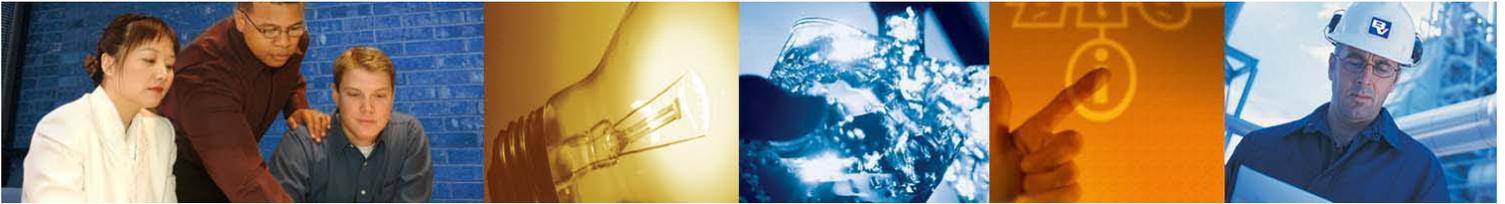


Wilts & Berks Canal Trust



**Wilts & Berks Canal
Melksham River Route
Supplementary Hydraulic Modelling Report
(Melksham Gate Options)**

November 2010

**Melksham River Route
Supplementary Hydraulic Modelling Report
(Melksham Gate Options)**

CONTENTS

1.	BACKGROUND	1
2.	PROPOSED MODIFICATION OF THE RIVER ROUTE PROPOSAL	2
3.	HYDRAULIC MODELLING	5
4.	DISCUSSION & ALTERNATIVES	6

Document issue details:

B&V project no. 120704 Client's reference no.

Version no.	Issue date	Issue status	Distribution
1	5/10/2010	Draft	Wilts & Berks Canal Trust
2	21/10/2010	Draft	Wilts & Berks Canal Trust
Final	01/11/2010	Final	Wilts & Berks Canal Trust

	Name	Signature	Date
Prepared	Suzie Stockwell		01/11/2010
Checked	Jack Mason		01/11/2010

Notice:

This report was prepared by Black & Veatch Limited (BVL) solely for use by the Wilts & Berks Canal Trust. This report is not addressed to and may not be relied upon by any person or entity other than The Wilts & Berks Canal Trust for any purpose without the prior written permission of BVL. BVL, its directors, employees and affiliated companies accept no responsibility or liability for reliance upon or use of this report (whether or not permitted) other than by the Wilts & Berks Canal Trust for the purposes for which it was originally commissioned and prepared.

In producing this report, BVL has relied upon information provided by others. The completeness or accuracy of this information is not guaranteed by BVL.

We must make it clear that the assessment of weather generated flooding is inexact and that analysis is limited by the accuracy and availability of recorded data. Higher water levels may occur in the future due to the actions or omissions of third parties, or to poor maintenance, blockage, storm events in excess of the design standard quoted, inaccuracy or unavailability of data. Flooding beyond that estimated in this report may also occur due to climate change.

1. BACKGROUND

- 1.1.1 Black & Veatch Ltd. (B&V) have been appointed by the Wilts & Berks Canal Trust to hydraulically review an alternative navigation arrangement along the River Avon in Melksham.
- 1.1.2 The option to use the River Avon through Melksham in Wiltshire was identified by the Wilts & Berks Canal Trust as the preferred route through Melksham for the restoration of the Wilts & Berks Canal. This proposed route, from the junction with the Kennet and Avon Canal at Semington to just north of Melksham, was assessed in the *Wilts & Berks Canal Melksham River Route Study May 2007* (the '2007 study') undertaken by Black & Veatch on behalf of the Trust.
- 1.1.3 Since the preparation of the report further discussions have been held between the Trust and stakeholders. This has necessitated some changes to the 1km of the route which utilises the River Avon through the Town.
- 1.1.4 The purpose of this brief report is to summarise the flood risk implications of the new proposals. In particular the new proposals must not increase flood levels when compared with the existing situation and ideally should reduce flood levels.
- 1.1.5 Full details of the 2007 study are not repeated in this report.

2. PROPOSED MODIFICATION OF THE RIVER ROUTE PROPOSAL

2.1.1 It is understood that further discussions with stakeholders has necessitated some changes to the design as identified in the 2007 study. The principal changes are summarised below:

Original Proposal	New Proposal
Construct new weir at Challymead to retain water levels through the town. Retained water level through the town 31.70m	Construct new weir at Challymead to retain water levels through the town. Retained water level through the town 31.20m (0.5m lower than original proposal)
Demolish existing Melksham Gate	Retain main weir structure, but remove existing gate and replace with a new lock and adjacent weir.

2.1.2 The new proposals minimise the increase in water levels through the town under normal conditions. However by reducing the retained water level this will reduce the available draught particularly upstream of Town Bridge. Whilst the navigation depths have not been checked by Black & Veatch, by modifying the Melksham Gate structure as discussed above this will retain water levels upstream of the weir and should ensure the required draught is achieved. The retained water level upstream of Melksham Gate will be 32.61m.



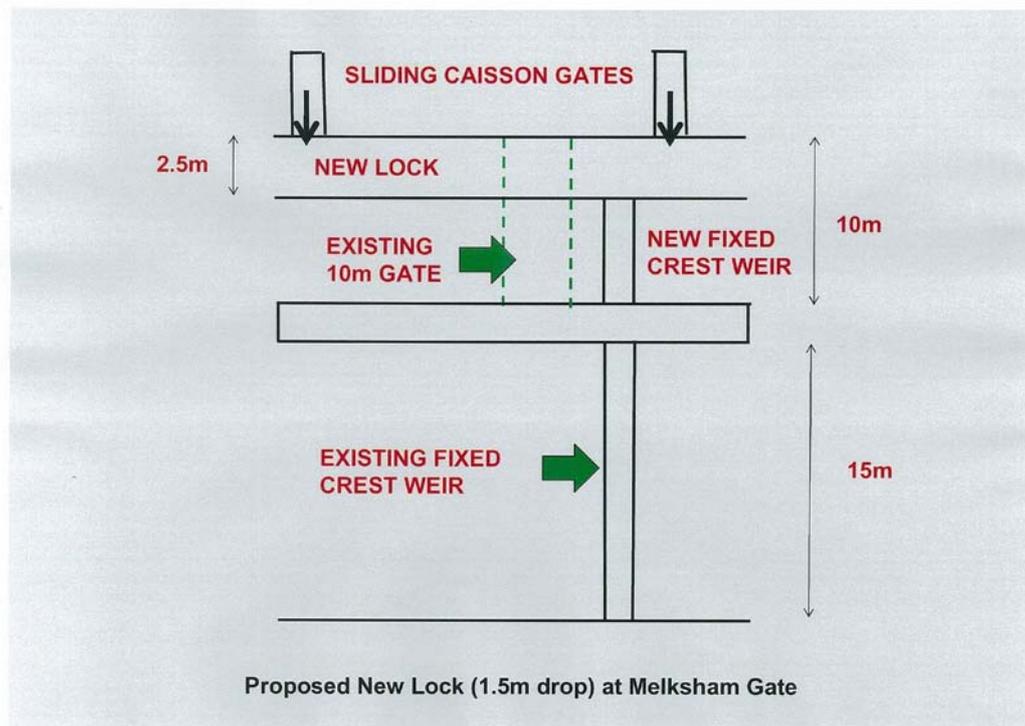
Existing Melksham Gate under flood conditions (with the gate open) taken from the upstream side.

2.1.3 The new proposal to be assessed was provided by the Wilts & Berks Canal Trust (Email from John Laverick 21 September 2010). Extracts from the email and the associated sketch are provided below:

The original proposal was to remove the existing Melksham Gate articulating weir and the adjoining fixed crest weir lowering the water level above the weir by 1m and raising the water level below the weir by 1m by the introduction of a new fixed crest weir at Challymead.

The revised proposal is to keep Melksham Gate weir in place and retain water levels above the weir as at present. The water level below the weir is now to be raised by 0.5m by the introduction of a new lower fixed crest weir at Challymead. The existing 10m wide gate is to be removed and a 2.5m wide lock is to be built in its place. The rest of the 10m gap is to be filled with a fixed crest weir at the same height as the existing 15m wide fixed crest weir next to the gate. See attached sketch.

It is intended that the lock gates will be of the sliding caisson type or similar so that the entire cross section of the lock can be used as a clear flood relief channel when required. The invert of that channel will be no higher than the existing sill below the gate. If necessary in order to provide a wider flood relief channel then the lock could be made wider but this additional construction and maintenance cost is to be avoided if at all possible.



Sketch provided by Wilts & Berks Canal Trust

- 2.1.4 One of the key benefits associated with the original design was the decommissioning of the existing vertical lift gate and the removal of the existing Melksham Gate structure. With the new arrangement the existing gate will still be removed but because of the step in water surface a new lock will be required (to lift levels from 31.2m downstream to 32.61m upstream). The new lock will also act to convey flood water during high flood conditions.
- 2.1.5 A cross section of the existing Melksham Gate structure and the new proposed design is shown in Figure 1. A number of features should be noted:
- In the new arrangement the existing gate superstructure (bridge etc) has been removed, and replaced with a simple access bridge.

-
- The new weir which partly replaces the gate is assumed to have a crest level of 32.61m, equal to that of the existing main weir. From a flood risk perspective this could be reduced to perhaps as low as 31.70m (but this would have implications on the appearance of the main weir, and possibly on the performance of the lock and the fish pass).
 - The bottom of the existing gate can only be raised to a maximum of 33.98m. In some severe conditions this level will not be above the water surface. This has significant implications with respect to the performance of the existing structure.

3. HYDRAULIC MODELLING

- 3.1.1 The existing hydraulic model of the River Avon through Melksham prepared in the 2007 study was used to assess the performance of the new proposals compared with the existing conditions.
- 3.1.2 A range of different flood conditions were assessed to determine the hydraulic performance of the system.
- 3.1.3 Modelling has shown that water levels from the new Challymead weir to the Melksham gate structure are not changed due to the reduced crest level of the new Challymead weir, when compared with the existing conditions. This was as expected because the weir is completely submerged under high flows (whether the weir crest level is 31.70m or 31.20m as now proposed).
- 3.1.4 The situation upstream of Melksham gate is more complex, and is summarised below:

Table 1: Modelling Results

Flood Event (Return Period ^{Note 1})	Existing Water Levels mAOD		New Proposal Water Levels Upstream of Structure mAOD	Difference in Water Level Upstream of the Gate Between New Proposal and Existing (mm)
	Downstream of Gate ^{Note 2}	Upstream of Gate		
1 in 2 year	33.46	33.60	33.71	+110
1 in 5 year	33.76	33.94	34.02	+80
1 in 10 year	33.94	34.14	34.21	+70
1 in 25 year	34.18	34.41	34.43	+20
1 in 50 year	34.36	34.63	34.61	-20
1 in 100 year	34.57	34.86	34.80	-60

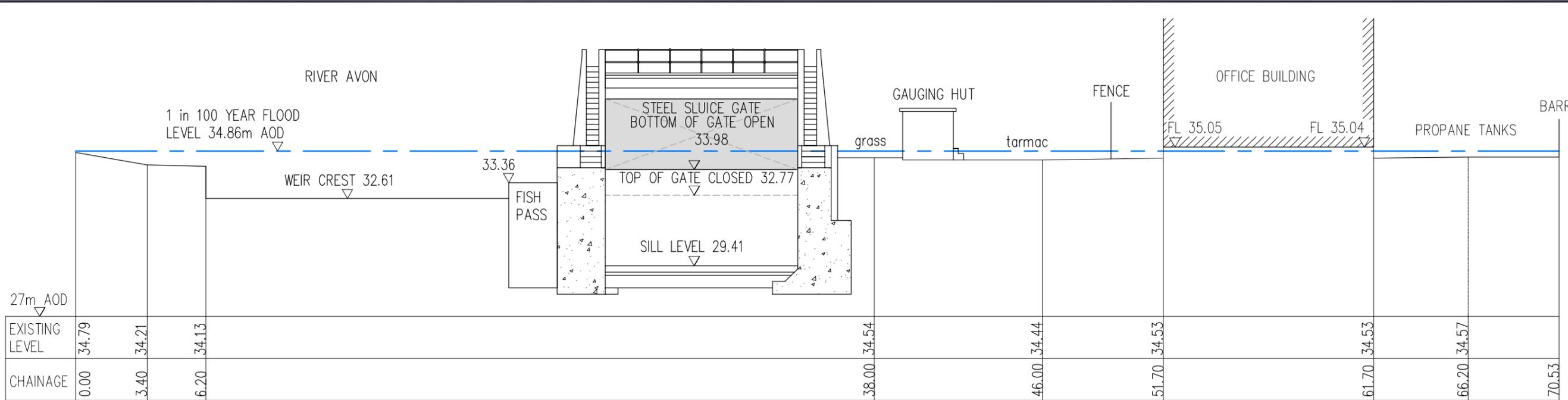
Note 1: Current best practice is to describe these values as annual probabilities (e.g. a 1 in 50 year return period is equivalent to a risk of flooding of 2% in any year)

Note 2: Modelling has shown that flood levels downstream of Melksham Gate are essentially the same when comparing the existing and new proposals

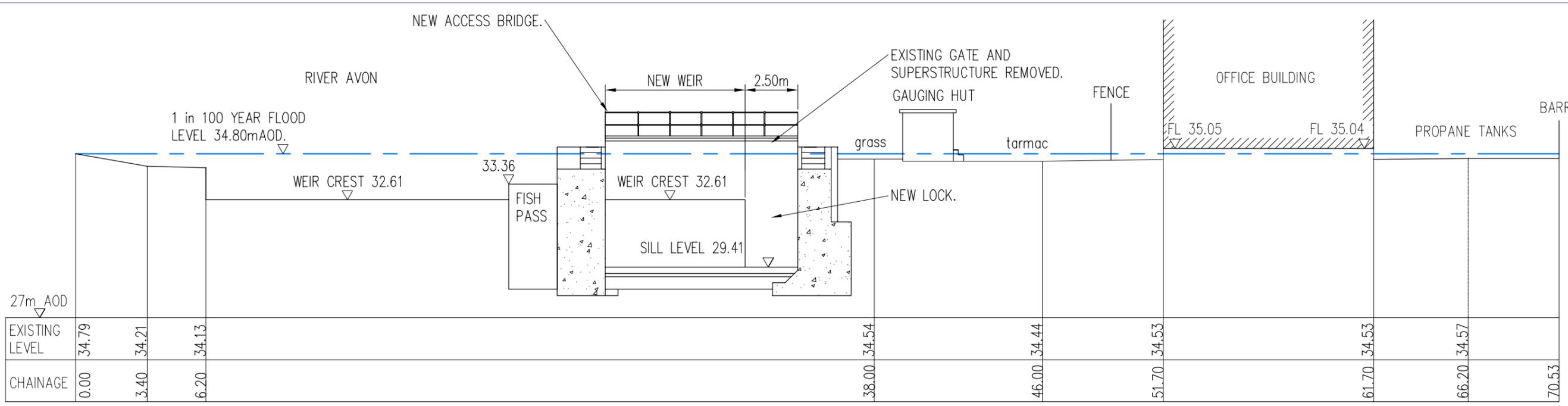
- 3.1.5 The results show that the change in flood levels associated with the new option is small when compared with the existing conditions. However the situation is complex. Simple 1-D models of hydraulic structures do struggle to accurately assess head losses, particularly when the differences in water levels are small anyway. Nevertheless the new proposals would increase flood levels for the less severe events and probably reduce flood levels slightly for major events.
- 3.1.6 The changes shown in Table 1 will extend upstream, but the change shown will gradually reduce. By the Murray Walk footbridge the difference is typically halved (e.g. an increase of 80mm at the Melksham 'Gate' structure reduces to 40mm at the Murray Walk footbridge).
- 3.1.7 The reason why the new structure is more efficient at high flows is because the bottom of the existing gate is below the water surface and causes some hydraulic losses. The new structure does not include the main gate (and the sliding caisson gates are fully open), and the model indicates that the new arrangement is slightly more efficient.

4. DISCUSSION & ALTERNATIVES

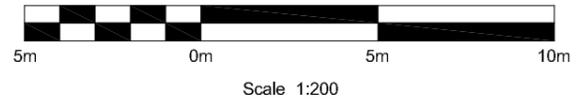
- 4.1.1 Whilst the new proposal does increase flood levels under certain conditions, critically the modelling indicates that flood levels are reduced in extreme floods. Since serious flooding in Melksham only commences during severe events then the Environment Agency may accept this arrangement.
- 4.1.2 However the 1-D modelling used is limited and it is not possible to be fully confident that the benefits as shown for the high events are 'real' and not a result of modelling inaccuracies. Figure 1 does show some net loss of flow area with the new option when compared with the existing condition. Whilst the modelling is likely to reflect the losses associated with the gate and it is not a simple 'area for area' comparison, it is easier to be confident in the results if the total flow area is maintained.
- 4.1.3 It is recommended that alternatives are investigated to increase the confidence that the new proposals will maintain or reduce flood levels, particularly under high flows. There are a number of options that could be considered:
- Widening of the lock
 - Lowering of the new weir (this has the disadvantage of focussing all the low flows over the new weir and leaving the existing weir potentially dry, as well as impacting on the fish pass and potentially the ease of navigation)
 - Lowering the whole weir
 - Widening of the weir on the south bank
- 4.1.4 A further option has been considered after further discussions with the Trust. This option has considered the relocation of the lock to the south bank. This option would leave the existing weir and sluice untouched and a new 2.5m wide lock would be built on land south of the river. Whilst a brief review of the area suggests that there is sufficient space for a lock, no assessment of the engineering or environmental practicalities of this option has been undertaken.
- 4.1.5 This option provides an opportunity to increase the flood capacity of Melksham Gate and reduce upstream water levels. However the existing sluice gate would remain, and the perceived advantage of removing the gate would be lost which was one of the key benefits to the Environment Agency.
- 4.1.6 If the canal lock was operated as a flood channel, hydraulic modelling has shown that this option would reduce upstream water levels for all events by between 20 and 40mm when compared with the existing condition. There would be no measurable impact downstream.
- 4.1.7 It is debatable whether this scale of flood benefit is sufficient to justify the works required to make the lock into a flood channel. It does have the advantage of providing some back-up in the event that the main sluice gate were to fail closed, and this redundancy may be attractive to the Environment Agency. Conversely the additional complexity of the system with increased maintenance would not be attractive to whoever undertook the long term maintenance of the system.
- 4.1.8 A lock located on the south bank without flood capacity would be less expensive. Any solution using the south bank may be more attractive from a public access perspective, but there would be additional health and safety issues to consider.



CROSS SECTION THROUGH EXISTING GATE AND WEIR



CROSS SECTION THROUGH MODIFIED GATE AND WEIR



BLACK & VEATCH
 Black & Veatch Limited
 Registered office

Grosvenor House, 69 London Road, Redhill, Surrey, RH1 1LQ, United Kingdom
 Tel: +44(0)1737 774 155 E-mail: bvi@bv.com

EXISTING AND NEW PROPOSED ARRANGEMENT
 AT MELKSHAM GATE
 FIGURE 1.

VERSION 0 - 5.10.2010

p:\120704\40\40.02\120704_GATE-FIGURE_0 (ILC.04.10.10) -X(NONE)