Skitter Beck Walkover Survey

September 2015

Summary of Key Findings

- Lack of flow is having the greatest impact upon the quality (and quantity) of aquatic habitat within the Skitter Beck. At the time of this survey, the headwaters were dry or had imperceptible flow and the remainder of the Beck had very low flows.

- Flows are currently too low to make meaningful physical habitat improvements. Without a sustained flow, physical habitat improvement works will not be effective in enabling the Skitter Beck to meet its WFD targets.

- The lower reaches of the Beck are backed up by the operation of the tide gates at the Humber outfall, making in-stream, physical habitat improvements impractical in this reach.

- Re-meandering or creation of a two-stage channel may be possible in the middle reaches of the Beck (between A180 and Crook Mill Road). This depends upon the gradient of the Beck between fixed points (road and rail culverts inverts) and having a sustained flow in the Beck.

- A new channel maintenance regime would have to be agreed and adopted to preserve any habitat improvements made.

1.0 Introduction

This report is the output of a walkover survey of the Skitter Beck, near Immingham, North East Lincolnshire. The Beck has two headwater streams rising at Kirmington (National Grid Reference TA 10740 11120) and Keelby (NGR TA1650010500), which have a confluence near Ulceby Junction (NGR TA1267714547). The Beck flows north (sometimes being called the East Halton Beck) into the Humber estuary at East Halton Skitter (NGR TA1447722907). The walkover survey was carried out by Tim Jacklin (Wild Trout Trust) and Steve Brayshaw (R. S. Brayshaw Ecological Consultancy) over three days (29th September to 1st October, 2015).

The walkover survey was carried out to inform Anglian Water's (AW) National Environment Programme. AW intend to undertake habitat improvement works on the Skitter Beck to address the fact it is currently failing its Water Framework Directive objectives. The aims of the survey are:

- To produce a high level geomorphological map of the river providing an overview of the flow types, channel form, habitats and vegetation along the watercourse.
- To highlight issues of sedimentation, obstructions, low flows and other relevant factors.
- To identify three or four 1-2 km stretches of river that may be suitable for restoration/habitat improvement, giving consideration to vehicle access.
- To provide fixed point photographs along the river, linked to the map with GPS locations, to help visualise key areas
- To check for signs of water vole (*Arvicola amphibius*) presence*.

*Although no signs of water vole presence were seen on this survey, many areas of the watercourse were densely vegetated making observation in sufficient detail to detect water vole signs impossible within the timescale available. Dedicated water vole surveys (ideally during the Spring) at sites where work is planned is recommended. Environment Agency records show only one water vole record for Skitter Beck at the tidal gate (TA1439822885) in 2009, but several in the Killingholme Marshes area to the east of Immingham (TA168187).

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left hand bank (LHB) or right hand bank (RHB) whilst looking downstream.

A large number of photographs were taken during the survey using a GPS enabled camera. These pictures are presented in a Google Earth file (.kmz file) providing a "virtual walkover". Google Earth software is available as a free download and the .kmz file can be opened via the File menu (File – Open).

2.0 Catchment Overview

The Skitter Beck is a chalk stream, therefore a UK Biodiversity Action Plan priority habitat. Under the Water Framework Directive (WFD), the Beck is classified as a heavily modified waterbody (Waterbody ID GB104029067655). In the two most recent assessments for WFD status, the overall classification of the Beck was "bad" (2013) and "moderate" (2014) ecological potential. A breakdown of the elements contributing to this classification is shown in Table 1 (Source: http://environment.data.gov.uk/catchment-planning/WaterBody/GB104029067655).

The assessment of hydrological regime as "does not support good" refers to surface water abstraction by water industry as the confirmed reason for this status. The assessment of invertebrates as moderate refers to the effects of groundwater abstraction by water industry on flow as the confirmed reason for this status.

The physico-chemical elements in Table 1 show the water quality is affected by elevated levels of ammonia and phosphate, which may be derived from sewage effluent discharges to the Beck, possibly exacerbated by lack of dilution because of low flows.

	2013 Cycle 2	2014 Cycle 2	Objectives
Overall Water Body	**Bad**	**Moderate**	**(Cycle 2) good**
Ecological	Bad	Moderate	(Cycle 2) good
Biological quality elements	Bad	Moderate	(Cycle 2) good
Invertebrates	Bad	Moderate	(Cycle 2) good
Hydromorphological Supporting Elements	Not-high	Not-high	(Cycle 2) not high
Hydrological Regime	Does-not-support-good	Does-not-support-good	(Cycle 2) supports good
Physico-chemical quality elements	Moderate	Moderate	(Cycle 2) good
Ammonia (Phys-Chem)	Moderate	Moderate	(Cycle 2) good
Dissolved oxygen	Good	Good	(Cycle 2) good
pH	High	High	(Cycle 2) high
Phosphate	Moderate	Moderate	(Cycle 2) good
Temperature	High	High	(Cycle 2) high
Specific pollutants	High	High	(Cycle 2) good
Chemical	Good	Good	(Cycle 2) good
Other Pollutants	Does-not-require-assessment	Does-not-require-assessment	-
Priority hazardous substances	Good	Good	(Cycle 2) good
Priority substances	Good	Good	(Cycle 2) not assessed

Table 1 Waterbody Classification data for Skitter / East Halton Beck (GB104029067655).

3.0 Reach Descriptions and Habitat Assessment

3.1 Keelby Arm – Keelby to A180 culvert

This section (marked on the map as the New Beck Drain) was walked in a downstream direction from the footbridge at TA1634711002. The channel was dry (Photos 1, 2) from this point to the confluence of a ditch on the RHB at TA1531911878, where some standing water was ponded (Photo 4). From this point downstream, the channel was largely dry or intermittently contained standing water, up to the Brocklesby Road bridge at TA1461112726, where a low flow estimated to be less than 0.5 litres/second could be observed over a small (approximately 0.15m) step weir (Photos 5, 6). A low, wet area of ground containing reedmace (*Typha latifolia*) and regenerating willows is present on the LHB immediately upstream of the bridge, which may indicate a source of water (a spring or surface drainage) feeding the Beck. Sticklebacks (*Gasterosteus aculeatus*) were observed in the standing water pools and the flowing section, and a kingfisher (*Alcedo atthis*) was seen near the road bridge.

The very low, almost imperceptible flow continued downstream of Brockelsby Road until an inflow from the left bank at TA1384713233. It appears that the section upstream of this point has intermittent flows depending upon groundwater levels, which in turn are influenced by rainfall and abstraction. Clearly the intermittent flow is the overriding factor on stream ecology upstream of this point and physical habitat improvement would not be a priority here unless permanent flows were established.

The channel has been engineered for land drainage throughout this reach (and indeed for the whole course of the Beck); it is straight and deeply incised, with water level some 2.5 to 3m below bank-top level. The banks are very steep and a bund of material, between 0.6 to 1m high is present on one or both banks, being former dredging spoil from the channel (Photo 7). The cross-sectional profile of the channel is trapezoidal in shape and there is no variation in water depth (when present). The bed of the Beck comprises largely gravel, although where aquatic vegetation is present, finer sediment is trapped forming a silt layer over the gravel.

Where flows are permanent, the interplay of shading, channel maintenance regime and flow rates influence the in-stream habitat present. It appears aquatic vegetation is routinely removed from the channel, probably on an

annual or biennial basis at the end of the summer to maintain channel capacity for higher winter flows. Following weed removal, the channel recolonises with “pioneer” chalk stream marginal vegetation such as fools’ water-cress (*Apium nodiflorum*) and brooklime (*Veronica* spp.). The frequency of weed removal means that succession from this plant community to other species such as taller emergents (reeds, rushes, sedges) and submerged species does not occur.

Where shading is absent, growth of vegetation (largely *Apium*) can completely choke the channel, trapping fine sediment in a layer above the gravel bed; this situation may be exacerbated by low flows which are insufficient to maintain a weed-free centre channel. Where the channel is “tunnelled” with trees, little aquatic vegetation grows. In between these extremes, vegetation colonises the margins, leaving a clear centre channel which is swept free of silt by the current.

The section through Alder Wood down to the railway crossing (TA1305013919) illustrates the above scenarios, with heavily-shaded sections being wide, shallow and open and other areas, where light can reach the channel, being choked with *Apium* (Photos 8 -10). There is some limited potential for habitat restoration here by re-shaping the bed of the Beck with an excavator (the “dig-and-dump” method), to create permanent marginal berms and deeper pool areas. However, access for plant is very limited and low flows remain a concern.

Downstream of the railway crossing (TA1305013919) to the A180 culvert (TA1258614401) the channel is open and overgrown with both in-stream and bankside vegetation (Photo 10).

3.2 Kirmington Arm – Kirmington to A180 culvert

This section was inspected from Limber Road, Kirmington (TA1075411126) to the confluence with the Keelby arm at the A180 culvert (TA1258614401).

At Kirmington, the channel was dry apart from some standing water ponded above the pipe culvert under the track to the house alongside the AW sewage pumping station (TA1086811176). Downstream of this point the Beck was dry (Photos 12 -15) until approximately TA1106911570 where a trickle of water enters on the LHB. Pools of standing water were present

downstream of this point (Photo 16) until TA1112911696, where treated effluent from the sewage works off Habrough Lane enters (Photo 17). From this point downstream water was present in the channel, apart from at the downstream end of the reach (see below). However, the flow was extremely small throughout this reach and appeared to be entirely derived from the sewage works discharge at the time of the survey. It is not known whether the WFD target failures for physico-chemical parameters (ammonia and phosphate) are related to this effluent discharge and the lack of dilution in the receiving watercourse, but it would be worth checking.

The pattern of vegetation in the channel at the toe of the banks indicates the recent flow history in this reach. Where the channel is dry, recent colonisation of thistles in the centre of the channel and sparse grass growth at the immediate toe of the bank indicate that water was flowing here to a depth of 10 – 15 cm earlier this year. More established grass growth above this level indicates the likely base flow level, when water is flowing (Photos 14, 15). Further investigation of the relationship between groundwater level, rainfall and abstraction is required prior to considering any habitat improvements within this reach.

A number of culverts are present along this reach which are recorded on the map; most are farm track crossings or railway culverts. There is a pattern of water ponding and fine sediment accumulation upstream of the culverts and bed scour (occurring at higher flows) downstream (Photos 21, 22).

In common with the previous section, the channel is engineered and maintained for land drainage, being straight, steep-sided and lacking any variation in depth (Photos 18 – 20, 23). Bed substrate is largely gravel, with fine sediment accumulations upstream of culverts as noted above. Aquatic vegetation is sparse and the banks are open throughout this reach from Kirmington to the culvert at Brocklesby Junction (TA1193413453), probably reflecting the channel maintenance regime here. Between Brocklesby Road and the railway crossing (TA1228913762) the channel is heavily shaded by hawthorn, blackthorn, elder and brambles (Photo 24).

Water is ponded above the railway culvert and downstream it flows over the concrete lip of the culvert (approximately 0.3m high) forming a small scour pool (Photos 25, 26). Immediately downstream the flow is extremely shallow over a hard gravel bed through a woodland area (Photo 27); this opens out causing the channel and banks to become increasingly vegetated

until it was impenetrable during this survey (Photo 28). A short distance downstream, where the channel emerges from the wood, it is dry again (Photo 29) and remains so until the A180 culvert where water from the Keelby arm backs up a short distance.

3.3 A180 culvert (Ulceby Junction) to South End

Immediately downstream of the A180 culvert the Beck pools above the culvert under the railway line (TA1253614554). Downstream of this point the Beck flows through a tractor ford then on towards the road bridge at Ulceby Skitter (TA1234614943), where there is an AW sewage pumping station with an emergency overflow to the Beck on the LHB (pers.comm. with AW employee on site).

This section between the railway line and Ulceby Skitter is a wider, open channel which was choked with *Apium* at the time of the visit. The river bed is hard gravel and small areas of clear water are present, with starwort (*Callitriche* sp.) and water-crowfoot (*Ranunculus* sp.). Just upstream of the road bridge is a step weir approximately 0.15m high which impounds water upstream and where fine sediment has accumulated (Photos 30 -33).

Downstream of the road bridge, the Beck runs alongside gardens of houses on the LHB until it reaches another railway culvert at TA1241915162. There is a mixture of tree-shaded and open sections here, with corresponding in-stream vegetation ranging from relatively open channel to one choked with *Apium*. The channel is wide (approximately 4m) and shallow (<0.2m) along this reach, apart from one deep hole (approximately 1m deep) which appears to have been scoured by a fallen tree (now removed). The flow appears to be lower than normal, as indicated by exposed river bed in the margins (Photos 34 – 36).

At TA1240615129 the Beck a weir (approximately 0.35m high) has been constructed from decking boards which diverts the flow into a short, narrow channel on the LHB which contains a waterwheel. This appears to be an ornamental feature, probably constructed by the occupier of the house on the LHB. There is a deeper area scoured below the outlet from the narrow channel indicating that the structure is effective at diverting flows via this route when the Beck is running higher (Photo 37).

A short distance downstream, adjacent to the garden of the last house on the LHB before the railway culvert, a small electric submersible pump was taking water from the Beck into the garden via a 1-inch pipe. In the same location, a number of plastic bags of dog faeces had been thrown into the Beck and a pile of garden/grass clippings was slumping into the watercourse (Photo 39).

A kingfisher was observed flying through the railway culvert (TA1241915162)(Photo 38). Downstream of this point the channel has varying levels of shade from riparian trees and bushes which influences the abundance of aquatic vegetation in the beck (predominantly *Apium*). The channel form remains straight, incised and trapezoidal in cross-section with no depth variation; the only exception is a deeper scour pool against the LHB where a pipe drains to the Beck from a height of approximately 2m above water level (dry at the time of the survey). With progress downstream towards another railway culvert (TA1252915742) the channel becomes more open and the bed of the Beck is filled with *Apium*. Very occasional clear patches were observed where starwort and water-crowfoot were present (Photos 40 - .42).

Beneath the railway culvert (TA1252915742) otter footprints were seen in the mud (Photo 43). These were seen in other locations, but no spraints were observed throughout the survey. Downstream of the culvert, the Beck enters a 1.2-km long, straight reach called Ulceby Carr. The Beck here is bordered by narrow grass fields on each bank which appear to be permanent pasture. The Beck is dominated by the growth of *Apium* which completely fills the channel. Occasional clear spots have some starwort, but also extensive growth of filamentous algae on the bed. A field drain enters from the LHB which was carrying fine sediment and discolouring the Beck at the time of the survey (TA1192216977). The LHB is lower than the RHB, probably because the latter is where spoil is dumped from channel maintenance. Short sections of the LHB are lower and less steep than the remainder of the bank (Photos 44 – 47).

At the downstream end of Ulceby Carr, the grass field margins give way to a grazed field (sheep) on the LHB and an arable field on the RHB, both being fenced alongside the river (Photo 48). A recently cleared ditch enters from the LHB (TA1199117430). The vegetation on the banks of the Beck is longer here (tall grasses, nettles) in the absence of grazing. *Apium* becomes

less prevalent in the channel as the Crook Mill Road culvert is approached (TA1219517887).

The Crook Mill Road culvert is a flat-bottomed, corrugated metal tunnel, downstream of which is a concrete sill with a step weir at the downstream end; the head difference is approximately 0.3m across the weir (Photo 49). Downstream is a small scour pool and a short section of slightly faster-flowing water before the Beck resumes its typical uniform shape and slow flow.

From Crook Mill Road downstream, the nature of the bed of the Beck changes from hard gravel to much finer sediment. The abundance of pioneer chalkstream plants (predominantly *Apium*) also becomes much lower, despite a general absence of shade. With progress downstream it also becomes clear that water levels within the Beck vary on a regular basis, indicated by a marginal zone of un-vegetated mud and silt (Photos 50 -56). It is likely that these effects are caused by the backing-up and release of water within the lower reaches of the Beck with the closing and opening of the tide gates.

On the day of the survey of the lower reaches of the Beck, the outfall to the Humber estuary (TA1439822885) was visited at about 10.00 hrs (shortly after a high tide of over 7m) and about 16.00 hrs (shortly after low tide). The outfall structure comprises side-hung, forward pointing gates which open and close according to differential water pressure (gravity operated). At high tide the gates are closed and sea water level was approximately 3 m higher than water levels in the Beck at 10.00hrs. Water in the Beck was backed-up and not flowing at this time. At low tide, the gates were open and the Beck was flowing out into the Humber estuary (Photos 57 – 63).

The effects of the “tide locking” of the Beck were observed from around the area of the wood (TA1207518324) upstream of Thornton Abbey through to the downstream extent of the survey at the railway bridge near South End (TA1230720616). The effects were more pronounced downstream of College Road bridge (TA1196919338) where there is a small step weir downstream of the culvert (Photo 54). No difference in water levels was observed at this step weir between high and low tide, suggesting water levels are not affected upstream of this point. However, flows in the Beck were very low at the time of the survey, so backing-up potentially occurs during higher flows; observations suggest this is the case.

The effects upon the Beck caused by the opening and closing of the tide gates greatly limit the effectiveness of in-stream habitat improvement techniques, so it is not recommended that these are undertaken on reaches downstream of Crook Mill Road.

Downstream of Crook Mill Road, a drain runs roughly parallel to the Beck on the RHB, rising near the road and joining the Beck opposite Thornton Abbey, alongside a lake (TA1212518345). This drain was being slubbed out at the time of the survey and this indicates the type of routine maintenance that may also take place on the Beck itself (Photo 64). This illustrates a crucial point – that if any habitat improvements are to be carried out, the landowners and/or land managers must accept the proposals and be prepared to change routine management practices.

4.0 Opportunities for Habitat Enhancement

The greatest impact upon the quality (and quantity) of aquatic habitat within the Skitter Beck is lack of flow. At the time of this survey, the Kirmington tributary was effectively dry (except for a small input of sewage effluent) and the upper 4km of the Keelby tributary were dry or had imperceptible flow. Throughout the remainder of the course of the Beck, areas of bed and bank scour were notable by their absence indicating flows are currently too low to make meaningful physical habitat improvements. Without a sustained flow, physical habitat improvement works will not be effective in making the Skitter Beck meet its WFD targets.

Another important factor affecting the opportunity for habitat works is the management of flows into the Humber estuary. As noted in the previous section, tide gates at the mouth of the Skitter Beck close at high tide, backing up freshwater flow, encouraging silt deposition and affecting growth of aquatic vegetation. This makes in-stream physical habitat improvements impractical in the reaches downstream of Crook Mill Road culvert (TA1219517887).

The areas where physical habitat improvement may be possible (notwithstanding the caveat regarding flow) are between the railway culvert immediately downstream of the A180 road culvert, downstream to Crook Mill Road (TA1253614554 to TA1219517887). The section through Ulceby Carr has sufficient room on either side of the channel to give potential for re-meandering and re-creation of natural river morphology (pool-riffle sequence and connected floodplain). Further information on the gradient of the river bed is needed to check whether this is feasible, because the river bed level has a fixed height at culverts. The gradient between these fixed heights will determine the extent of restoration possible. Relatively large amounts of spoil would be generated by this method, which would need to be disposed of locally to keep costs down (preferably spread to adjacent arable land).

An alternative to re-meandering is the creation of a low-flow channel within the existing engineered channel using the “dig-and-dump” method. This involved the re-distribution of river bed and bank material to create low berms (shelves) within the watercourse, focussing flows through a narrower, deeper channel. Flood flows over-top the berms and are contained by the larger engineered channel. Some examples of this technique are shown in Appendix 1.

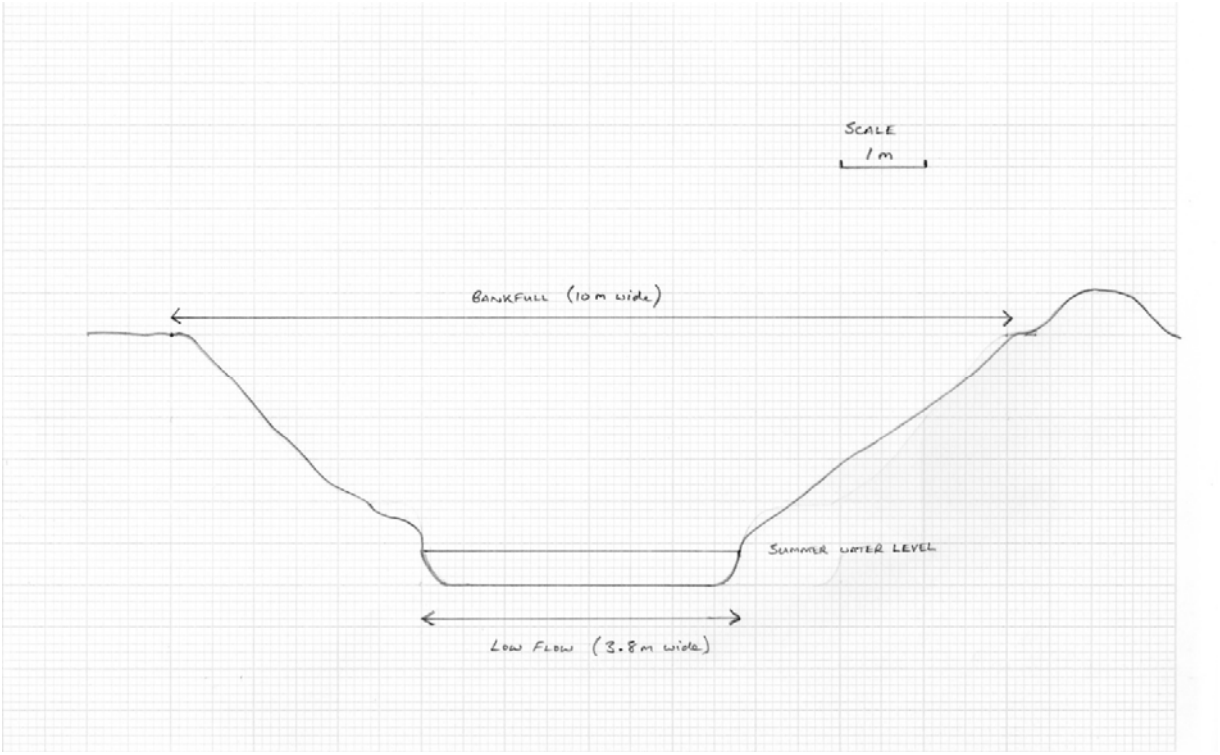
Landowner / land manager consent would obviously be required for works and key to the success of any habitat improvements would be the subsequent management regime. Current management practices are focussed on land drainage and keeping the channel free-flowing by regular weed and silt removal. An alternative management regime that preserves restored habitats whilst the maintaining land drainage function would need to be agreed and adopted.

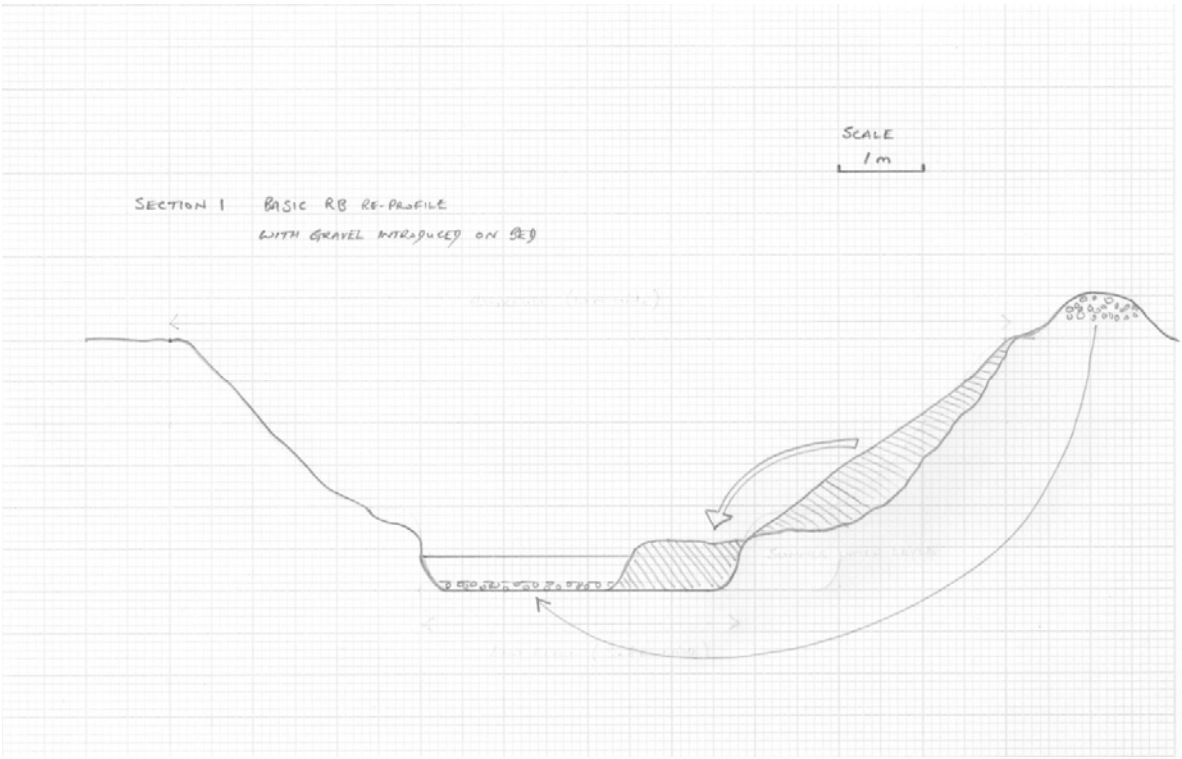
5.0 Disclaimer

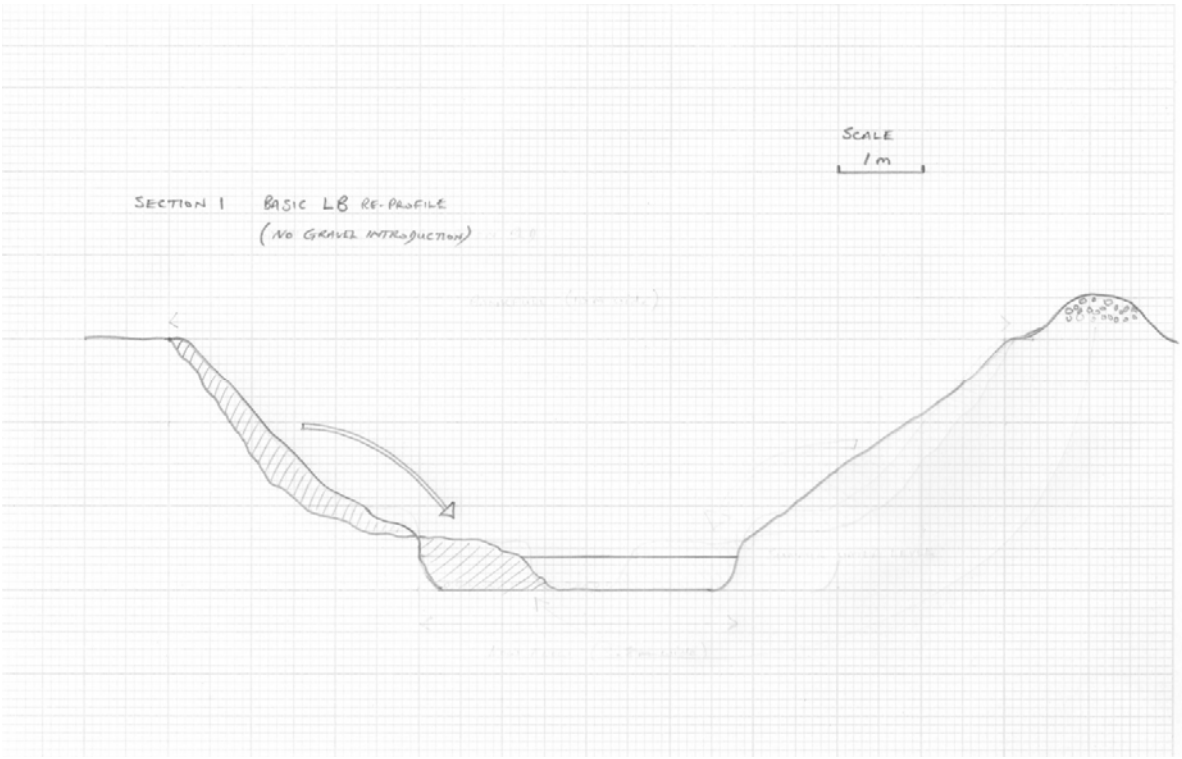
This report is produced for guidance only. Accordingly, no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon comments made in this report.

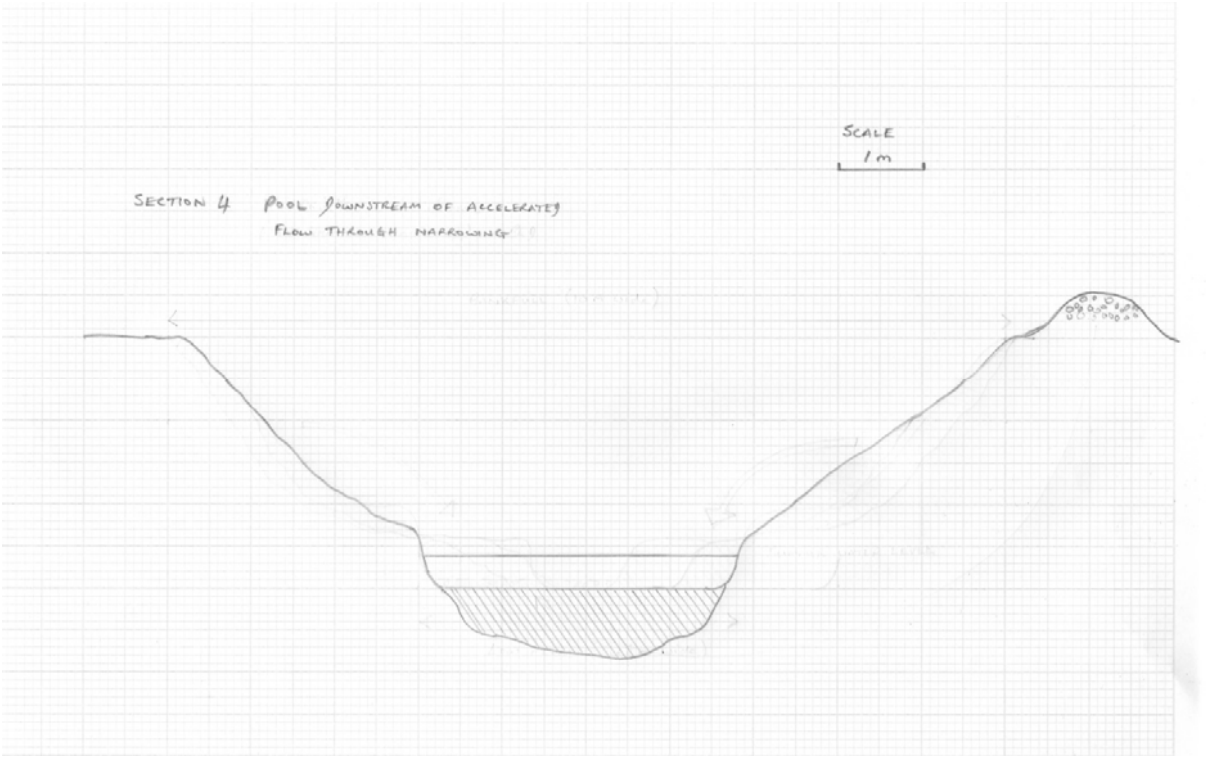
Appendix 1

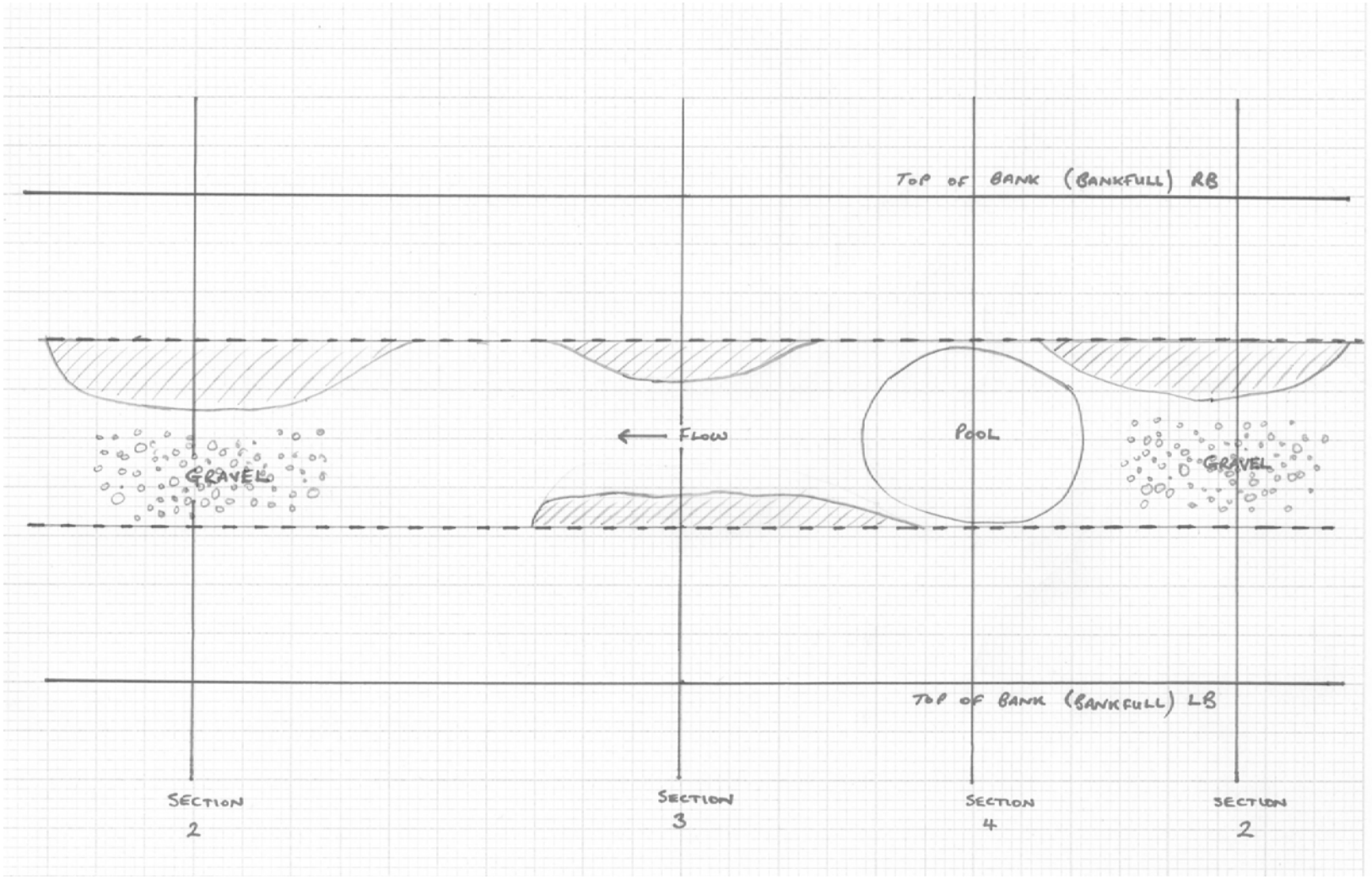
Examples of bank and re-profiling to alter channel cross-sectional profiles. The techniques create variation in depths, widths and bed substrate in heavily modified channels, without increasing flood risk. Figures in the following diagrams are indicative only.



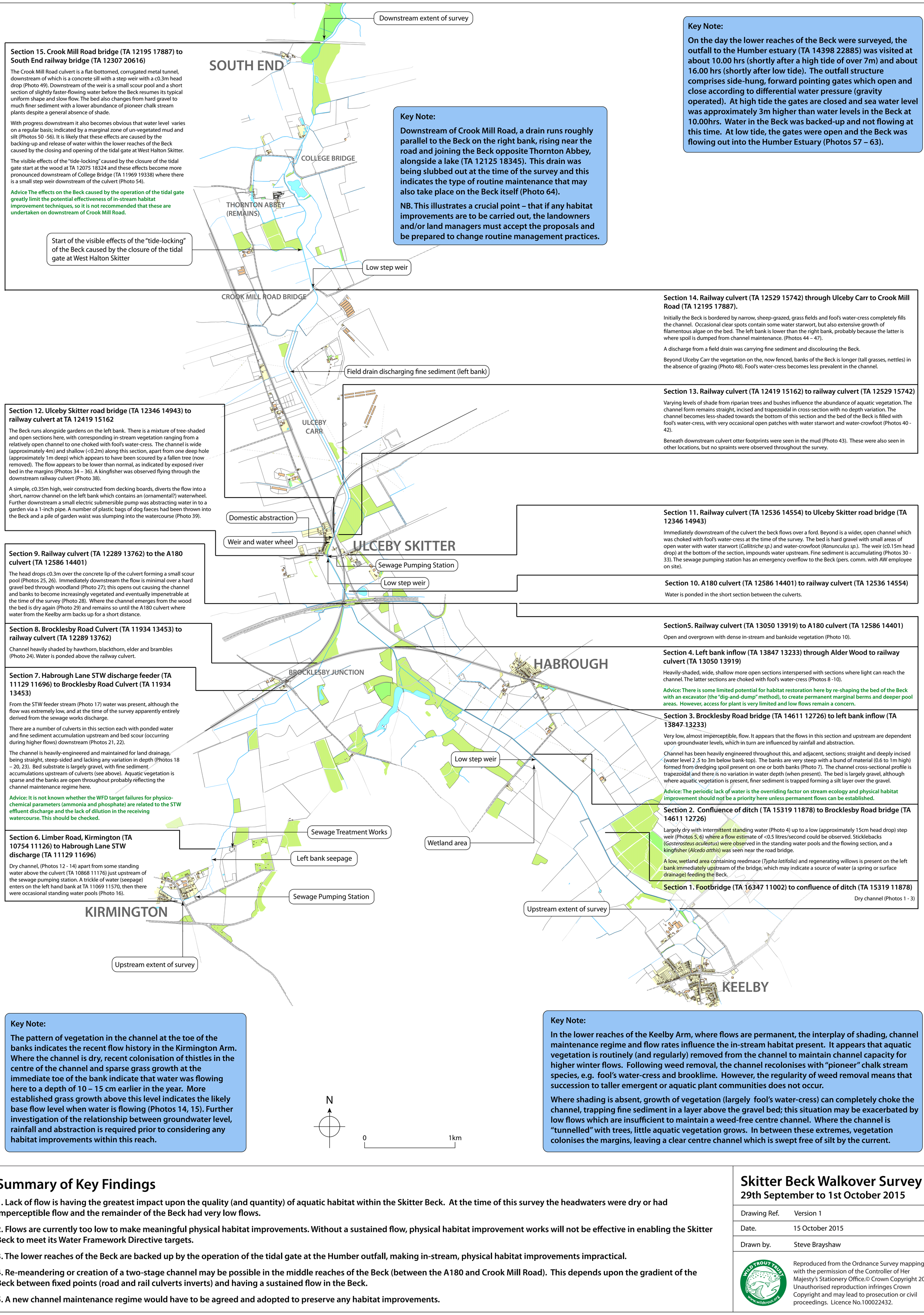

SCALE
1 m
SECTION 1 BASIC RB RE-PROFILE
WITH GRAVEL INTRODUCED ON BED


SCALE
1 m
SECTION 1 BASIC LB RE-PROFILE
(NO GRAVEL INTRODUCTION)


SCALE
1 m
SECTION 4 POOL DOWNSTREAM OF ACCELERATED FLOW THROUGH NARROWING


TOP OF BANK (BANKFULL) RB
FLOW
POOL
GRAVEL
GRAVEL
TOP OF BANK (BANKFULL) LB
SECTION 2
SECTION 3
SECTION 4
SECTION 2

SKITTER BECK WALKOVER SURVEY (29th September to 1st October 2015)



Key Note:

On the day the lower reaches of the Beck were surveyed, the outfall to the Humber estuary (TA 14398 22885) was visited at about 10.00 hrs (shortly after a high tide of over 7m) and about 16.00 hrs (shortly after low tide). The outfall structure comprises side-hung, forward pointing gates which open and close according to differential water pressure (gravity operated). At high tide the gates are closed and sea water level was approximately 3m higher than water levels in the Beck at 10.00hrs. Water in the Beck was backed-up and not flowing at this time. At low tide, the gates were open and the Beck was flowing out into the Humber Estuary (Photos 57 – 63).

Key Note:

Downstream of Crook Mill Road, a drain runs roughly parallel to the Beck on the right bank, rising near the road and joining the Beck opposite Thornton Abbey, alongside a lake (TA 12125 18345). This drain was being slubbed out at the time of the survey and this indicates the type of routine maintenance that may also take place on the Beck itself (Photo 64).

NB. This illustrates a crucial point – that if any habitat improvements are to be carried out, the landowners and/or land managers must accept the proposals and be prepared to change routine management practices.

Section 15. Crook Mill Road bridge (TA 12195 17887) to South End railway bridge (TA 12307 20616)

The Crook Mill Road culvert is a flat-bottomed, corrugated metal tunnel, downstream of which is a concrete sill with a step weir with a c0.3m head drop (Photo 49). Downstream of the weir is a small scour pool and a short section of slightly faster-flowing water before the Beck resumes its typical uniform shape and slow flow. The bed also changes from hard gravel to much finer sediment with a lower abundance of pioneer chalk stream plants despite a general absence of shade.

With progress downstream it also becomes obvious that water level varies on a regular basis; indicated by a marginal zone of un-vegetated mud and silt (Photos 50 -56). It is likely that these effects are caused by the backing-up and release of water within the lower reaches of the Beck caused by the closing and opening of the tidal gate at West Halton Skitter.

The visible effects of the "tide-locking" caused by the closure of the tidal gate start at the wood at TA 12075 18324 and these effects become more pronounced downstream of College Bridge (TA 11969 19338) where there is a small step weir downstream of the culvert (Photo 54).

Advice The effects on the Beck caused by the operation of the tidal gate greatly limit the potential effectiveness of in-stream habitat improvement techniques, so it is not recommended that these are undertaken on downstream of Crook Mill Road.

Section 14. Railway culvert (TA 12529 15742) through Ulceby Carr to Crook Mill Road (TA 12195 17887).

Initially the Beck is bordered by narrow, sheep-grazed, grass fields and fool's water-cress completely fills the channel. Occasional clear spots contain some water starwort, but also extensive growth of filamentous algae on the bed. The left bank is lower than the right bank, probably because the latter is where spoil is dumped from channel maintenance. (Photos 44 – 47).

A discharge from a field drain was carrying fine sediment and discolouring the Beck.

Beyond Ulceby Carr the vegetation on the, now fenced, banks of the Beck is longer (tall grasses, nettles) in the absence of grazing (Photo 48). Fool's water-cress becomes less prevalent in the channel.

Section 13. Railway culvert (TA 12419 15162) to railway culvert (TA 12529 15742)

Varying levels of shade from riparian trees and bushes influence the abundance of aquatic vegetation. The channel form remains straight, incised and trapezoidal in cross-section with no depth variation. The channel becomes less-shaded towards the bottom of this section and the bed of the Beck is filled with fool's water-cress, with very occasional open patches with water starwort and water-crowfoot (Photos 40 - 42).

Beneath downstream culvert otter footprints were seen in the mud (Photo 43). These were also seen in other locations, but no spraints were observed throughout the survey.

Section 12. Ulceby Skitter road bridge (TA 12346 14943) to railway culvert at TA 12419 15162

The Beck runs alongside gardens on the left bank. There is a mixture of tree-shaded and open sections here, with corresponding in-stream vegetation ranging from a relatively open channel to one choked with fool's water-cress. The channel is wide (approximately 4m) and shallow (<0.2m) along this section, apart from one deep hole (approximately 1m deep) which appears to have been scoured by a fallen tree (now removed). The flow appears to be lower than normal, as indicated by exposed river bed in the margins (Photos 34 – 36). A kingfisher was observed flying through the downstream railway culvert (Photo 38).

A simple, c0.35m high, weir constructed from decking boards, diverts the flow into a short, narrow channel on the left bank which contains an (ornamental?) waterwheel. Further downstream a small electric submersible pump was abstracting water in to a garden via a 1-inch pipe. A number of plastic bags of dog faeces had been thrown into the Beck and a pile of garden waist was slumping into the watercourse (Photo 39).

Section 11. Railway culvert (TA 12536 14554) to Ulceby Skitter road bridge (TA 12346 14943)

Immediately downstream of the culvert the beck flows over a ford. Beyond is a wider, open channel which was choked with fool's water-cress at the time of the survey. The bed is hard gravel with small areas of open water with water starwort (*Callitriche sp.*) and water-crowfoot (*Ranunculus sp.*). The weir (c0.15m head drop) at the bottom of the section, impounds water upstream. Fine sediment is accumulating (Photos 30 - 33). The sewage pumping station has an emergency overflow to the Beck (pers. comm. with AW employee on site).

Section 9. Railway culvert (TA 12289 13762) to the A180 culvert (TA 12586 14401)

The head drops c0.3m over the concrete lip of the culvert forming a small scour pool (Photos 25, 26). Immediately downstream the flow is minimal over a hard gravel bed through woodland (Photo 27); this opens out causing the channel and banks to become increasingly vegetated and eventually impenetrable at the time of the survey (Photo 28). Where the channel emerges from the wood the bed is dry again (Photo 29) and remains so until the A180 culvert where water from the Keelby arm backs up for a short distance.

Section 10. A180 culvert (TA 12586 14401) to railway culvert (TA 12536 14554)

Water is ponded in the short section between the culverts.

Section 8. Brocklesby Road Culvert (TA 11934 13453) to railway culvert (TA 12289 13762)

Channel heavily shaded by hawthorn, blackthorn, elder and brambles (Photo 24). Water is ponded above the railway culvert.

Section5. Railway culvert (TA 13050 13919) to A180 culvert (TA 12586 14401)

Open and overgrown with dense in-stream and bankside vegetation (Photo 10).

Section 7. Habrough Lane STW discharge feeder (TA 11129 11696) to Brocklesby Road Culvert (TA 11934 13453)

From the STW feeder stream (Photo 17) water was present, although the flow was extremely low, and at the time of the survey apparently entirely derived from the sewage works discharge.

There are a number of culverts in this section each with ponded water and fine sediment accumulation upstream and bed scour (occurring during higher flows) downstream (Photos 21, 22).

The channel is heavily-engineered and maintained for land drainage, being straight, steep-sided and lacking any variation in depth (Photos 18 – 20, 23). Bed substrate is largely gravel, with fine sediment accumulations upstream of culverts (see above). Aquatic vegetation is sparse and the banks are open throughout probably reflecting the channel maintenance regime here.

Advice: It is not known whether the WFD target failures for physico-chemical parameters (ammonia and phosphate) are related to the STW effluent discharge and the lack of dilution in the receiving watercourse. This should be checked.

Section 4. Left bank inflow (TA 13847 13233) through Alder Wood to railway culvert (TA 13050 13919)

Heavily-shaded, wide, shallow more open sections interspersed with sections where light can reach the channel. The latter sections are choked with fool's water-cress (Photos 8 -10).

Advice: There is some limited potential for habitat restoration here by re-shaping the bed of the Beck with an excavator (the "dig-and-dump" method), to create permanent marginal berms and deeper pool areas. However, access for plant is very limited and low flows remain a concern.

Section 3. Brocklesby Road bridge (TA 14611 12726) to left bank inflow (TA 13847 13233)

Very low, almost imperceptible, flow. It appears that the flows in this section and upstream are dependent upon groundwater levels, which in turn are influenced by rainfall and abstraction.

Channel has been heavily engineered throughout this, and adjacent, sections; straight and deeply incised (water level 2 ,5 to 3m below bank-top). The banks are very steep with a bund of material (0.6 to 1m high) formed from dredging spoil present on one or both banks (Photo 7). The channel cross-sectional profile is trapezoidal and there is no variation in water depth (when present). The bed is largely gravel, although where aquatic vegetation is present, finer sediment is trapped forming a silt layer over the gravel.

Advice: The periodic lack of water is the overriding factor on stream ecology and physical habitat improvement should not be a priority here unless permanent flows can be established.

Section 6. Limber Road, Kirmington (TA 10754 11126) to Habrough Lane STW discharge (TA 11129 11696)

Dry channel, (Photos 12 - 14) apart from some standing water above the culvert (TA 10868 11176) just upstream of the sewage pumping station. A trickle of water (seepage) enters on the left hand bank at TA 11069 11570, then there were occasional standing water pools (Photo 16).

Section 2. Confluence of ditch (TA 15319 11878) to Brocklesby Road bridge (TA 14611 12726)

Largely dry with intermittent standing water (Photo 4) up to a low (approximately 15cm head drop) step weir (Photos 5, 6) where a flow estimate of <0.5 litres/second could be observed. Sticklebacks (*Gasterosteus aculeatus*) were observed in the standing water pools and the flowing section, and a kingfisher (*Alcedo atthis*) was seen near the road bridge.

A low, wetland area containing reedmace (*Typha latifolia)* and regenerating willows is present on the left bank immediately upstream of the bridge, which may indicate a source of water (a spring or surface drainage) feeding the Beck.

Section 1. Footbridge (TA 16347 11002) to confluence of ditch (TA 15319 11878)

Dry channel (Photos 1 - 3)

Key Note:

The pattern of vegetation in the channel at the toe of the banks indicates the recent flow history in the Kirmington Arm. Where the channel is dry, recent colonisation of thistles in the centre of the channel and sparse grass growth at the immediate toe of the bank indicate that water was flowing here to a depth of 10 – 15 cm earlier in the year. More established grass growth above this level indicates the likely base flow level when water is flowing (Photos 14, 15). Further investigation of the relationship between groundwater level, rainfall and abstraction is required prior to considering any habitat improvements within this reach.

Key Note:

In the lower reaches of the Keelby Arm, where flows are permanent, the interplay of shading, channel maintenance regime and flow rates influence the in-stream habitat present. It appears that aquatic vegetation is routinely (and regularly) removed from the channel to maintain channel capacity for higher winter flows. Following weed removal, the channel recolonises with "pioneer" chalk stream species, e.g. fool's water-cress and brooklime. However, the regularity of weed removal means that succession to taller emergent or aquatic plant communities does not occur.

Where shading is absent, growth of vegetation (largely fool's water-cress) can completely choke the channel, trapping fine sediment in a layer above the gravel bed; this situation may be exacerbated by low flows which are insufficient to maintain a weed-free centre channel. Where the channel is "tunnelled" with trees, little aquatic vegetation grows. In between these extremes, vegetation colonises the margins, leaving a clear centre channel which is swept free of silt by the current.

Summary of Key Findings

1. Lack of flow is having the greatest impact upon the quality (and quantity) of aquatic habitat within the Skitter Beck. At the time of this survey the headwaters were dry or had imperceptible flow and the remainder of the Beck had very low flows.

2. Flows are currently too low to make meaningful physical habitat improvements. Without a sustained flow, physical habitat improvement works will not be effective in enabling the Skitter Beck to meet its Water Framework Directive targets.

3. The lower reaches of the Beck are backed up by the operation of the tidal gate at the Humber outfall, making in-stream, physical habitat improvements impractical.

4. Re-meandering or creation of a two-stage channel may be possible in the middle reaches of the Beck (between the A180 and Crook Mill Road). This depends upon the gradient of the Beck between fixed points (road and rail culverts inverts) and having a sustained flow in the Beck.

5. A new channel maintenance regime would have to be agreed and adopted to preserve any habitat improvements.

Skitter Beck Walkover Survey
29th September to 1st October 2015

Drawing Ref.	Version 1
Date.	15 October 2015
Drawn by.	Steve Brayshaw

Keelby Arm.

Photo 1 Dry channel at footbridge (TA1634711002). Ranging pole increments are 0.2m.

Photo 2 The bed of the dry section is predominantly gravel (TA1550811517).

Photo 3 More open section of Keelby arm (TA1545011609).

Photo 4 Ponded water close to confluence with a field drain (TA1531511881).

Photo 5 View upstream from Brocklesby Road bridge (TA1461112726). Wet area on true LHB (right of picture).

Photo 6 Step weir upstream of Brocklesby Road bridge (TA1461112726). Head difference approximately 0.15m.

Photo 7 Raised bund of former dredging spoil on one bank – typical throughout the course of the Beck. (TA1450512798).

Photo 8 Less aquatic vegetation in more shaded areas in Alder Wood (TA1363513360).

Photo 9 More aquatic vegetation in less shaded areas within Alder Wood (TA1332513565).

Photo 10 Overgrown section downstream of Alder Carr Wood and railway line (TA1279614121)

Photo 11 A180 road culvert (TA1258614401).

Kirmington Arm

Photo 12 Culvert under track to house adjacent to Kirmington East End sewage pumping station (TA1087211178)

Photo 13 Dry channel downstream of Kirmington (TA1097111246)

Photo 14 Thistles growing in bed of the beck give an indication of the length of time it has been dry – probably several weeks.

Photo 15 The pattern of vegetation establishment in the margins indicates growth in the current year since drying (red arrow) and more established growth indicating a probable winter base flow level (blue arrow).

Photo 16 Standing water (TA1106911570s).

Photo 17 Effluent from Habrough Lane sewage treatment works entering the brook. Fine sediment accumulation is due to recent clearing out of the drain and proximity upstream of a culvert (out of shot, left of picture)(TA1112911696).

Photo 18 Section of Kirmington arm (TA1119311861).

Photo 19 Section of Kirmington arm, Horns Wood (TA1130812153).

Photo 20 Section of Kirmington arm (TA1129712268).

Photo 21 Fine sediment accumulated in impoundment upstream of a culvert (TA1124712427)

Photo 22 Bed scour downstream of a culvert (TA1124712427).

Photo 23 View upstream from upstream of Brocklesby Road culvert (TA1193513451).

Photo 24 Densely shaded channel near Brocklesby Junction (TA1225113684).

Photo 25 Water ponded upstream of the railway culvert (TA1229113769).

Photo 26 Step weir immediately downstream of railway culvert (TA1229113769).

Photo 27 Very shallow flow over hard gravel bed (TA1233113853).

Photo 28 Channel and banks choked with vegetation in clearing in woods (TA1236213916).

Photo 29 Dry river bed (TA1249614201).

Confluence of headwaters (A180 culvert) to South End (downstream limit)

Photo 30 Upstream of Ulceby Skitter, channel choked with fools' water cress (TA1244814740).

Photo 31 Upstream of Ulceby Skitter, showing gravel bed under fools' water cress (TA1244814740).

Photo 32 Water crowfoot (Ranunculus sp.) in clear spot between fools' water cress (TA1240214821).

Photo 33 Step weirimmediately upstream of Ulceby Road (A1077) bridge (TA1234514944).

Photo 34 Downstream of Ulceby Road (A1077) bridge (TA1234514944). Unshaded section.

Photo 35 Downstream of Ulceby Road (A1077) bridge (TA1234514944). Partially shaded section.

Photo 36 Downstream of Ulceby Road (A1077) bridge (TA1234514944). Shaded section.

Photo 37 Decking board weir, river diversion and waterwheel (TA1240315126).

Photo 38 Railway culvert at TA1241815165.

Photo 39 Immediately upstream of railway culvert at TA1241815165. Electric pump abstracting water from the Beck (arrow), bags of dog faeces and garden waste.

Photo 40 Between railway culverts at TA1241815165 and TA1253115744. Shaded area.

Photo 41 Between railway culverts at TA1241815165 and TA1253115744. Partially shaded area.

Photo 42 Between railway culverts at TA1241815165 and TA1253115744. Unshaded area.

Photo 43 Otter footprints in mud under railway culvert. Increments on ranging pole are 0.2m. (TA1253115744).

Photo 44 Ulceby Carr section (TA1233716172)

Photo 45 Ulceby Carr section (TA1213516569).

Photo 46 Discolouration caused by fine sediment in water joining from a field drain. Note starwort and water crowfoot in water relatively free from fools' water cress (TA1192416980).

Photo 47 Filamentous algae on the bed in clear spots between fools' water cress (TA1189817133)

Photo 48 (TA1202317499)

Photo 49 Step weir downstream of Crook Mill road culvert (TA1218417902)

Photo 50 (TA1204618592).

Photo 51 (TA1204618592)

Photo 52 (TA1204618592)

Photo 53(TA1187119120)

Photo 54 Small step weir downstream of College Road bridge culvert (TA1197719339)

Photo 55 (TA1215319698)

Photo 56 (TA1219220285)

Outside of extent of survey – flow / tidal control structures; maintenance practices on other drain

Photo 57 Skitter Beck Flushing, an EA structure probably used intermittently to impound water and flush silt out of the lower beck (TA1396822628).

Photo 58 Sea side of Skitter Beck outfall, tide in and gates closed, 10.00hrs 30/09/2015 (TA1439822885).

Photo 59 Sea side of Skitter Beck outfall, tide out and gates open, 16.15hrs 30/09/2015 (TA1439822885).

Photo 60 Sea side of Skitter Beck outfall, tide in and gates closed 10.00hrs 30/09/2015 (TA1439822885).

Photo 61 Sea side of Skitter Beck outfall, tide out and gates open 16.15hrs 30/09/2015 (TA1439822885).

Photo 62 River side of Skitter Beck outfall, tide in and gates closed, water backing-up in the Beck, 10.00hrs 30/09/2015 (TA1439822885).

Photo 63 River side of Skitter Beck outfall, tide out and gates open, water flowing into estuary, 16.15hrs 30/09/2015 (TA1439822885).

Photo 64 Recent dredging of drain running parallel to Skitter Beck (TA1212518345).