous.

The technical note did not reference *Gauging the tide* which contains valuable background information.

It does not appear that the compiler walked along the field edge of the canal-side ditch and did not therefore have the benefit of a full visual inspection of the embankment from that perspective.

The remark that 'anecdotally water in 2014 [3 January] was up against the embankment for at least 5 hours' is a woeful understatement. The photographs supplied to the EA included this one of the Buckholdt siphon. The water did not quickly disappear after that as the technical note seems to imply.

Fig. 32 – 3 January 2014 five hours after high water at the Buckholdt siphon

The technical note focussed on the duration of overtopping of the outer warth, rather than how the tidal water finds its way to the inner warth, something which happens for a much longer period of time than expected because of the embayments and local topography.

There was little or no understanding of the hydrology of the site from Hock Ditch to Frampton Pill during normal conditions, periods of tidal inundation and draining down.

The complete failure to acknowledge the drainage bottleneck, or even mention the EA's tide flap/outfall is a serious oversight. There is a direct correlation between the length of time floodwater takes to drain and the length of time the canal bank is saturated.

The technical note made no mention of climate change or sea level rise, nor did its sampling of tides likely to inundate take any account of the variations that occur during the 18.6-year lunar cycle. All of this affects/will affect the potential periods of canal bank saturation.

It is highly disappointing that CRT have seemingly taken no action on the technical note's recommended ways forward regarding management and maintenance of the embankment to facilitate proper visual inspection and ensure its stability.

Mindful of the difficulties highlighted in this briefing note and the likely situation by 2028, how can Frampton's surface water be discharged in the future?

The present system is clearly untenable. Frampton's surface water has the least priority in the canal-side ditch, the drainage bottleneck severely restricts outward flow, the tide flap does not appear to comply with any current design standards and Frampton Pill frequently blocks with wrack, particularly at the field culvert. Additionally, the Buckholdt siphon is difficult/impossible to reach should a major blockage in its tide flap need removing during big spring tides.

In the **short** term there are works that should be considered in order to help evacuate surface water from Frampton on Severn and reduce the risk of flooding to land and residential properties on the east side of the canal. They include:

1. Widen the existing canal-side ditch from the Buckholdt siphon to the drainage bottleneck by approximately 1m incorporating a berm along the entire length (field side). This would create additional capacity, allow the toe of the canal bank to be left completely undisturbed by routine maintenance, and enhance the aquatic habitat by helping marginal vegetation to establish. In the short-term this will aid the deposition of silt which may help to support and protect the existing bank. However, it is anticipated that an engineered solution for bank protection by the relevant authority will need to be considered in the future.
2. Eliminate disposal of arisings from the ditch-widening by spreading adjacent to the drainage channel (field side) particularly in low areas. This will create a slightly raised maintenance strip allowing easier access for machinery. As tidal inundation increases, the general ground conditions will deteriorate making machinery access more difficult. The rate of siltation will also increase, which in turn will require increased maintenance/access.
3. Bypass the existing double culvert immediately upstream of the drainage bottleneck with a suitable sized galvanised helibore pipe/culvert, significantly reducing the restriction to flow whilst to continue to provide field access.
4. Demolish the old outfall structure/flood bank to remove the bottleneck.
5. Use the spoil to continue the existing raised bank on the seaward side of the upper reaches of Frampton Pill where there is a short low section. This will provide further flood protection.
6. Install a new box culvert, outfall structure and tidal flap on the existing downstream field culvert over Frampton Pill to prevent back flow, silt and debris into the canal-side ditch. This would then act as the first line of defence should the Buckholdt siphon flap fail during normal tides.

We recognise that these proposals would require consent from the landowner and further investigation and agreement from the relevant bodies concerned. With careful consideration, including modelling and some simple design, a combination of these works could provide a robust short-term solution relieving Frampton on Severn of surface water flooding over the next 10 to 20 years.

However, **the above is not a long-term solution**. Current evidence suggests that the situation will deteriorate to a position where it is not possible to maintain or guarantee the drainage of Frampton's surface water due to the increased height, frequency and duration of tidal inundation. At that stage access for emergency (and some routine) maintenance of the Buckholdt siphon, drainage ditch and outfall will not be practical.

It is therefore incumbent upon the FFR group to explore a range of alternative options. One such scheme would be to investigate the possibility of draining Frampton's surface water on the east side of the canal via the Brick Pit siphon and through the EA's modern (installed *c.* 1993 and more easily accessible) outfall which discharges into Frampton Pill. The capacity of the Brick Pit siphon under the canal would need to be assessed to confirm suitability. Altering the current directional flow of the watercourses serving the Buckholdt siphon should not be too difficult, and the ditch capacity appears adequate. As with any new scheme, multi-agency working, landowner consent and consultation with all stakeholders would be required.

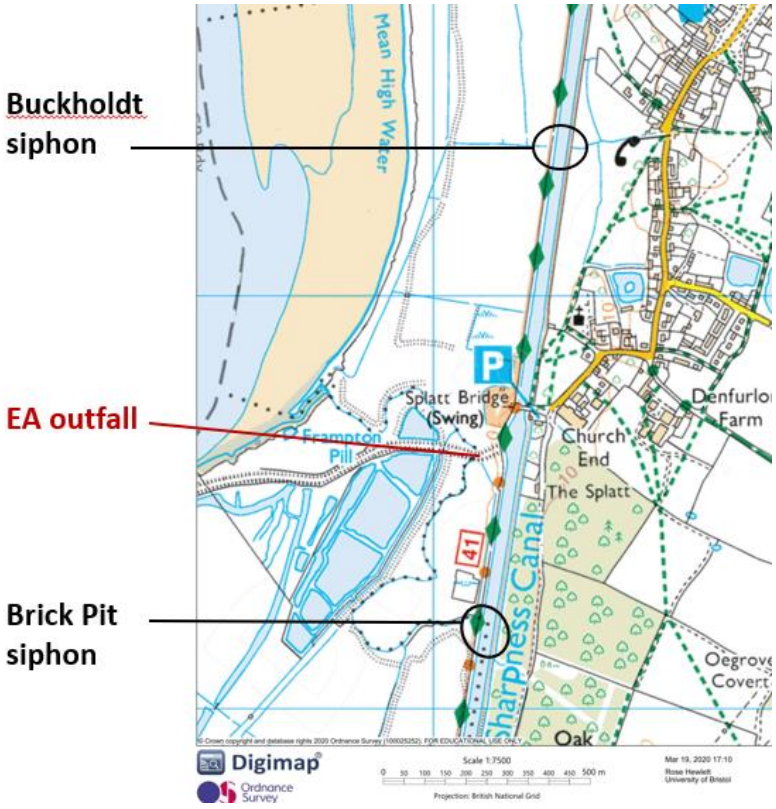


Fig. 33 – Locations of the EA outfall and the Brick Pit siphon

Fig. 34 – The Brick Pit siphon is accessible at all states of tide

Fig. 35 – Ditches landward of the outfall have adequate capacity

Given that the canal bank will be subjected to increased frequency and periods of saturation, what steps should be taken to ensure its integrity as a tidal flood defence

Short-term solutions, particularly to combat surface water flooding within the village have been discussed above and there is no doubt in ATL's mind that a combination of these will be required in the next 10 years.

ATL's long-term concerns lie with the risk of significant fluvial flooding either from a lack of maintenance of the existing canal bank resulting in a major collapse, or through increased sea levels combining with pluvial flows in the river to cause an overtopping of the canal embankment.

In order to avoid these risks an ongoing maintenance plan needs to be established with collective agreement from all relevant parties. This plan will establish frequency of inspections, vegetation clearance requirements and the like, and will ensure that the structural integrity of the canal embankment is maintained.

In addition to this, it is likely that more substantial engineering works will be required. There are a number of different solutions which could be adopted including steel sheet piling or concrete protection walls, but ATL suggest that regular maintenance would allow minor protection measures in the medium term before the need for more substantial engineered measures in the longer term. Not only does this reduce the overall cost of protection measures, but it also reduces long-term environmental impacts creating a far more robust plan.

Ecological matters

This briefing note has focussed on drainage and tidal defence in line with the original intended presentation. The compilers recognise that although some habitats and species are being lost through natural processes, there will also be ecological opportunities for the site in the coming years. Scarce and unusual plants are currently found on the old sea wall. When Upper and Lower Saul Warth lie wet for long periods, they provide sought-after freshwater habitat close to the estuary during the breeding season. As the inner warth becomes more tidal, a variety of saltmarsh plants may colonise. The reed bed, Saul hedge, field ditches, canal embankment and the warths all need consideration, and also whether grazing will still be possible.

The Severn Lands are currently in Higher Level Stewardship on an annual extension. Frampton Court Estate needs to be involved in any plans for the future of its land.

Fig. 36 – Nationally scarce and unusual plants inhabit the Severn Lands

Conclusions and recommendations

The Severn Lands is a coastal site,[25] and appropriate expertise is needed to explore ways of managing their future ecologically, the future flood resilience of Frampton on Severn and the continued supply of more than 50% of Bristol's water. In times of high fluvial flood, the canal

[25] *Gauging the tide*, pp. 8, 52.

takes in additional water at Gloucester to assist with essential flood relief.[26] Any compromising of its western embankment at Frampton has the potential to disturb the equilibrium between the two embankments for which the sheet piling merely serves as protection against wash from boat traffic.[27]

ATL recommends that a coastal engineer from Wessex EA takes a leading and proactive role from now on, supported by colleagues in West Midlands EA, and that the coastal wetlands expertise within WWT also drives this project forward. These measures aim to ensure the best possible outcomes for wildlife and flood resilience.

The embanked section of the canal between the Buckholdt siphon and Splatt Bridge is directly exposed to the stormy weather of the Severn Estuary and, increasingly, its tides. Through annual reporting, ATL have regularly highlighted that this section of embankment will become saturated for much longer periods of time and more regularly: these reports also reference *Gauging the tide*.[28] This is happening now, within the timescale predicted by ATL. Given the evidence for erosion between Hock Ditch and Frampton Pill, ATL have further predicted that much of the remainder of the outer warth will be lost by 2028. It is therefore highly regrettable that some of the important actions from the last FFR meeting, and recommendations from the EA's technical note, appear to have simply laid on file for the last nine months.

ATL recommends that all members of FFR individually confirm that they are seriously taking these timescales on board, set out their action plans to all other FFR members, and don't simply wait until it's happening, which seems to be the case at the moment.

ATL have suggested in this briefing note that the embankment is noticeably slipping 100m south of the Buckholdt siphon. Here it is largely visible. It would not be unreasonable to raise concerns that the situation could already be replicated elsewhere. Certainly, the profile of the top section of the riverward face of this section of embankment can be matched to several other locations along its length, and bears little resemblance to the more engineered profile also seen in places.

ATL recommends that a technical statement from CRT and the EA regarding the above be circulated to FFR members as a matter of priority.

In response to ATL concerns, CRT and the EA have previously stated that any localised failures of the embankment should be identified during the regular inspection programme and dealt with appropriately to avoid escalation. With the current embankment management, such identification in many cases seems a distinct **im**possibility, and ATL wonders whether the embankment has retained it Condition Grade of 3 (CG3) given that many elements have been obscured by brambles, cordwood and bark chippings over long periods of time.

ATL and the LSIDB recommend that CRT manage the western embankment to a standard that ensures a full visual inspection is possible from both the towpath and the field below before the big September tides. ATL is willing to undertake local monitoring and seeks a better understanding of the standards associated with CG3. FFR members should be alerted if the embankment drops below CG3. We can, and should, work in partnership, not in isolation, particularly at this difficult time.

The ability to successfully discharge Frampton's surface water in a timely way is of considerable importance. Tide-locking increases the risk of properties flooding and the current situation will only deteriorate in the 2020s. Sea level rise and increased storminess will put

[26] *Gauging the tide*, pp. 44-45.
[27] *Gauging the tide*, pp. 48-49.
[28] Severn Lands Monitoring Reports 1-6 and referencing to *Gauging the tide*, pp. 46-49.

additional pressure on the system. The LSIDB have undertaken initial investigations and suggested a solution with a relatively short life-span, and also a longer-term solution that would ensure the drainage system can be maintained at all times into the future.
ATL and the LSIDB recommend that these be fully discussed and developed under the leadership of the LSIDB, working in partnership with other agencies and organisations.


Fig. 37 – The two outfalls on Frampton Pill

The previous FFR meeting briefly discussed funding opportunities and partnership working. Peter Jones from the English Severn and Wye RFCC has said on more than one occasion to members of ATL that the RFCC should be asked to make some provision in their forward planning budget. As demonstrated above, keeping Frampton's properties flood resilient is only one aspect. The canal fulfils a vital role in Gloucester's flood relief schemes and supplying Bristol's water.
ATL requests assurance from the LLFA convenor and FFR members that one agency will be requested to coordinate the appropriate funding mechanisms, and that all FFR members will actively explore potential funding pots.

Rose Hewlett, ATL
with contributions from James Druett, LSIDB and Paul Burnside, ATL

LOWER SEVERN (2005) INTERNAL DRAINAGE BOARD

Engineering Meeting

Wednesday 2nd September 2020

Virtual Meeting
2pm

LOWER SEVERN (2005) INTERNAL DRAINAGE BOARD

TERMS OF REFERENCE
OF THE ENGINEERING COMMITTEE
Approved 5th Feb 2020 Minute 3002

MATTERS FOR DETERMINATION BY THE COMMITTEE

1. Small engineering schemes or works up to £30,000.
2. Machinery replacement in accordance with the pre-approved programme.
3. The adoption or declassification of watercourses in the context of an approved policy framework and the regimes of other statutory authorities in this regard.
4. To assess, agree and monitor works for the Capital Programme.

MATTERS FOR RECOMMENDATION BY THE COMMITTEE TO THE BOARD

5. To review the Board's rhine maintenance priorities.
6. To review future maintenance liabilities of assets e.g. Environment Agency, outfalls and main river
7. To review Avonmouth and Severnside developments commuted sums, infrastructure charges and modelling.
8. To review pumping station maintenance and repair.

Signed:…… (Chairman)

Minute 3002
05 February 2020

Minutes of the Engineering Committee
of the Lower Severn (2005) Internal Drainage Board
Meeting held Wednesday 24th October 2019 at 10.30 am
at The Gables Hotel Falfield

Present:

Mr Barnes	Chairman	
Mr W J Cornock		Mr G Littleton – Deputising for Cllr J Jones
Miss R Hewlett		Mr G Simms
Mr Hyslop		

Staff:

Martin Dear	Accounts Officer	AO
James Druett	Land Drainage Engineer	LDE
James Thomas	Civil Engineer	CE
Kieran Warren	Principal Officer	PO
Andrew Terrett	Foreman	
Louise Reading	Minutes	

2933	**Apologies** Apologies were received from Patrick Goodey, Rodger Godwin, Ian Ractliffe & Cllr J Jones.	
2934	**Declarations of Interest** No interests were declared.	
2935	**Minutes of Previous Engineering Committee Meeting** Miss Hewlett informed the Board that the initials NFU were no longer used by the Gloucestershire Severn Estuary Stake Holders and thus should be removed from minute number 2779. **It was resolved that:** • **Subject to the above alteration the minutes of the meeting held on 21st November 2018 are approved.**	
2936	**Update of the Capital Programme** The PO advised the Board that the first part of the report was a summary of how the programme had evolved and Appendix A was now historical as it related to the picture in February this year. Officers were aware that the forecasted figures were unreliable and out of date and reminded Members of the importance of revisiting and updating these figures more frequently based on experiences of completed schemes, material costs and possible additional works such as refurbishing or replacing current structures. Having done this the global cost of the Programme had increased from £2.3m to £3.5m. Some schemes had dropped out of the Programme as they hadn't been fully costed and remained aspirational. These works will undergo assessment, prioritisation and financial approval in the future alongside other works. The Capital Programme focused on the Pump station replacement programme and machinery replacement over the next few years. Mr Simms asked whether clarity should be sought for the responsibility for the management of the Capital Programme and the PO confirmed that Capital Programme projects were to be decided and agreed by the Engineering Committee. They would then go to the Finance & General Purposes Committee to agree how these schemes would be financed and then to the Board for approval.	

Un-approved

	Mis Hewlett suggested that the meeting schedule should reflect this. The CE recommended the Terms of Reference be amended to provide clarity as to the respective responsibilities of each Committee. In response to Mr Hyslop question about building new pump stations alongside the existing one and then decommissioning, the Engineers indicated that all aspects of design were taken into consideration when replacing or refurbing the pumps. Members heard that the Programme as revised and attached at Appendix B was complete as of today's date taken together with the vehicle and plant replacement programme. It had been extended by 2 years to avoid a steep rise in drainage rates. If approved at the next Board meeting, the LDE will write to the EA to request an extension. On the morning of the Board meeting a Finance and General Purposes meeting will be held to decide how to best fund the revised programme and the Engineering Committee will recommend that £200,000 from the unallocated reserves be transferred to the pump replacement reserve. **It was resolved that:** • **The Capital Programme as set out in Appendix B, be approved: and** • **The means by which the new proposals will be assessed and added to the Capital Programme be approved.** • **Subject to the meeting of Finance and General Purposes on 6th November 2019, requests the Board move £200k from the unallocated reserves to the pump replacement programme.** • **The LDE to write to the EA to request an extension from the 2025/2026 deadline for a further 2 years** • **The Terms of Reference be amended and submitted to the Board for approval.**	
2937	**Machinery Replacement Programme** . <u>Energreen 1500 AU11 HCH</u> The LDE reminded the Committee that the replacement of this machine had been deferred from 2018/19 for one year, owning to low hours. The LDE recommended that a replacement should now be agreed as the machine was starting to show signs of increase maintenance and repair. He also did not want to replace this machine any later as it would clash with other replacements and create a financial spike in the programme. The quote for the new Energreen was £212,000 with a part exchange available of £25,000 costing £187,000 + VAT In response to Mr Hyslop's concerns that the part exchange value was low the LDE and Mr Barnes reiterated that the machine was a specialist item and that made it difficult to sale second hand. **It was resolved that:** • **A new Spearhead SPV2 be purchased on 2020/21, part exchanging with AU11 HCH.**	
	The meeting closed at 11.20	

Unapproved

APPENDIX A

Capital Programme
Assessment Criteria

In order to ensure consistency and fair consideration for all potential projects, it will be helpful to identify and agree the criteria by which these projects will be judged prior to their inclusion in the programme. The following criteria are proposed:

1. The number of residential, agricultural and commercial properties that will enjoy greater flood protection benefits.
2. The area of farmland that will enjoy greater flood protection benefits.
3. The status of the land, ie where it is designated as a RAMSAR, SPA or SSSI site, the site of a Scheduled Ancient Monument or supports the implementation of the Board's Biodiversity Action Plan.
4. The extent (if any) to which the project assists the Board in the discharge of its statutory responsibilities.
5. The ongoing maintenance costs of the project (if any) post-completion.
6. The extent to which the Board's general maintenance programme might reduce as a result of the proposed works.
7. Confirmation of the Board's ability to finance the project in the proposed timescale.
8. The availability of external funding to support the financing of the works.
9. Where it can be measured, the Return on Investment for the project.

These principles should also govern the priority attached to each project. Should the Board need to respond urgently to a flooding event, then funds may have to be diverted from the Capital Programme. In such a case slippage might be unavoidable.

LSIDB PROJECTS 2019/20 - 2025/26

Project	**Benefits**	**Net Cost Estimate £K**	**Maintenance Implications + Or -**	**Timescale**	**Return on Investment**	**Comments description of scheme criteria met**
Plant + Vehicles Tractor/mower	Health & Safety and Efficiency	140*		2021/22		Offset by sale of old machine
Excavator	Health & Safety and Efficiency	90* 130* 110*		2019/20 2021/22 2023/24		Offset by sale of old machine
Vehicles	Health & Safety and Efficiency	25* 25*		2023/24 2024/25		Offset by sale of old machine
Spearhead m/cs	Health & Safety and Efficiency	170* 360* 260*		2020/21 2022/23 2024/25		Offset by sale of old machine

Pumping Stations Renewals	Statutory, Environmental and Efficiency	200* 225* 250* 275*		2019/20 2020/21 2021/22 2022/23		
Drainage Schemes						
Hill Pill outfall		75				Survey work approved
Aust/Olveston		500		?		
Demainment works		30		2019/20		
Cornham		500		?		
Rea Lane pumps		250		?		
Epney				?		
Rockhampton				?		
Renew office and workshop		400		?		

***** Sum already budgeted.

LOWER SEVERN (2005) INTERNAL DRAINAGE BOARD

REVISED

APPENDIX B

Cash Flow Forecast for the Pump Replacement Programme
Annual Increment of £25,000 from 2018/19 to 2025/26

		£ Original Budget (June 2015)	£ Revised Budget	2016/17 £ actual	2017/18 £ actual	2018/19 £ actual	2019/20 £ forecast	2020/21 £ forecast	2021/22 £ forecast	2022/23 £ forecast	2023/24 £ forecast	2024/25 £ forecast	2025/26 £ forecast	2026/27 £ forecast	2027/28 £ forecast	Total £ forecast
Income																
Provision from Income and Expenditure A/c		2,400,000	3,175,000	150,000	150,000	175,000	200,000	225,000	250,000	275,000	300,000	325,000	350,000	375,000	400,000	3,175,000
Provision from Unallocated Reserves			320,000				200,000							120,000		320,000
Income Total		2,400,000	3,495,000	150,000	150,000	175,000	400,000	225,000	250,000	275,000	300,000	325,000	350,000	495,000	400,000	3,495,000
Expenditure																
Pump Station	**No. of Pumps**															
Oldbury	3	513,300	867,358				6,779							553,110	307,469	867,358
Marshfield	2	385,860	577,247				6,776			406,562	163,909					577,247
Lapperditch	2	352,820	514,500				8,177	351,823	154,500							514,500
Wicks Green	2	553,420	851,854				5,728					556,307	289,819			851,854
Elmore Back	2	327,391	500,000	2,891		13,540	283,569	200,000								500,000
Saul	1	169,457	180,000	6,887	24,387	55,329	91,755	1,642								180,000
Expenditure Total		2,302,248	3,490,959	9,778	24,387	68,869	402,784	553,465	154,500	406,562	163,909	556,307	289,819	553,110	307,469	3,490,959
Net Movement in the year				140,222	125,613	106,131	-2,784	-328,465	95,500	-131,562	136,091	-231,307	60,181	-58,110	92,531	
Reserve																
	Balance b/f				140,222	265,835	371,966	369,182	40,717	136,217	4,655	140,746	-90,561	-30,380	-88,490	
	In year movement			140,222	125,613	106,131	-2,784	-328,465	95,500	-131,562	136,091	-231,307	60,181	-58,110	92,531	
	Balance c/f			140,222	265,835	371,966	369,182	40,717	136,217	4,655	140,746	-90,561	-30,380	-88,490	4,041	4,041

Notes:

1 Assumes inflation of 3% per annum.
2 Extends the period of income required fronm the Income and Expenditure Account.
3 Assumes two transfers of funds from Unallocated Reserves.
4 Moves the start date of Oldbury pump replacemtn from 2025/26 to 2026/27.

MEETING: Engineering Committee **MEETING DATE: 2.9.2020**

REF: KW/B5/2020 **REPORT BY: Principal Officer**

CAPITAL PROGRAMME – PROGRESS REPORT

Introduction

One of the matters for determination by this Committee is:

> **"To assess, agree and monitor works for the Capital Programme."**

This addition to the Engineering Committee's Terms of Reference was approved by the Board on 5 February 2020. [Minute 3002 refers.]

For ease of reference whilst considering the current position, set out below, a copy of the Capital Programme as at 30 June 2020 is attached at Appendix A.

Position as at August 2020

PUMPING STATIONS

SAUL – Project completed.

ELMORE BACK – Ongoing.

After the LDE updated members at the full Board meeting in July there have been further developments with the design and progress of the project.

A quotation for the upgraded power supply has been received from Western Power distribution which amounts to £13,707.

The Environment Agency are still yet to consent the fish pass and associated infrastructure which has now been designed.

An order has been placed with Bedford pumps in the sum of £97,705 which will be invoiced at various stages of the detailed design/pump build, outlet pipe design and installation.

Further concrete testing and bore hole drilling is being carried out to the inlet concrete foundation to ensure that is capable of carrying the new self-cleaning weed screen load.

A quantity surveyor is currently producing a bill of quantities which will give us a more accurate breakdown and total estimated cost of the project.

The most significant development relates to the existing building. After discussing various designs and safe methods to remove the new pumps by the Board for service or in the event of failure it has been concluded that the best option would be to remove the existing building altogether. This will allow easier and safer removal of the pump canisters in the future and remove a maintenance liability.

Demolition of the building requires planning permission and a pre-application meeting with Stroud District Council will take place in the very near future.

We will then have to wait for a further 6 weeks after a formal application has submitted to receive full planning permission although we will complete the tender documents after the pre application advice.

Unfortunately, this does delay the project by approximately 2 months and now we are looking to go out to 3 contractors for tender at the end of September 2020.

Tender appraisal and appointing a contractor is likely to be the end of October with a start date onsite estimated to be January 2021 which may prove beneficial as the site will now not be vacant through the Christmas period.

We still hope to be completed by the end of March 2021.

As the CP shows, the Board is scheduled to spend c£430,000 in 2020/21.

A detailed technical note is included (see appendix 1.)

Isometric view before (see appendix 2.)

Isometric view after (see appendix 3.).

REMAINING STATIONS – In order to streamline the introduction of each following scheme, survey work for these stations has been undertaken which include ground investigations, structural surveys and topographical surveys. These preparatory works should assist in keeping up momentum and achieving the targets set out in the CP.

PLANT AND VEHICLES

To date, the purchase of replacement plant and vehicles has not been adversely affected by the COVID crisis. Recent purchases include: 1 x Spearhead spv 2 which is currently in operation and p/x of our Energreen 1500.

WATER LEVEL MONITORING EQUIPMENT

This scheme relates to the Slimbridge Water Level Management Plan.

The water level monitoring equipment has been installed and is operational. The outstanding action of rootcutting and CCTV of a culvert near the canal crossing on Ryalls Lane has been completed. The monitoring now has a baseline to work from and data will now be gathered to allow the modelling of different scenarios. The data gathering is expected to last approximately 18 months.

Conclusions

Despite the challenges created by Covid 19, no significant slippage has occurred in our planned activities/expenditure so far this year. No adjustments to the CP are required at present.

Members of the Finance & General Purposes Committee were advised of the present position (minus the latest information now supplied in respect of Elmore Back and Water Level Monitoring Equipment) at its meeting held on 1 July 2020

Recommendation:

That the report be noted.

Kieran Warren

Principal Officer

LOWER SEVERN (2005) INTERNAL DRAINAGE BOARD

Expenditure Forecast for the Capital Programme - 2020/21 to 2027/28

As at 30 June 2020

		Budget	Previous Years Expenditure	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	Total 2020/28	
		£	£	£	£	£	£	£	£	£	£	£	
Pump Stations													
	No. of Pumps												
Oldbury	3	867,358	18,466	2,017						539,406	307,468	848,891	
Marshfield	2	577,247	18,463	2,018		392,857	163,909					558,784	
Lapperditch	2	514,500	19,865	340,135	154,500							494,635	
Wicks Green	2	851,854	17,417	2,017				542,601	289,819			834,437	
Elmore Back	2	500,000	70,582	429,418								429,418	
Saul	1	180,000	176,811	3,189								3,189	
Pump Expenditure Total		3,490,959	321,604	778,794	154,500	392,857	163,909	542,601	289,819	539,406	307,468	3,169,354	0
													-1
Plant and Vehicles													
Energreen 1500		210,000		210,000								210,000	
Energreen AU11 HCH		-25,000		-25,000								-25,000	
Water Level Monitoring Equipment		8,000		8,000								8,000	
Claas Mower		160,000			160,000							160,000	
Class Mower OU07 JXX		-10,000			-10,000							-10,000	
Kobelco Excavator		140,000			140,000							140,000	
Hyundai WX12 CWL		-10,000			-10,000							-10,000	
Energreen SPV3		400,000				400,000						400,000	
Energreen VX65 HVB		-40,000				-40,000						-40,000	
Kobelco Excavator		160,000					160,000					160,000	
Kobelco Excavator WU16 TZM		-15,000					-15,000					-15,000	
Isuzu Truck		35,000					35,000					35,000	
Isuzu Truck WU17 NVD		-5,000					-5,000					-5,000	
Energreen SPV2		300,000						300,000				300,000	
Energreen VX65 HTA		-40,000						-40,000				-40,000	
Ford Ranger Truck		40,000						40,000				40,000	
Isuzu Truck VO62 RPY		-5,000						-5,000				-5,000	
Loadall/Material Handler		90,000								90,000		90,000	
Merlo Loadall WX08 OSY		-1,000								-1,000		-1,000	
Plant and Vehicles Expenditure Total		1,392,000	0	193,000	280,000	360,000	175,000	295,000	0	89,000	0	1,392,000	0
													0
Capital Expenditure Total		4,882,959	321,604	971,794	434,500	752,857	338,909	837,601	289,819	628,406	307,468	4,561,354	

motion
84 North Street
Guildford
Surrey
GU1 4AU

Tel: 01483 531300
www.motion.co.uk

1.0 Background

1.1 This note has been prepared in response to a matter raised by the LSIDB in a project review meeting on the 30th July 2020. The purpose of the meeting was to discuss the detailed design of the proposed Elmore Back pumping station improvements, which was nearing completion, and the subsequent tender process.

1.2 An unresolved matter of particular concern to the LSIDB is the method of installation of the new pumps and canisters, both initially by the appointed civil engineering contractor and in the future by LSIDB operatives should the need arise for maintenance or replacement works.

2.0 Matters Relating to the Installation and Removal of Pumps

2.1 In the weeks prior to the meeting there had been some discussion on this issue and the key factors considered were as set out below.

Canisters

2.2 The canisters are approximately 4 metres in length and 0.9 metres in diameter. Two canisters are required, and each is to be supplied as a single monolithic item. Installation is to be carried out by a civil engineering contractor, and consideration has been given as to how this could be achieved. Entry through the existing door aperture would be impossible so installation would require either (i) significant enlarging of the door aperture to the full height of the building or (ii) removal and subsequent reinstatement of the building roof structure.

2.3 The pump supplier Bedford Pumps has advised that it would be possible for the canisters can be manufactured in two or three sections to facilitate entry to the building, with the intention that the sections would then be bolted together 'in-situ'. This option potentially removes the need to remove the roof; however, it is likely that the door would still require enlarging. The contractor would need a method by which the canister sections could be side loaded through the enlarged doorway. Once inside the building, the canisters would need to be manipulated into the correct orientation and lifted into position using either the existing hoist/beam arrangement or an uprated gantry lifting arrangement.

2.4 Concerns remain regarding the feasibility of the above solution because side loading through the door introduces the potential to damage the apparatus and/or building structure. The existing internal building hoist can only lift vertically, it has no means of horizontal travel whilst carrying a load. As such it is likely that once the apparatus is inside the building, operatives will need to manhandle it during the subsequent lifting operations to steady the load and assist with the positioning inside the building, which introduces safety concerns.

2.5 A new internal gantry crane lifting system capable of manoeuvring in two horizontal axes whilst carrying a load would partially address concerns for lifting operations inside the building. However, the concerns associated with side loading into the building would remain.

2.6 Once the canisters have been installed it is considered unlikely that they would need to be removed by LSIDB operatives; however, this cannot be ruled out in the longer term.

Submersible Pumps

2.7 The submersible pumps are approximately 1.8 metres in length by 0.8 metres in diameter and each has a mass of approximately 1,500kg. The concerns regarding installation of the pumps are similar to those described above for the canisters. However, in addition to the installation carried out by the civil engineering contractor, it is considered that provision should be made for LSIDB operatives to remove the pumps for future maintenance or replacement. Whilst regular removal for servicing is not anticipated; it is considered prudent to assume that mechanical failure may occur in the future, and thought should be given to how LSIDB operatives can complete the pump removal operation.

2.8 During the recent discussions on this, the following factors were considered:

- The pump would need to be lifted vertically out of the canister, rotated from a vertical to a horizontal orientation and placed on a nearby trolley.
- The trolley and pump would then need to be pushed towards the doorway. Due to the level differences at the site another mechanical handling device such as the LSIDB's telehandler could be used to approach the building, extend the forks through the door aperture, where the pump could be slung to the forks and extracted from the building.
- Re-installation would be the reversal of this procedure.
- An alternative option considered was to install hatch openings in the building roof directly above the pumps. This suggested was considered to be impractical for reasons of (i) structural integrity of the roof and (ii) an intricate lifting operation is still required which may require an operative on the roof to guide the apparatus through the hatch.

2.9 The combination of telehandler side loading and complicated lifting operations inside the building remain a concern for the LSIDB and having considered this matter in depth it is apparent that these operations carry a significant level of risk.

3.0 Feasibility of Alternative Solution – Building Demolition

3.1 Given the above circumstances it has become clear that alternative arrangements should be investigated. The LSIDB has asked Motion to consider the feasibility of removing the building altogether to improve access to the pumps.

3.2 The remainder of the document considers the case for demolition of the pump house building and the conversion of the pumping station to an uncovered facility within a safe compound utilising the existing substructure.

3.3 In order to consider this properly, an initial assessment has been made relating the implications of proceeding with the current design proposal to retain, repair and improve the existing building; referred to as 'Option 1' below. The subsequent section considers the implications of demolishing the building, referred to as 'Option 2' below.

Option 1 – Retain Existing Building (see current design drawings)

3.4 This option consists of retaining and refurbishing the building. An indicative isometric visualisation is shown in the drawing 1905003-ELM-SK19 and a summary of the current proposals and considerations is provided below:

- General building repairs/improvements would be carried out including repointing, external aesthetic treatments including reprofiling of the roof, replacement of windows and enlargement of the door. Internal aesthetic treatments to include general decoration and flooring. This proposal has the benefit of re-using an existing facility whilst improving its aesthetic appearance. Refurbishment costs will be incurred, but the demolition costs associated with option 2 are obviated.

- As part of the works it is likely that the existing beam and hoist will be affected, particularly if intrusive roofing works are carried out. This necessitates refurbishment and re-installation of the hoist and given the circumstances it is likely that the opportunity would be taken to install a new hoist, possibly with multi-axis capability as an upgrade to the current arrangement. This would improve functionality for lifting operations within the building but would carry increased supply/installation costs and require ongoing inspection / certification.
- New control equipment is to be housed in a metal cabinet; a simple arrangement similar to existing.
- The building provides a second level of security after the security fence.
- It may be necessary to engage with the planners in respect of the external appearance of the building; however, it may not be necessary to secure a planning consent for the refurbishment works (to be confirmed).
- It is envisaged that progressing with option 1 as planned will not affect the project programme.

Option 2 – Demolish the Building to Create External Facility and Secure Compound

3.5 This option consists of demolishing the building. An indicative isometric visualisation is shown in the drawing 1905003-ELM-SK20 and a summary of this scheme and the associated considerations is provided below:

- The proposed works would consist of removing the upper brick section of the building, to leave the lower concrete structure and discharge chamber on the northern side. The facility would have some resemblance to the appearance foul sewer pumping station, consisting of a flat concrete slab at ground level, with a cabinet enclosure housing the control gear above ground and the pumping apparatus concealed below ground (albeit that the canister heads will protrude approximately 0.5 metre above ground).
- This arrangement offers the clear advantage that the new canisters and pumps could be installed by the civil engineering contractor in accordance with normal procedures outlined by Bedford Pumps. Each pump could be lifted into position using a mobile crane and placed into the pumping station efficiently and safely in one controlled lifting operation.
- The new pumps could be maintained and removed safely and efficiently for maintenance purposes by the LSIDB in future. This will be an infrequent operation so it is not considered necessary for the LSIDB to invest in significant lifting equipment; temporary crane hire is considered suitable provision for this work.
- Whilst the demolition work and making good will incur some cost, there would be no expenditure on the building works/alterations and hoist costs as outlined in option 1. The ongoing costs of building/hoist maintenance and certification are also obviated.
- Bedford Pumps has confirmed that its products are often installed in external installations and the only revision to the existing pumps on order would be the addition of a weatherproof top cover and cable glands.
- A new control kiosk would be required as with option 1; however this would need to house the electrical gear associated with the incoming power supply. Control gear supplier Severn Controls has confirmed that the control cabinet would require an additional GRP enclosure to provide weather proofing. Existing cable routes in the slab would be utilised for pump power supply and level controls cabling. The new GRP kiosk would be secure and weatherproof and of the 'walk in' variety to create a safe working space, but would incur a slight cost increase over the option 1 control gear costs.
- The operation of the trash screen and eel pass systems will not be affected by the building demolition. However, some amendment will be required to the fixing / bracketing arrangements for the eel pass as under the option 1 proposal it will be secured to the side of the building.
- Floor tiles will need to be removed and a new weatherproof non slip screed will be laid to ensure safety when working around the control cabinet.

- The security fencing proposed will need to be reviewed to ensure that it is appropriate for an external facility.
- The hard standing areas around the pumping station will need to be reviewed to rationalise the existing floor level and the surrounding road/slabs. External areas could be reviewed to reflect the dual level nature of the pumping station, i.e. to reconcile the upper floor level at approximately 8.31m AOD with the screen and conveyor arrangements which sit at a significantly lower level of approximately 6m AOD.

3.6 The project structural engineers have provided their initial view that this proposal is structurally feasible provided that the demolition process takes due account of the elements of the pumping station that need to be retained. This will ensure that the integrity of the structure is not compromised.

3.7 The project architects have addressed the issue of demolition and made preliminary enquiries to the planning authority. An initial response has been received which indicates that a formal request for pre-application advice should be submitted; following which a meeting with planning officers can be arranged to determine whether planning consent would be required, and the likelihood of approval (correspondence is appended to this note).

3.8 The anticipated timescales for a response to the request for pre-application advice are 6 to 8 weeks. Should a planning permission be required a similar timescale should be allowed for determination of the application. Therefore this process could potentially add approximately 3 to 4 months to the overall project programme, however, the planning determination period could run in parallel with the contract tendering process to minimise the impact on project programme.

4.0 Conclusion

4.1 At this stage it is not considered that there would be a significant difference in costs between Option 1 and Option 2 given that any saving made from the omission of building work is likely to be needed to pay for demolition. However, in the longer term the costs of maintenance are likely to be lower given the ease of crane access to the pumps.

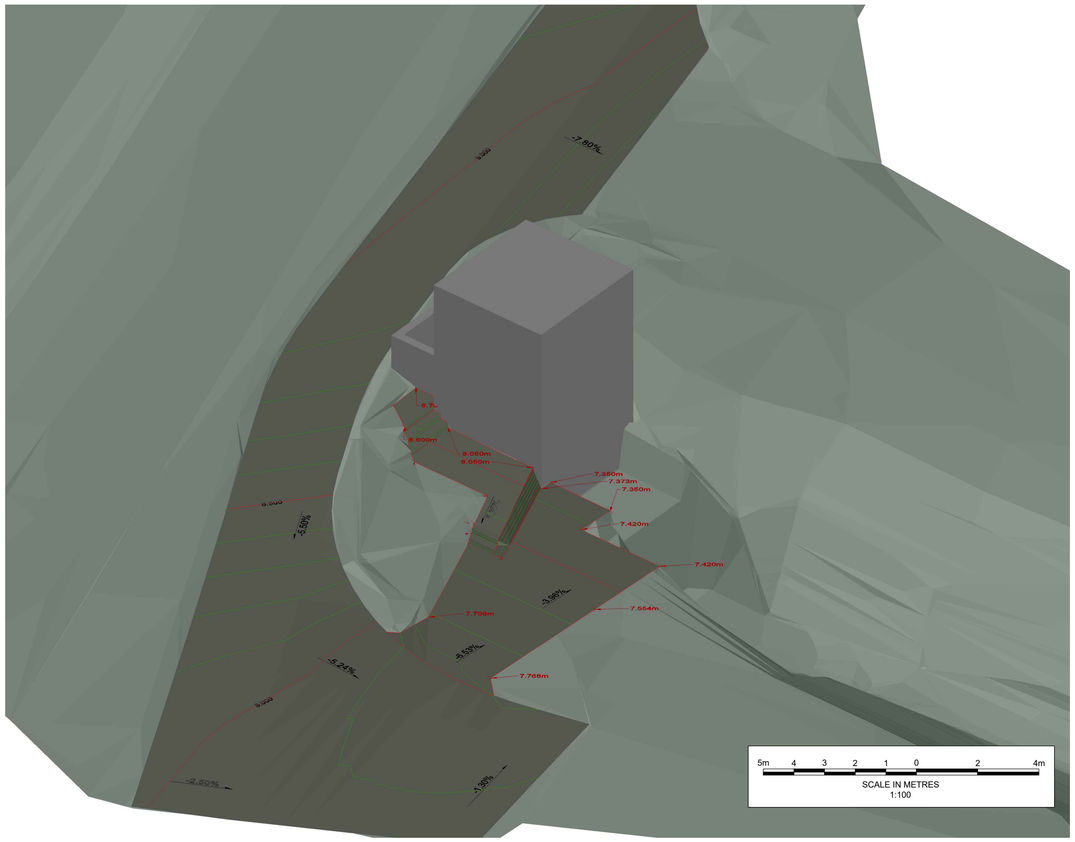
4.2 Furthermore it is likely that under Option 2, any operations involving the installation and future removal/replacement of the pumps would be controlled lifting operations carried out by a mobile crane. This will result in a much safer operation given that the need to manhandle heavy pumps will be obviated.

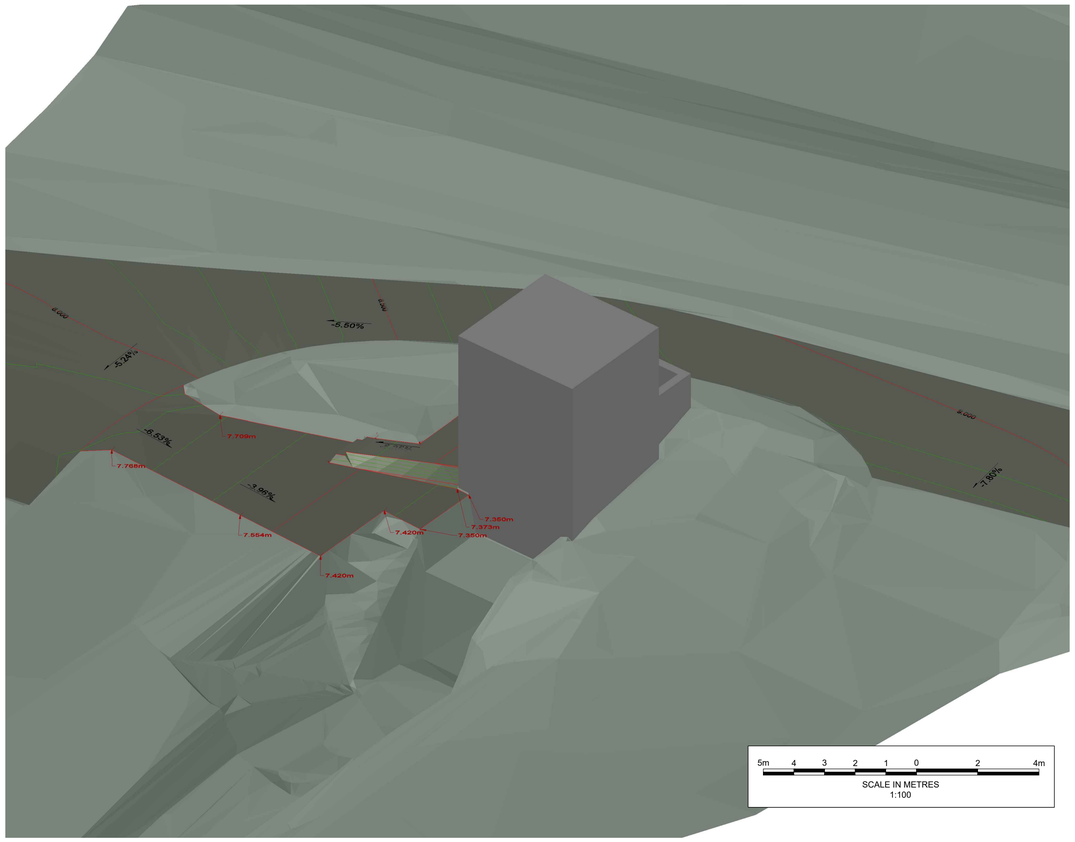
4.3 It is clear that option 2 is feasible, is unlikely to incur higher scheme costs and will give longer term benefits in maintaining the facility.

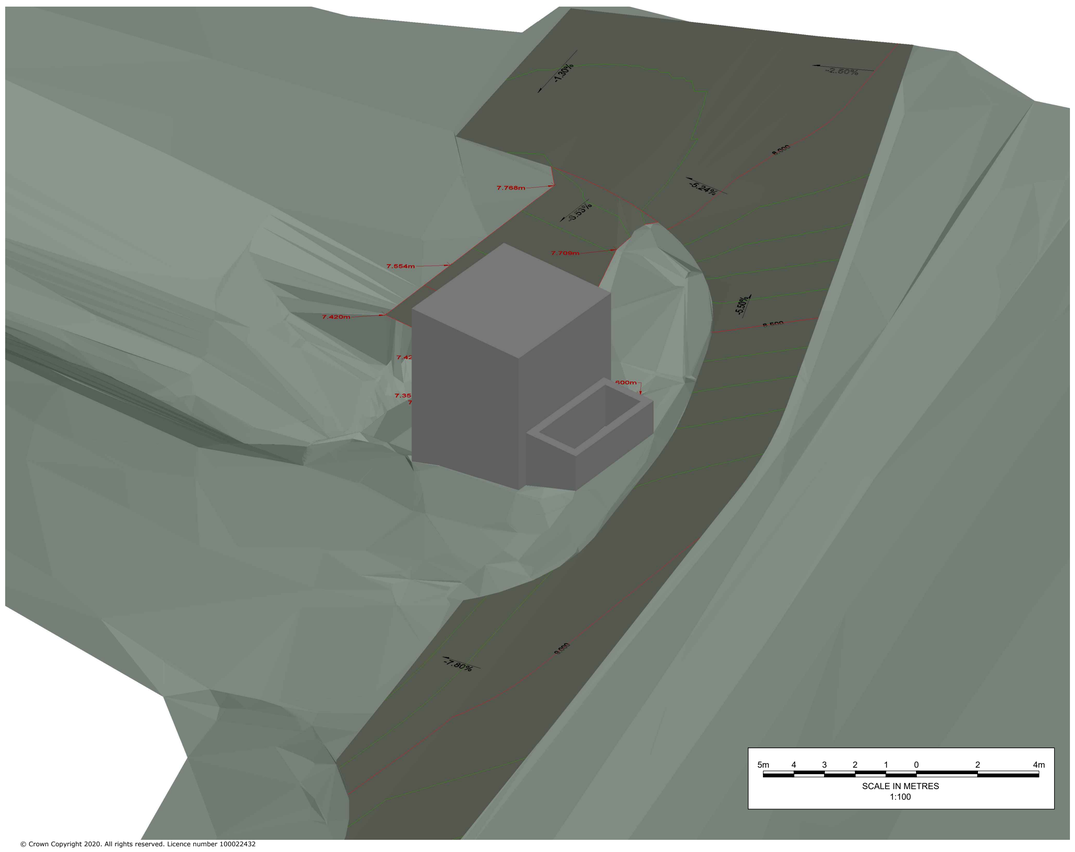
Recommendations

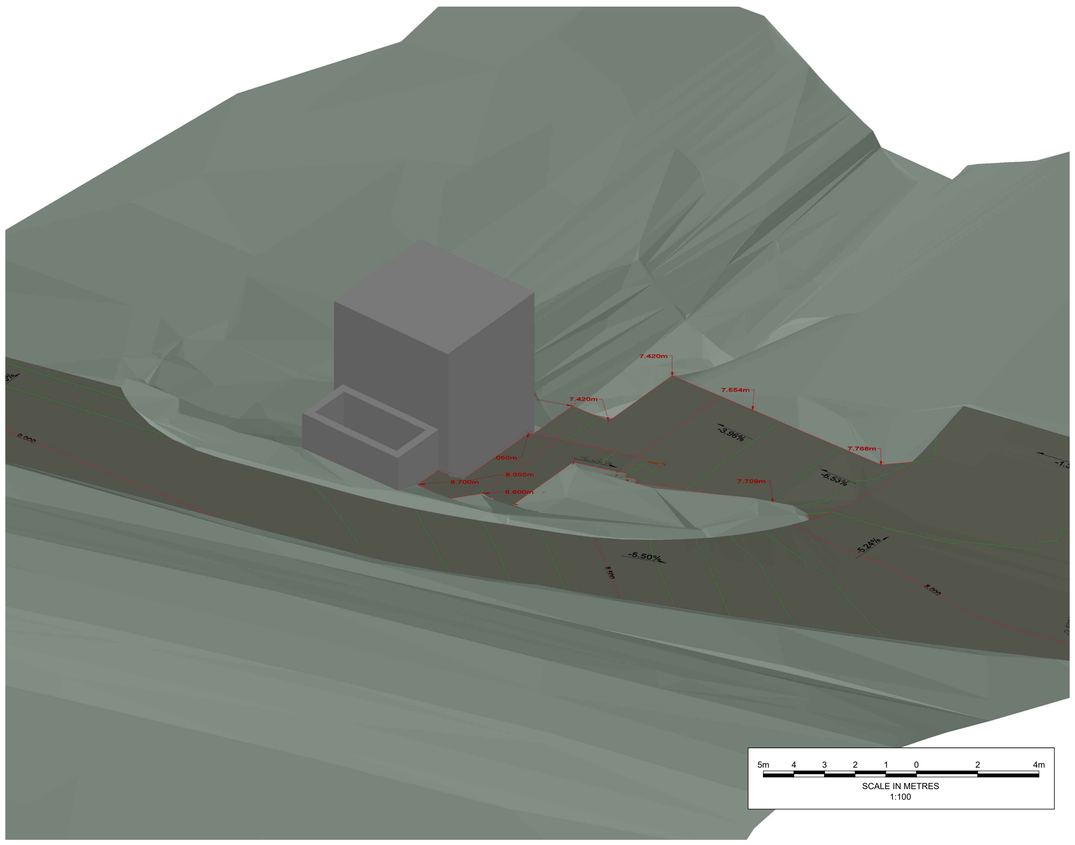
4.4 It is recommended that the enquiries with the planning authority are pursued with respect to option 2. This option has the potential to offer significant benefits and the LSIDB should determine whether these outweigh the potential delay to the project programme.

4.5 If it is determined that option 2 is to be progressed, the next step will be to revise the scheme design in accordance with advice from the planning authority. If it is confirmed that planning consent is required for the proposed alterations, a planning application should be submitted for determination in parallel with the contract tendering process.









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Revision	Notes	Drn	Chk	App	Date
A	First Issue	CC	JS	RB	05/08/20

Drawing Status:
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Guildford
Surrey
GU1 4AU
01483 531300

9 Greyfriars Road
Reading
Berkshire
RG1 1NU
0118 206 2930

Cargo Works
1 - 2 Hatfields
London
SE1 9PG
020 8065 5208

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Client:
Lower Severn Internal Drainage Board

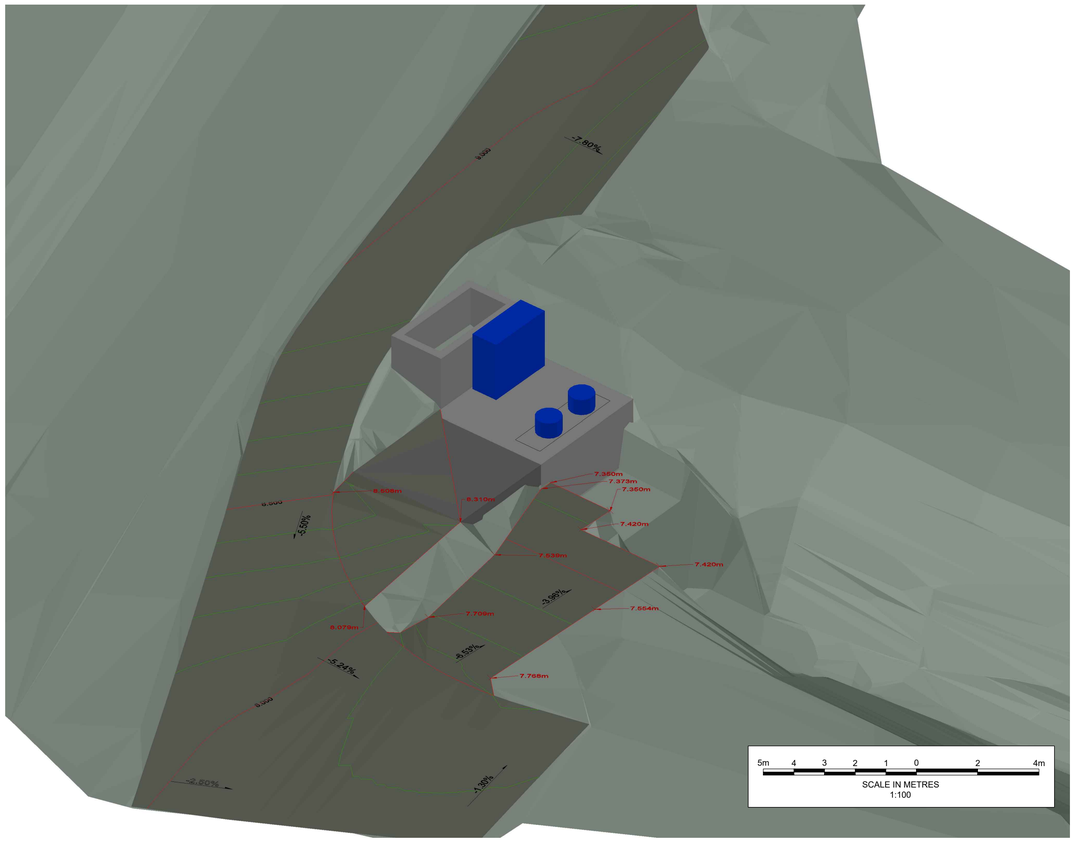
Project:
Elmore Back Pumping Station

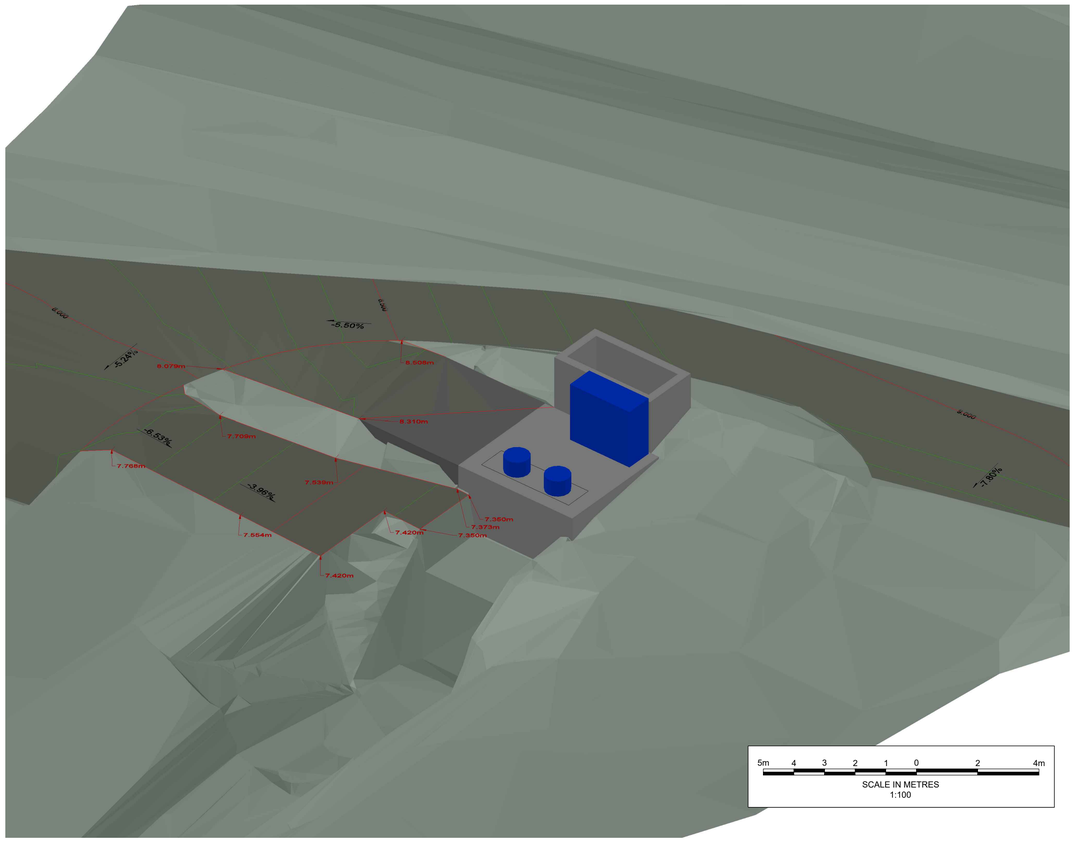
Title:
Isometric View - V1

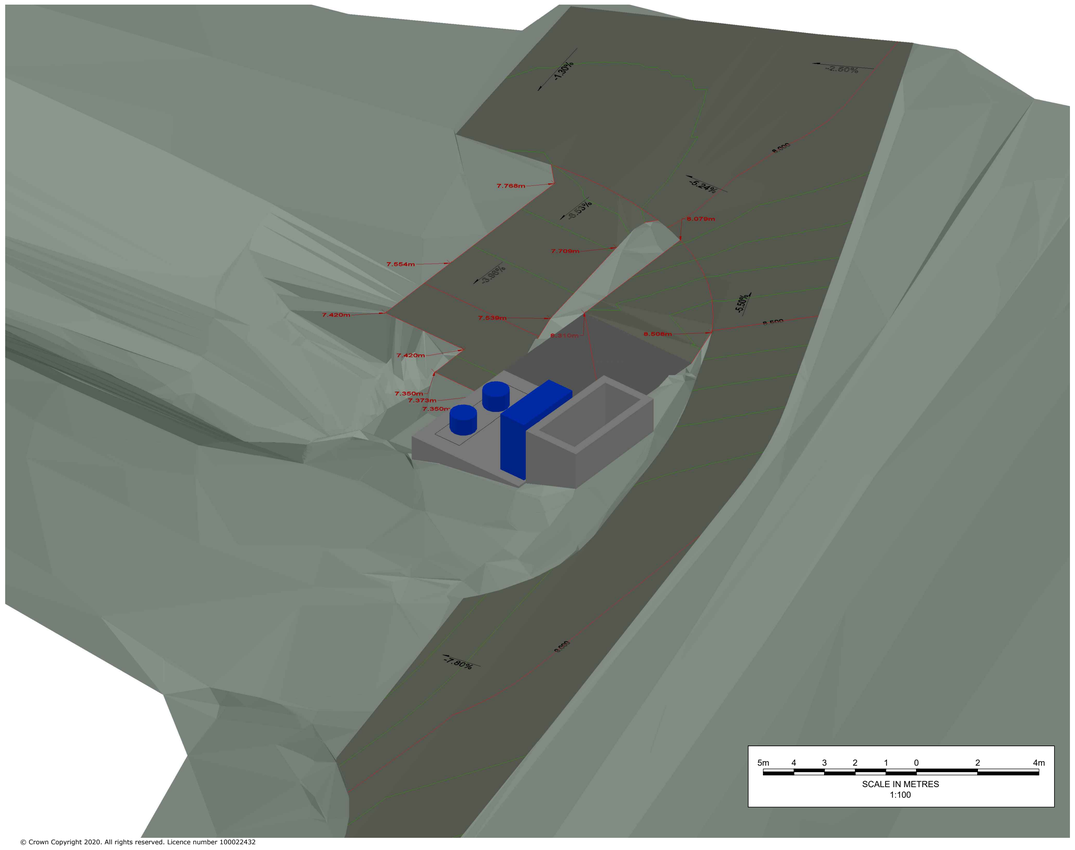
Scale:	Size:	Project No:
1:100	A1	1905003

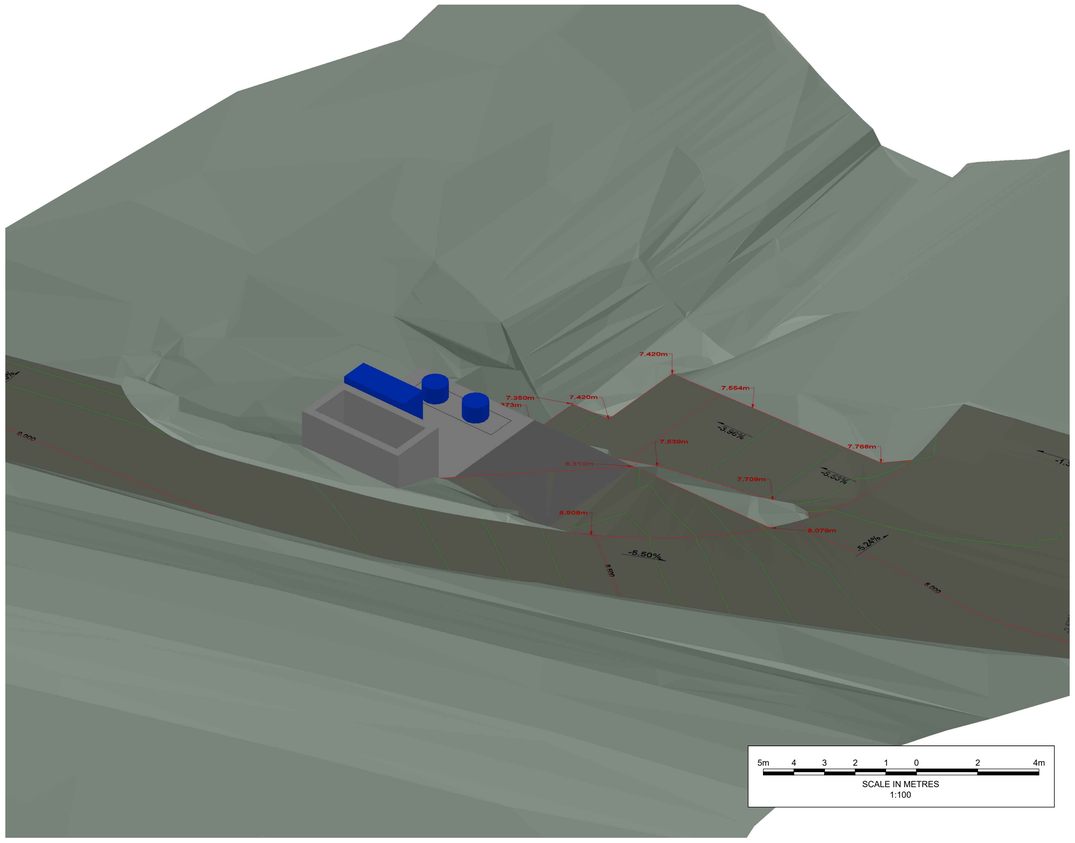
Drawing: 1905003-ELM-SK19

Revision: A









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	Dm	Chk	App	Date
A First Issue	CC	JS	RB	05/08/20
Revision Notes:				

Drawing Status:

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London
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Client:
Lower Severn Internal Drainage Board

Project:
Elmore Back Pumping Station

Title:
Isometric View - V2

Scale: 1:100	Size: A1	Project No: 1905003

Drawing: 1905003-ELM-SK20

Revision: A