


An Investigation of the Watercourses in Sussex Arising from the Chalk Aquifer of the South Downs Merged Reports from December 2009 & December 2010

A report to the Sussex Wetland Landscapes Project




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Executive Summary

In autumn 2009 an investigation of streams potentially fed by groundwater chalks springs arising from the South Downs in Sussex was undertaken. The primary aim of the project was to establish map the presence of chalk streams within the county. In addition, there was a requirement to report on the structure, status and potential for restoration/rehabilitation of such habitats. In 2010, on reviewing the information in county databases, it was discovered that there were potentially other chalks streams in Sussex that had not been surveyed. As a result, a further contract was let to survey further watercourses that potentially might be chalk streams in 2010.

Field survey methods, and reporting, were similar, but not identical, in each of the survey periods. The main difference was that assessment and reporting was streamlined in the second survey. This included the omission of one of the 5 'characterisation' criteria scoring 1-5 which was used to score flow characteristics in the first survey. Most fieldwork was undertaken during the autumn and winter period, with follow-up visits made where necessary. Where possible, field observations were made of the physical character of the watercourses and the land-use adjacent to them using a standard naming protocol used for recording rivers in the UK (River Habitat Survey).

Information was recorded by a combination of annotated maps and tabulated data gathered on 'features' and 'modifications' of each watercourse surveyed. Vegetation surveys were a key aspect of the work as chalk stream vegetation often provides a very good indication of both the physical character (and extent of degradation), as well as the present and historic flow character. The latter allows assessments to be made on whether watercourses are likely to have continuous spring flows feeding them (perennial), or this periodically or regularly fails (winterbourne). Using another standard method enabled the flora of the each watercourse to be classified into a national system.

The report of the first tranche of surveys noted that the findings challenged what was generally perceived to be the definition of chalks streams. The survey identified some very high quality streams arising from springs below the escarpments of the South Downs that were physically much more natural than many highly rated chalk streams and rivers that have both national and international conservation designations elsewhere in the UK.

Thus, conclusions drawn were that Sussex did have some fine examples of 'near-natural' headwater chalk streams, and also some exceptionally interesting local riparian spring/wetland habitats associated with others, some of which were much less natural. The surveys identified that many of the watercourses have small areas of wet woodland (carr) associated with them. In many cases these have developed from historic on-line ponds that have drained following the downstream impounding structures becoming dilapidated. Some now form extensive wet woodland with the springs and subsequent streams flowing shallowly over peaty silt, and not forming discrete channels. Such habitats are rare and have high conservation value.

In 2009, one area of springs and carr was found that is more pristine, and not developed as a secondary habitat from an historic pond – the source of the Offham stream; the c200m at its source is considered to be one of the three finest examples of a chalks stream in the whole of the UK. Other naturalised sections of chalk stream of high ecological and morphological interest were found at Alciston, Allington, Ashington, Cocking, Clayton, Fishbourne, Fulking, Gote, Lag Wood and Pyecombe.

In 2010 a further 112 separate watercourse units were surveyed and assessed. Four of the watercourses were considered to be of exceptionally high interest (eight survey units - 8% of the total surveyed), and six of very high interest (5%). This equates to 12.5% of all the survey units assessed. Sites of exceptional interest included: 'Bosham' watercourses at Funtington, considered worthy of at least being designated a County Wildlife Site as it illustrates classic winterbourne and perennial chalk stream characteristics; a stream in Harting which is a short tributary that is a near-natural winterbourne with a steep gradient; a one kilometre stretch of river at Sutton which is possibly the most natural small chalk stream in the UK, with abundant springs and flushes in the riparian zone; at Poynings a tufa-bed stream was identified in the same Newtimber catchment as one of the strongest perennial spring-fed habitats determined in the 2009 surveys.

High interest sites discovered in 2010 included: another watercourse in the Bosham area; a dynamic and diverse spring-fed stream in woodland at Nursted; a second stream in Harting showing clear affinity to perennial chalk stream character and strong springs; and the only watercourse in over 200 surveyed in Sussex in 2009 and 2010 to have the morphology of a typical Hampshire headwater winterbourne in grazed landscape AND *Ranunculus peltatus* at Bishopstone; in Arundel two watercourses of high interest were identified – one with a tiny section of river with clear perennial chalk 'stream' character but influenced at its source by the effects of tidal back-up water, and a classic perennial chalk stream community of macrophytes.

Physical modifications to, and factors impacting on chalk streams included on-line ponding for amenity reasons, ponding to create water storage for milling (historical), urbanisation and ditching for improved drainage, and creation of water-cress beds. Abstraction is the principal anthropogenic influence impacting headwater streams, with artificial inflows less influential. Invasive plant species were also an issue in some areas.

A conclusion drawn even more clearly from the 2010 surveys than those of 2009 was the extraordinary difference in land-use between the watercourses of high morphological quality and naturalness, and those that are most highly modified and of very low quality. *The former always flowed through ancient woodland.* Many of the surveyed watercourses were deemed to be ditches or very poor quality. However, although it may require more effort, these watercourses may still have some potential for restoration to their previous chalk stream form.

Recommendations in the reports are intended to:

- **stimulate informed discussions with landowners and local interests on the sort of protection and/or enhancement that might be undertaken generally, illustrated by specific examples;**
- **draw attention to some general management, enforcement and planning issues that will help protect and enhance the chalks streams surveyed;**
- **identify where further investigations could aid our understanding of the resource, and hence improve the knowledge base.**

Specifically, recommendations are made on:

- **ensuring the best streams, and those that are recovering from past degradations, are protected in the future and allowed to continue to improve;**
- **undertaking the rehabilitation of degraded watercourses, starting in areas where there is landowner/local community support to demonstrate what can be done, and at what cost;**
- **further investigations and reporting – on potential impacts from abstraction, linking present work to known hydrological conditions, looking at areas of special/unclear interest, work on invertebrates etc.**
- **working with local people and raising awareness of the high interests of these watercourses.**

Within the report, comments of note are highlighted in yellow.

PLEASE NOTE : Sites in this report summary are displayed in running order of the respective scores they received as chalk streams, from high scores at the beginning, to low at the end. This does not mean that chalk streams with low scores are necessarily of lesser value, and in fact those with low scores have more potential to be significantly enhanced.

Contents

1. Introduction

In summer 2009 the Sussex Wetland Landscapes Project (SWLP) and the Sussex Biodiversity Record Centre (SxBRC) initiated a project with the aim of establishing a clearer picture of the presence of chalk stream habitats within the county. The surveys were within the umbrella of the 'Sussex Wetland Landscapes Project', were carried out by an independent ecologist and expert in chalk stream ecology, and were supported by the Environment Agency (EA), and the South Downs Joint Committee (SDJC).

The following report provides a hierarchical summary of those watercourses surveyed which were deemed, via the survey to be chalk streams or chalk spring heads of ecological, hydrological and morphological value.

Figure 1a shows the geographical location of the survey area.

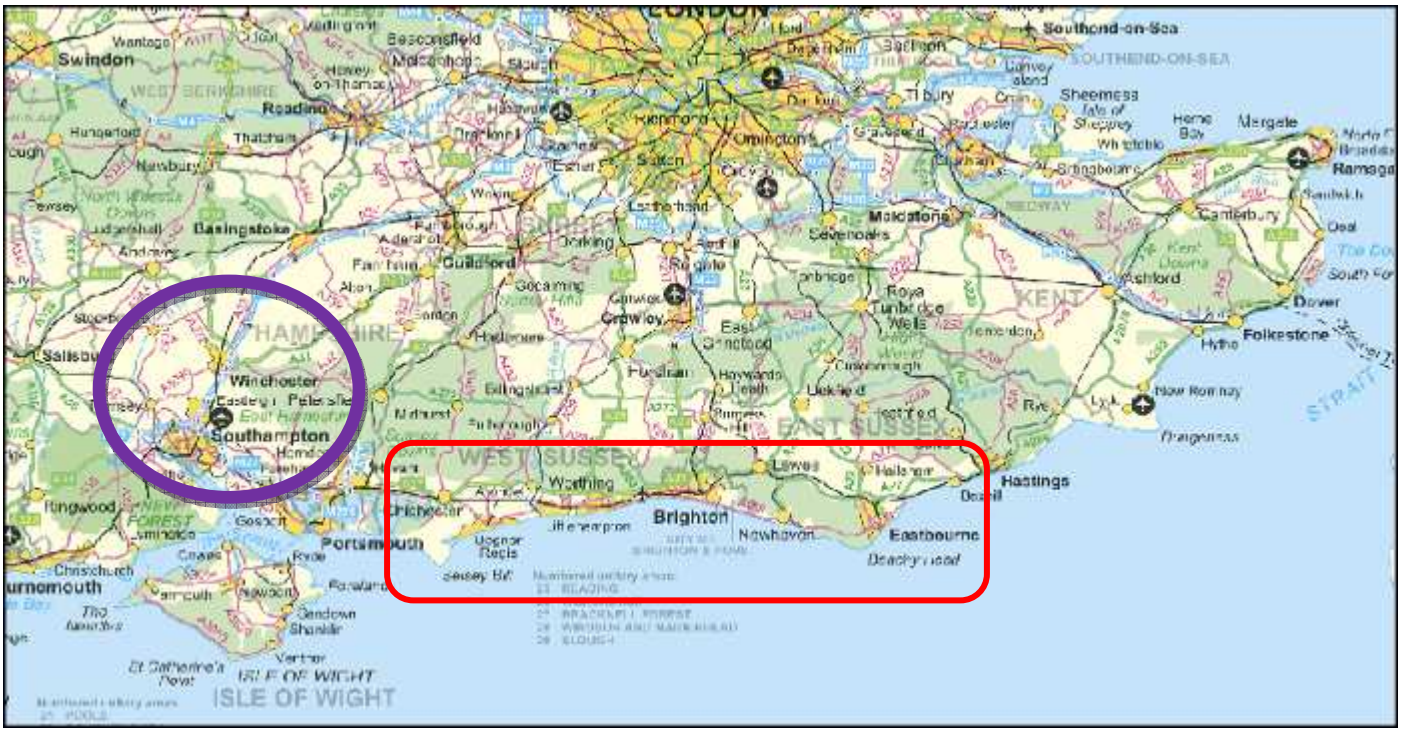


Figure 1a Sites surveyed (red oblong) adjacent 'classic Hampshire chalk stream' (purple circle).

2. Methods

The contractor was furnished with maps of potential chalk stream sites showing key features.

The original surveys of 2009 involved:

a) Annotating field sheets on land-use, key features and approximate locations of photos taken
b) Recording 'River Habitat Survey' (RHS) features and character for 'land-use', 'bank profiles', 'trees and tree features' 'in-channel features' (flow, bars cliffs and substrate)' and 'structures';
c) Recording the vegetation at the margins (base of bank) and in-channel using the standard Joint Nature Conservation Committee (JNCC) Method to enable classification. Where many aquatic taxa were also present, 'MTR' surveys were undertaken.

In 2010, field sheets were annotated as in 2009, but the formal recording of RHS features was abandoned in the interest of recording watercourse character on proforma that enabled the following overview of the 'naturalness' and perceived 'value' of each watercourse length surveyed. Five elements were scored in 2009 and five elements were scored in 2010 on a scale 1-5, with '1' being used for the most damaged and impoverished, to '5' for the most natural and diverse.

a) **Naturalness of morphology** Combination of objective and subjective observations and conclusions. Includes evidence of straightening, deepening etc. – impact on substrate (siltation), shade (not typical of most chalk streams today but historically small chalk streams would have been very shaded). ***Thus***

meandering streams in woodland, even if shaded and almost devoid of vegetation, should be considered more natural than ones in the open supporting the classic chalk stream flora.

b) **Diversity of physical structure** Even when the morphology is greatly changed, recovery of habitat features may be reasonable – i.e. tree root habitats, deposition and erosion features – again these are not typically thought to be associated with 'English Chalk rivers', but in headwaters with reasonable gradient, they would be a natural feature of more pristine sites.

c) **Vegetation character – how natural and characteristic is it of a headwater chalk stream?** Very difficult to judge as perennial sites would naturally be very different from winterbournes, and naturally shaded sites would not conform to the perception of a good 'English Chalk stream' flora – see original report for more information if required.

d) **Naturalness of hydrogeology and how much linked to chalk aquifer** – this was a very subjective assessment, and needed to combine information on the flora, the bed and the water clarity. It is impossible to determine from such snapshot surveys whether abstraction, for example, is having an impact on watercourses surveyed.

The fifth element **not** included in the second tranche of surveys was:-

e) **How free-flowing is the watercourse?** Are there impounding structures? If so, what is their impact? To be a stream, it should be flowing not impounded. Presence of historic mills, cress beds and old/new on-line ornamental ponds and lakes all impact directly the naturalness of the flow regime (velocity and depth), and also to some extent the discharge downstream. The impact is not just on freedom of water to flow, but on siltation and sediment movement and ability to form habitat through geomorphological processes. Obstructions to animal migration are also associated with dams that pond water upstream.

Unless watercourses were so heavily modified (photographic evidence collected), such field sheets were filled in during the time of survey. To provide evidence of the high quality, or impoverished nature, of the flora of most watercourses, a rapid JNCC macrophyte survey was undertaken. ***When making comparisons between chalk stream scores from the 2009 and 2010 surveys it should be noted that 2009 streams can score up to 25, whereas 2010 chalk streams can only score up to 20.*** Therefore if some streams appear to be numerically 'out of place with regards to their scores it is because they were scored in different years.

The prime aim of the project was to determine the extent of 'chalk streams' in Sussex. The most difficult task in making the assessments from a single snapshot survey of any watercourse is to answer the tautological question: 'when is a chalk stream a chalk stream and when is it not a chalk stream'?

To qualify as a chalk stream a key first requirement is that the watercourse must, for the majority of its length, flow over chalk. Another prime requirement is that the flow within the watercourse must primarily be derived from the chalk aquifer (this applies whether it is an intermittent stream (winterbourne) and one with a flow that never ceases (perennial). These key characteristics cannot be determined in the field in one snapshot visit. Surrogates were thus used. Spring water from chalk aquifers is 'filtered' on its passage through the earth, so chalk streams have a characteristic pristine clarity to their water. Unless chalk streams are wide, and shallow-edged, winterbournes flowing through grassland, most have (at least in places), exposed and clean gravel beds, often dominated by flints. Unless either or both these characteristics were noted in the field, watercourses would, in all probability, be dismissed as not being chalk streams.

Having water within a ditch at the time of survey simply means it is a ditch, not necessarily a chalk stream. Any doubt in classification is then based on flora, with chalk streams and winterbournes have classic species that set them apart from most other watercourses (see Summary, Chapter 4). Ideally assessments of vegetation would be carried out in July and August, but the contract for survey was let in the beginning of October. Only minor frosts had occurred, so most watercourses had vegetation that could be assessed adequately.

The information contained in this report would enable rehabilitation ideas to be developed should this be required in the future.

3. Mapped Areas

For the purpose of reporting, the study area was divided into five 'areas' in the first survey (see Figure 3a below):

Group A Streams – Ems & Lavant Catchments
Group B Streams – River Rother & Arun Tributaries
Group C Streams – Lower Adur
Group D Streams – Bevern Stream Tributaries & Upper Ouse Estuary Tributaries
Group E Streams – Lower Ouse Estuary and Cuckmere Area Tributaries

Figure 3a Map showing the location of the five separate reporting 'areas'

The study area was divided into six 'areas' in the second survey period (see Figure 3b below):

Group I Streams – Coastal Streams West of Chichester
Group II Streams – North-facing Downs streams from A27 in the West to the Arun in the East
Group III Streams – East Chichester to Arundel Coastal streams (south facing Downs)
Group IV Streams – North-facing Downs streams east of the Arun to Lewes (River Ouse)
Group V Streams – South-facing (Coastal) streams east of the Arun (Arundel) to Brighton
Group VI Streams – Everything east of Lewes and the River Ouse

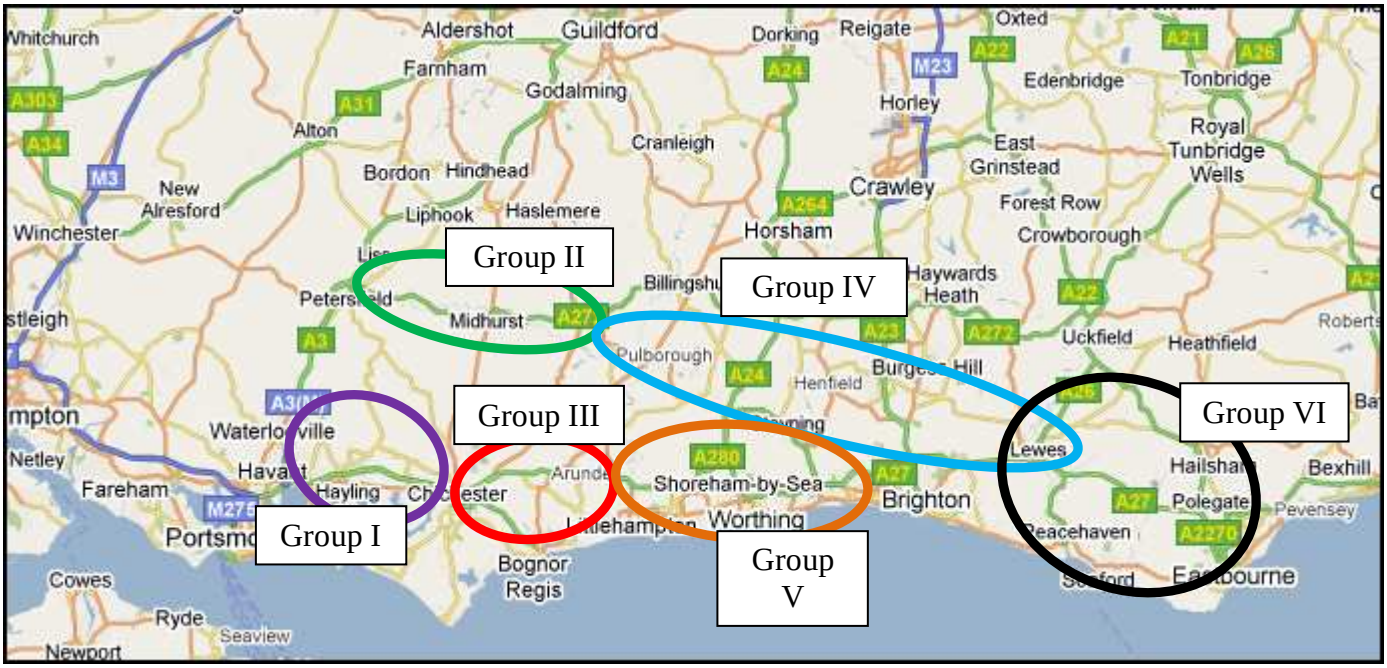
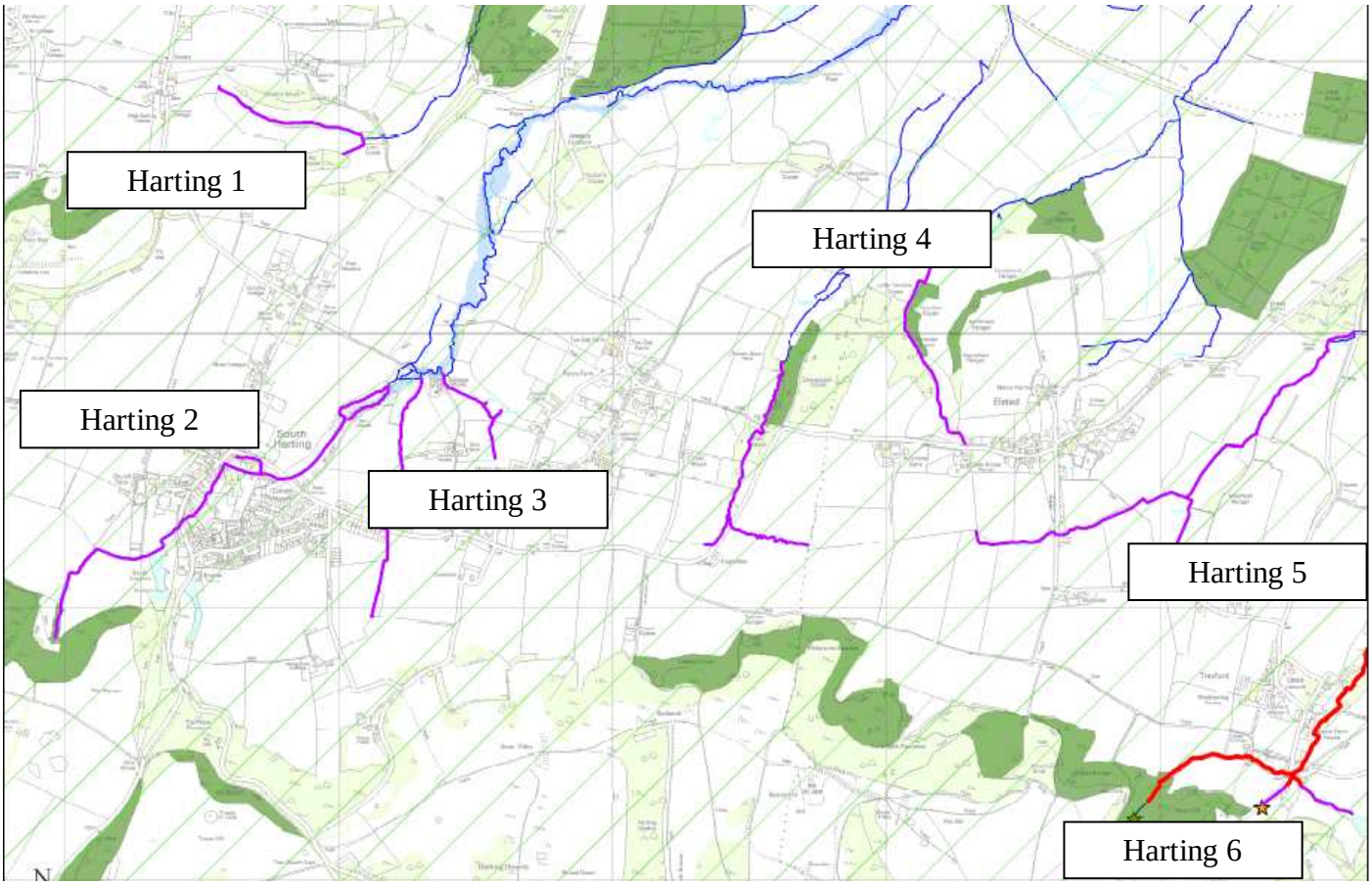


Figure 3b Map showing the location of the five separate reporting 'areas'

4. Results

II.2 Harting Streams (OS Square; 1:50,000 Map SU89537 18212). Several watercourse sub-catchments within this area. Six segments surveyed, some of which were further sub-divided into sub-segments.



Harting Stream II.2.4A

Naturalness of Morphology Amazingly natural stream – cut 2-5m below cultivated land in a meandering form.	**5**
Diversity of Habitat Fantastically diverse with cliffs, bars, varied substrates and woody debris.	**5**
Vegetation Character Winterbourne bare flora – as it should be.	**5**
Perceived naturalness of Hydrology Dry – natural winterbourne with likely strong seasonal flows.	**5**
OVERALL TOTAL (max 20)	**20**


Watercourse 50 Offham (OS Square TQ4011; 1:50,000 Map 198) Source <5m; Gradient <1:100
The 'Score Table' below is based on the headwater section upstream of the inflow into the 'Cut'

Land-use: The extreme headwaters are surrounded by willow-dominated carr (a few alders too) with rough pasture to the north and east. The cut runs alongside a steep wooded chalk escarpment on the right, and wet pasture on the left

Stream morphology: The extreme headwaters (c200m) are not marked by a defined watercourse – it is a swamp area with numerous springs; a defined channel has been created that takes the flow to the 'cut'. The channel is straight with very shallow banks, with the spoil still forming a raised edge on the right. The 'cut' is a deep sluggish channel with no morphological diversity.

Diversity of physical structure: The swamp area, and even the drainage channel through the swamp, has been scored as very diverse due to the range of wetland and woody debris features. The substrate is peat or soil, and the flowing water habitats merge with wet woodland carr in a way that would have been common in headwater chalk streams in pre-Roman times, but is exceedingly rare today. Photos top left and right, and bottom left show the transition from ill-defined swamp to man-made channel.

Vegetation character: Extremely interesting. The upstream part of the spring-fed swamp is dominated by fool's water-cress and hemlock water-dropwort, with lesser and greater pond-sedges also present. On passing downstream *Berula* was common, indicating a stronger spring flow that is almost certainly perennial. The 'cut' was dominated by drainage ditch species (including *Hottonia*), and at the inflow of a chalk 'issue' there was *Berula*, indicating this spring to be perennial. Sufficient species were present in the headwaters to allow a MTR survey to be undertaken – the only site in the Eastern Area 'E' where this occurred.

Hydrogeology: The springs in the headwaters are strong, and discharge at many locations along the northern boundary of the site. Strong springs along the course suggest a perennial flow is maintained. There was a single spring noted to discharge to the 'cut' along the right bank, and some may even break through the bed.

Naturalness of Morphology	**5(3)**
Diversity of Habitat	**5(3)**
Freedom from Obstructions to Flow	**5**

Vegetation Character	**5**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**24(20)**

Recommendation: **Exceptionally interesting site.** The c200m at the source must rate as one of the best (i.e. most natural) examples of a chalk stream source in the UK. Only the SSSI streams Bere (Dorset) and Nine Mile Water (Hants/Wilts) are in the same league. No other site known to the author has such an extensive source of springs within woodland that fail to create a distinct channel and simply form wetland carr – as would have been common two millennia ago. Priority to continue to protect; the SSSI citation and any site management should recognise the true uniqueness of the site. DO NOT MANAGE – LEAVE AS NATURAL WILDERNESS.

72X. Left Bank Tributary – 'Lag Wood Stream'. Extra stream not on the selected list for investigation. Survey of stream 72 showed massive changes downstream of the confluence of the tributary, which appeared, at least in its lower reaches, to be semi-natural. Source c55m; Gradient >1:50

Land-use: Totally dominated by woodland on the left, and a woodland fringe with improved grassland on the right.

Stream morphology: The stream is 'the' most natural and structurally diverse watercourses surveyed. It has probably had some diversions associated with the grassland on its right in the lower reaches, and most certainly its spring habitats at its original source (railway construction).

Diversity of physical structure: Exceptionally good throughout, with cliffs, sediment bars, many tree root/bough features and plenty of woody debris. There are also small waterfalls and pools formed where there is sedimentation of the substrate halting natural headward recession.

Vegetation character: Extremely impoverished for the most part as stone-bedded and shaded (save for bryophytes *Pellia, Platyhypnidium & Thamnobryum*). In the extremely short open section near the end the ponded water and pebble shoals were colonized by *Juncus, Veronica beccabunga & Glyceria notata.*

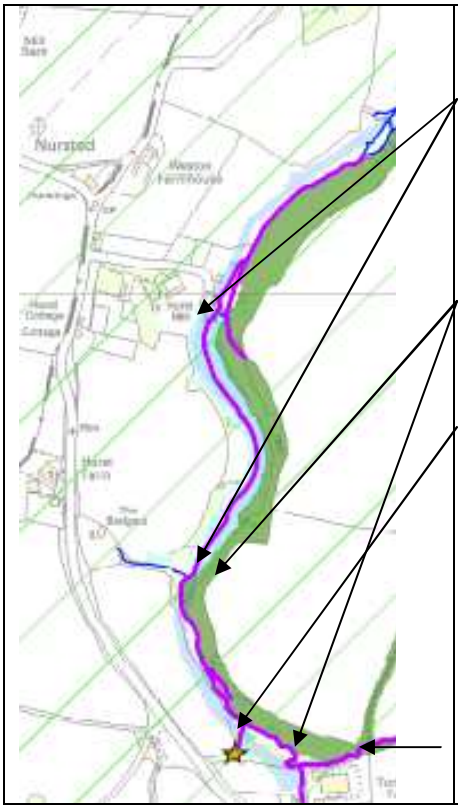
Hydrogeology: It is not possible to be certain of the flow regime, but the owner reports that there is always at least a trickle flow present. It is probable the stream is impacted by the formation of the railway, as its source is a flow from a culvert by the side of the railway. Investigation in January 2010 showed it to have the most powerful groundwater flow of any watercourse surveyed; note assumed influence of the Wolstonbury Hill Knoll.

Recommendation: The whole section is considered very very important, and protection in the future is essential – perhaps local or national designation should be considered. The owner is concerned about water quality in the future due to a 'green cemetery' operating in the groundwater catchment in the headwaters.

Naturalness of Morphology	**5**
Diversity of Habitat	**5**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**5**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**23**


Recommendation for 71/2: The whole of the Lag Wood Stream, and the main stream from Clayton downstream from the confluence, should be considered so important, as to justify local or even national designation that would afford protection from damage in the future. The owner is supportive of protection, but the issue of whether this is achieved through designations has not been discussed.

Nursted Stream II.1.1B (OS Square; 1:50,000 Map SU7663920314) – Downstream of 1A and right bank tributary (Nursted 2)



Influence of mill pond – abandoned survey at upstream limit of ponding shortly d/s of left bank trickle feeder

Very diverse river structure and wet flushes/wet wood in narrow valley floor

Springs dry at source of gulley, but perennial springs before entry to main channel

Right bank tributary, Nursted 2

Land-use: Beyond the immediate riparian corridor the land-use is arable and improved grassland. Within the valley floor **wet woodland** and flushes are important habitats.
Stream morphology: The watercourse is very diverse within the short section upstream of the impounding effect of Hurst Mill. At first the bed is dominated by rocky substrates, but progressively grave, sand and then silt increases the closer to the impounding influence the stream gets. Woody debris is common, and banks are very very variable. Pools, riffles, bars and cliffs present. Very natural at start,
Diversity of physical structure: See above – diversity is greater than would be naturally because the impounding influence of the mill pond affects substrate and subsequently habitat.
Vegetation character: Relatively rich, but with no taxa confirming the stream flow is 100% guaranteed at all times, including drought.
Hydrogeology: Appears naturally a perennial head. The flush to the left is reliable on at the base of the gully. Variety of spring flow **should make this stretch exceptionally interesting for invertebrates** (increased interest too due to wet woodland and fine, peaty, substrates.

Pebble dominated active bed; example of numerous woody debris and tree features present

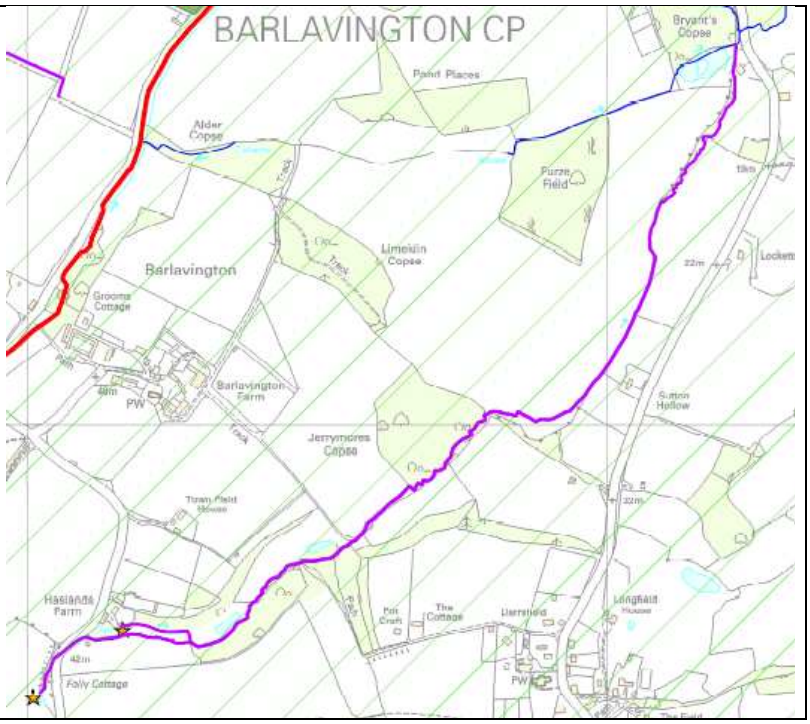
	
Silty substrates and wet woodland u/s mill pond	**Upstream limit of mill pond impounding effect**

Naturalness of Morphology	**5**
Diversity of Habitat	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 20)	**19**

Recommendation: Protect as far as possible. Justifies consideration as County Wildlife Site (CWS) but short.

Sutton II.6.2

Naturalness of Morphology: Apart from close to bridge and at source – very natural.	**4**
Diversity of Habitat: Extremely diverse with steep gradient adding to amazing array of features.	**5**
Vegetation Character: Some ditch flora present, but this stream has a rich winterbourne flora, plus ***Berula*** **indicative of perennial flow.**	**5**
Perceived naturalness of Hydrology: Ever increasing discharge as more and more springs and flushes discharge to the stream.	**5**
OVERALL TOTAL (max 20)	**19**



This is remarkably different from Sutton 1 – a very diverse and more or less natural chalk stream.

Land-use: Extensive woodland, rough pasture and improved grassland dominate. The most valuable feature, however, is the numerous springs and flushes in the immediate riparian zone.

Stream morphology: More or less natural except where modified close to source and partially through the garden.

Diversity of physical structure: Diversity is extremely high, and most is 'natural', enhanced by the extensive tree features. The steep gradient results in cliffs, springs, riffles and un-vegetated side bars being recorded as 'extensive', and mid-channel bars, pools and waterfalls are also present. This is a remarkable list of habitats for a chalk stream.

Vegetation character: Rich, but highly noteworthy for the presence of *Berula,* this indicating perennial flow.

Hydrogeology: Gets stronger and stronger as springs and flushes add to the discharge from the riparian zone and edge of the river.

Recommendation: THIS IS A SHORT SECTION OF THE MOST NATURAL CHALK STREAM HABITAT IN THE UK. Make steps to ensure interest is safeguarded for the future. PLEASE NOTE, the owner is pleased that he has such a special section of river!!


Springs and flushes in the riparian zone





Examples of the very diverse channel features present within this section of watercourse

Poynings IV.3.2D

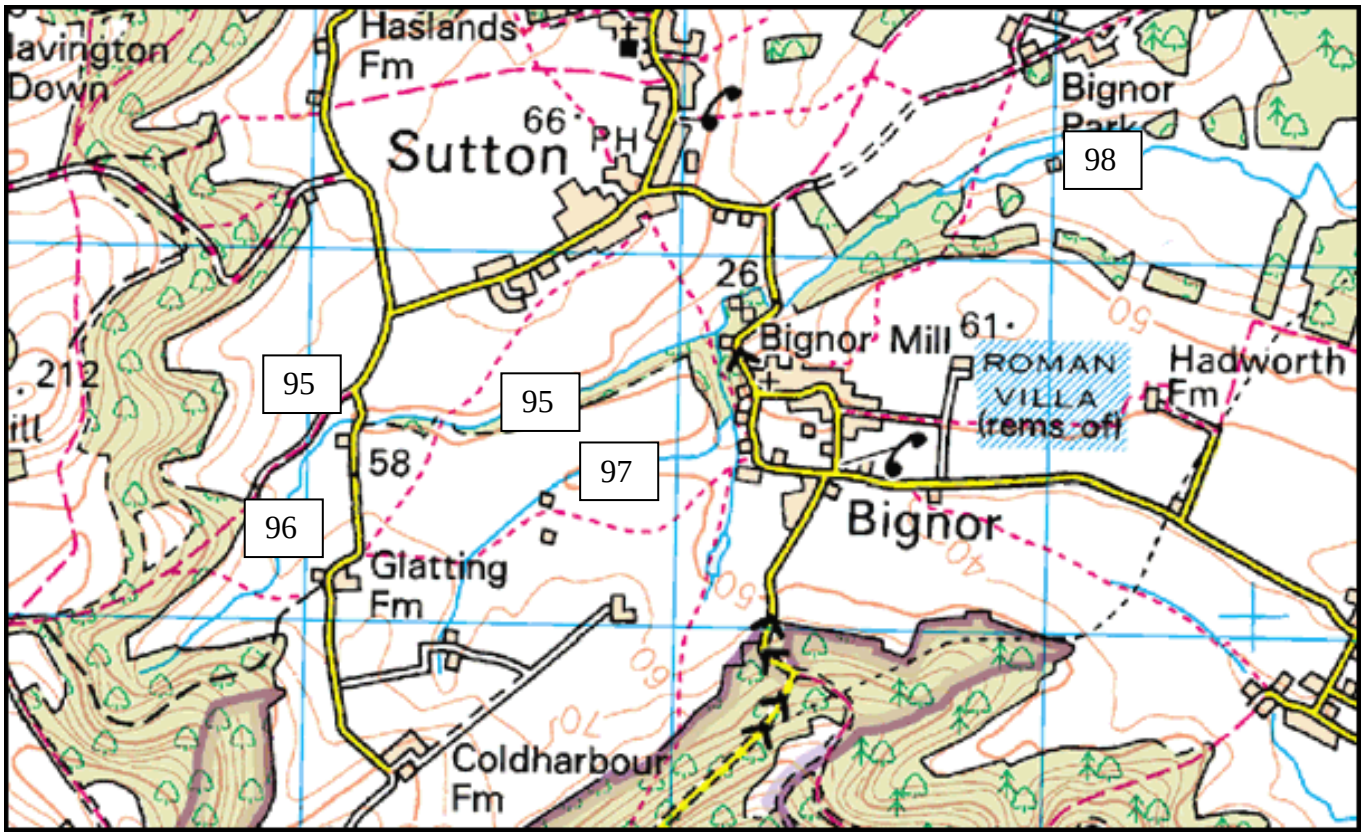
Land-use: Mixture of natural woodland, arable and improved grass.	
Naturalness of Morphology: Starts unpromisingly as drain. Then has a diverse section within woodland where historically it has still been greatly modified (existing shallow pond and breached one) but recovering to more natural conditions	**4**
Diversity of Habitat: Great variety of habitats within woodland, with tufa pebbles/cobbles and bedrock particularly noteworthy.	**5**
Vegetation Character: Bare for the most part in the more natural woodland section, but occluded with winterbourne species (*Apium* mainly) in lower, open, section	**5**
Perceived naturalness of Hydrology: Flora suggests flow would fail in extreme drought – morphology appears to suggest near perennial.	**5**
OVERALL TOTAL (max 20)	**19**


Tufa pebbles and bedrock – very clear evidence of strong spring flow influence


Contrasting near-natural woodland section and the open channel near the d/s limit

Recommendation: Consider protection, even designation as CWS, of the WHOLE catchment. Note the 2009 survey identified one of the very best perennial spring-fed habitats on the main channel, and this surveyed section is very interesting and a diverse contrast. Really interesting site with Tufa bed, then dense winterbourne flora. **May be winterbourne and perennial streams together?**

95-98 – Bignor Streams (Mostly in SU9714/9814). C4km, divided into 4 with section 95 & section 98 being of highest value.



96 – Headwater stream W of Glatting Farm; southern trib of stream 95 Source c100m; Gradient >1:20

Land-use: Terrestrial land-use is dominated by arable cultivation, but as clearly seen from the recent aerial image, there is a narrow woodland fringe through which the stream flows. Mature trees and scrub dominate the banks (see picture below). The source of the stream is within a pheasant pen!! and the downstream section is surrounded by improved grassland.

Stream morphology: The stream has a modified appearance throughout, but the very steep gradient within a deep gulley in the upper sections suggests straight alignment is natural here. This character is not seen in Hampshire chalk streams, so the vastly different morphology is at least near-natural, and more natural than the well known chalk rivers. This stream, and the whole complex of streams here, gives great credence to the view that many of these Sussex chalk streams should be considered a sub-type of chalk

streams (character therefore needs to be assessed separately) from other chalk rivers. The substrate is very different from many chalk streams too – an absence of flints and mobile gravels, and presence of silt, sand, clay and cemented/limescale encrusted stones (tufa-like). The stream is noteworthy for having natural clay waterfalls (see image). There is evidence of some ancient flow structures and widening of the river.

Diversity of physical structure: Tree roots, waterfalls and varied substrate provide some structural diversity, but in general the character is not very variable, and there is evidence of minute fluvial features being formed naturally.

Vegetation character: The exceptionally low JNCC check-list total indicates low diversity; there were insufficient aquatic taxa to enable a MTR survey to be undertaken. The paucity of species is more a reflection of the very dense shade (natural) than undesirable human impact. The dominance of the bryophyte *Pellia* in the channel, and ferns and trees on the bank is natural.

Hydrogeology: At time of survey the flow was minimal. Perennial flow is assumed, but this is far from certain given the single site assessment. If it is perennial, it is weaker than on the Treyford, Cocking and Duncton streams.

Naturalness of Morphology	**3**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**4**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**19**

Recommendation: The overall score is moderately high because of the retention of wooded stream character, but reduced because of the combination of some modifications. Without an understanding of what was there historically, no intervention is recommended.

95 – Starts as headwater stream west of Glatting Farm, the majority of length being d/s of Stream 96 Source 60m; Gradient c1:50

Land-use: The upper 500m had formal RHS data and macrophyte surveys; the rest was walked and notes taken regarding character. The terrestrial land-use in 95.1 (upper 500m) is dominated by arable cultivation, but there is a narrow woodland fringe along most of it, and some improved grassland. The downstream section flows primarily through woodland and improved grassland.

Stream morphology: Structurally the stream has minimum in common with typical chalk streams of Hampshire, and it has many appearances of being very natural. Apart from upstream of its confluence with stream 96 (where it flows down a farm track), the morphology is diverse and dynamic. The bed character is very different from virtually all other streams surveyed, being dominated by bedrock and boulders. There are cliffs and bars (formed by cobbles), and the morphology is NATURAL, but not like the character associated with chalk streams – more akin to a Derbyshire Dales, limestone, stream.

Diversity of physical structure: Tree roots, cliffs, bars and varied other coarse substrate features create natural and varied structural diversity, with much evidence of fluvial features being shaped and formed naturally. The bed is composed primarily of very coarse rocks, including boulders and cobbles. In places the stream is a deep 'ghyll', more akin to a steep-gradient Weald Stream than a chalk stream.

Vegetation character: As with stream 96, the exceptionally low JNCC check-list total indicates low diversity and insufficient aquatic taxa to enable a MTR survey. The paucity of species is a natural reflection of the dense shade and dynamic and mobile rocky bed. Bryophytes dominated in the channel, and ferns, trees and shade-tolerant *Carex pendula,* on the banks. Not a 'traditional' chalk stream character, but assessed as natural.

Hydrogeology: At time of survey the flow was strong, and there is a mill downstream. Perennial flow is assumed.

Recommendation: The overall score is very high because of the combination of morphological dynamism and little evidence of damaging intervention. Protection, not intervention, is recommended.

Naturalness of Morphology	**4**
Diversity of Habitat	**5**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 25)	**23**

97 – Starts as headwater stream south of Salters Farmhouse Farm; streams 97 & 95 join to form stream 98 downstream of Bignor Mill Source 60m; Gradient c1:60

Land-use: The upper 500m was subject to RHS data collection and macrophyte surveys; the rest was walked and notes taken regarding character. The terrestrial land-use in 97.1 (upper 500m) is dominated by arable cultivation, and improved grassland, but the source area shows signs of being a classic perennial chalk stream (see photo opposite and below) but shortly the stream becomes associated with gardens where the stream has been made into ornamental ponds.

Stream morphology: The stream is very different from the stream it joins, watercourse 95. In the headwaters it is a series of lakes/ponds that dam the spring flows to form landscape features within gardens. Downstream the water flows in a straightened ditch with steep, re-sectioned, banks that are most often colonized by trees and shrubs, at least on one bank, and sometimes both.

Diversity of physical structure: Variety of habitats, but lots are artificial. Close to the source the channel is a series of ornamental ponds, and downstream it is a structurally a much more impoverished ditch than either 96 or 95.

Vegetation character: In total contrast to neighbouring streams 95 and 96, the exceptionally HIGH JNCC check-list total indicates very high diversity with ample aquatic taxa to enable a MTR survey to be undertaken. The richness of species is a combination of the unnatural formation of lakes, and the lower gradient of the channel – leading to an open channel. Some aquatic vegetation has obviously been planted within the lakes. Bryophytes do not dominated in the channel, but instead species characteristic of perennial chalk streams are present (crowfoot, blunt-fruited water-starwort, stream water-crowfoot and opposite-leaved pondweed) alongside other species indicating perennial flow (e.g. curly pondweed, un-branched bur-reed)

Hydrogeology: At time of survey the flow was strong, and presence of ornamental ponds at the source suggests healthy perennial flow. No doubts that this is a stream fed by perennially-flowing springs from the chalk.

Naturalness of Morphology	**1**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**16**

Recommendation: The overall score is much lower than the more natural watercourse 95, despite clear indication of strong chalk stream flow, and a chalk stream flora!! This is because the channel is highly modified. It is recommended that contact is made with the owners of the properties where the stream has been modified into on-line pools to ensure the maximum diversity of channel can be achieved without impacting their aspirations of enjoying the aesthetics/landscape features if their impounded stretch. Protecting the rare example of a perennial head spring flow with associated classic chalk stream flora is essential – it is not known if the land at the source is in the same ownership as the property with the on-line ponds.

97.2 – Stream flowing from Salters Farmhouse Farm; upstream of confluence with watercourse 95 where joins to form stream 98 downstream of Bignor Mill

97.1

97.1

97.2

97.2

Land-use: The land-use on the left is a mixture of improved grassland and patches of woodland, but on the right, woodland dominates (more so than historically).

Stream morphology: The stream is a straightened ditch with steep, re-sectioned, banks that colonized by trees and shrubs. On passing downstream the channel is located in a shallow ravine (see opposite), so there is no/has never been a floodplain at all. Woody debris and other tree-related habitat features are noteworthy. The stream then passes into lakes and headers for the mill of minimal ecological or habitat value.

Diversity of physical structure: Limited, with no morphological features.

Vegetation character: Very limited and very ditch-like.

Hydrogeology: Upstream flow, and presence of mill, suggests perennial.

Recommendation: Do nothing. This is a ditch that has long since been unnaturally disconnected from the floodplain. Thus recommendations are different than for the upstream section of the channel.

98 – Stream flowing from Bignor Mill – the combined flows of streams 95/6 and 97

Land-use: Totally dominated by woodland on the right (at the start), and tall rank herbs and woodland on the left. Thus the land-use is very low intensity, and predominantly floodplain woodland.

Stream morphology: The stream is very different from the stream 97, and has extremely high morphological diversity akin to parts of the much more dynamic stream 95. (Note it flows at lower altitude and with a gradient of c1:100.) It has virtually no characteristics of a chalk stream, having more in common with energetic, high energy, gravel-bedded clay rivers of the Weald. As with 95, cobbles, pebbles and gravel dominate the substrate (not flints though), and woody debris abounds.

Diversity of physical structure: Great variety of habitats with riffles, pools, cliffs and bars. This is mostly clearly seen in the appended photos, as well as the archived images.

Vegetation character: In total contrast to the exceptionally high JNCC check-list total of the upstream watercourse 97.1, this reach was exceedingly impoverished. This is NATURAL due to bed instability and shade, as indicate by the virtual absence of anything that is not very tolerant of shade.

Hydrogeology: There is very good reason to suggest perennial flow, but the extent of dynamic morphological features suggests large amplitudes in flow, with surface runoff significant at times of high rainfall. Thus it is suggested the hydrology is not typical of a chalk stream or any other high base-flow index river type.

Recommendation: The overall score is very high as this is perceived to be one of the most natural sections of watercourse encountered. However it is not typical of a chalk stream and it is suggested its morphology is greatly indicated by surface run-off. Measures to control rapid run-off, carrying sediment, should be investigated, and adopted if possible

Naturalness of Morphology	**5**
Diversity of Habitat	**5**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4**
OVERALL TOTAL (max 25)	**23**

Consider protection in the catchment as a whole – it has a very unusual combination of watercourse types within a confined area.

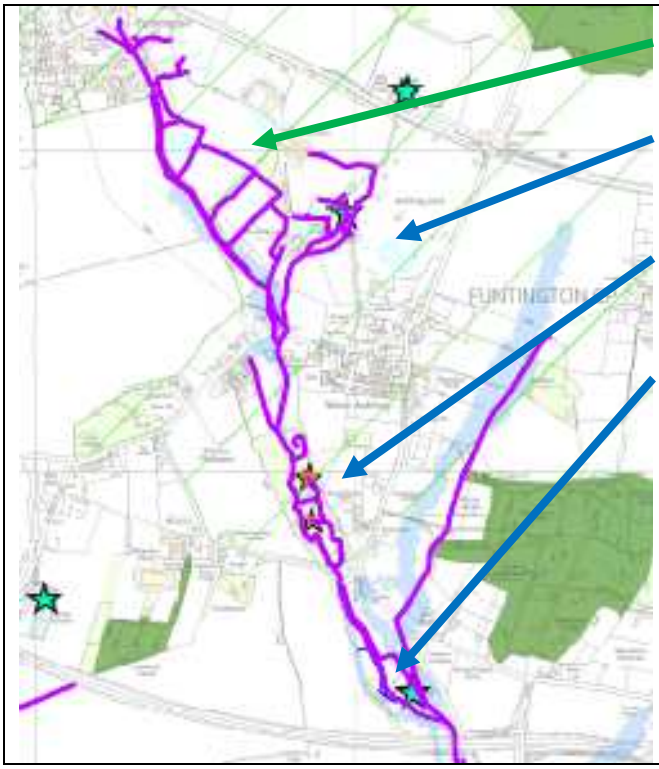
Bosham I.2.1c – Section downstream of Mill pond fed by Bosham 1a/b

Land-use: Wet woodland dominates. Therefore fabulous adjacent habitat to go with the fabulous watercourse	
Naturalness of Morphology: Historically ditched, but series of backwaters and secondary channels have many near-natural characteristics.	4
Diversity of Habitat: Great diversity, with open and shaded sections, and also some very good tree root features. Gravel-pebble dominated bed.	4
Vegetation Character: Very rich flora, AND special. The flora depicts classic perennial flow, with *Ranunculus penicillatus, Berula & Callitriche obtusangula* all present. Also the dominance of the sedge *Carex acutiformis*, and presence of *Carex paniculata,* on the banks is highly characteristic of natural chalk streams.	5*
Perceived naturalness of Hydrology: Must have classic perennial spring flow.	5*
OVERALL TOTAL (max 20)	18




Recommendation: Do nothing but recognize this is an exceptional stretch of perennial chalk stream.

Bosham 1.2.1.a-c (plus top of 1d)



1a Winterbourne complex

1b Classic example of headwater perennial chalk stream in open grazed landscape

1c Classic example of chalk stream and wet woodland (similar to SSSI in Hampshire) – one of the best examples in the UK

1d Before ponding influence of mill impacts stream, top of this channel has good chalk stream character too

IN RECOGNITION OF SPECIAL CHARACTER – I.E. THE BEST EXAMPLE OF A WATERCOURSE WITH THE PERCEIVED CHARACTER OF A HEADWATER 'CHALK STREAM' IN SUSSEX, AND ALSO BEING ADJACENT TO A WINTERBOURNE SUB-CATCHMENT, JUSTIFIES FULL PROTECTION, AND NOTHING LESS THAN CWS STATUS

Bosham 1d Mill Section u/s of dual carriageway

Land-use: Improved grassland dominates, but gardens, on-line mill pond, woodland and scrub present	
Naturalness of Morphology: Heavily modified – first ponded upstream of mill pond, and then clear drainage channel d/s	**1**
Diversity of Habitat: Mixed diversity – very good chalk stream for c200m, then ponded. At end very heavily managed, but with good pebble-dominated bed.	**3**
Vegetation Character: Flora not as rich as u/s but typical of chalk stream with perennial flow.	**3**
Perceived naturalness of Hydrology: Will be perennial, fed from upstream and possibly enhanced through springs within the reach	**4**
OVERALL TOTAL (max 20)	**11**

Recommendation: Recognise as chalk stream, albeit heavily modified. Potential for enhancement d/s if landowner amenable to convert to more natural and dynamic stream with simple manipulation of the bed and bank margins.

The near-natural extreme u/s section followed by ponding at Mill

The heavily managed sections d/s of the mill pond

38 Shirley House (TQ1413) Source 65m; gradient c1:50.

Land-use: Predominantly a mixture of broad-leaved woodland (at start), improved grassland (in middle) and poplar plantation (downstream).

Stream morphology: The stream is mostly <1m wide, and often a mere 0.5m or less. There are two headwaters with similar character, both widened ditches within woodland. There is some meandering of the channel that suggests some has not been historically straightened.

Diversity of physical structure: Morphology is not diverse throughout, but there is variation in substrates from clay with silt (upper sections), flints and sand (see photo bottom right, of bed through the poplar plantation). Some banks are vertical, forming very low 'cliffs'. No discrete bars are present, but woody debris and other habitats of interest were present. Variety of habitat is also provided by hydrology – the majority of the stream was dry at the time of survey safe for water being present in a short section in the middle (see picture adjacent).

Vegetation character: Poor diversity, with the bed being predominantly bare or colonized by terrestrial species. The exception was the short section with water (see above) where *Apium* (classic winterbourne taxon) was dominant.

Hydrogeology: Dry for the most part, but with interest provided by a short section in the middle holding water. Abundance of sand substrate suggests influence from the sandstone aquifer?

Recommendation: The overall score is high as there is some morphological diversity within the channel, and the planform is one of the least modified of all the rivers surveyed. Being a watercourse with both prolonged drying and longer periods of flow makes it of ecological interest. Being spring-fed from the chalk it is an unusual headwater chalk stream and at least warrants some consideration for protection.

Naturalness of Morphology	**4**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 25)	**22**

72 Lag Wood Downstream

Land-use: Dominated by improved grassland throughout on the right. Improved grassland and natural broadleaf woodland dominate on the left with one garden associated with an isolated property.

Stream morphology: This is a long section where the upstream part, upstream of lag wood, is very different from the rest, and for that matter very different from most watercourses surveyed. The stream is partially degraded to form an open, rush and reed edges ditch upstream of the confluence with 'Lag wood Stream' (see separate section for this stream). Grazed edges add to the diversity and rarity of this stream character.

Downstream it is then predominantly a natural-looking woodland stream (apart from a small on-line silty pond) despite the straight plan-form on the map.

Diversity of physical structure: Limited in the upper section, but exceptionally good downstream of Lag Wood stream where there are cliffs, sediment bars, many tree root/bough features and plenty of woody debris. Stream morphology (and biological diversity) improved by local trampling where livestock access the river.

Vegetation character: Impoverished for the most part in the wooded downstream section as stone-bedded, and very shaded. The open channel upstream of the Lag wood Stream confluence has terrestrial species and wetland species at the edge, with rush (*Juncus effusus & inflexus*) dominant, and lesser pond-sedge common.) The channel is often choked with *Apium*; with water-cress also present (classic winterbourne community). Downstream the shaded, pebble-bedded, areas have little flora (save for bryophytes *Pellia, Platyhypnidium & Thamnobryum*), but the open, silted, locally ponded area has many aquatic wetland species such as *Apium, Rorippa, Sparganium, Glyceria maxima* etc.

Hydrogeology: Dry upstream of the Lag Wood Stream confluence – only weak perennial summer flow downstream. There is a gauge that should be able to verify long-term character, but the morphology and vegetation suggests flow is maintained most of the time in the lower reaches, and in good re-charge periods have prolonged high flows.

Recommendation: **Lower section is considered very important, and recognition of this to ensure future protection is very strongly recommended**. Even the modified upstream section warrants protection (i.e. continued similar influences from grazing) as it is an unusually open, shallow-edged, winterbourne that has not been deep dredged and does not have a hedge running alongside it either.

Naturalness of Morphology	**2/5 (4)**
Diversity of Habitat	**2/4 (5)**
Freedom from Obstructions to Flow	**4**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 25)	**22**

Watercourse 82 Source 80m; Gradient c1:33 at start, then gentler

Watercourse 82 - Land-use: Mixed arable and improved grassland dominate on the left bank, but there is a mixture of woodland, plantation, improved grassland and garden on the right.

Stream morphology: The morphology is dramatically different in the upstream half and downstream half. At first the watercourse is a deeply dredged, dry, totally impoverished ditch. In the lower half it is a near-natural wooded stream with a small flow. This has the appearance of being very natural, but in no way typical of the conventional view of what a natural chalk stream should look like.

Diversity of physical structure: Minor variation, at best, is seen in the ditched upper section, with the bed dry and alternating between gravel/pebble and coarser bed material. In the lower section (but it deteriorates at the end), there are some bankside cliffs and marginal gravel shoals. Woody debris is also present.

Vegetation character: Extremely impoverished; dry ditch flora in the upper half and very shaded, with unstable bed, in the lower half.

Hydrogeology: A winterbourne ditch in the upper half – either winterbourne or near perennial downstream of the inflow from the 'Gote' tributary. A gauge at this point should provide key information, but the springs feeding the Gote stream seem to be perennial. Local people suspect historic abstraction may have an impact (see Gote Stream 82A report notes).

Recommendation: Very much a ditch with no special interest in upper half; protection and allowing to develop naturally is the recommendation for the stream downstream of the Gote stream inflow. The dry upper section is of minimal interest, but the lower section through the wood is of very high interest.

Naturalness of Morphology	**(u/s 1) 3 (d/s 5)**
Diversity of Habitat	**(u/s 1) 3 (d/s 4)**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**(15)19(22)**

91.3 Lavington Park stream. Source 50m; Gradient c1:55. Farthest d/s section of three on same stream

Land-use: Terrestrial land-use dominated by improved grassland and floodplain woodland on left, and grassland and newly dug gravel pits on right. **There is valued woodland, some of it wet, adjacent to the river within this stretch.**

Stream morphology: Much less modified with NO on-line lakes. The watercourse is densely shaded by bankside trees, and there is some meandering with formation of small cliffs and shoals. The bed is dominated by pebbles, but other substrates are present where the flow types change from the dominant 'rippled' to 'smooth'. Photos illustrate the nature, despite being taken in dense shade. The relative naturalness of the morphology, and the formation of cliff, bar and 'riffle' habitats challenges the normal perception of a 'natural' headwater/small chalk stream. The gradient is important, as is the retention of bankside trees and not being made ruler straight. High conservation value, especially if left to continue to recover from historic modifications.

Diversity of physical structure: Very good, and all the more valued due to its relative naturalness.

Vegetation character: No formal JNCC survey as undertaken upstream of the same watercourse. No major change other than loss of most of the *Berula* as so shaded, and the dominance of bryophytes. Lack of the artificial ponds meant *Hippurus* was absent.

Hydrogeology: At time of survey the flow was very healthy and a perennial flow is assumed, despite the lack of crowfoot (naturally the stream would have been too shaded?).

Naturalness of Morphology	**4**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 25)	**22**

70.2 Lower Pyecombe

Land-use: Dominated by arable on the left and improved grassland, tall rank herbs, woodland and road to the right. There is a property on the left. **On the right, near the start, are strong perennial springs giving rise to flushes and then a linear pond; recent refurbishment of the weir downstream has been completed.**

Stream morphology: For the majority of its length the watercourse itself is moderate to poor, as it flows through a straight, perched, channel above the floodplain. Below it, perennial springs discharge into a linear pond (head held by downstream weir) before this flow is discharged to the elevated channel. Downstream of the confluence the watercourse flows in a wooded area where it has a semi-natural and meandering character.

Diversity of physical structure: Morphology of the channel itself is limited until downstream of the confluence with the pond discharge.

Vegetation character: Impoverished in the channel, but the spring flushes and pond is rich in true macrophytes, dominated by *Berula* and including *Elodea*.

Hydrogeology: Channel is expected to predominantly have a perennial flow from close to the start, and definitely downstream of the discharge from the pond. The pond and the springs that feed it are, based on the flora, definitely perennial. There is a gauge to check flow character. It is interesting to note that the strongest springs in this sector are furthest to the north – close to a knoll (Wolstonbury Hill) jutting out from the Downs.

Naturalness of Morphology	**2/5 (4)**
Diversity of Habitat	**2/5 (4)**
Freedom from Obstructions to Flow	**3/5 (4)**
Vegetation Character	**5**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**(21) 16 u/s:24d/s**

Recommendation: This length of watercourse that is perched above the 'perennial spring habitat' area is modified and changing it would be difficult, may cause impact elsewhere, and difficult to justify. The stream downstream of the 'perennial spring habitat' area has very natural character, and is more dynamic than 'typical' chalk streams (again due to gradient). The spring flushes and perennial pond is a highly valued habitat and all mechanisms to encourage protection in the future should be adopted as a matter of urgency. Options to extend the natural stream character should be explored with the landowner.

Stream perched above wetland (left) and in woodland downstream (right)

The perennial chalk springs and the linear pond created downstream and where springs break in bed

36/7 Lower Chancton Farm (TQ1312; 1313 & 1413). Source 65m; Gradient c1:50 of streams flowing north to Ashington - Buncton

Land-use: Totally dominated by woodland at the start; downstream land-use dominated by improved grassland, then arable cultivation.

Stream morphology: The stream starts in woodland (see adjacent image), parts of which are wide and with shallow banks. On passing downstream the channel becomes more ditch-like, with a hedge on one side (see photo adjacent). Further downstream the morphology appears to be near-natural in places (see bottom right photo), although the plan-form indicates historical straightening.

It has virtually no characteristics of what is commonly perceived to be features associated with chalk streams, having more in common with energetic, high energy, gravel-bedded clay rivers of the Weald. Physically it is similar to parts of watercourse 95-98 immediately to the west, but with no flow at time of survey. The channel through the wood (37) was very natural and energetic, with minor bars and cliffs. The character challenges the common perception of English headwater chalks streams in their wooded, winterbourne, sections.

Diversity of physical structure: Great variety of morphology; cliffs and bars were evident and riffles and pools might be expected when there is flow. Pebbles (often flints) and gravel are common on the bed, with silt, and woody debris is also present. **The stream d/s of the road is an energetic, very natural, woodland stream (with issues marked on the map) for c500m.**

Vegetation character: In common with streams immediately to the west, this reach was exceedingly impoverished. This is again NATURAL due to bed instability, very dense shade, and lack of flow each year.

Hydrogeology: There is very good reason to suggest natural winterbourne. It is impossible to know from a single site visit if the natural hydrology has been greatly modified, but the gradient and periodic high discharge gives more stream power than is normally associated with low gradient chalk rivers.

Naturalness of Morphology	**2(3)4**
Diversity of Habitat	**2(3)4**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 25)	**17(19)21**

Recommendation: The overall score is high as this is perceived to be a watercourse recovering from historic ditching. However it is not typical of a chalk stream and it is suggested its morphology is greatly influenced by surface run-off as well as winterbourne flow. Leave to continue recovery – possibly investigate the 'Weald-like' section downstream – not typical chalk stream, but a good natural stream.

Watercourse 84 Plumpton (OS TQ3613/14; 1:50,000 Map 198) - East bank tributary, confluence with watercourses 81-83. Long, interesting system divided into two survey lengths; Source 60m; Gradient d/s mill c1:50

Section 84.1 Land-use: Starts as a series of very large lakes (converted mill ponds) in huge gardens and property. Images in the folder are Xa-d. Passing downstream the dominant land-use is improved grassland, with a riparian fringe of woodland dominated by alder, with ash, sycamore and hazel.

Stream morphology: The morphology is impacted in different ways, but NOT throughout. Close to the source the stream has been converted to a lacustrine habitat (top left image) upstream of a huge mill weir (image 84a in reference file). Downstream the watercourse has been ditched (top right image), but on passing further downstream, trees on the bank have assisted in natural recovery with fine 'wild' river habitats reflecting steep gradient and high energy (bottom images).

Diversity of physical structure: Diverse because of physical manipulation, and some recovery in the lower sections. Substrate is varied and there are some distinct bars and cliffs, as well as an abundance of underwater tree roots.




Vegetation character: The JNCC survey list is for the stream only, downstream of the lakes. In the lakes the flora is totally lacustrine, with species such as *Potamogeton crispus, P pusillus/berchtoldii, Myriophyllum, Sparganium, Typha, Fontinalis, Chara* etc. with *Glyceria maxima* common at the margins (with *Gunnera*). Shaded winterbourne flora predominates in the channel downstream (legacy of the lakes upstream result in filamentous algae being common). Bryophytes are common on the structures and trees. Much of the bed is naturally bare due to shade. Aliens on bank too at Drews Farm.

Hydrogeology: Impossible to tell what is natural, given the huge physical modifications at the source to create such large on-line lakes. Probably perennial springs, with mill close to source (as is common).

Recommendation: Parts of the lower section challenges the conventional view of a natural chalk stream, being wooded and with more energy than is the norm, creating geomorphological features and many tree root features. Protection of the lower section, thus allowing for further development of natural features, is recommended.

Naturalness of Morphology	**2(4)**
Diversity of Habitat	**5**
Freedom from Obstructions to Flow	**1(5)**
Vegetation Character	**3(4)**
Perceived naturalness of Hydrology	**3?**
OVERALL TOTAL (max 25)	**14(21)**

Stream 89 – Treyford (OS squares SU 8118/8218 – 1:50,000) Source: 95m; Gradient c1:30

Land-use: Dominated by improved grassland in valley, and gardens. Source is in woodland, and then stream passes through gardens with grassland on either side. In lower half the stream flows through a narrow woodland strip on right.

Stream morphology: More than 60% (in the upper section) is straight ditch or impounded to form amenity garden ponds. In this section there is a culvert, 3 low weirs and 1 high weir. Very poor habitat and minimal rehabilitation potential except at source. In lower 35% the stream is much more natural, with a cliff and bar recorded and diversity of flow features. This short section is a priority protection area. Bed is dominated by pebbles, mostly concreted and not very mobile, with flow types typically being rippled or smooth, with no perceptible flow in the ponded sections. Banks show little evidence of recent sectioning, but must have been in the distant past – but perhaps not in the downstream 35%. There is dense shade and a good range of tree habitats associated with the trees that occur almost continuously down both banks. The stream has a very high altitudinal source and very steep gradient; it starts very close to the base of a very steep escarpment.

Diversity of physical structure: Very good in the downstream 35%, but very limited or 'artificial' in the upper 65%.

Vegetation character: Above average diversity of JNCC taxa, and sufficient species to enable a MTR site to be established. No classic taxa of perennial chalk streams present, but winterbourne taxa very well represented. Bryophytes common, as in many sites, with the tree roots an important habitat. Flora a mixture of ditch and winterbourne character, with presence of *Vaucheria* (and MTR of 46) suggesting modest enrichment.

Hydrogeology: At time of survey minimal flow, with possible leakage to bed resulting in possible reduced discharge in low flow periods on passing downstream? Presence of ornamental on-line lakes suggests more or less perennial, but flora suggests not a perennial chalks stream but a very strong winterbourne. There is a gauge upstream of the village that should enable flow characteristics to be confirmed. It is suggested (despite flora to the contrary) that this has probably a natural, but very weak, perennial spring flow in all but (and possibly in) drought years; impacts from abstraction over the escarpment in the Lavant Valley cannot be discounted. When visited in January 2010 it had a strong spring flow. Impacts on hydrology also include impounding lakes.

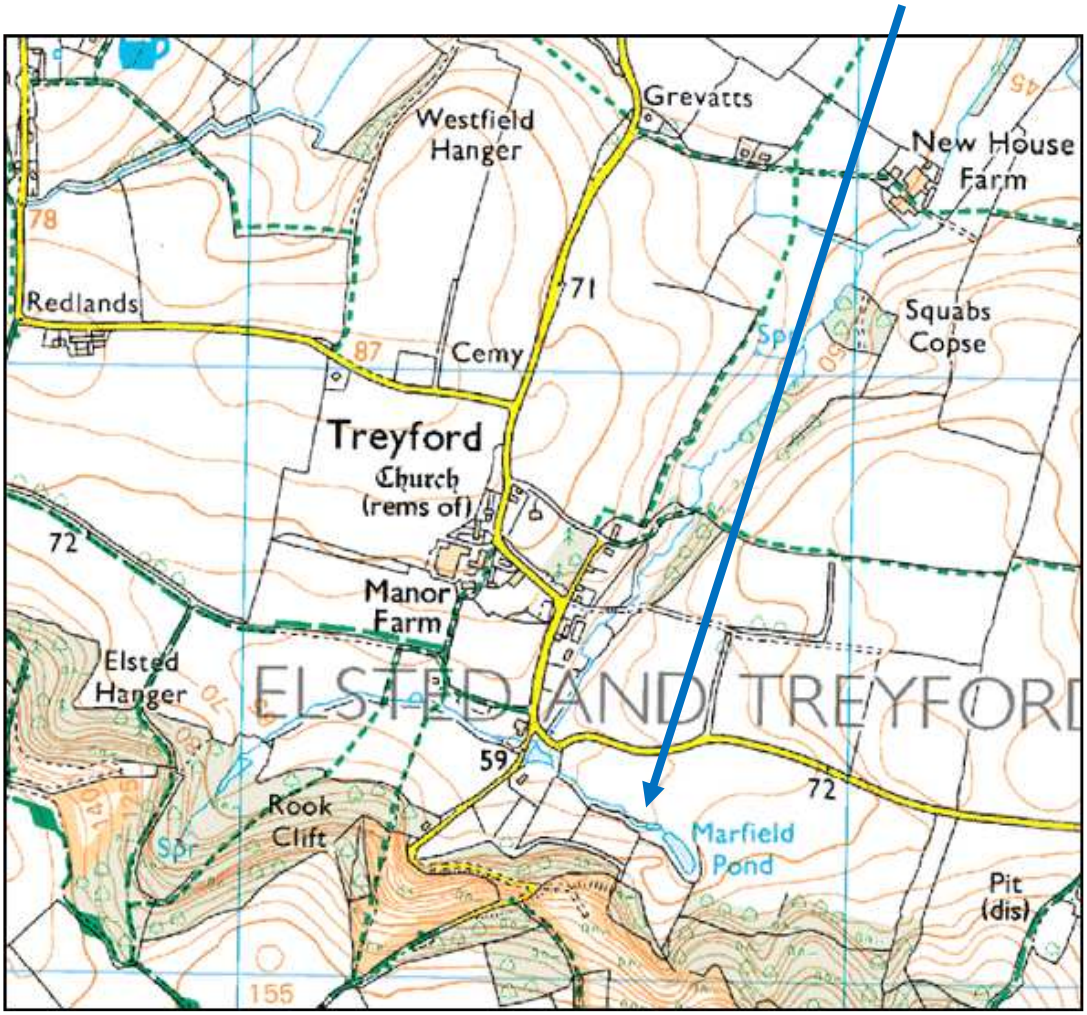
Naturalness of Morphology	**2 (5 in lower 35%)**
Diversity of Habitat	**2 (5 in lower 35%)**
Freedom from Obstructions to Flow	**1 (5 in lowest 35%)**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**3?**
OVERALL TOTAL (max 25)	**12 (20 in lowest 35%)**

On-line lake character upstream (left) and more natural character in lower 35% (right)

Recommendation: Little can be done regarding the habitat through private gardens in the upper >60%. The lower section should be considered high priority to acknowledge as worthy of some form of protection; this might be a priority if the scale of the semi-natural stream is shown to be greater by survey downstream in the future. It is a very good example of a very steep gradient, chalk stream.

It is also recommended that a tributary, not on the survey list and not investigated, be looked at in the future to determine if it too has chalk stream characteristics; like the main channel, it has an on-line lake.

The downstream wooded section in January 2010, showing good habitat structure and strong flow



Survey may also be continued downstream (to New House farm) of the original (and mapped) recommended boundary of survey if protection of the lower section is considered. The map shows a reasonably natural alignment, woodland and some spring discharges.

Watercourse 8 – Fishbourne – Downstream Watercourses 19 & 6 (SU8304) Map 197

Land-use: Dominated by private gardens and tall rank vegetation on right, and open grassland, wet woodland and scrub on left. At downstream limit the watercourse enters reedbed and wet woodland associated with tidal Chichester harbour.

Stream morphology: Modified by some historic realignments, and also a structure impounding flow upstream. The character is overwhelmingly like a diverse small chalk stream, impacted by the impounding structure (very low gradient with ponded flow upstream for more c100m). There is a small and straight channel flowing into the watercourse from the north that has a rocky bed but no morphological diversity. At the downstream limit there is a rubble weir, downstream of which the flow is tidal and brackish (*Ulva* present).

Diversity of physical structure: Short sections have diverse chalk stream morphology with semblances of sediment bars on the inside of meanders and also narrower 'riffle' habitats are present. Ponding occurs not only upstream of the structure, but upstream of the rubble weir too.

Vegetation character: Flora was richer than the norm, with sufficient taxa to do a MTR survey. Despite the morphology of a perennial chalk stream, the flora lacked crowfoot and lesser water-parsnip. The presence of whorl-grass (*Catabrosa*) was noteworthy, as this has not been recorded anywhere else; it a species typical of perennial chalk streams with silty/trampled margins. There is therefore a suggestion that flow may fail in severe droughts. The *Catabrosa* was present downstream of the inflow from the mill pond, and this appears to have perennial spring flow.

Hydrogeology: Discharge increases (good accretion) on passing downstream, indicating *in situ* springs. This is considered a genuine chalk stream, the only one in area A.

Recommendation: Investigate options for enhancing degraded sections and securing long-term protection - 5* priority due to limited resource of this stream type in the area. Link to possible removal of impounding structure

Naturalness of Morphology	**4**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4**
OVERALL TOTAL (max 25)	**19**

Ponding occurs upstream of the structure, as in other places, but the predominant character of reach 8 is typical of a chalk stream, with a gravel bed

74/3 Keymer (TQ OS3114 Map 198) Source 65m
74 Upstream section Upstream B112 Gradient c1:66

Land-use: Dominated by improved grassland on the left, and mixed arable and improved grassland on the right. There is a riparian woodland strip of variable width along much of the upper 60% of the course, and is especially wide on the right bank. This has remained unchanged for a long time, as shown by the two maps. There was also a small patch of reedy/sedge swamp on the left bank.

Stream morphology: The stream starts as springs downstream of a lake where it is predominantly gravel-pebble bedded within woodland. There have been obvious modifications to the channel from its natural state (see image below), with widening an obvious change; now such areas have formed wet woodland (carr) habitat merging imperceptibly with the course of the stream itself (image, left). The middle section where there is extensive woodland on the right bank the watercourse is modified into a straight ditch. Once out of the woodland into the area of improved grassland, the stream becomes a trapezoidal ditch.

Diversity of physical structure: Morphology is varied, as there are very great changes in substrate and bank slopes. Natural morphology, with bankside trees and associated tree root/boughs and woody debris, is only present in the woodland section of the upper 60% of the course, and only within 50% of this section.

Vegetation character: Naturally impoverished within the very densely shaded woodland section. In the open ditch sections higher plants such as *Apium, Schoenoplectus* (very rarely seen in the other streams) *& Sparganium* were present, and *Berula* was also locally common. This flora reflects a perennial, or rarely failing, flow. The edges of the 'ditch' section also have a good mix of wetland species, giving this watercourse one of the more interesting floras recorded.

Hydrogeology: Within the woodland at the source there was water, but discharge gave the impression of diminishing on passing downstream. It is suspected that flow is reliable in wet years, but would fail for short periods, or flow under the gravels, for some time in drought years.

Naturalness of Morphology	**3**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**5**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**19**

Recommendation: The overall score is good. This watercourse has had previous modifications but exhibits a wide diversity of morphological features, and a flora reflecting more or less reliable flow. It is a very unusual watercourse, with a much modified upstream section that has now evolved into wet woodland, local areas of adjacent wetland, and what appears to be almost perennial flowing ditch sections interspersed with winterbourne ditch sections. Protection is a priority, of the best, but some enhancement is worth considering also.

96 – Headwater stream W of Glatting Farm; S tributary of stream 95 Source c100m; Gradient >1:20

Land-use: Terrestrial land-use is dominated by arable cultivation, but as clearly seen from the recent aerial image, there is a narrow woodland fringe through which the stream flows. Mature trees and scrub dominate the banks (see picture below). The source of the stream is within a pheasant pen!! and the downstream section is surrounded by improved grassland.

Stream morphology: The stream has a modified appearance throughout, but the very steep gradient within a deep gulley in the upper sections suggests straight alignment is natural here. This character is not seen in Hampshire chalk streams, so the vastly different morphology is at least near-natural, and more natural than the well known chalk rivers. This stream, and the whole complex of streams here, gives great credence to the view that many of these Sussex chalk streams should be considered a sub-type of chalk streams (character therefore needs to be assessed separately) from other chalk rivers. The substrate is very different from many chalk streams too – an absence of flints and mobile gravels, and presence of silt, sand, clay and cemented/limescale encrusted stones (tufa-like). The stream is noteworthy for having natural clay waterfalls (see image). There is evidence of some ancient flow structures and widening of the river.

Diversity of physical structure: Tree roots, waterfalls and varied substrate provide some structural diversity, but the character is not very variable, and there is evidence of minute fluvial features being formed naturally.

Vegetation character: The exceptionally low JNCC check-list total indicates low diversity; there were insufficient aquatic taxa to enable a MTR survey to be undertaken. The paucity of species is more a reflection of the very dense shade (natural) than undesirable human impact. The dominance of the bryophyte *Pellia* in the channel, and ferns and trees on the bank is natural.

Hydrogeology: At time of survey the flow was minimal. Perennial flow is assumed, but this is far from certain. If it is perennial, it is weaker than on the Treyford, Cocking and Duncton streams.

Naturalness of Morphology	**3**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**4**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**19**

Recommendation: The overall score is moderately high because of the retention of wooded stream character, but reduced because of the combination of some modifications. Without an understanding of what was there historically, no intervention is recommended.

Harting II.2.2C

Naturalness of Morphology Short U-shaped source below steep scarp face from which springs discharge	**3**
Diversity of Habitat Interesting bed with extensive silt and sand (from springs) with gravel/pebble and even cobbles. **RARE HABITAT – SEE PHOTOS**.	**4**
Vegetation Character Classic winterbourne flora yet morphology suggests **perennial**, or virtually so.	**4**
Perceived naturalness of Hydrology Historically a classic chalk stream, but was/is modified by abstraction, and is very short section of perennial stream before impounding. Perhaps historic abstraction caused periodic drying, and reason why *Berula* (present in catchment) not now present?	**5**
OVERALL TOTAL (max 20)	**16**




Recommendation: Consider as minimum gaining protection through cooperation of owner(s) and or make CWS!! Rare short section of chalk stream.

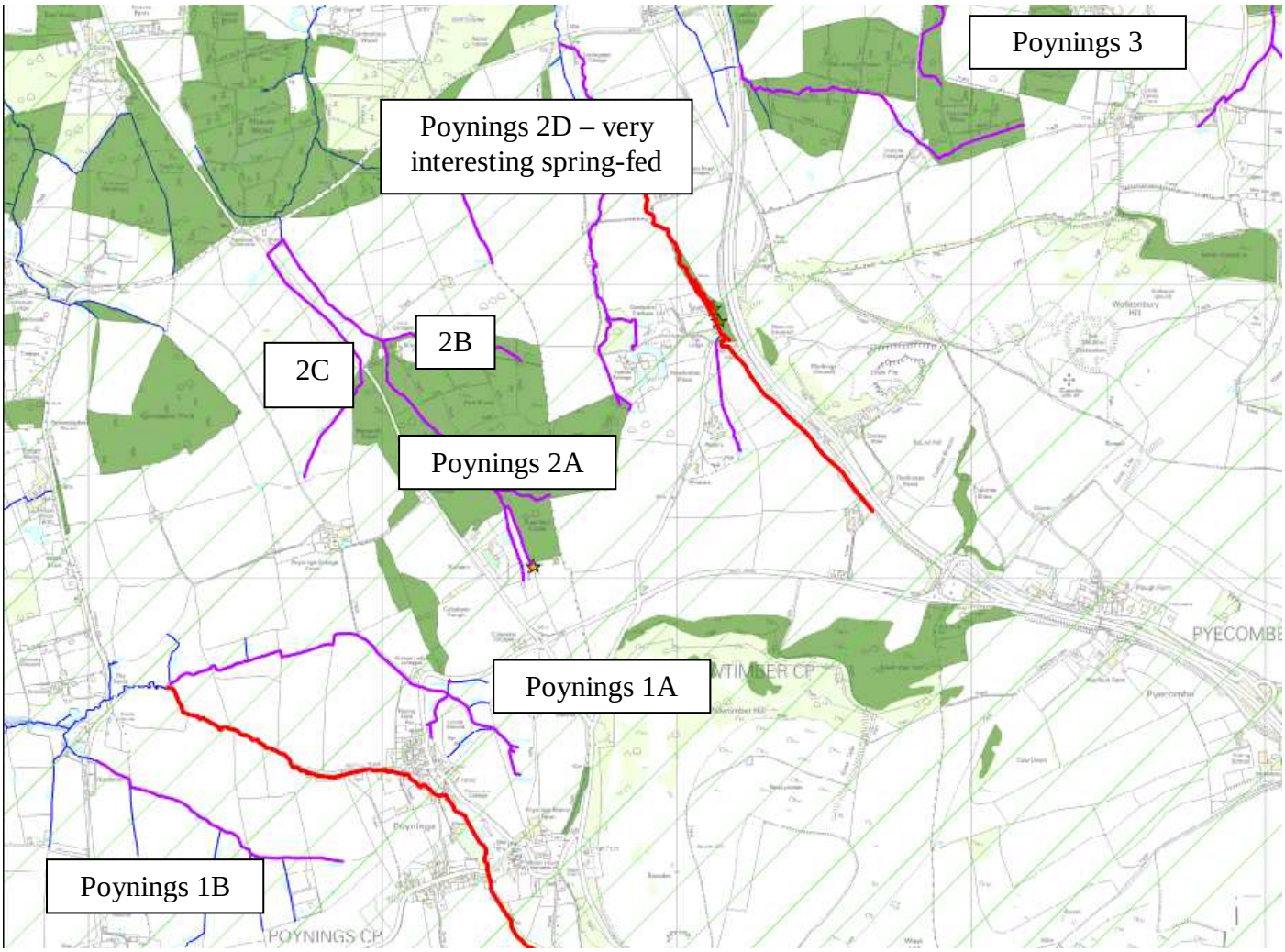
Harting 2 as a whole interesting habitats and clearly a chalk stream, albeit much modified. Some very good habitats locally, and classic flora reflecting chalk stream character.

Tangmere III.1.2c

Land-use: Unlike others, land-use dominated by improved grassland.	
Naturalness of Morphology: Although historically straightened, banks are rarely steep or high, and many are open to be trampled and grazed by livestock	**3**
Diversity of Habitat: Good variation as also some fine silt substrates in slacker sections and gravel in others. Trees add to the diversity in their own right, and diversify flow and substrate locally.	**3**
Vegetation Character: Absolute classic strong winterbourne flora with *Apium & Rorippa* dominant. Rich community also, with bryophytes on flints and on trampled edges.	**5**
Perceived naturalness of Hydrology: Classic strong winterbourne; suspect would fail in major droughts, hence no perennial chalk stream taxa.	**5**
OVERALL TOTAL (max 20)	**16**

Recommendation for 2a-c: encourage protection and continuance of same land-use in 2c.

IV.3 Poynings and Newtimbers TQ26497 13597 Map 198 Four sub-catchments surveyed 27/10/10 This is in a location of surveys done on Poynings Stream and Newtimber Stream in 2009, both of which have historic or extant strong spring flows



Poynings IV.3.1A – north-east tributary of the Poynings Stream

Land-use: Parkland and rough pasture predominates	
Naturalness of Morphology: Ditches and drains but with fantastic springs all over the place and small flushes converted to shallow ditches	**3**
Diversity of Habitat: Flint-bedded ditches dominated where springs erupt, and where deeper and more sluggish silt adds variety	**3**
Vegetation Character: The archetypal strong winterbourne flora, just lacking *Ranunculus peltatus* (recorded only once in all surveys in 2009/10 in over 200 sites!!)	**5**
Perceived naturalness of Hydrology: Very strong spring-fed watercourse. The appearance is of perennial flow, but this is unlikely, and the springs would expect to dry during extreme droughts, but continue in 'normal' re-charge years. Classic strong winterbourne, hopefully far enough removed from the Poynings abstraction not to be impacted.....or were they perennial springs 200 years ago???	**5**
OVERALL TOTAL (max 20)	**16**

Recommendation: Protect and encourage present land-use of animal access to the channel to continue.


Poor photos of fabulous source area – pouring with rain during survey

Fishbourne 8.1. Mill Pond East (MPE)

Stream morphology: This is a totally freshwater channel, with a bed dominated by firm pebbles. There is a strong flow, but with no great velocity.

Diversity of physical structure: Not very diverse; uniformly strong flowing with a pebble-dominated bed.

Vegetation character: The flora is dominated by *Callitriche obtusangula,* with *Apium* common with some *Rorippa & Veronica anagallis-aquatica* agg. The macrophyte community has *Callitriche* that is typical of a perennial spring flow yet the absence of *Berula & Ranunculus* casts doubt on an historic chalk fed flow. Both *Lemna minor & minuta* are present.

Hydrogeology: This appears exceedingly interesting from an historical perspective. At present water flows west to east FROM the pond. This channel from the mill pond extends up to a bed in watercourse 8 where there is a structure. At present the structure holds water at a high level and is not directly linked to the structure in watercourse 8 alongside it. It is suggested that historically this MPE channel could feed water INTO the mill pond from watercourse 8, with the flow then from east to west!! This may account for it not having a perennial chalk stream flora.

Photos above of the **mill pond stream east** – the typical clear channel with starwort on the left, and the over-flow to watercourse 8.

The photo on the left is the structure on **watercourse 8** marking the point at which flow could historically have been ponded upstream and diverted INTO the mill pond via the stream leat that now flows FROM the pond. It appears to be in its historic location, but nothing of the ancient structure appears to remain.

Recommendation: Investigate the potential to remove the concrete structure on watercourse 8, and undertake habitat enhancement on the mill stream itself without detriment to the visual amenity that the channel now has for local people walking along the footpath, and the property owners to the north.

Bosham I.2.1b – Most eastern channel north of Funtington

Land-use: Improved grassland (horse grazing) dominates, but a fishery lake is also a dominant feature.	
Naturalness of Morphology: All ditched, but with very shallow banks (classic character of small chalk streams in Hampshire) in the lower reaches but steep banked, and deeply incised, near the fishery lake.	**3**
Diversity of Habitat: Not great diversity, as channel is mainly ditches, but the open access periodically allowed in the lower reaches means the banks are shallow and merge with the grassland. Gravel/pebble totally dominates the bed before the channel, as does Bosham 1a, discharging into a large mill pond with black swans!!	**2**
Vegetation Character: Rich flora, but also special. The flora depicts classic perennial flow, with *Berula, Ranunculus penicillatus & Groenlandia present. The last is an exceptional rarity in watercourses surveyed.*	**5**
Perceived naturalness of Hydrology: Appears to have classic perennial spring flow to complement the winterbourne character of its near neighbour.	**5**
OVERALL TOTAL (max 20)	**15**

Recommendation: Do nothing except recognize this is a perennial section of chalk river that is very similar to small chalk streams in Hampshire; this is almost certainly the only one like it in Sussex!! See later for catchment recommendation.

***Hildenbrandia* a rare occurrence in any of the watercourses, and water-cress dominated sections**

***Ranunculus* dominance and very shallow edges merging with the meadow (both very rare occurrences)**

Harting II.2.6B

	
Impoundment holding water in pond at source	**d/s impoundment some very diverse morphology**

Land-use: Extensive arable and improved grassland.

Stream morphology: Very modified at source with pond, with impounding 2m+ weir. Also modified d/s at bridge. Between, a very surprisingly natural-looking (although historically has been straightened) 'stream'.

Diversity of physical structure: Morphological interest is high within the **wooded riparian zone** where the low gradient stream has abundant tree features, including woody debris, wet peaty margins and areas of gravel/pebble riffles.

Vegetation character: Richer due to on-line pond, but overwhelmingly characteristic of winterbourne flow.

Hydrogeology: Either very strong winterbourne, or weak perennial flow, despite the flora suggesting the former.

Recommendation: Do nothing – this is not exceptional, but encouragement to retain the value of the 'shaded jungle' through which the stream flows is suggested.

Eastergate III.2.1e

Land-use: Very dominated by improved grassland, but several other land use types evident also, including rough pasture, wood and scrub.	
Naturalness of Morphology: Converted to drain, but recovery through trampling has restored some nearer-natural characteristics	**3**
Diversity of Habitat: Very variable – steep shrubby banks, flat shallow trample ones and substrates ranging from flint gravels to fine silts	**3**
Vegetation Character: Classic very strong winterbourne/near perennial flora – lacking *Berula & Ranunculus* strongly suggests would dry in prolonged drought. Very rich assemblage.	**4**
Perceived naturalness of Hydrology: Unlike some neighbouring watercourses, this one appears to be totally driven by chalk groundwater.	**5**
OVERALL TOTAL (max 20)	**15**
Recommendation: This is a very special little section of stream with all the classic characteristics of a typical Hampshire headwater chalk stream!! Encourage continued land-use that has been important in maintaining/allowing recovery, of present-day morphology. Some morphological enhancement of the channel d/s and u/s of the existing best parts could be considered.	

Starts as 'boring' dry ditch

Suddenly becomes classic chalk stream

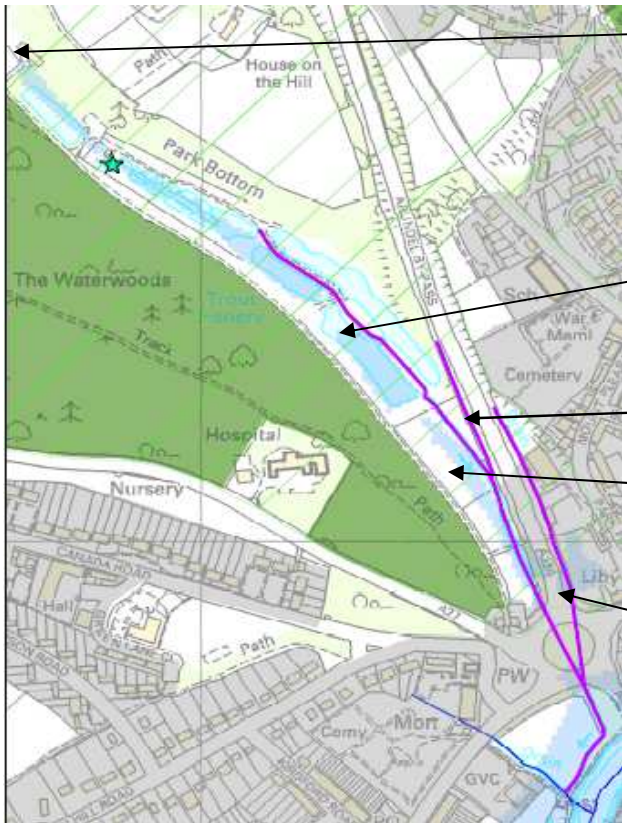
With classic strong winterbourne/near perennial flora

Over 400m of good quality habitat – then progressively more sluggish and less like chalk stream

Arundel Steam III.4.2 – West of Arundel and dominated by fish farm

Land-use: Mixed, with **woodland**, improved grassland and artificial open water dominant, but with urban infrastructure, and scrub also 'extensive'	
Naturalness of Morphology: Totally unnatural throughout. Most artificial in area of fish farm, but with recovering morphology through grazed area d/s.	**2**
Diversity of Habitat: Very varied despite historic straightening and being diverted in a very steep-banked channel through fish farm. In meadow area shallow trampled margins are highly valued wetland habitat	**4**
Vegetation Character: The richest communities recorded for any site in 2010, with all three taxa epitomising perennial chalk streams present – *Ranunculus penicillatus, Berula & Callitriche obtusangula.* **Note also *Impatiens glandulifera* present**	**5**
Perceived naturalness of Hydrology: Strong perennial springs, some discharging to the bed of the stream on passing d/s. Heavily modified regime, but perhaps water 'borrowed' through fish ponds, not lost (as in PWS abstraction).	**4**
OVERALL TOTAL (max 20)	**15**

Recommendation: A very special bit a watercourse that requires all those with a mutual interest in it staying that way working together. The commercial fishery has a key influence, and its presence may have stopped PWS abstraction. There is potential for easy habitat enhancement of the watercourse through the fish farm without detriment. Partnership efforts (between the Trust and Fishery) to improve and protect the stream is recommended, and an immediate need is to attempt to rid the system of the Himalayan Balsam.



Source as pond

Series of fishing lakes and rearing ponds with stream between, with some flow to the lakes

Side drain with spring flows

Stream in improved grassland (horse paddock)

Steep sided, shaded, drain with spring flow

	
One of numerous fishing lakes or rearing stews	The 'natural' bed and flora of the stream through the farm
	
Open grazing = trampling on both banks d/s	Further d/s trampling on side and hedge on the other

Ditchling IV.4.2A

Land-use: Tributary ditch with more extensive **woodland** and improved grassland.	
Naturalness of Morphology: More shallow banks and some slight semblance of recovery to more natural conditions, especially through the woodland.	**3**
Diversity of Habitat: Variety of habitats very good where it is a tiny stream meandering through woodland	**4**
Vegetation Character: Very bare in the wood (naturally so) and winterbourne/ditch flora elsewhere	**4**
Perceived naturalness of Hydrology: Classic winterbourne bed dominated by flints and gravel. This watercourse is more 'connected' to spring chalk water than any of the others	**4**
OVERALL TOTAL (max 20)	**15**

Recommendation: Do nothing. This is not special, just a reasonable watercourse with clear evidence of good spring flows and morphology not totally destroyed by ditching.

Newhaven VI.3.2: Land-use: Primarily improved grassland, with the scarp woodland to the west.

Naturalness of Morphology: Shallow wide 'scrape' in the upper 2/3, becoming a more defined deeper and narrower ditch downstream. **Upper section classic form of winterbournes elsewhere, but extremely rare in Sussex.**	**3**
Diversity of Habitat: Habitat variation limited due to being shallow, grassy-bedded winterbourne	**2**
Vegetation Character: Probably has the most classic winterbourne floras of all watercourses surveyed – *Apium, Rorippa,* and for the first time in all surveys, *Ranunculus peltatus.* This occurs in the Lavant, but has not been found elsewhere.	**5**
Perceived naturalness of Hydrology: Has without a shadow of a doubt a classic weak winterbourne flow with flow expected for many months in winter in spring and drying EVERY summer and autumn without fail. May go for >12 months dry in a major drought.	**5**
OVERALL TOTAL (max 20) **NOTE ONE NEGATIVE – POND WITH *CRASSULA***	**15**

Recommendation: **This deserves recognition as a classic winterbourne in Sussex (along with upper Ems and Lavant).** It has both the classic morphology and the flora of a weak, yet reliable, winterbourne. Also recommend at least attempting to eradicate *Crassula* from pond – see annotated field sheet.

Firle VI.4.1b

This section of river was a big, and unexpected, shock. **In the woodland the habitat was relatively diverse and most significantly, there was clear evidence of some morphological character being shaped by chalk-spring flows in the form of tufa dams and tufa pebbles.**

Recommendation: Encourage protection. This section is NOT unique in Sussex, but probably is so locally.

Land-use: totally dominated by deciduous woodland and improved grassland	
Naturalness of Morphology: Clearly historic straightening and ditching, but recovery to near-natural character in parts of woodland	**3**
Diversity of Habitat: Very varied due to recovery in woodland and formation of tufa features – pools, riffles, bars, cliffs and tree features.	**4**
Vegetation Character: Naturally not diverse, and often very limited due to shade. Presence of reeds suggests remnant of post millennia wetland before drainage.	**3**
Perceived naturalness of Hydrology: Strong winterbourne with clear evidence that morphology influenced by water source in terms of tufa features. Suspect flow would fail in long drought period.	**5**
OVERALL TOTAL (max 20)	**15**

Source in flat open grassland

Tufa damp and d/s pool

Trees at bed-level help habitat diversity development

Pool and riffle d/s tufa bed

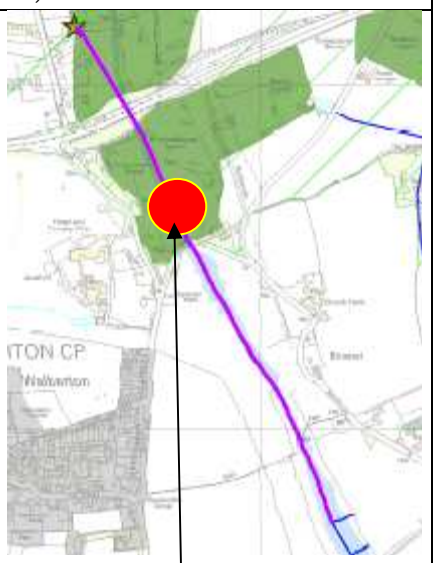
Heyshott II.4.2B – no formal survey as not chalk stream – drain

Naturalness of Morphology: Drain but with some variation in structure. Historical recovery from ditching (as is typical, **better where in woodland** not open intensive farm land).	**2**	
Diversity of Habitat: Much greater diversity than in 2A as some sections with good variation in substrate and some woody debris.	**3**	
Vegetation Character: Very poor flora – mostly bare but this is what it should be in woodland with dense shade.	**3**	
Perceived naturalness of Hydrology: Appears to be typical winterbourne – clean stone bed suggests strong winter/spring flows dropping to nothing in most years by autumn.	**3**	
OVERALL TOTAL (max 20)	**12**	

Recommendation: Do nothing – not as woefully bereft of diversity as 2A, this section has some variety of morphology but is not special. This section of river has some characteristics of a chalk ditch, unlike the other watercourse of Heyshott that have nothing in common with chalk-fed watercourses.

Eastergate III.2.1c

Land-use: Mixed, with parkland grass and **deciduous woodland** (mainly laurel!!) dominant.	
Naturalness of Morphology: Mixed – part very ditched, but within woodland a short section of near-natural stream with shallow banks merging with flushes	**3**
Diversity of Habitat: Not diverse for most part, but good habitat associated with near-natural section and some shrub features through gold course.	**3**
Vegetation Character: Reasonably rich, with a classic winterbourne flora.	**3**
Perceived naturalness of Hydrology: Appears to have chalk-fed springs that flow most of the time, but these are weak late in summer/autumn, and may well fail in droughts. Surface water flow probably greater influence on morphology and ecology except in short near-natural section	**3**
OVERALL TOTAL (max 20) **Recommendation:** Do nothing for the majority, but check out the ownership and any potential vulnerability of the short near-natural section.	**12**



Near-natural section where wet woodland and flushes merge with the stream

10.2 – Downstream Track from Blackboy Lane

Land-use: A mix of rough pasture, suburban/urban areas and parklands and gardens predominate.

Stream morphology: Obviously re-aligned but as flows through urban areas and rough pasture with grazing, the morphology is more varied than upstream. A mix of silt and gravel/pebble forms the bed, with gravel/pebble predominating.

Diversity of physical structure: More varied bank profiles than upstream, with a variety of constrained sections with walled banks but also some open areas with grazed, trampled and shallow banks.

Vegetation character: Nowhere near as impoverished as upstream. The flora indicates very strongly a winterbourne flow that would be reliable for most of each year – the presence of starwort and bur-reed alongside *Apium, Rorippa nasturtium-aquaticum, Glyceria fluitans, Veronica beccabunga & V. Anagallis-aquatica* agg., as well as the rarity of terrestrial herbs and grasses is indicative, and may even suggest perennial flow might occur here.

Hydrogeology: All indications are that springs flow would occur throughout most of each year, and may even persist weakly except in severe droughts.

Recommendation: A winterbourne/almost perennial section with typical flora and not totally degraded physically. No special recommendations. The sections with hard bank protection are very short, making work to 'naturalise' not justified; retaining grazed open edges in contrast to fenced area is very desirable.

Naturalness of Morphology	**2**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4**
OVERALL TOTAL (max 25)	**18**

68/9 Poynings (TQ OS2611/2612/2512 Map 198)

69 Downstream Poynings road bridge (Two RHS datasets gathered)

Land-use: Upstream (69.1) Dominated by parkland and gardens, and arable on the right, and improved grassland on the left. **Downstream (69.2)** is open farmland, with both arable and improved grassland on both sides.

Stream morphology: The stream is extremely modified in the upper section, being predominantly a tree-lined ditch with three culverts and at least four weirs (see above right for one 'attractive' example). At the start the river has been converted to a lake with a concrete exit channel. The lower half, downstream from the STW and properties, flows in what appears to be a relatively natural channel, with only a single weir.

Diversity of physical structure: Morphology is extremely limited in the upper section, but trees provide the only redeeming features – except at the end in open grassland where an atypically shallow chalk stream character is evident for c75m (MTR site shown adjacent). Downstream, in open farmland, there is a small on-line pond (d/s of the STW discharge) and then very varied stream morphology with a river cliff and three gravel bars evident (see example section adjacent). This section is one of the most structurally diverse sections of headwater stream noted in open farmland (*cf.* woodland where several other streams were more structurally diverse).

Vegetation character: The upstream ditch is very impoverished, the community supporting primarily just ruderals and common ditch species. At the end of the upper reach, and the whole of the lower reach, the flora was dominated by true, and particularly fool's, water-cress, and with iris, rush and bur-reed.

Hydrogeology: Flow was evident throughout, and increased on passing downstream. The flora is not typical of a perennial chalk stream, but this does not preclude there being flow at all times (enhanced by the STW discharge). Physically the stream has the appearance of a good chalk stream with near perennial flow.

Recommendation: There is little that can be done in the upper half with so many private properties having manipulated the channel; downstream it should be simply left to develop naturally. There is an issue with a very small pond that is present downstream of the STW and this has had some periodic de-silting. This whole section too should be looked at in relation to the options upstream that will involve the water company.

Naturalness of Morphology	**1/4 (overall 3)**
Diversity of Habitat	**2/5 (4)**
Freedom from Obstructions to Flow	**1/4 (3)**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**2**
OVERALL TOTAL (max 25)	**9 u/s:18 d/s**

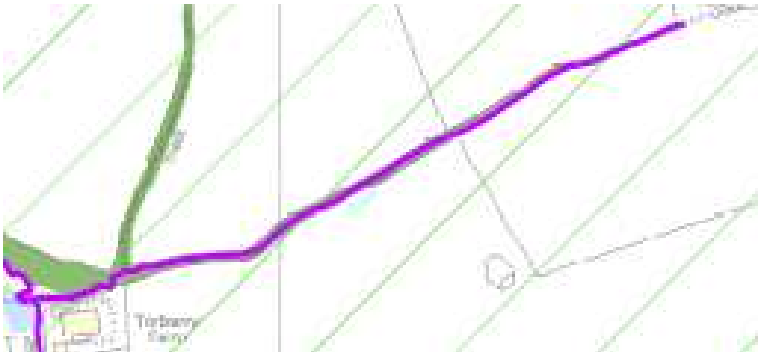
Bosham I.2.1a – Most western, inter-connected, channels north-west of Funtington

Land-use: Improved grassland dominates, but gardens/parkland also extensive. Mixed rough pasture, open water and urban also.	
Naturalness of Morphology: All ditched, but with shallow banks.	**2**
Diversity of Habitat: Not great diversity, being ditches. Great variation in substrate and wetness or dryness of ditch gives main variation	**3**
Vegetation Character: Rich flora in sections with most reliable spring flows, with *Apium* very dominant. Some ditches with tall ruderals on banks, others with mown grass, and one section along road cleared of vegetation.	**4**
Perceived naturalness of Hydrology: Appears to have classic winterbourne character. Upper sections fail for long periods, and downstream, and further east, flow would be expected to fail only in drought years	**5**
OVERALL TOTAL (max 20)	**14**

Recommendation: Do nothing except recognize superb range of winterbourne character within a small confined area. **Should have great range of specialist invertebrates**. See later for catchment recommendation.




Nursted Stream II.1.2 (OS Square; 1:50,000 Map SU7663920314) Right bank tributary of Nursted 1



Land-use: Land-use totally dominated throughout by arable cultivation but there is a **riparian woodland strip** as well as a woodland strip along an ancient track at right angle to the stream.

Stream morphology: Poor habitat for most of length – but good diversity on dry bed in lower 250m where obvious spring flows would be strong for much of the winter and spring. Bed character dominated by cobbles in this section.

Diversity of physical structure: Reasonable – it has a steep gradient and an abundance of large rock surfaces on the bed, and even some rock cliffs. Tree features, including woody debris, present.

Vegetation character: Extremely impoverished – but scored at '4' as this is natural for an intermittently flowing rocky stream.

Hydrogeology: very much a winterbourne, with more reliable flow in d/s 200m.

Naturalness of Morphology	**3**
Diversity of Habitat	**3**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 20)	**14**

Recommendation: Do nothing – but perhaps if Nursted 1B section is to be considered as a CWS, then the d/s 250m of this stream should be included as well.

Arable dominated land but riparian woodland strip

Rocky bed shows strong periodic flow

	
Diverse structure (with mature trees) and active	**Very active, but dry bed, in lower 250m**

Harting II.2.2A

Naturalness of Morphology Ditched all the way. On-line pond modifications and armouring. More natural close to source with good range of habitats, and less obviously ditched	**2**
Diversity of Habitat Good variety of substrates and great variety of base-rich shrubs on margins forming habitat. Very good variety, including shallow wet edges and spring flushes at margins near source.	**3**
Vegetation Character Classic winterbourne flora where not too shaded. Enriched flora due to on-line pond which should possibly lower the 'score'.	**5**
Perceived naturalness of Hydrology Almost perennial springs, but suspect the flow from them might fail in severe droughts. On-line ponding impacts hydrology. Interesting stronger spring flows upstream, and drying to underground d/s.	**4**
OVERALL TOTAL (max 20)	**14**

Spring source and really good stream habitat

Ditches and degrading habitat on passing d/s

Recommendation: Do nothing – upstream good and possible protection? Near perennial chalk stream/drain.

West Burton Stream (Bignor) II.7.1

Land-use: Both arable cultivation and improved grassland are extensive. Also off-line as well as on-line ponds.	
Naturalness of Morphology: Modified by straightening and impounding, but a good range of near-natural features present now	**3**
Diversity of Habitat: Diverse although modified in several ways. Very characteristic flint bed of perennial/near perennial chalk stream and some tree features, including woody debris, **in wooded section**.	**4**
Vegetation Character: Very bare as so shaded (so natural) and some good winterbourne flora in open sections – *Pellia endiviifolia* dominates in the shade on rocks.	**3**
Perceived naturalness of Hydrology: Appears to have perennial springs that discharge near the source – but flora does not confirm this so must be weak or dry in drought years.	**4**
OVERALL TOTAL (max 20)	**14**

Recommendation: Much the superior watercourse of the two, with interesting woodland/ravine spring fed chalk stream section. Considerable legacy of modifications. Encourage protection of the most natural section u/s of the impounding pond.

Storrington IV.2.2A

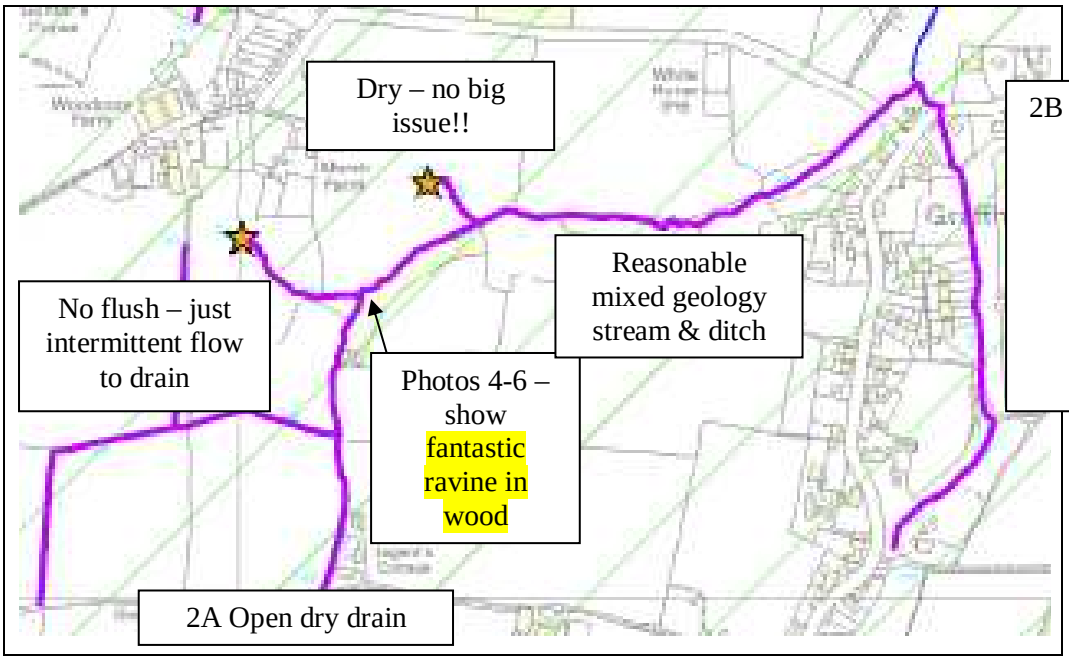
Land-use: Mixed, with urban, improved grass and **woodland co-dominants** – importance of the last, as is often the case, in maintaining a near-natural section of watercourse.	
Naturalness of Morphology: Major modifications include on-line lakes and bank/bed reinforcements, but there is a great short section of near-natural stream within the wood.	**3**
Diversity of Habitat: Great diversity within wood, including variations in bed materials, water depth, as well as bank heights and slope. Also tree features and woody debris.	**4**
Vegetation Character: Flora reflects spring feed and rocky substrate, with mosses and liverworts dominant in the channel (*Platyhypnidium & Cratoneuron*), the latter indicative a spring-fed/splash calcareous habitats.	**3**
Perceived naturalness of Hydrology: Important local chalk stream with perceived natural perennial flow, or failure in extreme droughts only	**4**
OVERALL TOTAL (max 20)	**14**

Recommendation: A very unexpected 'treat'. This is a true chalk stream, probably impacted by historic abstraction, but significance now not known. Note presence of flow gauge. Suspect the discharge is perennial but the flora does not confirm this. Presence of on-line lakes and a waterfall shows major historic physical modifications. **Great short section of near-natural stream through woodland, deserving of protection.**


Double rarity – flow gauge and a waterfall!!


Ancient abstraction within a near-natural section of chalk stream

Graffham II.5.2 (East Lavington). Surveyed 14/10/10 – Form filled in with macrophyte survey



2B DITCH WITH TRICKLE - not surveyed

Dry spring source

Land-use: Mixed woodland, grassland, urban, gardens etc., but very dominated by improved grassland.
Stream morphology: Varies from being pure ditch to having good structure in woodland.
Diversity of physical structure: Minimal where ditched, but very diverse where more natural ravine.
Vegetation character: Flora dominated by bankside taxa, and little in the shaded/ditched channel. Where open is winterbourne character.
Hydrogeology: Winterbourne with enhanced flows from surface water providing the energy to form diversity in the ravine section.

RECOMMENDATION: Do nothing. Ensure the wilder ravine section (depicted in photos) is protected as this is a short section of high quality stream.

Naturalness of Morphology	**1-4 (4 = ravine)**
Diversity of Habitat	**1-5 (4 = ravine)**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**3**
OVERALL TOTAL (max 20)	**13**

Watercourse 6 (Downstream A259 – upstream confluence of Watercourse 19 – flowing into 8) SU8404 Map 197 Source (same as 16)

Land-use: Dominated by woodland on the right, and pasture on the left. In the downstream section there is garden on the right, and wet wood on the left.

Stream morphology: The channel is obviously modified, and changes drastically down its length. Historic changes are likely to have occurred, as would more recent ones associated with the roads to the east (see the map images). There are no erosion or deposition features.

Diversity of physical structure: There is reasonable diversity due to the initial character being a silt-bedded ditch. On passing downstream springs emerge from the bed to create winterbourne character with the bed covered in *Apium*. At the footbridge, and downstream, the morphology (in places) resembles near natural chalk stream character, with gravel/pebble the dominant substrate (except where the water is ponded – silt overlays the gravel/pebble bed in such places).

Vegetation character: Relatively impoverished, especially in the upper 50% where there is only a ditch community present. From the mid-point the flora has a typical winterbourne character – with *Apium* dominant, and *Oenanthe crocata & Rorippa* also common.

Hydrogeology: It appears the source is intermittent and unreliable; from the mid-point the flora and stream morphology suggests spring flows from the chalk, with failure to flow being rare, but possible/probable in drought years.

Recommendation: The lower section is definitely chalk stream/winterbourne. Protection and even some slight enhancement is recommended to improve habitat diversity. This section is upstream of watercourse 8 which is also of high interest (and similar recommendations have been made). Before enhancement can be achieved, ownership of the land needs to be determined. Only a short section upstream of the footpath has the obvious potential for easy enhancement to create greater in-stream diversity of X and Long Section.

Naturalness of Morphology	**2**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4**
OVERALL TOTAL (max 25)	**17**

Changing character on passing down watercourse 6

Watercourse 46.2 (downstream off-line lake of 46.1 and upstream of Allington Lane); downstream the watercourse becomes 47 and then 48 downstream of Beechwood Lane

Land-use: Dominated by woodland, but with improved grassland at the end upstream of the Allington Lane bridge. There was also a garden on the right here.

Stream morphology: The morphology is much more diverse than upstream, and less obviously ditched. At the start the stream is diverted through a small lake, and then it meanders through woodland. Unusually, the banks do not show clear evidence of having been re-sectioned. At the end the watercourse is a 'uniform ditch'.

Diversity of physical structure: The morphology is much more diverse than upstream, with hints of gravel shoals present, and many vertical clay banks. Small amounts of woody debris are present, with shading / overhanging boughs extensive. The bed varies from cobbles and gravel/pebble to clay, with coarse materials predominant.




Vegetation character: No formal survey undertaken. Impoverished, but naturally so as so shaded. The ponds had abundant *Typha*, and the cobbles were predominantly bare, or covered with the liverwort *Pellia*.

Hydrogeology: A trickle flow only – either weakly perennial, or winterbourne.

Recommendation: Wooded section merits consideration for protection in the future as an example of a short section of wooded headwater chalk stream. The ditch sections could be considered suitable for modification to more natural morphology but are less obvious candidates for such treatment than the section upstream.

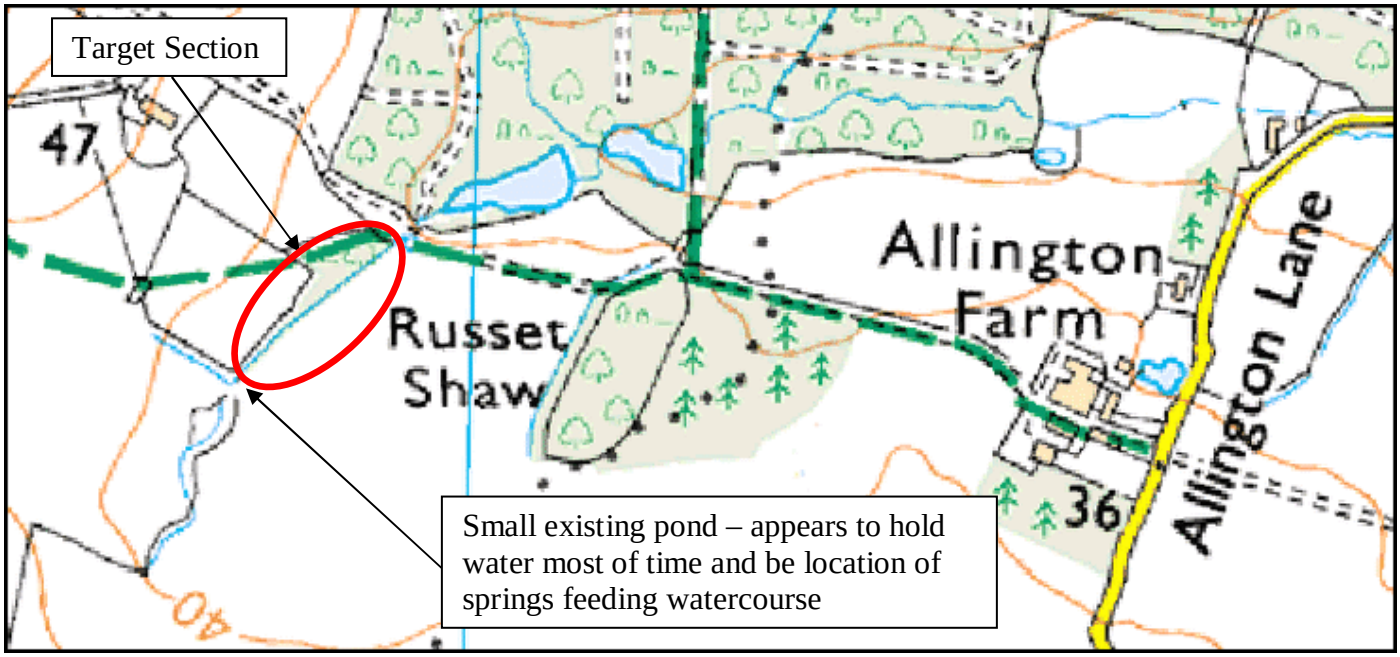
Naturalness of Morphology	**3**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**17**

APPENDIX 4F Allington Farm Stream (TQ3713)

Countless sections of watercourses surveyed have been converted to featureless ditches. A typical example in a rural/agricultural setting is the Allington Farm stream, north-west of Lewes. This is probably a winterbourne, expected to dry in late summer and autumn in very dry years, but sustain a trickle flow in others (check with Landowner). The target stretch is shown on the map below. Many watercourses, now effectively ditches, flowing in rural areas could have been selected to illustrate potential enhancements. The prime reason for targeting this to illustrate potential is that, unlike the ditch west of Chichester, this one is expected to have a much more reliable flow, and be expected to hold water permanently in any pools created.

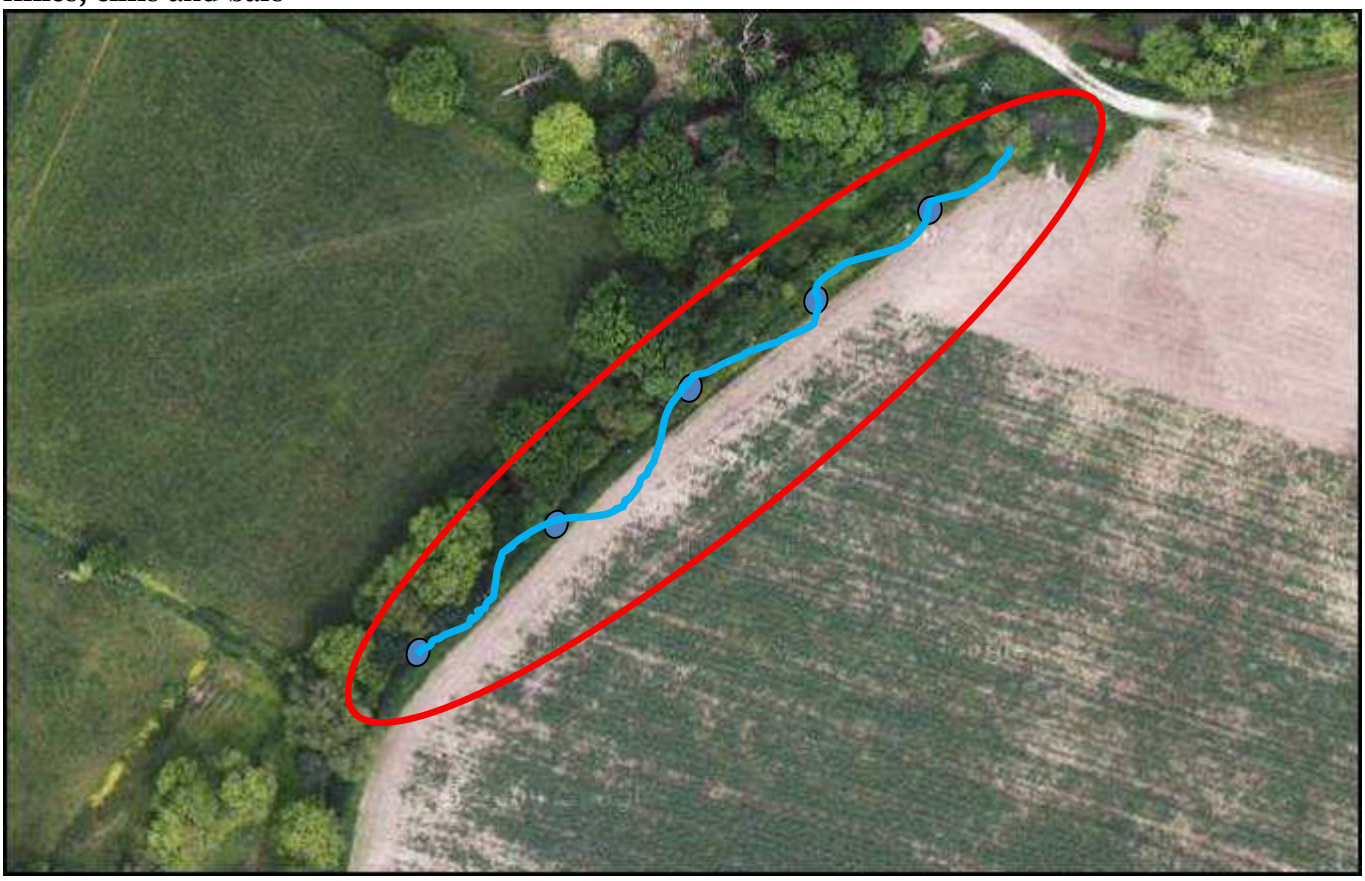
Conveyance of flood water is not deemed critical here, as there is a strip of woodland on the left, and a grass strip along the right. In many other cases this is true too, especially where watercourses flow through land converted to improved grassland.

The flora of the ditch is very limited, being very over-grown by tall herbs. No information is available on invertebrate life within the channel, but this probably reflects the specialised fauna that is associated with periodic drying streams of this type. Any changes to the channel structure would not result in anything other than short-term impacts on the existing communities, and provide additional habitats suitable for other species too.



Option A – simply creating pools, upstream 'runs', and re-profiling of right bank to form shallow ledges

Option B – re-meandering the watercourse to create more natural and dynamic stream with pools, riffles, cliffs and bars



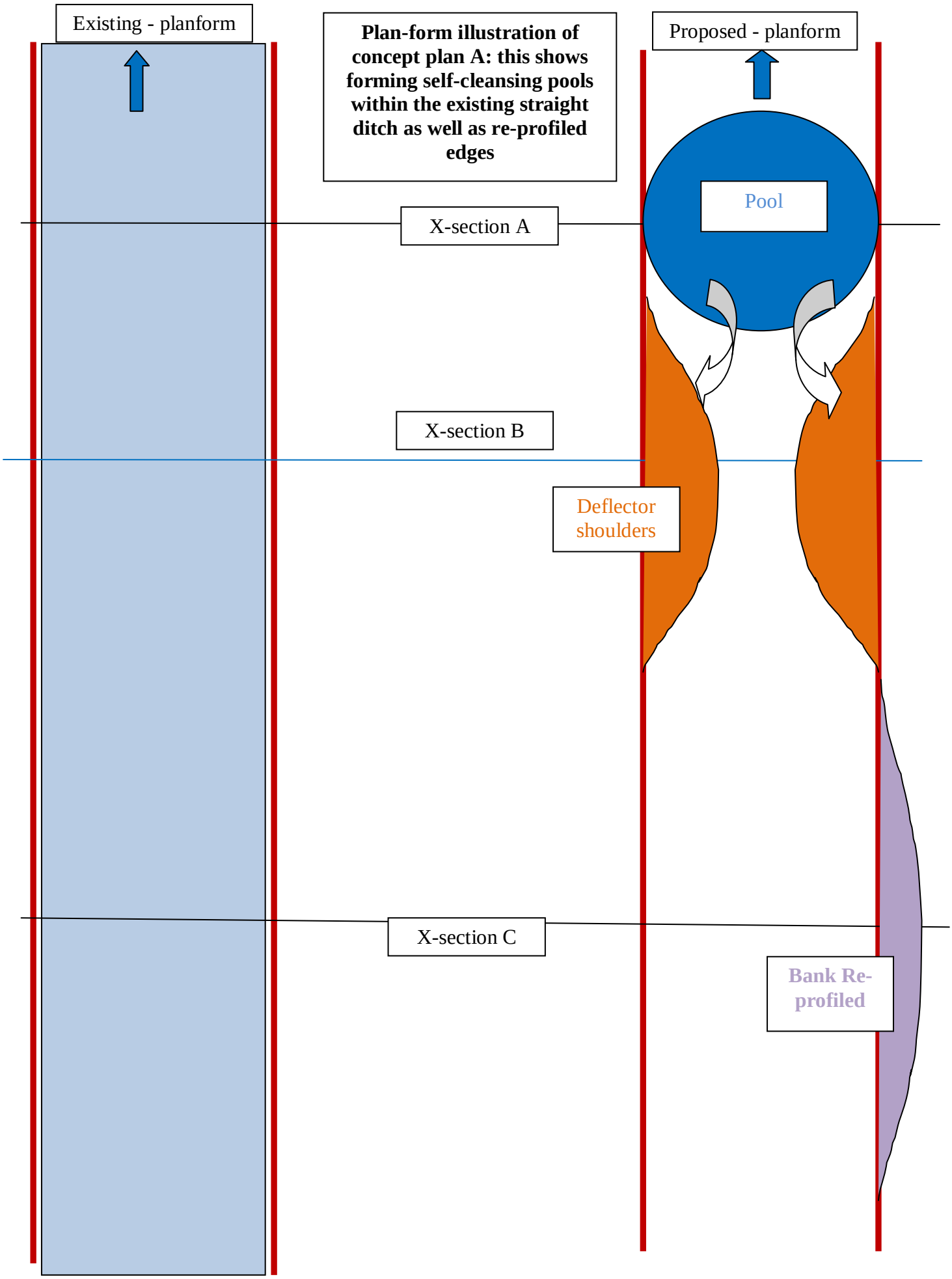
The on-line pond at the upstream end of the target section of watercourse that would appear to hold water throughout the year except in drought years?

The featureless character of the existing ditch looking upstream and downstream

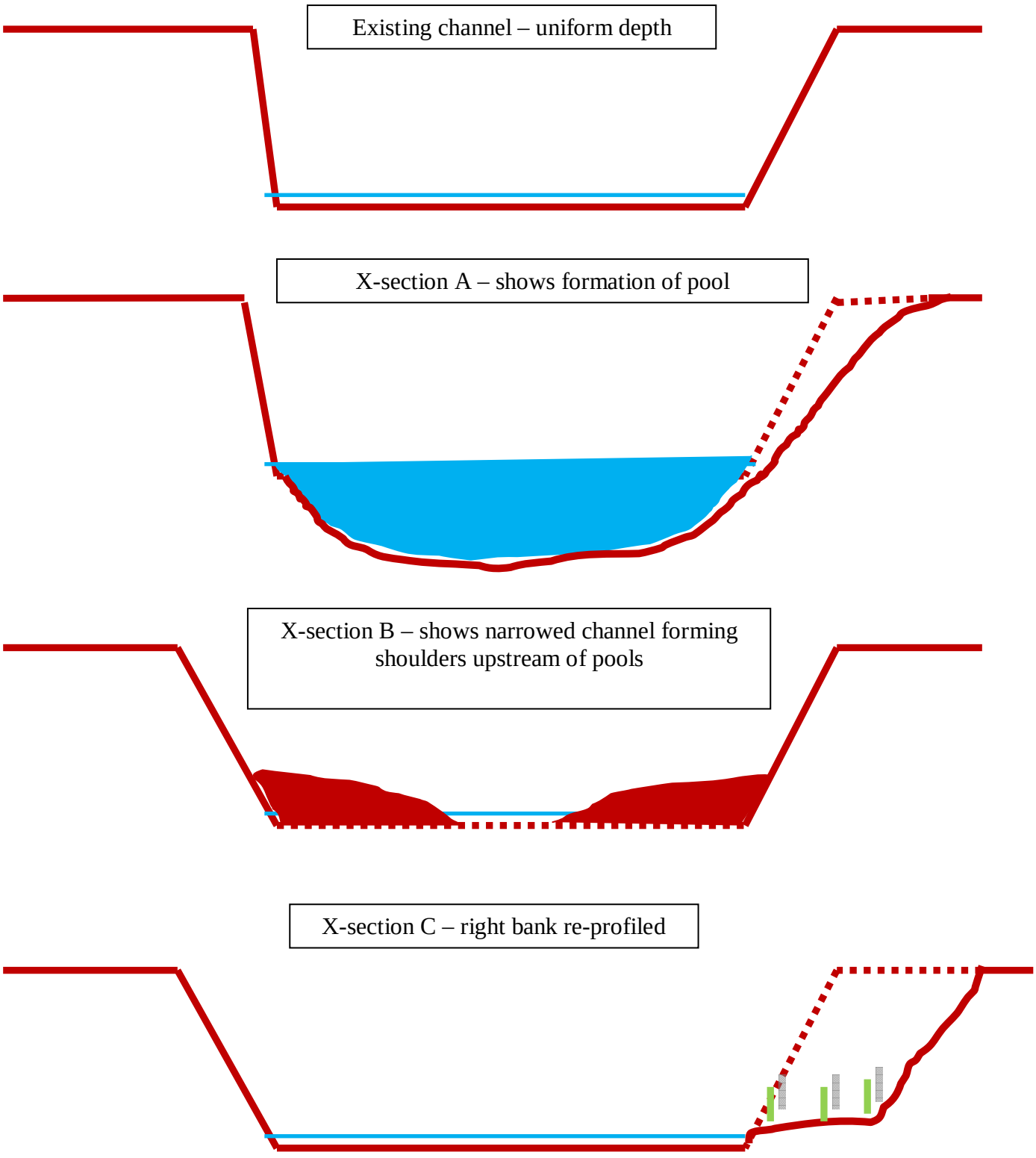
Creation of the option A end-state requires simply digging deeper and wider pools in locations say 40m apart; spoil arising from this is place at the edges of the ditch upstream to form raised 'shoulders' that consequently form a narrower low-flow channel that forces water at increased velocity into the created pools. This results in the pools being cleansed of silt in high flows.

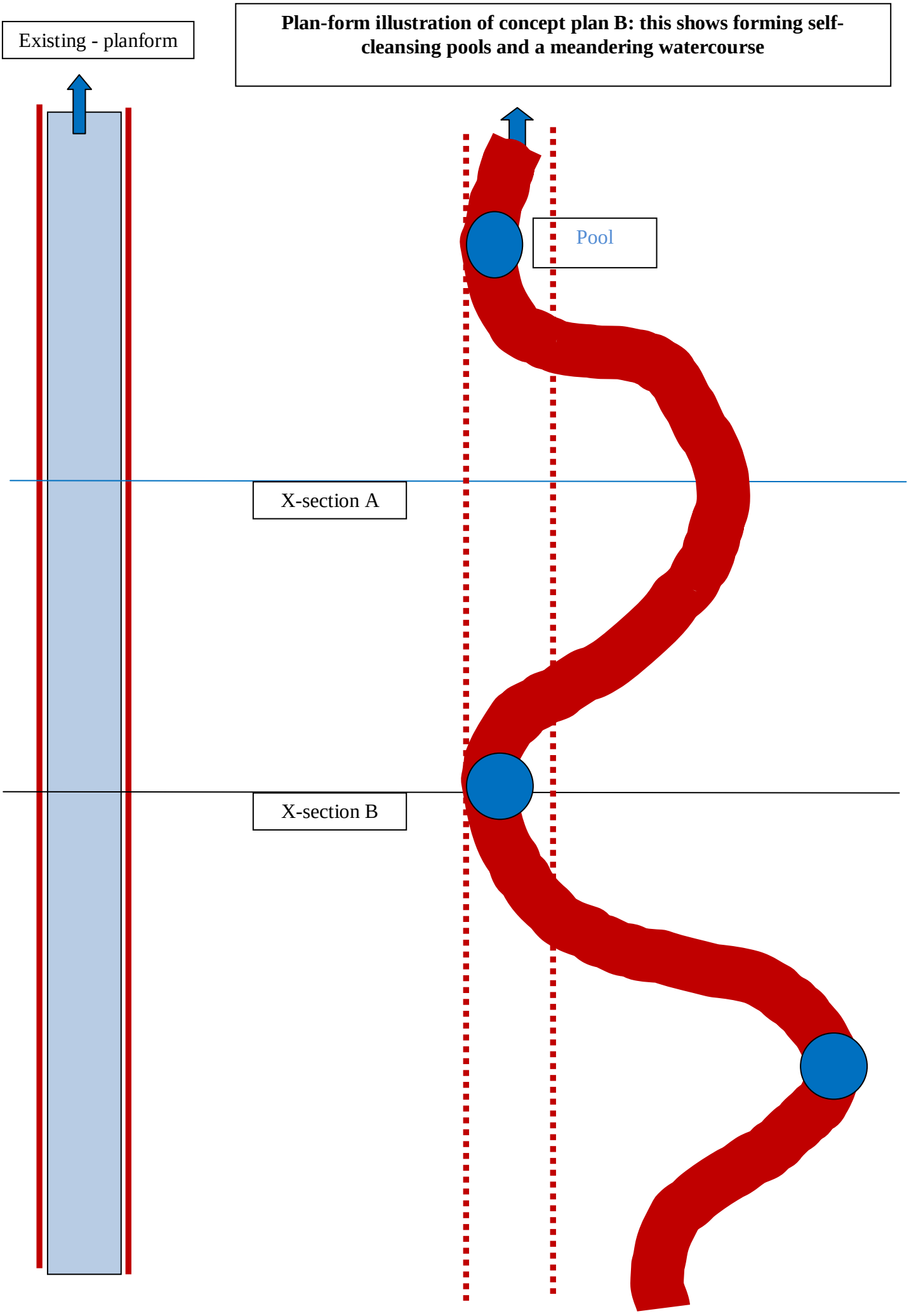
At this site it may be possible to re-profile the right bank to form ledges close to the water level. This provides the potential for reed (*Phragmites*) to be planted.

The left bank is left untouched, thus retaining the habitat and not changing the landscape character.

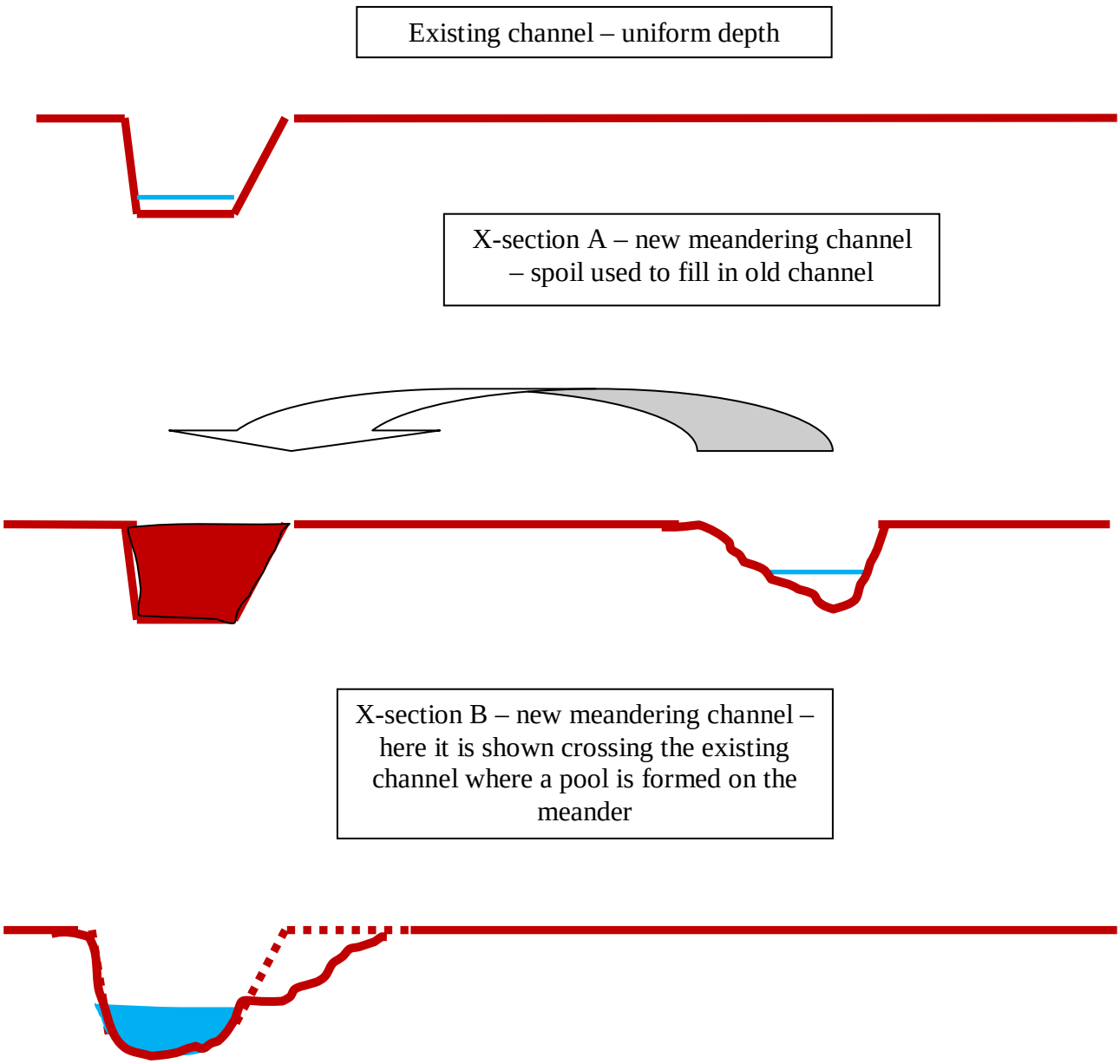

Existing - planform
Plan-form illustration of concept plan A: this shows forming self-cleansing pools within the existing straight ditch as well as re-profiled edges
Proposed - planform
Pool
X-section A
X-section B
Deflector shoulders
X-section C
Bank Re-profiled

Cross-sections illustrating concept plan A: formation of self-cleansing pools




Existing - planform
Plan-form illustration of concept plan B: this shows forming self-cleansing pools and a meandering watercourse
Pool
X-section A
X-section B

Cross-sections illustrating concept plan B: these show transforming the straight channel with uniform width into a sinuous channel, creating pools on meanders etc. – these are illustrative only



Option B involves creating a small, more structurally varied, channel that meanders across, and alongside, the existing channel. Spoil that arises from this is placed into the existing channel.

The ledges on the new channel could be planted with reed, or left to vegetate naturally.

It is recommended the left bank, with its trees and shrubs, is left untouched to retain the habitat and not change the landscape character. By meandering away from the hedge, additional habitat variety will be formed as open and shaded sections will result.

58 – Watercourse at Preston Court Farm (OS Square TQ4607; 1:50,000) Source 25m; Gradient c1:66

Land-use: The recent aerial image confirms arable and improved grassland are the dominant land-use categories, but in the upper reaches there is a wooded riparian zone on both sides of the stream.

Stream morphology: The stream has been greatly altered, but has some interesting features. It would appear that in the upper few hundred metres the stream has been historically widened, and impounded. The impounding influence is long gone, but evidence of the wide shallow channel with margins now occluded with trees (many growing into the channel) is clear to see (see image adjacent). Silt and sand dominate here due to low velocity of water when there is flow. The other photos on this page show that the remainder of the channel is a ditch, with either both banks wooded, or one open to grazing.

Diversity of physical structure: This is limited, but there is a range of silted habitats with wide shallow margins, steep wooded ditch banks, and open, grazed, ditch banks. The main habitat interest is the extent of wet woodland that is developing in the abandoned over-widened and impounded channel at the head of the watercourse.

Vegetation character: The flora is not diverse, but the grazed and open edges of the ditch areas have a much richer flora than they would have if they were fenced and the banks become colonized by shrubs (e.g. brooklime and water-cress). This was very rarely encountered during the surveys. Insufficient aquatic species were present in the channel to allow a MTR survey to be undertaken.

Hydrogeology: At time of survey the majority of the bed was just damp, with a minute flow from very weak springs. This continued downstream.

Recommendation: There could be major differences in opinion as regards what would be the ideal conservation management of the upper section that is now very silted and becoming occluded with trees. The recommendation made here is that the system is allowed to recover naturally to form a narrow and wild wet woodland. It is very desirable to ensure the open edges remain unfenced and grazed to ensure maximum habitat diversity for marginal wetland plants, invertebrates and other species – a rare habitat character encountered.

Naturalness of Morphology	**2**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**4**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**17**

I.2.2a Bosham Eastern arm

Land-use: Arable cultivation and urban areas predominate, but mix of rough pasture, shrubs, grassland and a cress farm all evident.	
Naturalness of Morphology: Watercourses ditched, but some variation in depth of banks, and some tree features provide semblance of some naturalness.	**2**
Diversity of Habitat: Diversity scores higher than naturalness due to variation in substrate (some silt and other clean gravel areas) plus tree root features in middle reach.	**3**
Vegetation Character: Vegetation is rich and reflects perennial chalk spring feed (*Berula & Callitriche obtusangula*).	**4**
Perceived naturalness of Hydrology: Clearly fed by chalk springs, with flow at least partially affected by source being used as cress-farm	**4**
OVERALL TOTAL (max 20)	**13**

2a Water-cress farm source and semblance of chalk stream character evident d/s on eastern channel

Recommendation: Do nothing other than encourage protection as a chalk stream (but effectively a drain). The majority of the drain is too deeply incised to enable effective habitat restoration without major diversion.

Bosham I.2.2b - Same catchment as 2a, d/s, at Nutbourne

Land-use: Mixed urban and tall rank herbs dominate.	
Naturalness of Morphology: Ditched, much with vertical walls within the urban area	**1**
Diversity of Habitat: Limited diversity except urban area has a fast-flowing, shallow, firm cobble-bedded channel, and sluggish channel through tall ruderals has fines and has negligible velocity.	**3**
Vegetation Character: Classic flora of perennial chalk stream, with *Berula and Ranunculus*. Presence of the alga *Vaucheria* clear indication of enrichment	**5**
Perceived naturalness of Hydrology: Appears to have cast iron guaranteed perennial spring flow.	**5**
OVERALL TOTAL (max 20)	**14**

Recommendation: Scores are perhaps generous, but this short section of watercourse was not what was expected. Spring flows evident to produce a **2-300m section of classic urban chalk stream**, dominated by Ranunculus. **This is one of very few sections with *R. penicillatus* subsp. *vertumnus* present**, and some *Berula & Callitriche obtusangula* were present - making this section having the classic flora of a perennial chalk stream; so why called Nut**BOURNE**? If flow fails, it would do in exception droughts only. Protect and possibly look to enhance and value more the section running along the roadside.

Adur V.3.1

Land-use: Mixed improved grassland, reedbed wetland and rough pasture dominate	
Naturalness of Morphology: Drained with little naturalness except where virtually no course visible in an area of carr. Also two small ponds near source, and a ponded section due to sluice	**2**
Diversity of Habitat: Variable in terms of habitat due to ponds and wild area in woodland. Variable banks but no gradient so variability limited. Occasional flushes at margins. Occluded by reeds	**3**
Vegetation Character: Totally dominated by emergent *Phragmites*. Open areas with richer flora, including classic species of chalk streams *Callitriche obtusangula & Berula*. **VERY VERY RICH COMMUNITY**	**4**
Perceived naturalness of Hydrology: Link to chalk aquifer appears very strong based on water clarity and flora	**4**
OVERALL TOTAL (max 20)	**13**

Recommendation: This is a very difficult 'call' in terms of stream type. It has clear springs from the groundwater source which break through into flushes at edges and in the **wet woodland**. However the channel is perched on clay, and it has no gradient. Water clarity suggests it is groundwater dominated.....so classifying it as a 'ponded chalk stream'. **As it is unusual, and clearly there is interest within the area for wildlife conservation, suggest further protection and enhancement.** If this watercourse was in Amberley Wild Brooks area, it would be managed...**it is now very occluded and clearance (at least partially so) is strongly recommended. NOTE: it has a rich flora, but the ever-increasing cover of reeds will potentially lead to species loss, and perhaps soon**.

41 Wiston Park (TQ1511/1612 OS Map 198) Source 50m; Gradient c1:40

Land-use: Dominated by improved grassland on the right, and arable and natural woodland on the left. There is a riparian woodland strip of variable width along much of the course, especially near the source; this has remained unchanged for a long time, as shown by maps.

Stream morphology: The stream is a wooded, predominantly silt-bedded, ditch at the start within woodland. For the most part, however, the steep gradient gives rise to a stone-bedded, steep-banked, ditch. Water velocity and scour are obviously significant at times and the stream character is much more energetic compared with 'typical chalks streams'; it also appears to have more energy than the neighbouring watercourses to the west (36-40) – note steeper gradient.

Diversity of physical structure: Morphology is varied, but no features were so well developed as to form discrete bars and cliffs recordable in RHS. Substrate was very variable, with coarse material and silt extensive. 'Waterfalls' were present where rock has been cemented hard by carboniferous deposits (see image below). Exposed tree roots on the banks were extensive. Recovering from very historic ditching.

Vegetation character: Impoverished, with the bed mostly bare. The more open, silt-bedded areas had higher plants species such as *Apium & Sparganium*, but generally the bed was bare and the banks dominated by shade-tolerant species (ferns, pendulous sedge and trees themselves).

Hydrogeology: Dry or damp only in the upper 250m upstream of the clay-lined, on-line, pond – not known if this is natural, but springs shown on the map. A trickle only was in the stream for the remainder, until there was a large, on-line, lake. For the whole length the field observations would suggest that in years with good re-charge, it would flow all year, and in poor re-charge years it would dry throughout its length for some time.

Recommendation: The overall score is only moderate as previous modifications, and the existing on-line lakes/ponds, are a major departure from natural morphology and impact hydrology. As with many watercourses surveyed, there are no rehabilitation options that appear to be obvious or worth considering. Along with many others, this watercourse challenges the historic view of what a chalk stream in the UK should 'look like', and there is merit in considering ways in which to ensure future degradations do not occur.

Naturalness of Morphology	**4**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**16**

44 Edburton (TQ2311 OS Map 198) Source 50m; Gradient >1:50. Right at base of very steep escarpment

Land-use: Upstream of the road woodland dominates, with urban infrastructure to the right. Downstream, mixed arable and improved grassland dominate, with some tall rank herbs, a car park and a house and garden also present.

Stream morphology: The stream has occluded wooded sections (for example a relatively natural section shown in the adjacent image), some sections that are open to grazing and trampling on one side (image below left), and short sections open on both margins (image below right shows recently cleared are of stream). The section upstream of the bridge is a series of on-line, chalk spring fed, ponds. Downstream one section has been impounded to also form an on-line pond in the grounds of the adjacent property – as this is not fed directly from the chalk, it has a very different character to the source pools.

Diversity of physical structure: Morphology is varied, as there are vegetated grazed/trampled margins as well as shaded ones dominated by an abundance of exposed tree roots and overhanging boughs on the banks. Rippled and smooth flow alternate, and the bed is dominated by gravel/pebble.

Vegetation character: The channel had a relatively impoverished flora due to shade – (trees were recorded as dominant flora on the bed of the river as well as on the banks). *Apium* was present in open areas, but this was not the norm, with the shade-tolerant *Oenanthe* co-dominant but present in shaded areas. *Sparganium* was present also where water was ponded and the channel was not heavily shaded, and *Carex acutiformis*, a species typical of perennial chalk stream margins, was also present.

Hydrogeology: A small discharge was evident at the source, and this was maintained, and increased, on passing downstream. The gravel/pebble bed is typical of perennial chalk streams too where not impounded. Weak perennial flow is the suggested characterisation, despite macrophytes that are indicative of perennial chalk streams were not found. Interesting perennial flow resulting from being so close to the escarpment?

Recommendation: The watercourse has been greatly modified in the past, and the refurbishment of the weir associated with the relatively new on-line pond indicates modifications continue and are still evident. The habitat is reasonably varied, and the vegetation reflects this. Given moderate status already, but absence of any special features, leads to the recommendation that it should be left to continue to develop naturally in the future.

Naturalness of Morphology	**3**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4**
OVERALL TOTAL (max 25)	**15**

Reach 52/3 – 52 is very short 'flowing section' downstream of railway culvert; 53 is DRY.

Land-use: Mixture of woodland (dominant on right bank in section 53 by disused railway), tilled ground (allotments on the left) and with some tall rank herbs and roads.

Stream morphology: Straight ditch. Banks mostly steep, and in section 53, most are vertical. The morphology suggests significant floods occur that erode both the banks and the bed; in places there are huge steps in the bed marking headward recession upstream to a hard section of bed (nick-point).

Diversity of physical structure: Only diversity is a result of section 52 having flowing water, and d/s section 53 being dry.

Vegetation character: Good winterbourne flora in the very short section 52, and just dried aquatic mosses on the bed in the much longer section 53. The presence of true and fool's water-cress indicates true winterbourne character of 52; the bed was green (see images over-leaf) with mosses *Leptodictyum, Fissidens & Platyhypnidium* – the dominance of the first species indicates enrichment of the groundwater. The same species were present on the dry bed in section 53, but with little else. This suggests flow had only failed shortly before the survey was carried out in August 2009, indicating typical winterbourne character. The banks were predominantly bare or colonized by ferns and non-aquatic herbs.


Images of the short 'flowing' section 52


Images of the 'dry' section 53 – note green bed due to mosses

Hydrogeology: This is a very interesting section of river, with very reliable (but probably not perennially-flowing) springs discharging through the very short section 52 (<100m) before the flow disappears underground in section 53 (when the water-table is not high). It is impossible to know if this is natural or impacted by any abstraction; it almost certainly will have been impacted by historic diversions and building of the railway lines

Recommendation: The overall score is much higher than given for the upstream section 51 because of the contrast from true winterbourne with very regular flow with winterbourne with intermittent flow. Hydrology is deemed to be impacted by severe deepening and diversion due to railway building. The site probably contains good invertebrate assemblages. Section 53 is similar to some of the **better** parts of the Lavant in Chichester.

Naturalness of Morphology	**1**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**3?**
OVERALL TOTAL (max 25)	**16**

62 – Watercourse N-W of Alciston (OS Square TQ5006; 1:50,000 Map 199) Source 50m; Gradient c1:50

Land-use: Totally dominated by woodland upstream of the bridge, and then improved grassland, on the left and arable cultivation on the right downstream of the bridge. Little change in land-use is apparent based on historic maps and recent aerial images, with the extensive woodland cover unchanged in the catchment.

Stream morphology: The watercourse is very much a ditch, and was dry throughout at the time of survey (see photo adjacent .500m from source).

Diversity of physical structure: Very limited and non-existent after 3-400m, from whence it is a featureless ditch with a silt/clay substrate and steep banks. The upper section is interesting as it has a substrate that is, in several places, tufa-like, with calcified deposits, some so hard that small waterfalls have been created (see photo adjacent). This is unusual, but not unique within the study area.

Vegetation character: The flora is extremely impoverished, and typical of a very shaded ditch except in the upper reaches. In the upper reaches the tufa bed provides firm substrates for the liverwort *Pellia* (see photo above) to dominate the bed, and the banks are dominated by trees and the bryophytes *Conocephalum & Thamnobryum*.

Hydrogeology: At time of survey no flow at all. With the tufa bed in the upper reaches, there are strong signs that this is a classic chalk-spring fed winterbourne.

Naturalness of Morphology	**1**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**16**

Recommendation: A winterbourne, then a ditch. Extremely modified and not an obvious candidate for rehabilitation. The unusual character in the upper reaches is worthy of protection, but as there are better examples, this is not a priority for designation to achieve this. Hydrology with diversity of stream substrate suggests this may be important for specialised invertebrates.

66/67 Fulking (TQ OS2411 Map 198) Source 55m (at base of steep escarpment); c1:66 gradient (shallower than most in the area)

66 – Upstream Road – Fulking (short headwater feeding directly into watercourse 67)

Land-use: Dominated by riparian woodland on steep slopes, with improved grassland beyond. On approach to the road, it is bordered by pub and garden.

Stream morphology: Extremely modified – has been widened and presumably historically ponded, upstream (photo opposite). At the pub it is either in a narrow engineered channel or widened into an amenity 'pond' feature.

Diversity of physical structure: Morphology is very varied. The abandoned upstream historically ponded area has silt on the bed at the margins, but the central low-flow channel is dominated by gravel/pebble. Near the pub the bed is dominated totally by pebble and gravel, as it is where it runs alongside the road (photo left).

Vegetation character: Reasonably diverse and typical of a winterbourne (no *Berula* or *Ranunculus*). More open, silt-bedded areas had *Apium* dominant, and gravel/pebble areas *Apium* was present with bryophytes such as *Pellia, Cratoneuron & Hygroamblystegium,* as well as encrusting lichens and blanketweed. The alien *Mimulus* was present, a common species of lowland chalk streams.

Hydrogeology: In the upper reaches there was a spring flow that continued all the way downstream without diminishing. The character of the area and bed suggested perennial flow, yet macrophyte species indicative of a perennial flow were not found. Very weak perennial chalk stream or very strong winterbourne. Like the neighbouring Edburton stream, the flora does not indicate perennial character, but the morphology does. Perhaps in extreme droughts such as 1934-6, 1975-6 and 1989-92 it may fail, and historic droughts may have resulted in species of perennial chalk streams not colonizing such sites; it may be that they are also a long way from sources of such plants for establishment at any time.

Naturalness of Morphology	**2**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**4?**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**16**

Recommendation: Specific to this length, eradication of monkey flower, *Mimulus*.

85 – Watercourse Wannock (North); (OS Square TQ56/703; 1:50,000 Map 199). See Photos and description of short section downstream referred to on the maps as watercourse 86. Source 30m; Gradient c1:80

Land-use: Dominated by improved grassland in the upper half, and running alongside houses and gardens in the lower half. Woodland is significant on the left bank, and trees are present more or less totally along both banks.

Stream morphology: The watercourse has been ditched, totally. The source is wide and shallow (see photo adjacent) arising in the familiar small patch of retained woodland. For more than a kilometre it is a straightened ditch.

Diversity of physical structure: Diversity is very limited, but there is substrate variety from silt/clay to pebbles and cobbles close to the bridge within Wannock. Despite dense tree and shrub cover (see adjacent photo), large woody debris habitat features were very limited.

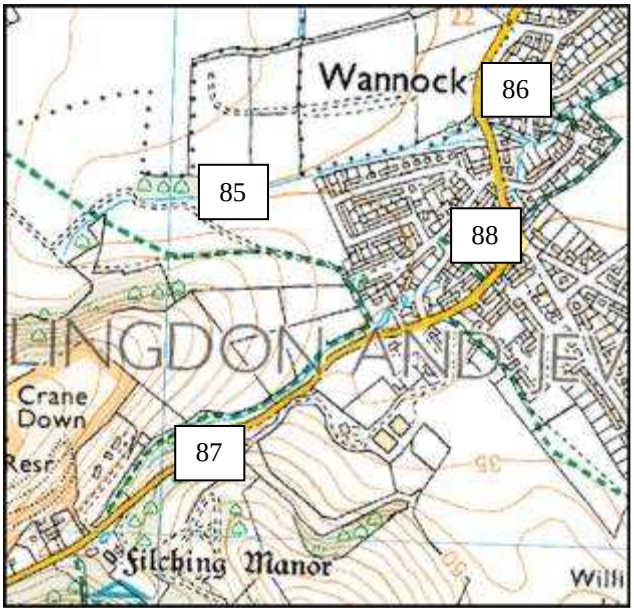
Vegetation character: Flora is extremely impoverished, and typical of a very shaded ditch except in upper reaches. The liverwort *Pellia*, and mosses *Hygroamblystegium & Cratoneuron* are present on tree roots and rocks near the bridge. *Apium* is common where there is enough light reaching the river, (see adjacent photo) but generally substrate is bare due to dense bank-side willows, other trees and tall rank ruderals.

Hydrogeology: At time of survey there was no flow at the source, but within 250m there was water, and this persisted all the way downstream, but never with evidence of flow.

Recommendation: A winterbourne, then a shaded straight ditch with what appears to be perennial water present in it, even if there is no obvious flow. Very modified and not an obvious candidate for rehabilitation. There are no exceptional interests justifying any special protection measures either.

Naturalness of Morphology	**1**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**16**

86 & 88 – Watercourse in Wannock (OS Square TQ5703; 1:50,000 Map 199).



86 is an extremely short stretch of watercourse downstream of the road.

Watercourse 88 is part culvert and part on-line lake upstream of the road, and a revetted open ditch downstream of the bridge.

Both appear to have perennial flow, as both have abundant *Pellia* growing on the bed, and had flow in August 2009.

Downstream of the confluence the combined watercourse would be considered perennial, but not chalk stream as it is very straight and in an urban environment.

Parrot's feather was present in watercourse 88 downstream of the bridge; it survived the cold winter (yellow arrow shows presence in Jan 2010). It should be removed in case it becomes permanently established here and elsewhere.

Recommendations would be, where possible to enhance the stream through the urbanised sections.

Stream 90 – Cocking (OS square SU 8717 – 1:50,000 Map series No 197) Source 65m; Gradient c1:66

Land-use: Dominated by improved grassland on left above valley floor, then urban and gardens. On the right tilled land, urban development and garden dominate. Source is in a deep ravine u/s of the railway with springs entering. In the upper 40% the channel is in a deep ravine with no floodplain, where historically a cress-bed operated.

Stream morphology: Very modified throughout with minimal geomorphological activity. Pond at source and on-line, abandoned, cress beds soon after. In lower 50% the stream has some natural features, but no cliffs or bars recorded. Bed is dominated by pebbles, mostly concreted and not mobile, with flow types typically being rippled or smooth, with no perceptible flow in ponded sections. Banks mostly re-sectioned and or armoured. There is dense shade and a much more limited range of tree habitats associated with the bankside trees than in 89. Scores only 2 as little semblance of natural morphology except away from cress-beds and ponded sections (3 culverts and three weirs). There are on-line lakes, the largest upstream of the mill; downstream of this the channel is in culvert and then flows more naturally through woodland at the downstream limit of the survey unit.

Diversity of physical structure: Only resembling naturalness in a few locations, but 'artificial' ponds, cress beds etc. contrast with the more natural, shallow, and rock-dominated stretches. Scores 3 as more 'diverse' than natural.

Vegetation character: Above average diversity of JNCC taxa, and a good range of MTR species. Several stretches were bare or only had bryophytes due to the dense shade cast by the bankside trees. Bryophytes common, as in many sites, with the tree roots an important habitat. Flora a mixture of ditch, winterbourne and true chalk stream character. Scores '5' for vegetation as the two most classic species of small chalk streams are present (*Berula* & *R pseudofluitans*). The flora is interesting as it contains more bryophytes than is typical for most chalk streams, with *Chiloscyphus* present, and common. This reflects the abundance of large cobbles and cemented rocks that give the appearance of a limestone flush in the Derbyshire Dales. **There is a negative that should be addressed – the presence of *Crassula* (New Zealand pigmy-weed) in the pond at the source, and Skunk cabbage is present too.**

Hydrogeology: At time of survey in August spring flow was obvious, but small. The flora and the historical cress-bed very very strongly suggests a perennial chalk stream which the author would expect never to fail, Scores 5 as a chalk stream – with archetypal flora, it might be expected that invertebrates of perennial spring habitats would be present in the area of the cress beds and source pond. Lower altitudinal source below a steep escarpment results in more reliable perennial spring flow than watercourse 89.

Naturalness of Morphology	**2**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**5**
Perceived naturalness of Hydrology – true perennial chalk 'stream'	**4**
OVERALL TOTAL (max 25)	**16**


Part of upper river was historically a cress bed (left) and more natural character in lower 35% (right)

Recommendation: Programme to eradicate *Crassula* at the source – before it takes over and spreads further. The old cress beds could be made into a more natural chalk stream very simply, with contrasting wetland habitat adjacent. Simply re-distribution of the gravel material to form a narrow, sinuous, low-flow channel within the existing width of the cress bed would form an improved chalk stream habitat and be easily achieved in a few hours. However this needs careful consideration as the cress beds were the only ones found, and have historical interest if unique for S. Downs streams.

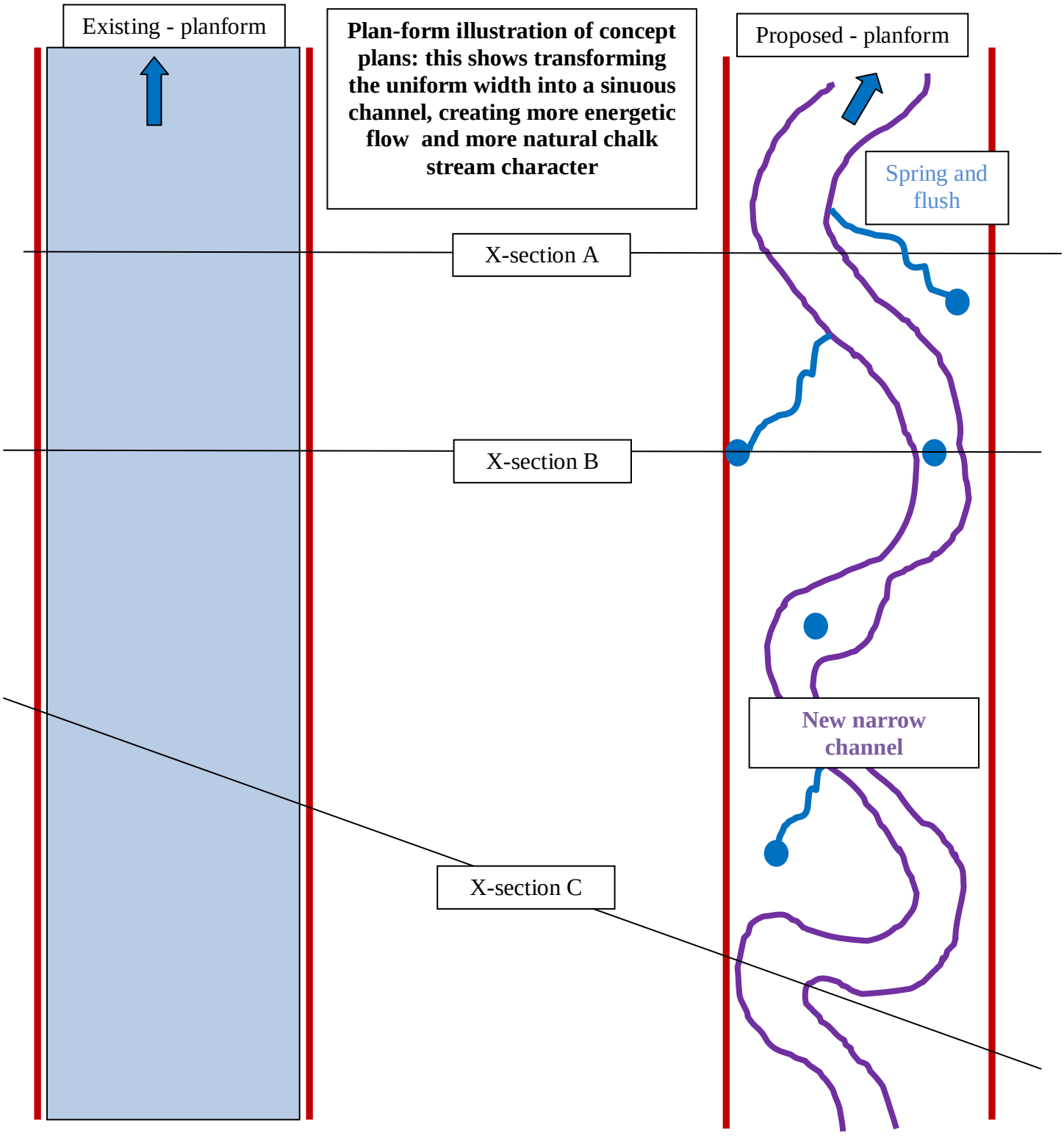
Suggestions for rehabilitation of Cocking/Costers Brook (SU8717) Perennial stream/ancient cress beds. Consider conversion of old cress-beds to near natural chalk stream character

This is a 'one-off' rehabilitation option as there was just a single abandoned cress-bed section found in the entire area of study. If this truly is the only one of its type (on-line) that was established on streams arising from the South Downs in Sussex, it has significant historical interest that might well out-weigh the ecological interests.

Existing ecological interest will need to be assessed also before anything is done, as abandoned cress beds often have some seasonal ornithological interests (but these could be potentially enhanced by the proposed works). There is the potential to create here a small, and much more natural, chalk stream habitat that could be achieved at little cost and with few practical difficulties.

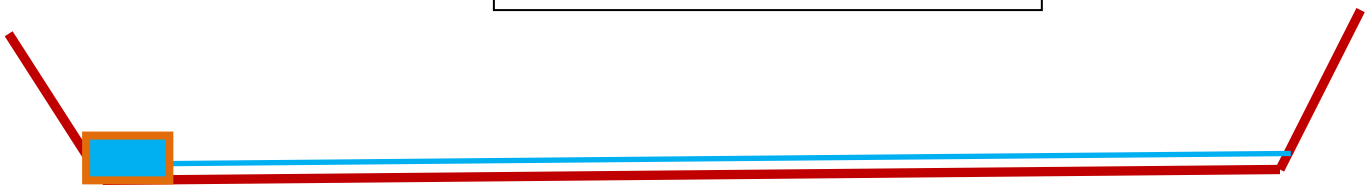
The existing character is illustrated by the four images below and over-leaf. As would be expected for an abandoned on-line cress-bed, the channel has been modified to be very wide, and the gradient is very even (both across and along the bed). The result is even flow depth and velocity across, and along, the channel, with fine sand and silt clogging the gravels. Some crowfoot (*Ranunculus*) and water-parsnip (*Berula*) is present, both indicative of perennial flow derived from groundwater chalk springs. There are also some remnants of the working cress bed, most noticeable being a high level feed channel down the left, north, bank.

An indicative project would be to re-distribute the bed material to create a discrete sinuous channel within the existing wide channel, creating variations in width and depth also. This could be simply achieved using an excavator within the channel and completed in a day. Cross and long sections illustrate the proposal.

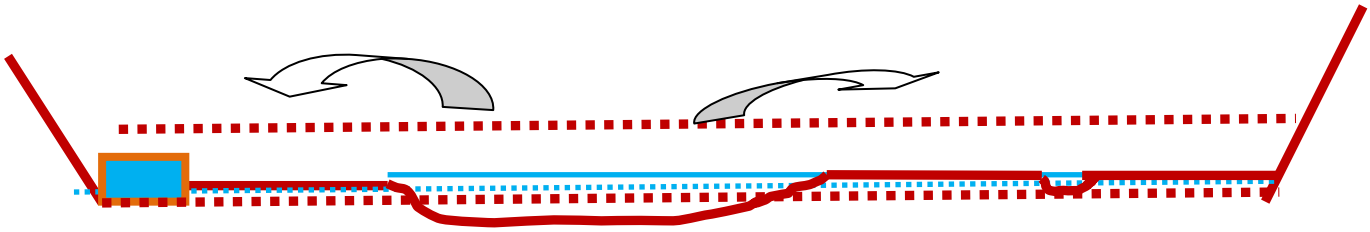


Cross-sections illustrating concept plans: these show transforming the uniform width into a sinuous channel, creating more energetic flow and more natural chalk stream character – these are illustrative only, with on-site decisions made to reflect such things as where springs break to from bed etc.

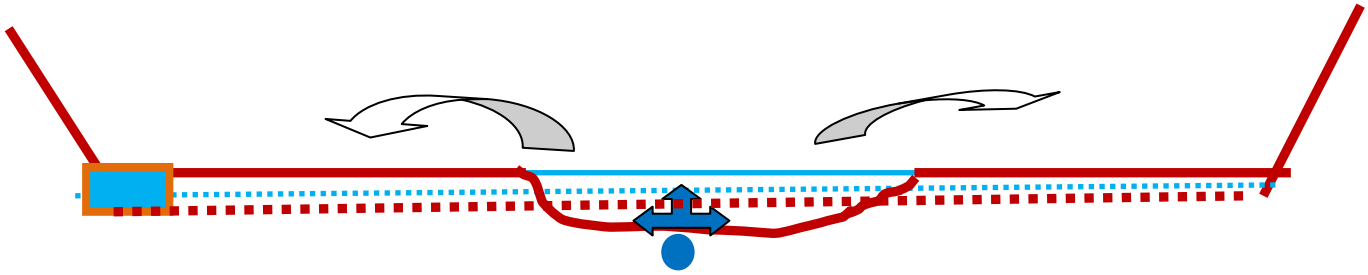
Existing channel – uniform depth



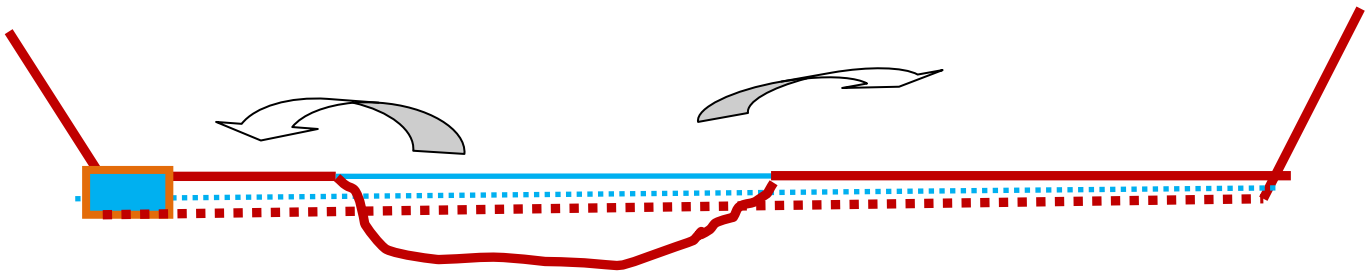
X-section A – shows narrowed channel forming a shallow fast ‘riffle’ habitat with flush formed from spring on right



X-section B – shows narrowed channel where springs break through the bed



X-section C – shows narrowed channel forming a deeper pool on meander



Duncton Barlavington 92 – Very small stream close to headwaters of longer watercourse 91 (SU9516) Source 50m; Gradient c1:35

Land-use: Dominated by reeds, wet woodland, scrub and rough pasture. **Valued wet habitat, especially at downstream limit.**

Stream morphology: The watercourse is more a small ditch conveying the spring water that discharges from the issues within the wetland.

Diversity of physical structure: Very limited as interest is the wetland through which the stream flows.

Vegetation character: No survey. Limited interest, with *Berula* present, but banks dominated by *Eupatorium* close to the edges, and great abundance of *Phragmites*.

Hydrogeology: Considered to be natural spring/flush stream, but there is no way of knowing if impacted by abstraction or other factors.

Recommendation: The section is deemed of minimal interest in relation to the watercourse itself, but highly important as a habitat as a whole, that includes the reed dominated wetlands with encroaching scrub. Worthy of consideration as private or trust reserve, with some minor management to ensure it does not become totally dominated by scrub and dry out.

Naturalness of Morphology	**2**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**16**

97 – Starts as headwater stream south of Salters Farmhouse Farm; streams 97 & 95 join to form stream 98 downstream of Bignor Mill Source 60m; Gradient c1:60

Land-use: The upper 500m was subject to RHS data collection and macrophyte surveys; the rest was walked and notes taken regarding character. The terrestrial land-use in 97.1 (upper 500m) is dominated by arable cultivation, and improved grassland, but the source area shows signs of being a classic perennial chalk stream (see photo opposite and below) but shortly the stream becomes associated with gardens where the stream has been made into ornamental ponds.

Stream morphology: The stream is very different from the stream it joins, watercourse 95. In the headwaters it is a series of lakes/ponds that dam the spring flows to form landscape features within gardens. Downstream the water flows in a straightened ditch with steep, re-sectioned, banks that are most often colonized by trees and shrubs, at least on one bank, and sometimes both.

Diversity of physical structure: Variety of habitats, but lots are artificial. Close to the source ornamental ponds dominate, and downstream it is structurally a much more impoverished ditch than either 96 or 95.

Vegetation character: In total contrast to neighbouring streams 95 and 96, the exceptionally HIGH JNCC check-list total indicates very high diversity with ample aquatic taxa to enable a MTR survey to be undertaken. The richness of species is a combination of the unnatural formation of lakes, and the lower gradient of the channel – leading to an open channel. Some aquatic vegetation has obviously been planted within the lakes. Bryophytes do not dominated in the channel, but instead species characteristic of perennial chalk streams are present (crowfoot, blunt-fruited water-starwort, stream water-crowfoot and opposite-leaved pondweed) alongside other species indicating perennial flow (e.g. curly pondweed, un-branched bur-reed)

Hydrogeology: At time of survey the flow was strong, and presence of ornamental ponds at the source suggests healthy perennial flow. No doubts that this is a stream fed by perennially-flowing springs from the chalk.

Naturalness of Morphology	**1**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**16**

Recommendation: The overall score is much lower than the more natural watercourse 95, despite clear indication of strong chalk stream flow, and a chalk stream flora!! This is because the channel is highly modified. It is recommended that contact is made with the owners of the properties where the stream has been modified into on-line pools to ensure the maximum diversity of channel can be achieved without impacting their aspirations of enjoying the aesthetics/landscape features if their impounded stretch. Protecting the rare example of a perennial head spring flow with associated classic chalk stream flora is essential – it is not known if the land at the source is in the same ownership as the property with the on-line ponds.

97.2 – Stream flowing from Salters Farmhouse Farm; upstream of confluence with watercourse 95 where joins to form stream 98 downstream of Bignor Mill

97.1

97.1

97.2

97.2

Land-use: The land-use on the left is a mixture of improved grassland and patches of woodland, but on the right, woodland dominates (more so than historically).

Stream morphology: The stream is a straightened ditch with steep, re-sectioned, banks that colonized by trees and shrubs. On passing downstream the channel is located in a shallow ravine (see opposite), so there is not/has never been a floodplain. Woody debris and other tree-related habitat features are noteworthy. The stream then passes into lakes and headers for the mill of minimal ecological or habitat value.

Diversity of physical structure: Limited, with no morphological features.

Vegetation character: Very limited and very ditch-like.

Hydrogeology: Upstream flow, and presence of mill, suggests perennial.

Recommendation: Do nothing. This is a ditch that has long since been unnaturally disconnected from the floodplain. Thus recommendations are different than for the upstream section of the channel.

Harting II.2.2B

Naturalness of Morphology Ditched all the way. Very poor morphology	**1**
Diversity of Habitat Good variety of substrates only. Rest = poor and steep sided trapezoidal banks, much occluded by tall ruderals	**2**
Vegetation Character Classic perennial flow flora gives the high 'score' – even got *Veronica anagallis-aquatica* agg.	**5**
Perceived naturalness of Hydrology Probably just perennial spring flow.	**4**
OVERALL TOTAL (max 20)	**12**


Recommendation: Do nothing other than note is perennial chalk stream with drain morphology.

Harting Stream II.2.3A
Survey limited to u/s bridge as d/s ditch and lacking chalk stream character

Naturalness of Morphology Short upstream section of interest (shallow and less modified), but rest pure ditch.	**2**
Diversity of Habitat Very limited habit diversity beyond source woodland area (but this is dry and not particularly noteworthy).	**2**
Vegetation Character Classic winterbourne/drying ditch flora.	**4**
Perceived naturalness of Hydrology Appears to be a natural winterbourne with strong winter/spring flow and long periods in summer without flow.	**4**
OVERALL TOTAL (max 20)	**12**

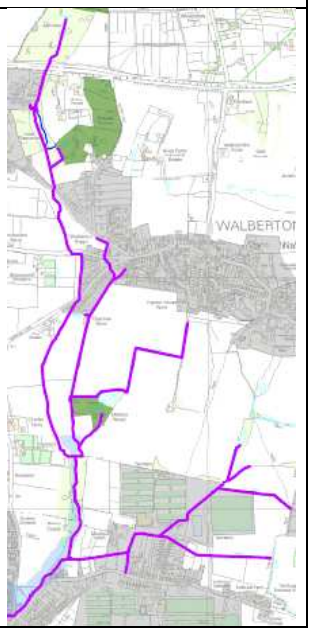

Eastergate III.2.1a

	
Clean gravel/pebble bed and crystal-clear water – key indicators of chalk-spring fed watercourse	**From start to finish, channel cleared as if an IDB drain and flood threat**

	
As above – but more than 500m downstream before it become more sluggish with a silt bed	

Land-use: Totally dominated by improved grassland		
Naturalness of Morphology: Modified by straightening, very much deepened, and present-day 'weed' clearance'. Some minor marginal bars create a semblance of recovery of some naturalness features.	**2**	
Diversity of Habitat: Not very diverse as so deep-dredged as a ditch, and also cleaned. Substrate changes as becomes sluggish in extreme downstream limit	**2**	
Vegetation Character: Very bare for much of length as had vegetation very recently removed.	**4**	
Perceived naturalness of Hydrology: Appears to have perennial springs – but flora does not confirm this totally (only *Callitriche obtusangula* present of the main perennial chalk stream species) so may dry in drought years.	**4**	
OVERALL TOTAL (max 20) **Recommendation: This is the classic 'dilemma' watercourse – clear evidence of chalk stream hydrology, and strong influence of springs on the ecology, but morphology is totally ruined by ditching to an extreme degree with deep dredging to form a very incised, steep-banked, ditch. Less extreme vegetation clearance is strongly recommended.**	**12**	

Eastergate III.2.1f

Land-use: Very dominated by improved grassland, but several other land use types evident also, including rough pasture, wood and scrub.		
Naturalness of Morphology: Basically a drain but with some recovery.	**2**	
Diversity of Habitat: Very changeable, with classic winterbourne flint bed dominating. Banks mostly very steep, and often high, with diversity increased by local trees on banks close to water's edge.	**3**	
Vegetation Character: Classic winterbourne flora with the in-channel habitats very dominated by *Apium*. Reasonable assemblage, but with banks dominated by tall ruderals and trees/shrubs.	**3**	
Perceived naturalness of Hydrology: Good winterbourne flow within a ditch morphology. Some flow fed to a pond!!	**4**	
OVERALL TOTAL (max 20) **Recommendation:** This is OK but nothing special – do nothing.	**12**	

Trees help increase morphological diversity

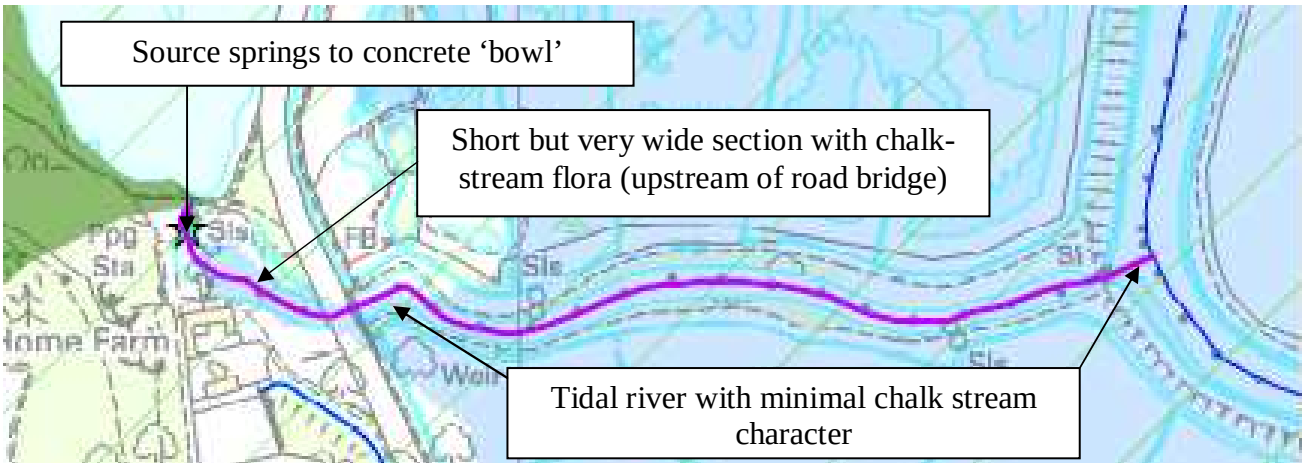
Classic flint bed predominates

Classic flint bed predominates, despite very modified channel

Very steep and high banks in lower reaches

Arundel Steam III.4.1 – East of Arundel and predominantly influence by tidal river d/s

An amazing shock after so different character a few kilometres away at Binsted Wood to find two systems in Arundel with significant interest that is clearly associated with chalk springs.



Extremely unusual watercourse. Source is springs into a concrete-bedded and walled bowl, adjacent to a large ornamental lake. After a shallow weir, flow discharges to a very wide section of river, some 100m long upstream of the road bridge. This section clearly is affected by tidal back-up, but predominantly the chalk spring nature of the water is retained within this short section. Flora reflects perennial chalk stream character, but there is a distinct tide mark on the banks indicating daily fluctuations in water level due to tidal back-up of fresh water.

Land-use: Mixed, with improved grassland, woodland and tall rank herbs predominant.	
Naturalness of Morphology: Totally unnatural, but different!!	**1**
Diversity of Habitat: Very varied, with concrete chamber, then cobble wide shallows to tidal mixed substrates with ebb and flow of tide	**3**
Vegetation Character: One of the richest communities recorded, with perennial chalk stream taxa in the section u/s of the bridge – *Ranunculus penicillatus*. Note also *Zannichellia* present	**5**
Perceived naturalness of Hydrology: Strong perennial springs, but heavily modified and assumed impacted by abstraction.	**3**
OVERALL TOTAL (max 20)	**12**

Start of c100m of freshwater 'chalk stream'

Species include *Ranunculus* at source

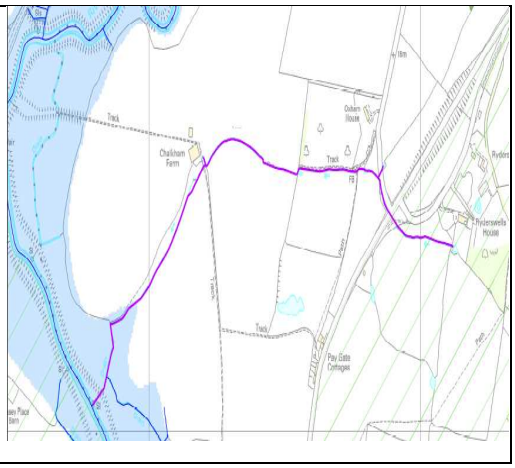
	
Tidal back-up creates tide-line near source	**Tidal wilderness after c150m**

Recommendation: This is habitat is unique, or virtually so, in the UK due to the tidal nature of the chalk stream. Take steps to ensure safeguarded, but there are not reasons why it should be under any threat. Designate CWS?

VI.1.1. Chalkham Farm, near Lewes TQ42506 12517 OS 1:50,000 Map 198

Land-use: dominated, quite unusually, by a mixture of rough pasture, improved grassland and woodland.

Naturalness of Morphology: Featureless ditch at start but character changes on passing downstream where much of it is wide and shallow, without form in places.	**3**
Diversity of Habitat: Variable form of depth and width and also presence/absence of tress/shrubs	**3**
Vegetation Character: Interesting mix of wetland and winterbourne species, with *Apium* dominant in the channel and hard rush dominant on the bank.	**3**
Perceived naturalness of Hydrology: Appears to have winterbourne character – definitely not a perennial chalk spring flow but a periodic high groundwater level	**3**
OVERALL TOTAL (max 20)	**12**



Recommendation: This is a bit of an 'enigma' site as lack of gravel/flints indicates not a chalk stream – but other signs point to it being a weak winterbourne, where there would be little flow but frequently a very high water table. Good wildlife watercourse but nothing exceptional. Using precautionary principle would have to be classed as an unusual winterbourne with minimal gradient.

43 Steyning [Downstream – flows from Watercourse 42 in Steyning] (TQ1711 OS Map 198)

Land-use: Dominated by the urban area of Steyning, with the watercourse backing on to gardens or properties for the whole length. Historic maps show housing development on both sides of the river has taken place in the last 100 years.

Stream morphology: The stream is extremely modified – with a combination of short lengths of culvert alternating with vertical, armoured, banks.

Diversity of physical structure: Very limited. The bed (in the non-culvert areas) is relatively flat, but some slight variation in X-section is present, but rarely sufficiently obvious to create discrete bars (see images adjacent and below left). Banks are mostly hard, vertical and engineered (see below right).

Vegetation character: Impoverished due to physical degradation, but with true aquatics present that indicate a true perennial chalk stream flow (e.g. *Hildenbrandia* [see photo library] *Berula & Callitriche obtusangula*). Presence of *Apium & Rorippa* and others enabled a MTR site to be established – a rarity in this group of watercourses surveyed.

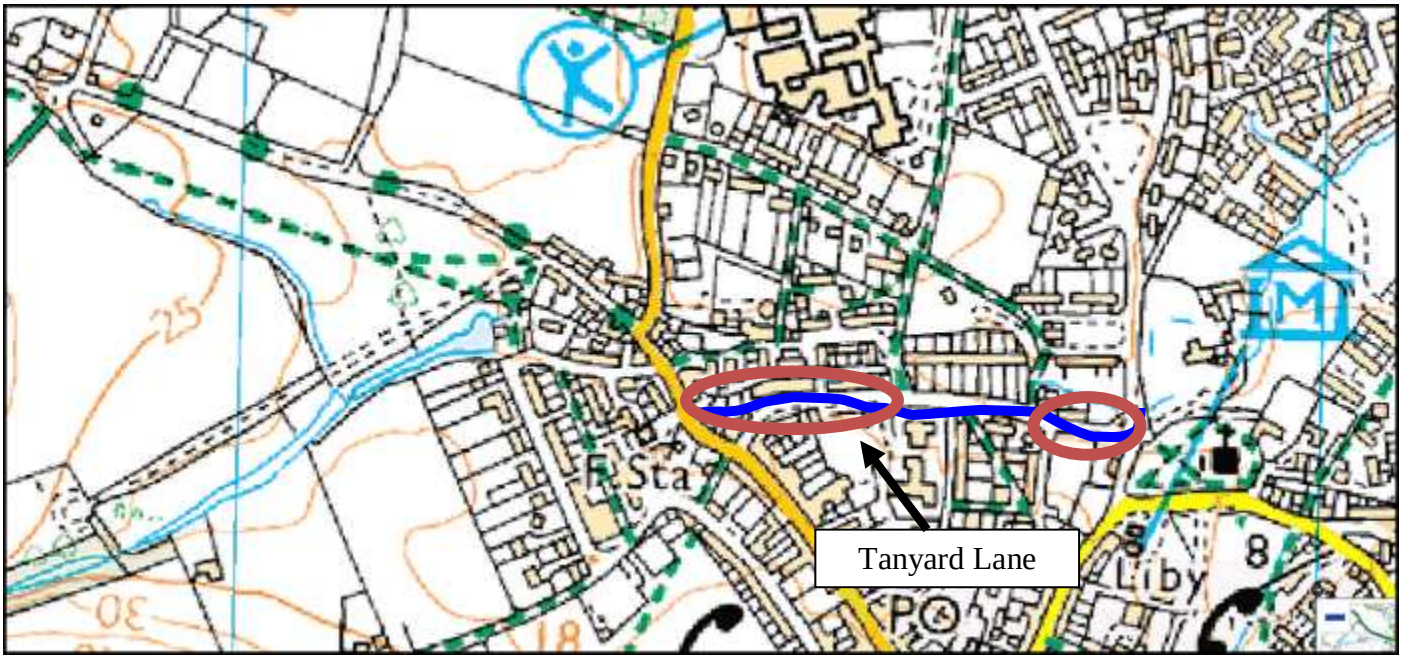
Hydrogeology: Flow was present throughout at the time of survey, and the flora suggests it is present all year round.

Naturalness of Morphology	**1**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**15**

Recommendation: The watercourse is heavily modified and uniform, but has perennial flow. Improvements to the habitat could be easily made – see recommendations below.

Steyning (TQ1711) – Urban Restoration on Watercourse with Perennial Flow

The watercourse flowing through the small town of Steyning has been chosen as the example of a degraded, perennially flowing, watercourse that is ripe for rehabilitation. The main report has suggested that the watercourse enjoys perennial flow, but is heavily modified and uniform. Improvements to the habitat could be easily made to create greater cross-sectional and longitudinal variation. Small pool, riffle (shallow energetic sections) and bar (exposed ledges at low flow) habitats could be formed. In particular the bar habitats provide great potential for improvements in the visual aesthetics of the river, enhanced by some planting of colourful edge species.



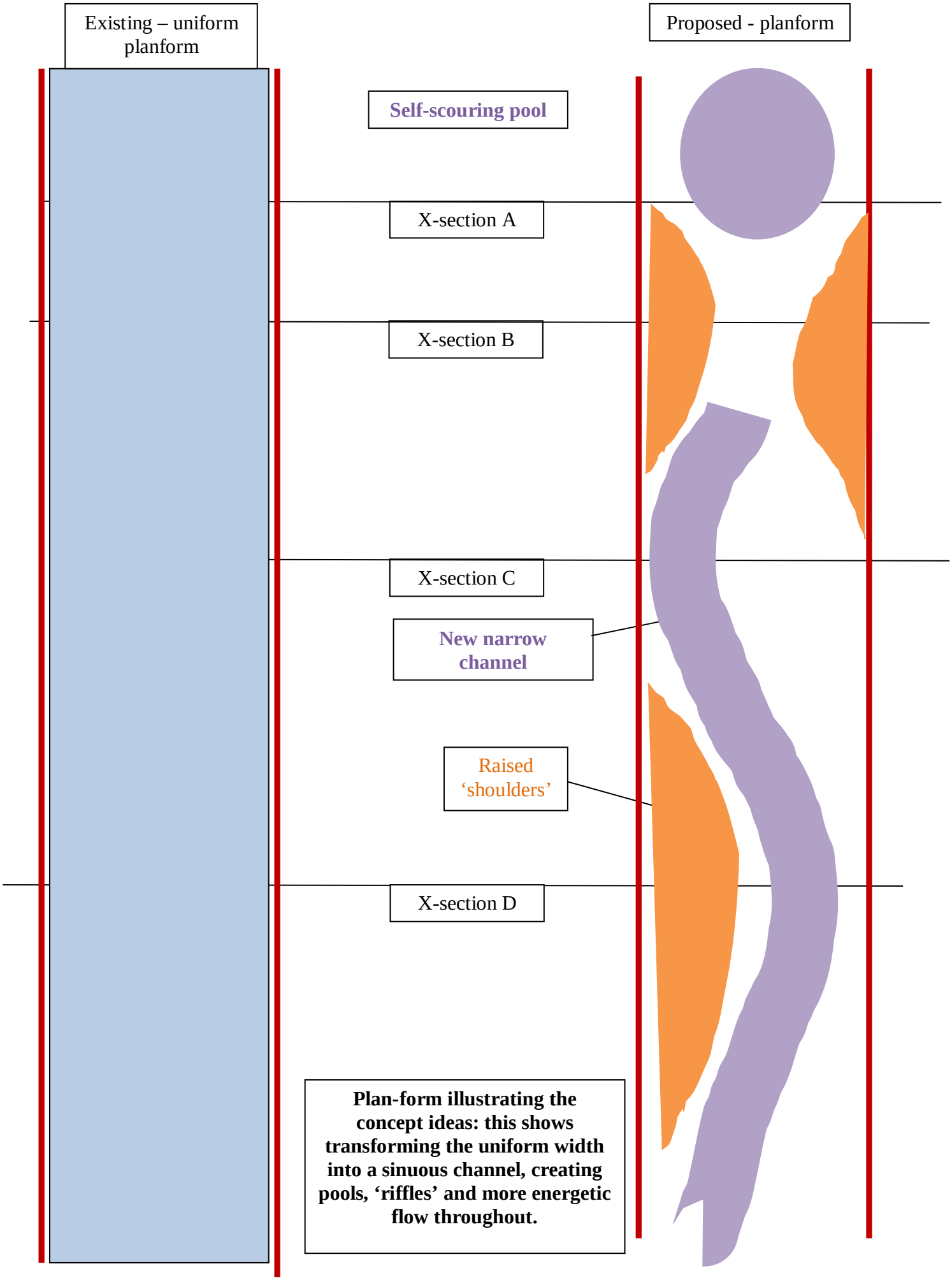
The map above shows two open sections (the brown crescents marking where the watercourse is not in culvert) that are considered ripe for enhancement. Both are visible to some degree to the general public also, so combining landscape enhancements with restoration of more natural chalk stream character is justified. Simple rehabilitation work could be achieved by using a small excavator within the channel, but gaining access will be the major problem. No increase in flood risk would result as the open channel is much bigger than upstream and downstream culverts; these control what maximum sized flood can be conveyed through the open channel.

Images below and above illustrate the present character. Not only does it have a primarily uniform bed, most of the banks are protected by revetments. Proposed enhancements would not only improve the habitat and biodiversity of the channel, but also screen to some degree the unsightly hard bank defences.

In essence, the core component of the project would involve re-distribution of existing bed material. A narrow, sinuous, low-flow channel would be excavated shallowly along the channel, and the spoil would be used to form low berms (shoulders). These raised edges would be above water in low flows, and shelve gently from a height just above water at medium flow to meet the bed gradually below water level. The main desire is to produce more diversity of flow type and turbulence, areas of increased coarse substrate and enhanced aeration, and distinct marginal habitats; all are lacking now.

The proposals are outlined schematically at the end of the text. In addition to just forming a narrow low flow channel, small riffle-pool habitat may also be appropriately established here. It is proposed that where pools are dug, the dug bed material would be placed at the edges of the river upstream to form exposed shoals. These shoals will concentrate flow into the narrowed channel width, and force water at increased velocity into the pool to ensure it remains free of silt. Planting of berms (shoulders) is recommended with colourful species such as hemp agrimony, purple loose-strife, meadowsweet and iris.

All enhancement work could be achieved by using a very small excavator within the channel. Work could only proceed following complete support from the Environment Agency (land drainage consent and flood risk assessment), local people, the local council, and with a full assessment of known flood risk (even though the proposals that could be drawn up would not lead to increased flood risk). Checks should be made to ensure services do not run along or across the river bed.

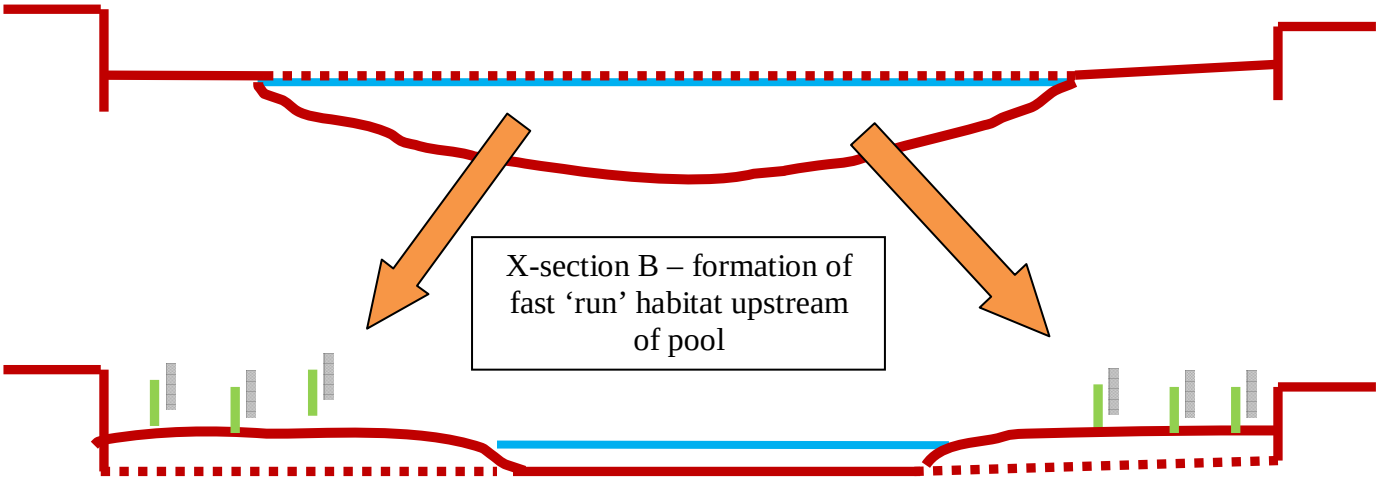


Plan-form illustrating the concept ideas: this shows transforming the uniform width into a sinuous channel, creating pools, 'riffles' and more energetic flow throughout.

Cross-sections illustrating concept ideas: these show transforming the uniform width into a channel with a sinuous low-flow channel with pools and 'riffles'. This will create more energetic flow and more natural chalk stream character – these are illustrative only.

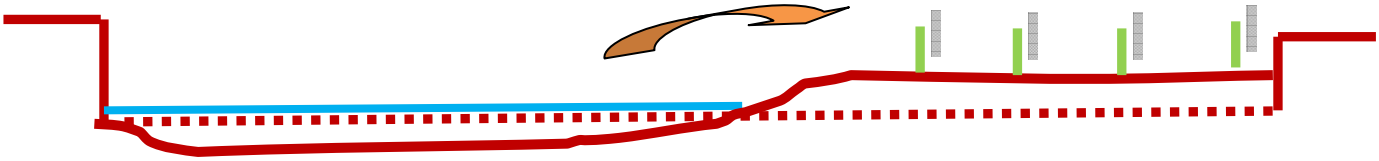
Existing channel – uniform depth

X-section A – creation of a pool

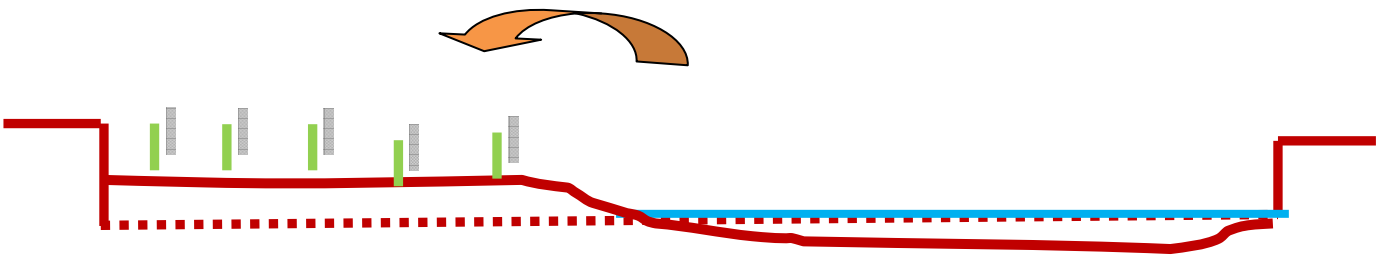


X-section B – formation of fast 'run' habitat upstream of pool

X-section C – formation of narrow-low flow channel and low ledges (planted)



X-section D – inverse of above – narrow low flow on other side of channel



Watercourse 81: Middleton Manor (trib. of watercourse 82/3) (OS Squares TQ34/512: 1:50,000 Map 198) Source 75m; Gradient c1:50

Land-use: Rises as springs (dry at the time of survey) within relatively unimproved grassland before entering woodland (some plantation and some semi-natural broad-leaf woodland). Little change in land-use appears to have occurred in a century.

Stream morphology: Classic open winterbourne in the upper reaches, rising in an ephemeral pool and then flowing (when water present) in a straight, shallow banked ditch (top two photos). On passing through woodland (bottom two photos) it becomes clearly a shaded ditch, and becomes increasing more impoverished physically. Even 1km downstream it is barely 1m wide with vertical clay banks.

Diversity of physical structure: Minor variation in physical form except change from dry open winterbourne ditch to shaded wooded ditch. Tree features limited as dense shade from trees in woodland, not on banks. Bed silt/soil to start, then totally dominated by gravel/pebble.




Vegetation character: Classic flora of winterbournes that are dry for long periods at the start – *Apium, Glyceria notata, Veronica beccabunga* etc. alongside typical bankside species in the channel – *Juncus acutiflorus & inflexus, Filipendula, Achillea* etc. Poor aquatic cover in the longer wooded section, being shade-impoverished

Hydrogeology: Definitely naturally winterbourne at start, and probably so for much of its length.

Recommendation: Very much a ditch; do nothing. Open winterbourne source of interest, and being low gradient and lacking trees is unusual in the study area.

Naturalness of Morphology	**2**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**15**

Watercourse 82 & 83 (Gote Area) plus extra 82A (Gote Stream proper) Source 80m; Gradient c1:33 at start, then gentler

Watercourse 82 - Land-use: Mixed arable and improved grassland dominate on the left bank, a mixture of woodland, plantation, improved grassland and garden on the right.

Stream morphology: The morphology is dramatically different in the upstream half and downstream half. At first the watercourse is a deeply dredged, dry, totally impoverished ditch. In the lower half it is a near-natural wooded stream with a small flow. This has the appearance of being very natural, but in no way typical of the conventional view of what a natural chalk stream should look like.

Diversity of physical structure: Minor variation, at best, is seen in the ditched upper section, with the bed dry and alternating between gravel/pebble and coarser bed material. In the lower section (but it deteriorates at the end), there are some bankside cliffs and marginal gravel shoals. Woody debris is also present.

Vegetation character: Extremely impoverished; dry ditch flora in the upper half and very shaded, with unstable bed, in the lower half.

Hydrogeology: A winterbourne ditch in the upper half – either winterbourne or near perennial downstream of the inflow from the 'Gote' tributary. A gauge at this point should provide key information, but the springs feeding the Gote stream seem to be perennial. Local people suspect historic abstraction may have an impact (see Gote Stream 82A report notes).

Recommendation: Very much a ditch with no special interest in upper half; protection and allowing to develop naturally is the recommendation for the stream downstream of the Gote stream inflow. The dry upper section is of minimal interest, but the lower section through the wood is of very high interest.

Naturalness of Morphology	**(u/s 1) 3 (d/s 5)**
Diversity of Habitat	**(u/s 1) 3 (d/s 4)**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**(15)19(22)**

Watercourse 84.2 Plumpton

Land-use: Wet alder woodland is extensive on both banks, with improved grassland on the left and gardens on the right both extensive.

Stream morphology: Some good woodland stream morphology in the upper 30%, deteriorating downstream as the effects of ponding from the downstream historic mill are felt (in the wet alder woodland, where the connectivity of the watercourse with the wet woodland is superb. Downstream of the mill the watercourse is certainly not a chalk stream, and the habitat impoverished.

Diversity of physical structure: A mixture of a clay ditch and woodland stream with good tree root habitat present locally. Silt and clay predominate, as opposed to gravel/pebble upstream (the more natural chalks stream habitat area). No bar features present.

Vegetation character: No formal JNCC survey undertaken as one done upstream. Flora was not rich, being ditch-like and often impoverished by shading.

Hydrogeology: Almost certainly a perennial stream.

Recommendation: Stream morphology historically impacted by ditching and impounding influence of historic mill (old mill pond appears now to be the wet woodland!! – an extremely valuable habitat and illustration of what habitat can develop naturally over time – protection to continue evolving is recommended). Only very short sections have semi-natural woodland character, but the section upstream of the mill in the old mill pond is worthy of further study and special attention in the future use as an education area demonstrating succession.

Naturalness of Morphology	**2**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**2(impact at mill d/s)**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**15**

91.2 – Duncton Barlavington - Middle section of three

Land-use: Terrestrial land-use dominated by improved grassland/parkland (playing fields on left – Lavington Park), and woodland along both banks that rise steeply to form a deep valley in the top 50%.

Stream morphology: Much is heavily modified by on-line lakes, two small ones used as fish stews and a major one at the downstream end. Between the lakes, and dominant in the upper 50%, the stream is fast-flowing with a rocky, almost boulder, substrate. There is a short section resembling a lowland chalk stream upstream of the largest lake. Photos show the massive differences in character between impounded lakes, and fast-flowing non-impounded sections. Morphology reflects the steep gradient, with physical characteristics more akin to a Derbyshire dales river than a southern chalk stream.

Diversity of physical structure: Good only between the lakes. The lakes provide unnatural, but undeniable, diversity in open water habitat, as is illustrated by the flora present.

Vegetation character: The MTR sites had a similar flora to the upstream site in 91.1, with a mixture of bryophytes, and *Apium & Berula* dominant. No JNCC survey was undertaken, but as upstream, bryophytes were also common, with *Chiloscyphus* common. The MTR score of 55 suggest no serious water quality impacts on the flora, but the presence of the pelt alga *Vaucheria* suggests enrichment from the fish farms or other sources. In the lake *Hippurus* was common.

Hydrogeology: At time of survey the flow was very healthy when some streams elsewhere from the Downs were barely flowing; this, the flora, and the presence of ornamental on-line lakes, suggests perennial flow.

Naturalness of Morphology	**2**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 25)	**15**

The much more natural character and steep gradient in upper section(left) & on-line d/s lake (right)

Recommendation: It is very probable that little can be done regarding the habitat through private gardens in the lower third where the longest lake is present – it is a major ornamental feature that is likely to be highly prized and probably has historic interest. The short sections with fish stews are probably of sporting and commercial interest. It is imperative that these are properly licensed and managed to ensure water quality is not impaired by legal operations. The non-impounded stretches deserve recognition as examples of steep gradient perennial chalk streams of southern England.

Stream 16 – West Chichester (OS SU8404/8405 – 1:50,000). Source 25m; Gradient c1:90

Land-use: Dominated by either arable or improved pasture, with a thin fringe of woodland on the right (was much more extensive 100 years ago) and some rough pasture on the left (school grounds).

Stream morphology: Very straightened, with the only bends being very artificial doglegs between otherwise ruler-straight sections. Not erosion or deposition features.

Diversity of physical structure: Non-existent; little or no variation in bed material (silt/earth) and as no flow, no variation fin flow types either.

Vegetation character: Very impoverished. The flora indicates a very very weak winterbourne flow that reliably fails for many months each year – classic taxa in such areas include *Apium* alongside terrestrial herbs and grasses occupying the bed. *Phalaris* was locally abundant in the lower, open ditch, areas.

Hydrogeology: Ditch is created in an area of intermittent springs that fail for long periods each year.

Recommendation: A winterbourne converted to a very poor ditch. Remediation not recommended unless done in tandem with the owners of the public open space – potentially this could be a good site for a demonstration project to show what can be done to such degraded sites. It should be noted that such habitats often support specialist invertebrates, and therefore have ecological value that is rarely recorded; thus retaining as open channel is important.

Naturalness of Morphology	**1**
Diversity of Habitat	**1**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**14**



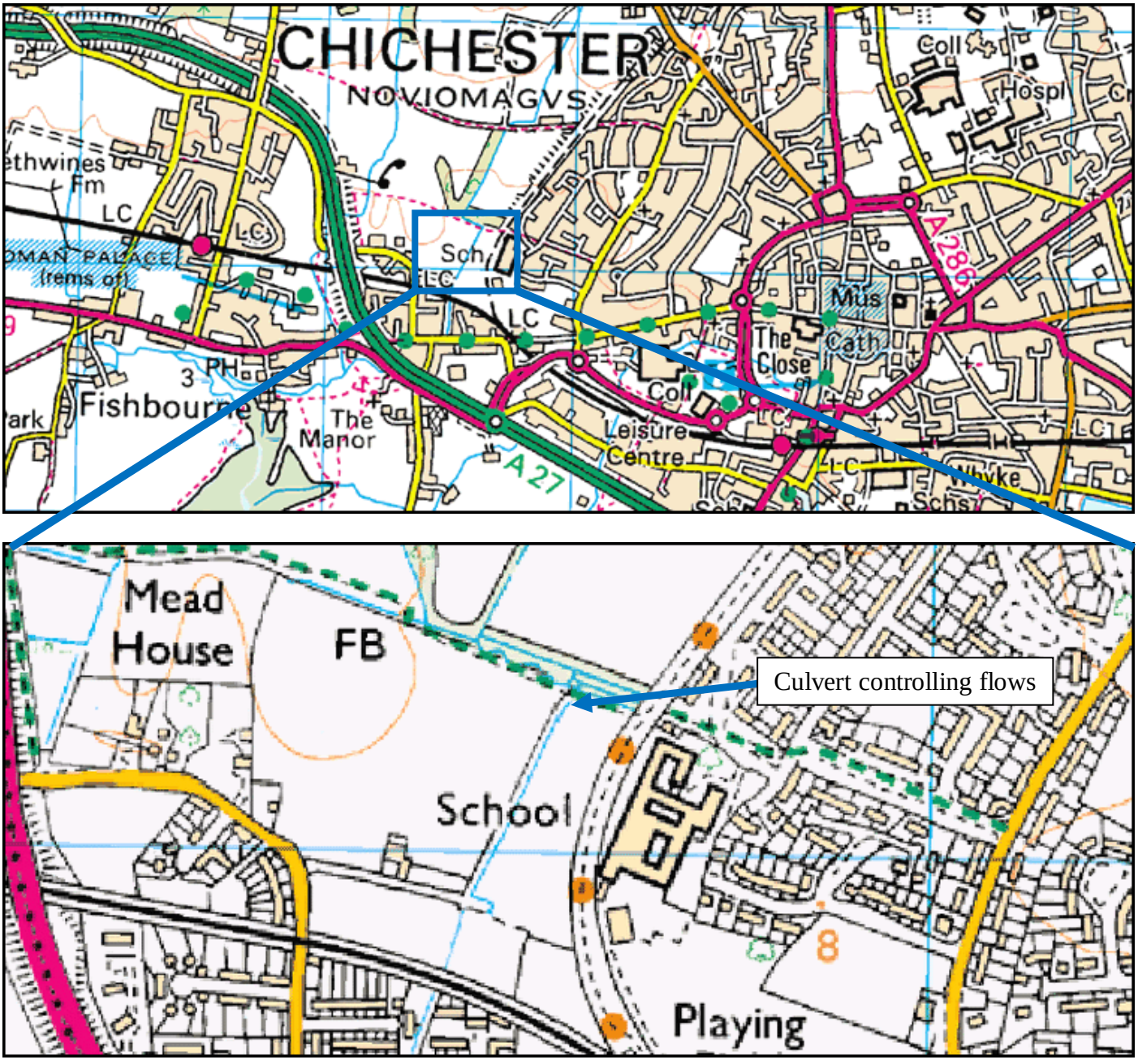

APPENDIX 4E Rehabilitation recommendations Fishbourne Stream
Enhancement of winterbourne *in situ*

Countless sections of watercourses surveyed have been converted to featureless ditches. A typical example is found west of Chichester, the precise location being shown on the maps below. This is a winterbourne, expected to dry in late summer and autumn in all but the wettest years.

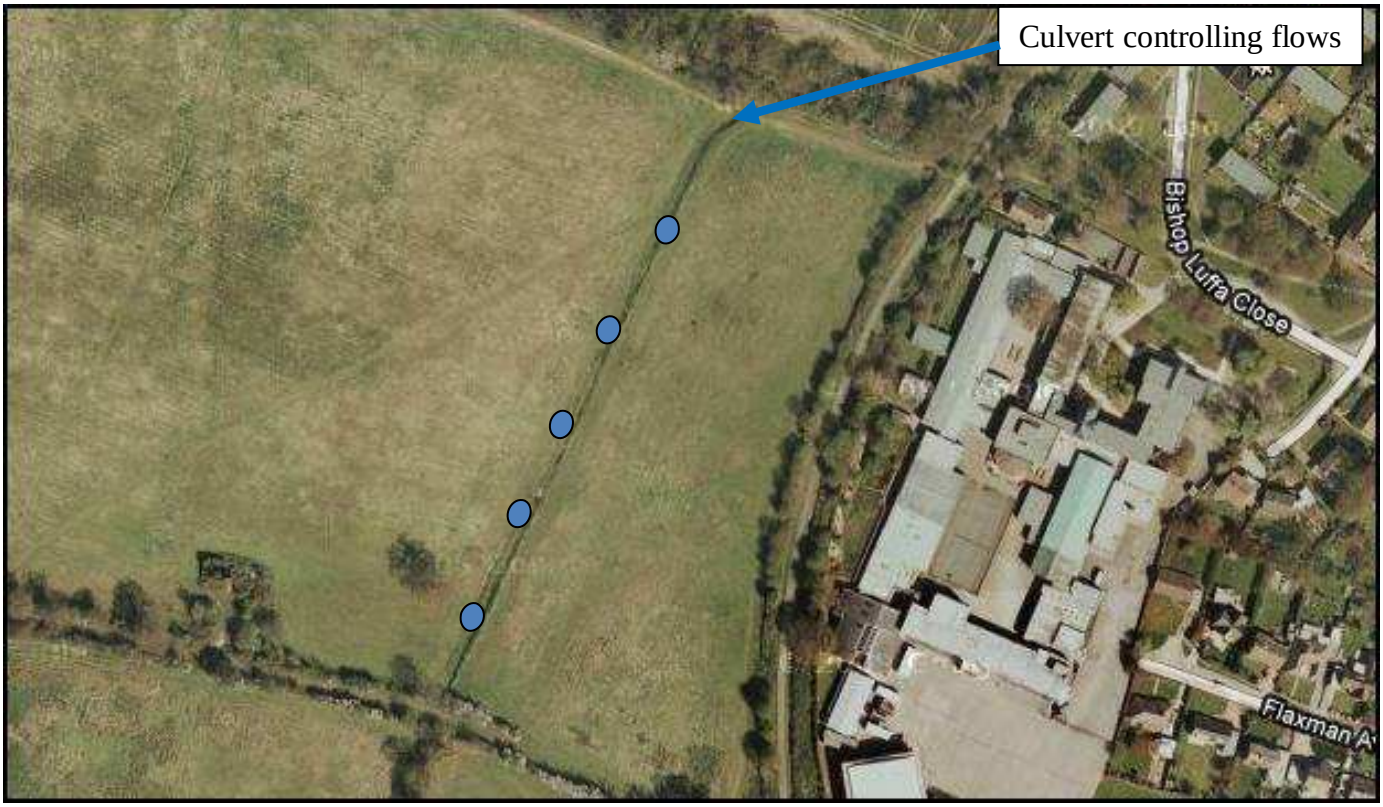
As in most cases, the ability of the ditch to convey flood flows is not restricted by the size of the channel, but the culvert upstream.

The flora of the ditch is limited, indicating periodic flow only. No information is available on invertebrate life within the channel, but this probably reflects the specialised fauna that is associated with regularly drying streams of this type. Any changes to the channel structure would not result in anything other than short-term impacts on the existing communities, and provide additional habitats suitable for other species too.

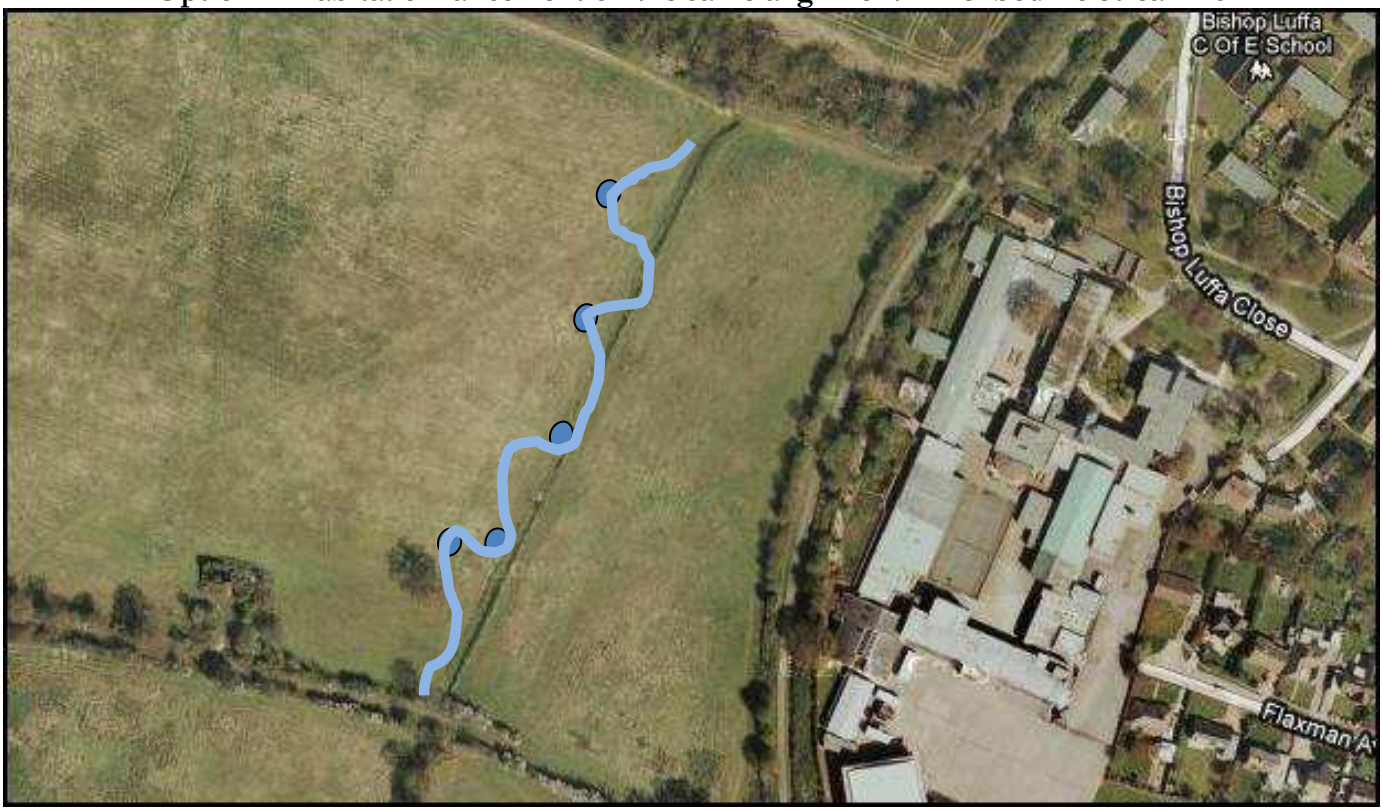
The site is located in rough pasture/school playing fields. The open access, close to a school, gives extra impetus to do enhancements as all work would be visible to the general public, and provide outdoor environmental education opportunities for the school.



An aerial image of the target area is shown below. Two possible options are shown. Option A is by far the simplest and cheapest, with implementation possible in just a few hours. Option B would take longer, perhaps three days. The former involves simply digging deep pools along the existing channel, and the latter would re-meander the channel, as well as create pools along the newly formed channel.



Option A Habitat enhancement on the same alignment – Fishbourne Stream 16



Option B - Habitat enhancement changing the alignment – Fishbourne Stream 16

Being a winterbourne, there are limits to how much change can be translated into improved floodplain habitat or re-establishment of more characteristic stream biota. The creation of deeper pools means water will be held for much longer, and may even result in the streams being able to support breeding amphibia. With a meandering channel formed, additional habitats can be created, changed and sustained by the stream itself, such as small

cliffs on the outside of the meanders and deposited bars on the inside. This site has been selected as it is close to a school, habitat enhancement could be achieved simply, and the local community and education system can be involved with it from the start, and monitor its development.


The watercourse in August 2009 – bone dry along whole length

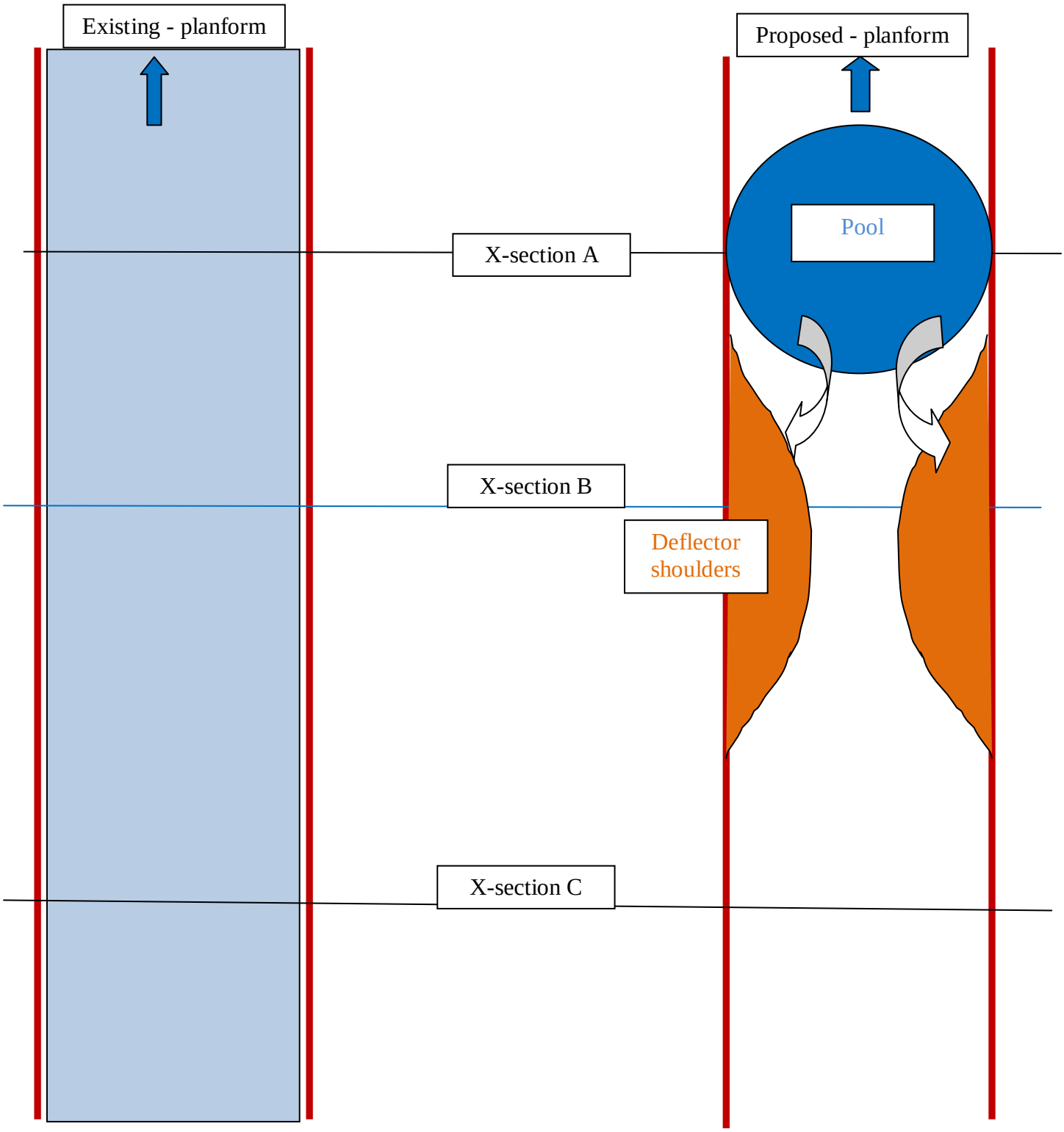

Flowing water in January 2010

Creation of option A end-state requires simply digging deeper and wider pools in locations say 40m apart; spoil arising from this is place at the edges of the ditch upstream to form raised 'shoulders' that consequently form a narrower low-flow channel that forces water at increased velocity into the created pools. This results in the pools being cleansed of silt in high flows.

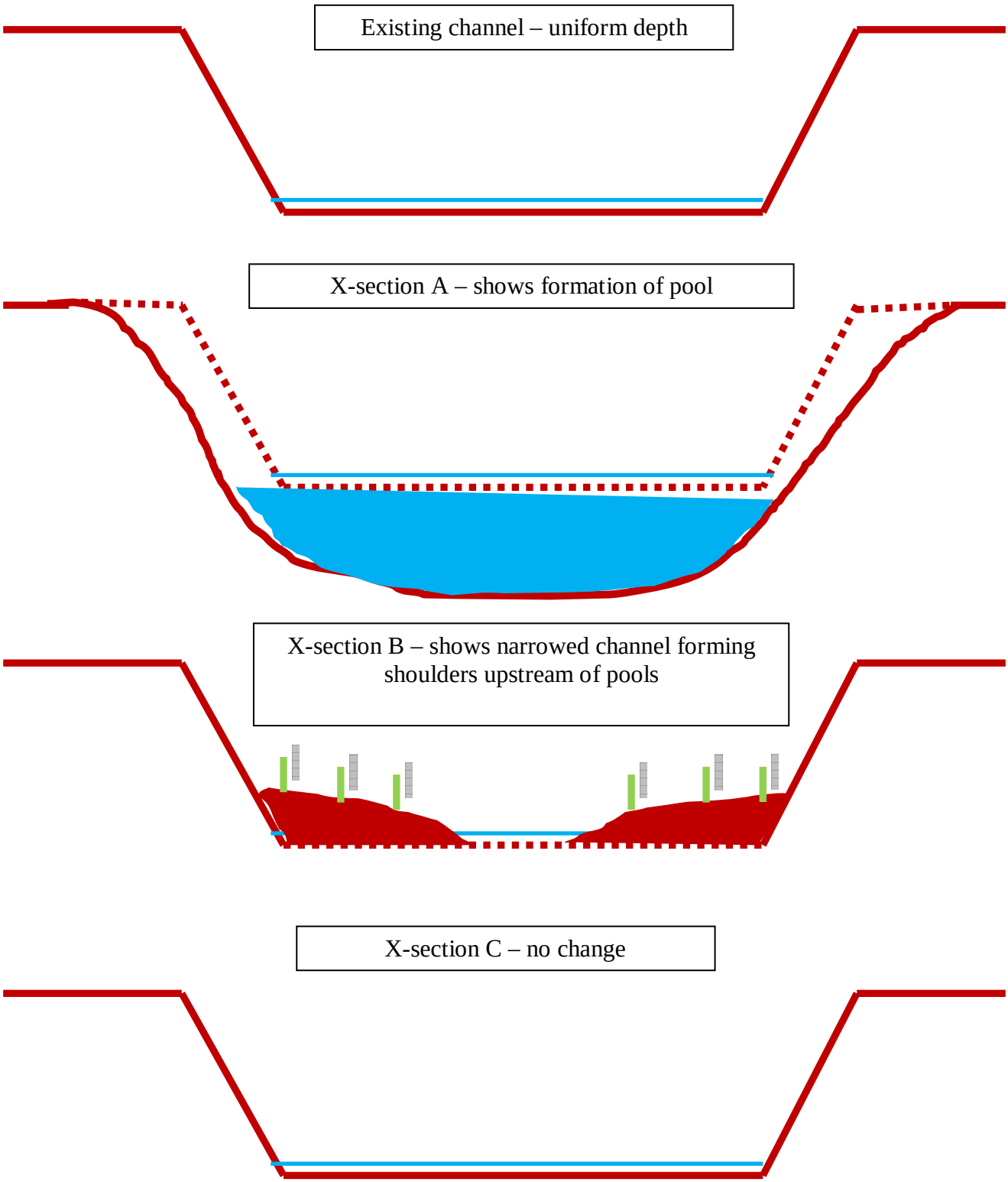
Option B involves creating a small, more structurally varied, channel that meanders across, or alongside, the existing channel. Spoil that arises from this is placed into the existing channel.

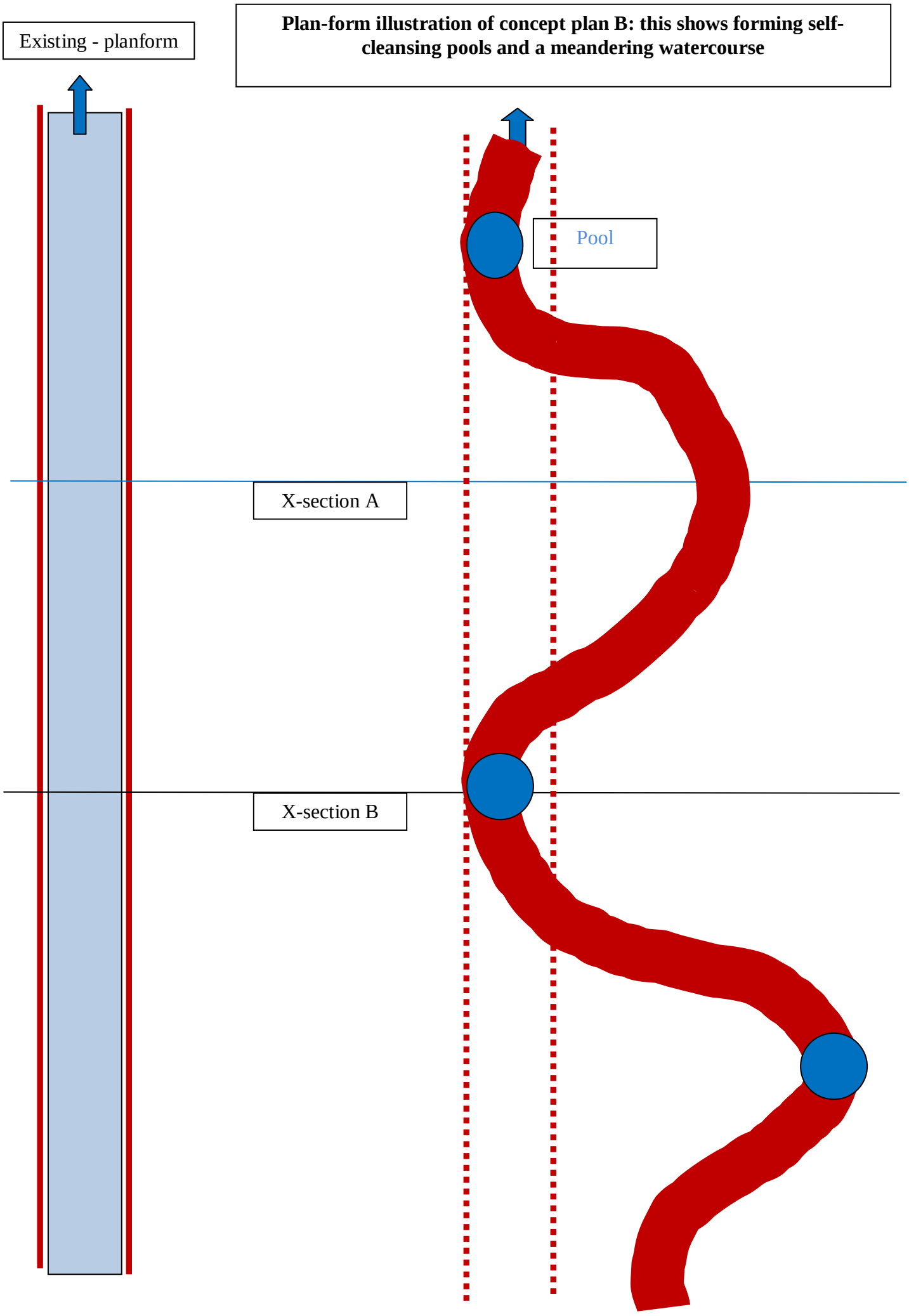
The ledges on the new channel could be planted with colourful edge species, involving local people. Species such as meadowsweet, purple loosestrife, water-mint, flag iris etc. would be suitable. The annex at the end of this Appendix illustrates potential native species that might be used, all of which would be in keeping with the area.

Plan-form illustration of concept plan A: this shows forming self-cleansing pools within the existing straight ditch



Cross-sections illustrating concept plan A: formation of self-cleansing pools

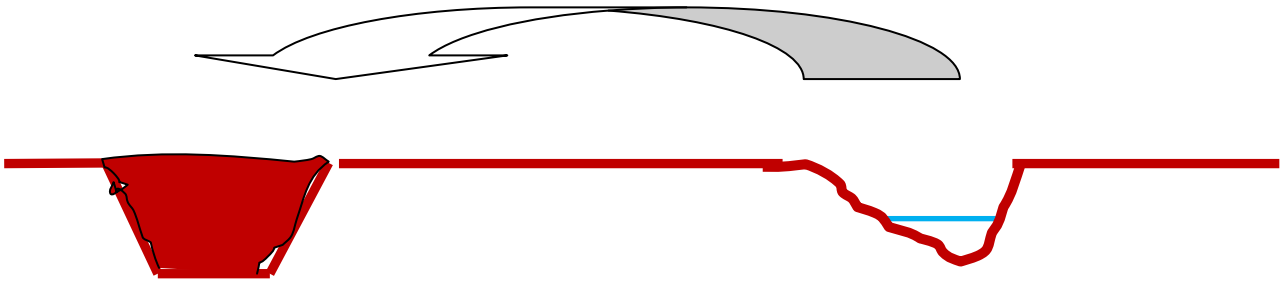



Existing - planform
Plan-form illustration of concept plan B: this shows forming self-cleansing pools and a meandering watercourse
Pool
X-section A
X-section B

Cross-sections illustrating concept plan B: these show transforming the straight channel with uniform width into a sinuous channel, creating pools on meanders etc. – these are illustrative only

Existing channel – uniform depth

X-section A – new meandering channel – spoil used to fill in old channel



X-section B – new meandering channel – here it is shown crossing the existing channel where a pool is formed on the meander

Watercourse 45 Chillington/Novington Lane (TQ3713/14; OS Map 198) Source 55m; Gradient c1:50

Land-use: Mixed arable and improved grassland dominate on the right and improved grassland and the road extensive on the left.

Stream morphology: Morphologically bereft of any diversity. It is simply a narrow ditch.

Diversity of physical structure: Minimal diversity, with main variation in uniform ditch character provided by whether the bed is wet or damp. Gravel/pebble predominates on the bed, suggesting this is a winterbourne.




Vegetation character: Extremely impoverished for the majority, with a dry ditch flora dominated by terrestrial species on the bed as well as the bank. Species such as *Stachys, Filipendula, Epilobium* and non-aquatic herbs on the bed indicate long periods each summer without flow. In the upper half few hundred metres (see photo top right), flow is obviously retained for much longer, and the bed is dominated by *Apium*.

Hydrogeology: A winterbourne ditch. The intermittent flow is assumed to be totally natural, but the morphology not so. The ditch loses water on passing downstream – the bed was damp in the extreme upstream location, and dry for the majority. How natural the lack of accretion is, is unknown.

Recommendation: Very much a ditch with extremely impoverished morphology and intermittent flow. May be important for invertebrates, but otherwise not a stream of great interest and not in need of any special attention; rehabilitation options minimal.

Naturalness of Morphology	**1**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**14**

64 – Watercourse East of Wilmington (OS Square TQ5504; 1:50,000 Map 199) Source 25m; Gradient c1:80

Land-use: Totally dominated by arable land, with just a small area of woodland at the source – a typical source character for many of the streams. This is illustrated in the adjacent photo.

Stream morphology: The watercourse is very much a ditch, and had no flow throughout at the time of survey. At the source a few puddles were present, but downstream the bed was dry or just damp.

Diversity of physical structure: Non-existent, it being a straightened ditch throughout.

Vegetation character: The flora is extremely impoverished. At the source the bed and tree roots had bryophytes such as *Pellia & Cratoneuron* (typical of chalk streams/winterbournes) and *Apium* where more open. The dry ditch is dominated by *Epilobium* and terrestrial species, with *Typha* on the damp open bed near the downstream end (see image adjacent).

Hydrogeology: At time of survey no flow at all. Although morphology has been greatly modified to form a ditch, the hydrology may be natural – a winterbourne.

Naturalness of Morphology	**1**
Diversity of Habitat	**1**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**14**

Recommendation: A winterbourne ditch. Extremely modified and not an obvious candidate for rehabilitation. Hydrology may mean the very physically degraded ditch is still important for specialised invertebrates. No habitat restoration or special protection measures recommended, but potential to enhance should the landowner seek to do so.

65 – Watercourse North of Folkington (OS Square TQ55/604; 1:50,000) Source 25m; Gradient c1:100

Land-use: Mixed arable land and improved grassland on the left bank, and improved grassland on the right. The stream rises in a small area of woodland at the source – and there are small patches of woodland present within the otherwise intensively farmed area through which the stream flows. The photo adjacent shows the 'ditch' close to the source where shade from the woodland results in ivy being the dominant species on the bed. There are two watercourses with winterbourne flows, with the one to the east most wooded.

Stream morphology: Both the watercourses are very much like ditches, and had no flow throughout at the time of survey. With pasture on one side and arable cultivation on the other, the main ditch is fenced (see adjacent image).

Diversity of physical structure: Non-existent, being ditches throughout – very like neighbouring stream 64.

Vegetation character: As for 64, the flora is extremely impoverished. *Apium* is present where more open, and the dry ditches are again dominated by *Epilobium* and terrestrial species (including ivy in the most shaded stretches), with *Iris,* not *Typha* on the damp open bed near the downstream end (see image adjacent).

Hydrogeology: At time of survey no flow at all in either ditch. Even at the sources there was no water, and the bed was only just damp in the lowermost section surveyed.

Recommendation: As for 64. Extremely modified winterbournes, forming ditches that are not obvious candidates for rehabilitation. Hydrology may mean the very physically degraded ditches are still important for specialised invertebrates, especially in the wooded sections. No habitat restoration or special protection measures recommended.

Naturalness of Morphology	**1**
Diversity of Habitat	**1**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**14**

91.1 – Upper section of three – Lavington Park stream Source 50m; Gradient to d/s lake (A285) c1:55

Land-use: Terrestrial land-use dominated by improved grassland, and gardens, with some woodland, **and also reed swamp near end.**

Stream morphology: The majority is heavily modified. There are two major lakes with high impounding structures, as well as a fish stew pond, also with a significant weir downstream. Between the two lakes there is a short stretch of wide, shallow, pebble/gravel dominated stream akin to a chalk stream. In the lowermost section there is c50m of high quality chalk stream flowing through herb-rich margins with adjacent reed swamp. **This short section is a priority protection area – true perennial chalk stream.** Bed is dominated by pebbles in this most natural section, with flow types typically being rippled. The lakes were assumed to have silt beds and had no perceptible flow velocity.

Diversity of physical structure: Good only between the two lakes and in downstream 50m and 'artificial' in remainder.

Vegetation character: Above average diversity of JNCC taxa, and sufficient species to enable a MTR site to be established. Only a single classic taxon of perennial chalk streams was present - *Berula*, but winterbourne taxa were very well represented. Bryophytes were also common, as in many sites, with the tree roots an important habitat. The liverworts *Chiloscyphus* (in particular) and *Pellia* were common. The MTR score of 59 suggest no serious water quality impacts on the flora. In the lake there is *Hippurus, Zannichellia & Berula.* Overall the flora is diverse, with 41 JNCC taxa recorded (but no crowfoot was found).

Hydrogeology: At time of survey in August 2009 the flow was healthy, and the presence of ornamental on-line lakes very strongly suggests perennial flow (or naturally a very strong winterbourne flow). Flora suggests perennial – again a low altitudinal source below very steep escarpment supports assessment as perennial flow.

Naturalness of Morphology	**2 (5 in lower 50m)**
Diversity of Habitat	**2 (4 in lower 50m)**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**5**
OVERALL TOTAL (max 25)	**14**

On-line top lake (left) and the much more natural character in lower 50m (right)

Recommendation: It is very probable that little can be done regarding the habitat through private gardens in the majority of the stretch, as lakes form significant ornamental features that are likely to be highly prized and may have historic interest. The short section between the two lakes could be enhanced, but the length is very short. The lowest 50m section should be considered high priority to acknowledge as worthy of some form of protection.

The section at the very start, downstream of the source ornamental pond (illustrated opposite) is a good candidate for creation of a more natural chalk stream – but this would need discussion with landowners.

EX 02 – Friston Chalk Stream; Cuckmere Estuary Floodplain (OS Square TQ5100; 1:50,000 Map 199). Too short to enable formal 500m vegetation or habitat survey. Source <5m; Gradient c1:100?

Land-use: Totally dominated by improved grassland or rough pasture. The short watercourse arising directly from the chalk springs is <100m long (photo adjacent) before it flows through the old Cuckmere River floodplain.

Stream morphology: The watercourse is just a ditch, and was dry (see photo adjacent).at the start. It is a grazing marsh ditch downstream (see photo below).

Diversity of physical structure: Almost non-existent; the only variety being the upper section has a dry bed for much of the year, and the grazing marsh section would have standing water present all year round.

Vegetation character: The flora of the dry winterbourne ditch was typical of a winterbourne that dries for long periods – dominated by non-aquatic grasses and herbs, with sparse *Persicaria amphibia, Mentha, Juncus inflexus & Carex hirta.* The grazing marsh ditch <75m from the spring source is rich in aquatic macrophytes that indicate the perennial presence of standing water. Species included: *Rumex hydrolapathum, Apium, Berula, Sagittaria, Hydrocharis, Alisma, Ceratophyllum, Lemna, Sparganium, Schoenoplectus, Phragmites, Glyceria maxima* etc.

Hydrogeology: 75m of chalk-spring fed winterbourne then grazing marsh ditch with standing water all year round. Not possible to determine if anthropogenic impacts impact water availability but likely. Upstream of the springs, is a lined permanent pond.

Naturalness of Morphology	**1**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**5?**
OVERALL TOTAL (max 25)	**14**

Recommendation: A winterbourne, then a grazing marsh ditch. Hydrology with diversity of stream substrate suggests this may be important for specialised invertebrates. Minor protection effort only recommended. There is nothing to suggest this has ever been a perennial spring head, but it is reported that public water supply boreholes may have an impact.

Bosham 1.2.1e – downstream section of catchment 1a-d (plus g) from Funtingdon

Strange and confusing section of watercourse. On passing under the dual carriageway, the discharge appears to diminish. The 'main channel' (not surveyed, flows to the east and is impounded for its entire length (see photos 1 & 2 and 12 & 13), but there is a more natural channel that flows through improved grassland to the west. At the start it has very shallow, gently graded, trampled banks, but in the lower section is deeply incised.


Impounded channel on the left, and the lower meandering course on the right


Good winterbourne character for several 100m, then deeply ditched

Land-use: Arable cultivation and improved grassland dominate.	
Naturalness of Morphology: Canyon-type drain at end, but **very attractive floodplain shallow 'stream' with trampled edges for >50% of length.** NOTE; this is the western channel – eastern channel featureless and ponded.	**2**
Diversity of Habitat: Main diversity is in the variety of bank heights and profiles, and bed material. Gravel/pebble dominates, but silt also important component in places	**3**
Vegetation Character: Typical rich flora of near-perennial/very reliable winterbourne watercourses. Presence of *Berula* confirms perennial community	**4**
Perceived naturalness of Hydrology: Too much flow diverted to eastern channel so the more natural one is 'starved'.	**2**
OVERALL TOTAL (max 20)	**11**

Recommendation: Try to get more flow down the more natural channel. Recognise good habitat of the upper section within the open grassland area, but it is not as special as upstream.

Watercourse 82A (extra - Gote Stream proper; TQ3413) Source 75m; Gradient c1:35

Land-use: Starts as 'walled' spring downstream of the road, and then flows through extensive landscaped garden. Downstream is flanked by rough pasture on the right, and extensive gardens on left.

Stream morphology: The morphology changes greatly in the short length. At the start it flows in a pebble bedded semi-natural looking course before flowing in lined channels and ponds in the garden. Downstream it is a trapezoidal ditch with a pebble bed. There are no natural morphological features, and several weirs.

Diversity of physical structure: Varied due to intense manipulation. Only a few 10s of metres at the start, and then the lower 50%, has semblance of natural chalk stream character.




Vegetation character: Mosses are common on the rocks at the start, and on the concrete weirs. In the flowing channel downstream, winterbourne flora is present, as indicate by the dominance of *Apium* and presence of water-cress. Aquatics such as *Elodea* are present in the ponded sections.

Hydrogeology: The source suggests perennial flow, but the owners re-circulate water to maintain water in their on-line pools. Near perennial flow is suggested by the vegetation (*Callitriche obtusangula*), and the owners – they report drops quicker than it did prior to 2000. An old pumping station (photo a in the library) upstream of the road is implicated in affecting hydrology. Gote is Anglo-Saxon for stream.

Recommendation: Very interesting system, but one that is highly modified. The modifications provide unnatural habitat diversity to a stream with a near-perennial spring feed at its source. Effort and finance to make more natural would not be justified given the high level of landscape and amenity value provided by previous investment. An interesting system where hydrology is important; investigate further (EA gauge downstream) and work with owner to protect and enhance in the future.

Naturalness of Morphology	**1**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**13**

93 – Barlavington. Stream joining watercourse 91 (SU9616) from south Source: 35m; Gradient c1:70

Land-use: Terrestrial land-use dominated by fish farms, with gardens and improved grassland. At the downstream end the stream flows through woodland. Very close to the source (see right) is a large, on-line pond with huge fish. Noteworthy for abundance of adjacent artificial open water habitat.

Stream morphology: Greatly modified throughout. The river is impounded at the top and with weirs and has revetted banks in many places (see below), except in the lower sections (see below right) where the banks are tree or sedge-lined. The watercourse is less shaded than many stretches surveyed. There is little morphological variation other than the substrates of the ponded sections are not composed of gravel/pebble (there is local sand downstream), and associated variation in flow types.

Diversity of physical structure: Limited, and not very natural, except at the downstream limit.

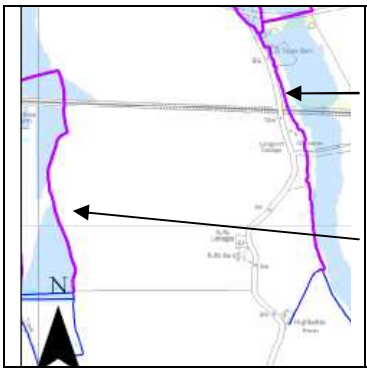
Vegetation character: Many species present indicate a perennial flow, with *Groenlandia & Hippuris* abundant in the upstream lake (see opposite) [with *Zannichellia & Schoenoplectus*]. River water-crowfoot was present also, at the downstream limit where semblance of chalk stream character evident. The MTR score indicates enrichment. Although not proven, the extent of fish farming on, and adjacent to, the watercourse suggests some implication from this source.

Hydrogeology: At time of survey the flow was healthy, but small. Perennial flow is assumed with the presence of the fish farms and lakes added additional support to the flora indicating no failure to flow. Has appearance that was previously a classic perennial chalk stream that was modified to harness the guaranteed flow that could used to turn a mill wheel.

Recommendation: The section is highly modified due to historic mill and commercial fishery interests associated with the stream (and now the adjacent land). Some potential enhancement could be made to the channel where it flows adjacent to fish stew ponds, but the reward may be limited (low to medium priority only) Working with fisheries interests is recommended to ensure nutrient enrichment is kept to a minimum.

Naturalness of Morphology	**1**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**4**
Perceived naturalness of Hydrology	**4**
OVERALL TOTAL (max 25)	**13**

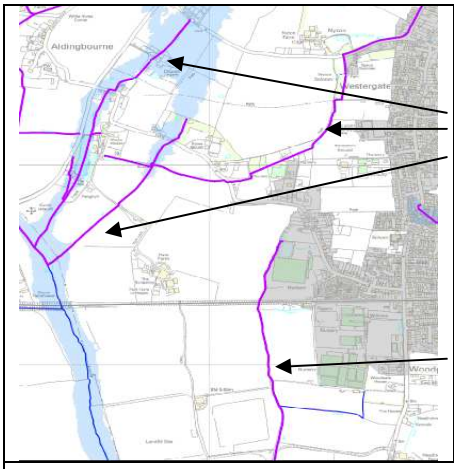
Tangmere III.1.1b

	**This section only surveyed** **This watercourse not surveyed; must assume just a drain as others in this area, with element of spring fed flow**

Land-use: Arable cultivation and improved grass.	
Naturalness of Morphology: Still a **featureless ditch.**	**1**
Diversity of Habitat: No diversity, still with steep banks.	**2**
Vegetation Character: Good winterbourne and absence of any taxa indicative of perennial flow. Silted, more sluggish section, had *Sparganium.*	**3**
Perceived naturalness of Hydrology: Appears to have reasonable spring flows, but would expect to fail in prolonged drought. Given higher score as clearly the groundwater component is a stronger component than upstream	**4**
OVERALL TOTAL (max 20)	**10**

Recommendations for whole catchment: do nothing. These are clearly drains with mainly weak spring flows, so potential for rehabilitation extremely limited, and reasons to specifically protect are limited.

Tangmere III.1.2d



These channels surveyed

Recommendation: Do nothing. Suspect high groundwater flows may be of flood concern?

2 e This channel not surveyed; assumed/predicted on land-use to be drain only

Land-use: Mainly arable, but with improved grassland also common.	
Naturalness of Morphology: Straightened and ditched throughout. Morphologically very uniform.	**1**
Diversity of Habitat: Minimal. Heavy weed clearance is evident (like an IDB channel) so no channel form has been able to develop within the uniform dug channel. Tiny silt bars present, and on-line lake'	**2**
Vegetation Character: Dominant taxa indicate winterbourne, with ivy, shrubs and ruderals on banks	**3**
Perceived naturalness of Hydrology: Strong winter flow from springs suggested by flints on bed, the presence of a previous mill pond and also information from locals. Strong winterbourne	**4**
OVERALL TOTAL (max 20)	**10**






Adur V.3.2

Land-use: Mixed, with wetland (reedbed) and rough pasture dominate	
Naturalness of Morphology: Ditch all the way.	**1**
Diversity of Habitat: Variability mainly in gradient and if wet or dry!!	**2**
Vegetation Character: Again totally dominated by *Phragmites,* but also other reeds and emergents, included rushes at the margins. Open areas winterbourne flora of *Apium & Rorippa.*	**3**
Perceived naturalness of Hydrology: Link to chalk aquifer less strong than in 1a, with upstream winterbourne, and d/s perennial by virtue of ponding and nil gradient there	**4**
OVERALL TOTAL (max 20)	**10**

Recommendation: Check not impacted by abstraction making it winterbourne; not very special, but worthy of note as winterbourne rapidly becoming water-logged drain in wilderness wetland habitat. This is a spring-fed winterbourne in a river floodplain (i.e. floodplain silts overlay the chalk aquifer that feeds the watercourse).


Classic winterbourne in upper section


Ponding influence from Adur floodplain

51 Lewes Winterbourne (OS Squares TQ3909-4109; 1:50,000 Map 198) Source c20m; Gradient c1:100

The Lewes Winterbourne has been segmented on the provided GIS maps into six sections. For reporting purposes all are treated as one, with photos labelled according to the GIS references 51-56. Two separate JNCC and RHS survey forms were completed for reaches 51 and 52/3;

Reach 51 – headwater upstream railway culvert.

Land-use: Wider corridor dominated by improved grassland (horse paddocks) with scrub, tall rank herbs and roads.

Stream morphology: Straight ditch with re-profiled, mostly shallowly sloping banks.

Diversity of physical structure: Minimal save for minor variation in substrate.

Vegetation character: Very poor diversity, and typical of a winterbourne that dries for long periods most years. Bed dominated by terrestrial grasses and herbs.

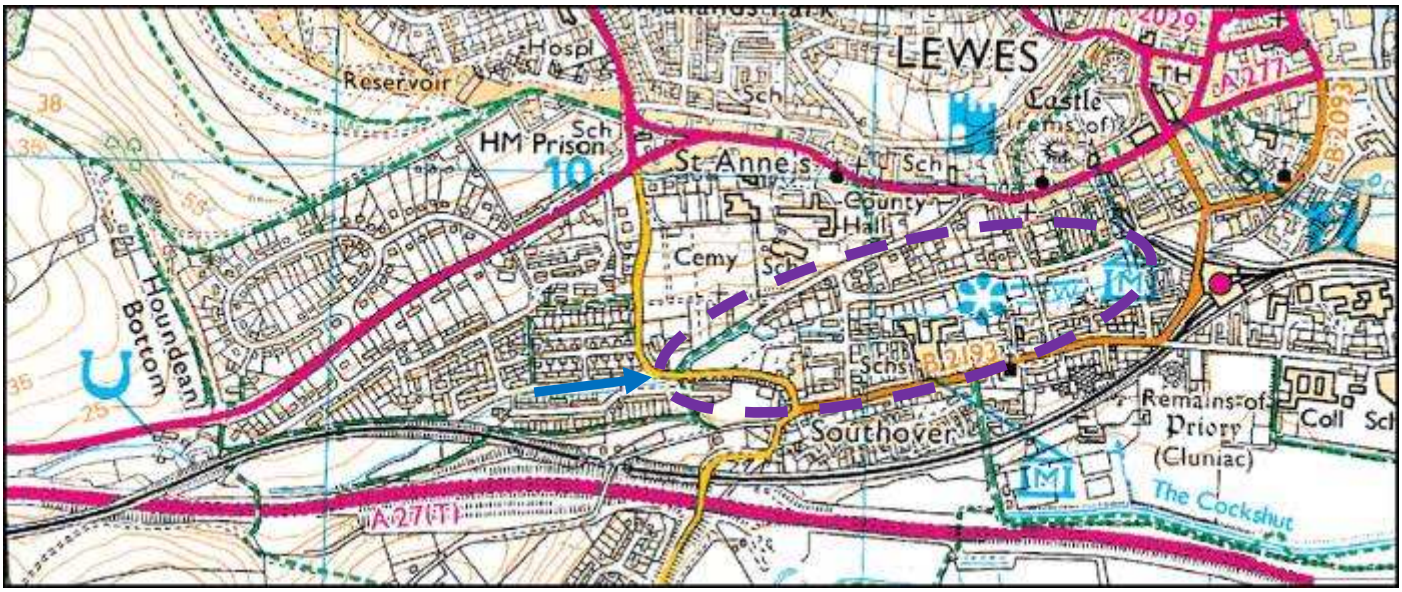
Hydrogeology: Flora and substrate indicate a regular winterbourne that is dry for many months each year.

Naturalness of Morphology	**1**
Diversity of Habitat	**1**
Freedom from Obstructions to Flow	**5**
Vegetation Character	**1**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**12**

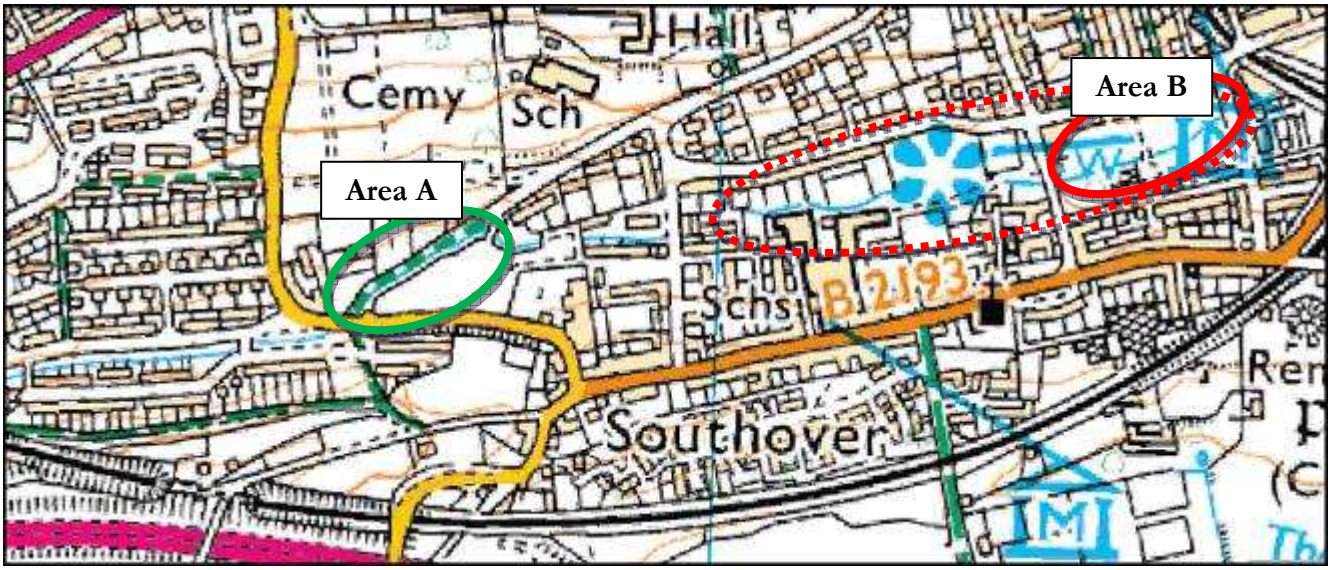
Recommendation: The overall score is higher than would be expected for such a degraded stream, with high scores for being perceived to be a natural winterbourne, and having no obstructions to flow (within the surveyed reach). Nothing recommended in terms of rehabilitation, but it is important to provide protection as such winterbournes often have very higher invertebrate interest.

APPENDIX 4B Lewes Rehabilitation Options (TQ4009/4109) – Urban winterbourne

The second example of potential urban rehabilitation is the Lewes stream through the town. Flow is intermittent, and the watercourse is heavily modified and uniform. The location of two areas of winterbourne stream where enhancements could be undertaken is shown in the map below, indicating the location within the town.



The area of watercourse shown above within the purple outline changes in character on passing downstream. At the upstream (Area A -circled green below) end the channel has armoured banks and a gravel/pebble bed. In the middle the channel is in culvert. At the downstream end (Area B - circled in red) the watercourse is as modified and as unnatural as you can get – a concrete bedded and banked channel. Both open areas are within parkland and very visible to the general public. The visibility of the watercourses to the public is clearly shown in the photos that illustrate the channel character.



Area A Lewes Winterbourne.

In Area A similar improvements to the habitat as outlined for the Steyning stream could be easily made, creating greater cross-sectional and longitudinal variation. Small pool, riffle and bar habitats could be formed. In such an open parkland area, the bar habitats provide great landscape improvement opportunities when planted with colourful edge species. The difference is that flow is intermittent here, and would be expected to fail for short periods in late summer/autumn in most years.

Enhancement could be achieved by using a small excavator, and gaining access in the location illustrated below would not be a problem. No additional flood risk would result as the open channel is bigger than upstream and downstream culverts. Other areas also offer opportunities for rehabilitation, but would be very expensive.

In essence, the core component of the project would involve re-distribution of existing bed material. A narrow, sinuous, low-flow channel would be excavated shallowly along the channel, and the spoil would be used to form low berms (shoulders). These raised edges would be above water in low flows, and shelve gently from a height just above water at medium flow to meet the bed gradually below water level. The main desire is to produce more diversity of flow type and turbulence, areas of increased coarse substrate and enhanced aeration, and distinct marginal habitats; all are lacking now.

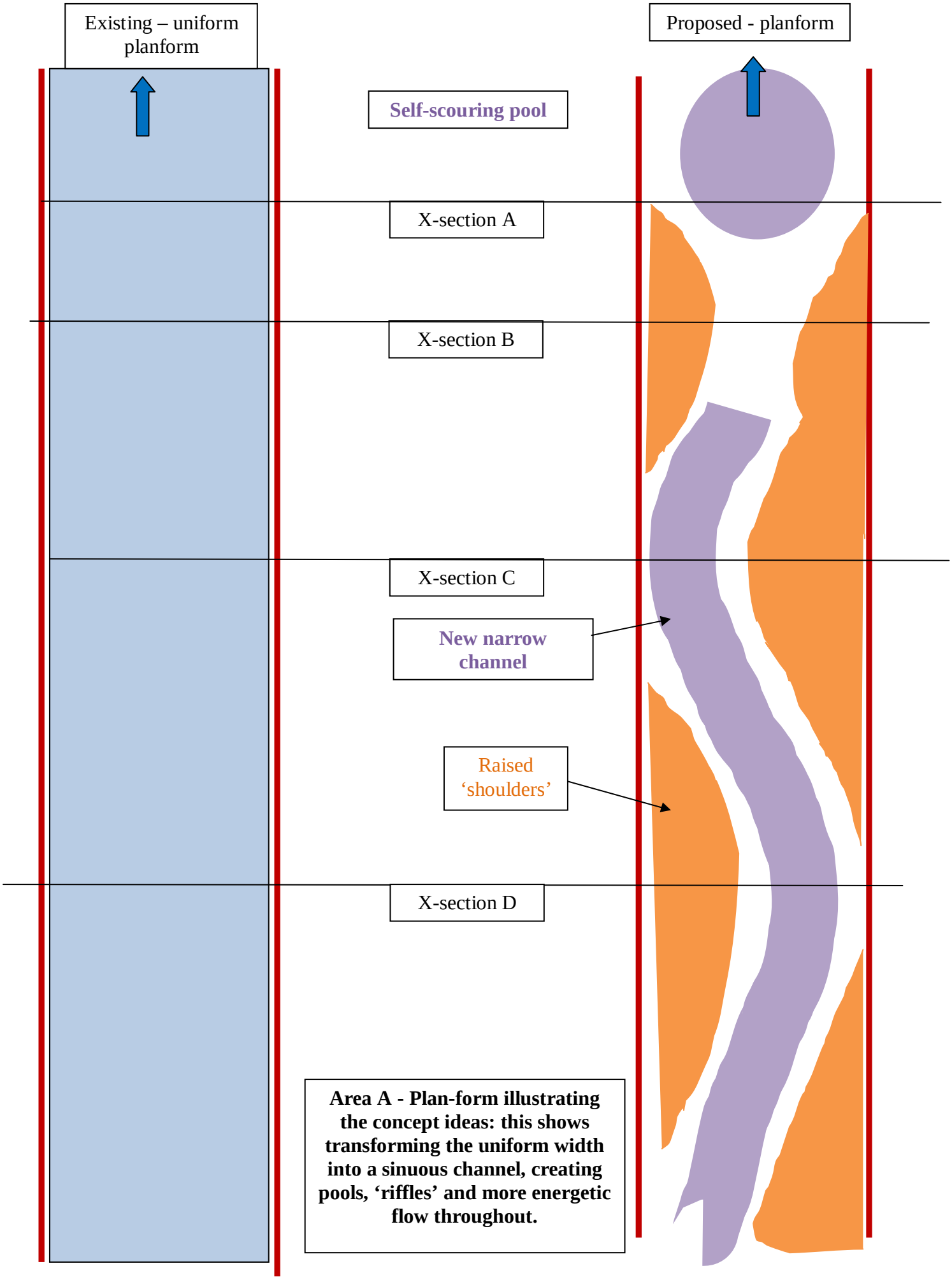
The proposals are outlined schematically at the end of the text. In addition to just forming a narrow low flow channel, small riffle-pool habitat may also be appropriately established here. It is proposed that where pools are dug, the dug bed material would be placed at the edges of the river upstream to form exposed shoals. These shoals will concentrate flow into the narrowed channel width, and force water at increased velocity into the pool to ensure it remains free of silt.

Planting of berms (shoulders) is recommended with colourful species such as hemp agrimony, purple loose-strife, meadowsweet and iris.

All enhancement work could be achieved by using a small excavator working within the channel, or on one or other bank. There is much easier access to undertake this work than on the Steyning stream. Work could only proceed following complete support from the Environment Agency (land drainage consent and flood risk assessment), local people, the local council, and with a full assessment of known flood risk (even though the proposals that could be drawn up would not lead to increased flood risk). There would also need to be checks made to ensure services do not run along or across the river bed. Should services run down the bed, the proposed ideas would need to be shelved or amended; if some run across the channel, they would need to be factored into the detail design before work began.

Area A; showing dry bed in autumn

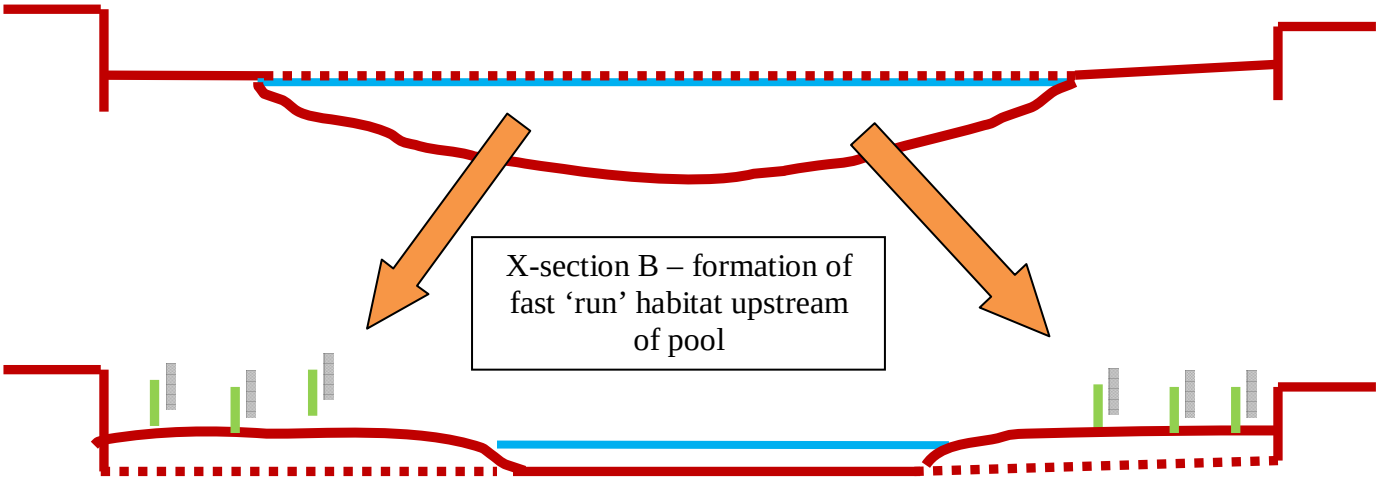
An Annex to this Appendix illustrates the type of species that might be suitable for planting on the raised ledges, as well as examples of where such work has been successfully completed in the past; however these illustrate more rural locations.


Existing – uniform planform
Proposed - planform
Self-scouring pool
X-section A
X-section B
X-section C
New narrow channel
Raised 'shoulders'
X-section D
Area A - Plan-form illustrating the concept ideas: this shows transforming the uniform width into a sinuous channel, creating pools, 'riffles' and more energetic flow throughout.

Cross-sections illustrating concept ideas for Area A: these show transforming the uniform width into a channel with a sinuous low-flow channel with pools and 'riffles'. This will create more energetic flow and more natural chalk stream character – these are illustrative only.

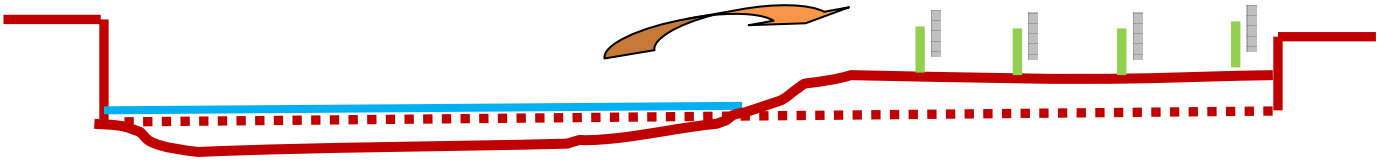
Existing channel – uniform depth

X-section A – creation of a pool

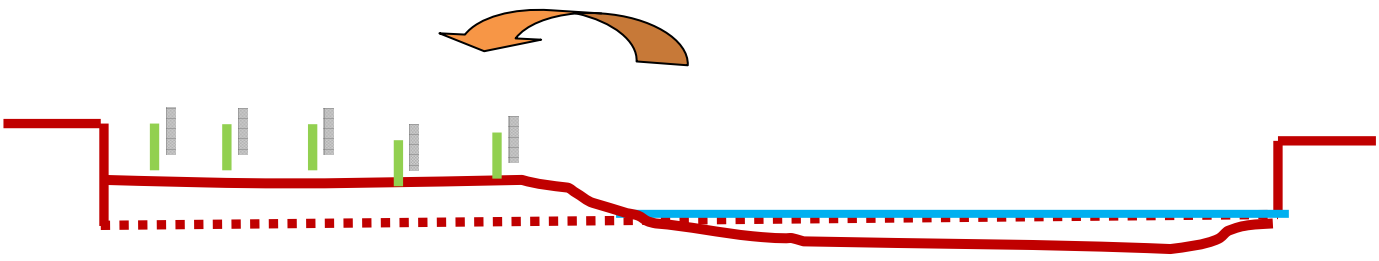


X-section B – formation of fast 'run' habitat upstream of pool

X-section C – formation of narrow-low flow channel and low ledges (planted)



X-section D – inverse of above – narrow low flow on other side of channel



This is the area marked in the red oval shapes on previous pages. As can be seen from the two photos below, the winterbourne has been straight-jacketed to form a uniform concrete channel (upstream it is buried within a culvert. The upstream section is shown by the left image – the watercourse within an urban concrete garden; the right image is the downstream section in parkland (which is fenced off from the river).

The feasibility/desirability of creating an open channel in the grassland parkland in the downstream section should be investigated with the local authority. If this was done, the river would be considered a positive feature of the park, not an eyesore and a potential danger to the public requiring fencing. Good examples of such schemes exist in London. It is recommended that if there is just tacit interest in this, contact should be made with the River Restoration Centre who can provide examples of such work having been carried out on several urban London watercourses.


Concrete in Garden Park – Grange Road


Concrete in Parkland – Southover Road

Whilst work in Area A could be completed quickly and cheaply, any potential work to enhance Area B would be very expensive and take much longer in consultation and implementation.

94.1 – Upper River – Barlavington (Mostly in SU9716). Over 1km, divided into 2 lengths, Only 94.1 with formal survey Source 55m; Gradient c1:44

Land-use: Terrestrial land-use dominated by woodland at start, then mixed tall herbs/ruderals, gardens, roads and improved grassland.

Stream morphology: Greatly modified throughout. The upper river was historically made into a lake, which has now in-filled with silt and forms a valuable wetland habitat with flowing water with adjacent woodland (see adjacent). It then becomes a narrow, perched, ditch where it flows above a garden (with pond) where perennial flow appears to occur (see below left) before it becomes a dry ditch (see below right) and final an impoverished, occluded, ditch, with minimal flow.

Diversity of physical structure: Limited, and not at all natural. Diversity created by in-filled historic headwater pond, open ditch with perennial spring flow, dry ditch, and shaded ditch. Limited morphological features.

Vegetation character: Very variable through the 500m. In the headwaters (the previous on-line pond), winterbourne taxa are typical (true and fool's water-cress, water mint and pendulous sedge at the edge) but in the open section, perched above the cottage, the perennial ditch has bur-reed with *Groenlandia.* River water-crowfoot was not present in this stream. Downstream in the dry and occluded ditch sections wetland flora is absent or minimal. The JNCC check-list total indicates low diversity.

Hydrogeology: At time of survey the flow was minimal. Perennial flow is assumed in the short section above the cottage with the presence of *Groenlandia,* but flow fails downstream. Whether this is natural or not is unknown. Upper reaches have thick sand substrate, giving appearance of flow from sand aquifer (except in local area where *Groenlandia* present).

Naturalness of Morphology	**1**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**2**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**3**
OVERALL TOTAL (max 25)	**12**

Recommendation: The overall score is low and reflects great modification and a predominance of ditch morphology. Little to no habitat enhancement is proposed, although it could be argued that a more natural stream character could be established in the area of the historic headwater pond – however this has now developed wetland habitat that might be considered equally valuable, and would be changed. Without a clear idea of what would be lost in return for restoring a very short stretch of chalk stream, nothing is recommended.

Bosham I.2.1i – Water-filled, coastal, drain with chalk-spring source

Land-use: Dominated by arable cultivation but urban areas extensive too.	
Naturalness of Morphology: Drain morphology throughout	**1**
Diversity of Habitat: Minimal diversity but variety provided by shrub habitats	**2**
Vegetation Character: Ditch flora in the main, but elements of perennial base-rich flow	**3**
Perceived naturalness of Hydrology: Assumed perennial flow as source is spring-fed cress farm, but this is artificially discharged to the channel, and there appears to be little or no accretion at the time of survey.	**3**
OVERALL TOTAL (max 20)	**9**

Recommendation: Do nothing – a poor habitat of a drain with a chalk spring feed – would describe as drain, but cannot deny has chalk-spring feed. Morphology and character gets further and further removed from chalk stream character on passing downstream.

II.2.6A. Harting Stream – two arms surveyed separately as very different character (short tributary arms of Treyford Stream surveyed in 2009)

	6A	6B
Naturalness of Morphology	1	4
Diversity of Habitat	1	4
Vegetation Character	3	4
Perceived naturalness of Hydrology	4	3
OVERALL TOTAL (max 20)	9	15

Harting 6A

Dry ditch until a near perennial spring discharges from bank. Steep gradient ditch alongside road with nil habitat variety save for some parts dry drain, and others wet!!

Flora is of classic winterbourne type, even though the spring may be more or less perennial. No reason to suspect spring flow is impacted, therefore hydrology probably not impacted greatly.

Tangmere III.1.1a

Several channels surveyed that converge east of Oving. All lengths have been totally 'ditched', with banks steep (often near vertical). At the sources the watercourses were all at least wet, with the water present being very clear (but not flowing). This suggests that all have reasonably strong spring flows from the under-lying chalk, at least in the lower reaches. In the downstream section the suggestion is that flow, even if weak, would persist in all but the severest droughts.

Water clarity and some of bed features indicates 'chalk spring fed' watercourses, but as so physically ditched difficult to classify as 'chalk streams'. Upper sections definitely have intermittent (winterbourne) flow, and downstream flow would persist almost throughout the year except in drought years.

Land-use: Arable cultivation totally dominates all the channels, with urban areas and a small amount of improved grassland in the downstream sections.	
Naturalness of Morphology: Featureless ditches.	**1**
Diversity of Habitat: No diversity with steep banks. Only real diversity is minor variations in substrate and whether channel merely wet or with water flowing!!	**2**
Vegetation Character: Good winterbourne flora present locally with both *Apium & Oenanthe crocata* abundant locally.	**3**
Perceived naturalness of Hydrology: Appears to have winterbourne spring flows at start and more reliable flow d/s. No reason to think greatly impacted, but groundwater will be significantly augmented by surface flows and from drains from the intensively farmed arable land.	**3**
OVERALL TOTAL (max 20)	**9**

Recommendations for whole catchment: do nothing. These are clearly drains with mainly weak spring flows, so potential for rehabilitation extremely limited, and reasons to specifically protect are limited.

42 Steyning [Upstream - flows into Watercourse 43] (TQ1611/1711) Source only 30m; Gradient >1:50.

Land-use: A mixture of arable, tall rank herbs, rough pasture, improved grassland and natural woodland for the majority of the length. In the downstream section (42.2) the land-use is dominated by gardens and private homes. The upper 250m is surrounded on both sides by a wide riparian woodland strip.

Stream morphology: The stream has historically been modified to create a series of holding, on-line, ponds upstream of a mill to the west of Steyning. This is shown very clearly on historic maps. Due to this, all sections are highly modified. Two ponds still exist that hold water at all times at (presumed) historic levels.

Diversity of physical structure: Morphology is varied, with fallen trees and woody debris particularly abundant. Overhanging tree boughs on the banks were also extensive. Substrate is dominated by silt (wide, abandoned on-line lake beds), with sand common at the start, and some gravel present on the bed between the two on-line lakes that still exist. No discrete morphological features were seen, but the wet woodland that now occupies an old on-line pond is considered a very important habitats.

Vegetation character: Impoverished, with the bed mostly bare, but filamentous algae were abundant. As was commonly seen elsewhere in such watercourses recovering from historic impoundment, the more open, silt-bedded, areas had higher plants species such as *Apium & Mentha,* but generally the bed was bare and the banks dominated by shade-tolerant species (ferns, pendulous sedge and trees themselves).

Hydrogeology: There was flow throughout. In the headwaters, small flow was seen coming from discrete springs (see photo record). Discharge increased on passing downstream, and was sufficient to hold water in the two downstream, on-line, mill ponds.

Naturalness of Morphology	**1**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**3?**
OVERALL TOTAL (max 25)	**11**

Recommendation: The overall score is very low due to previous modifications, and the existing on-line lakes/ponds, are a major departure from natural morphology and impact hydrology. No rehabilitation options appear to be obvious as the habitat that has developed (from the collapse of structures that once impounded water into on-line ponds) is perceived to be valuable in itself, if not natural (wet woodland habitat). This watercourse could be considered alongside several others for potential rehabilitation – selection of which one(s) should be judged on desire of landowners to see change, and there being little impact on historical interest or impacting existing wildlife and landscape interests - see recommendations.

54 Lewes Winterbourne - Railway to Bell Lane.

Land-use: Totally urban: a road runs alongside the left bank, and gardens back on to the right bank.

Stream morphology: Dead straight ditch with trapezoidal re-profiled banks. There is also a concrete gauging weir, and several sections of the bank have hard revetments.

Diversity of physical structure: Minimal variety of habitats with a flat bed dominated by gravel/pebble and no bars. Trapezoidal or hard banks only.

Vegetation character: The bed and bank is colonized by non-aquatic herbs and grasses; the only non-aquatic found was hemlock water-dropwort (*Oenanthe*). At the downstream limit the bed was still damp, and there were a few *Apium* plants.

Hydrogeology: This has all the characteristics of a winterbourne lacking sustained flow year after year

Recommendation: Like many parts of the Lavant in Chichester, the Lewes Winterbourne appears to present many flood risks but offer little landscape benefits. As with all such regularly drying winterbournes, invertebrate communities may be very interesting.

Naturalness of Morphology	**1**
Diversity of Habitat	**1**
Freedom from Obstructions to Flow	**4**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**3?**
OVERALL TOTAL (max 25)	**11**

68 Upstream Poynings Road Bridge (TQ OS2611/2612/2512) Source 75m (in ravine at base of steep escarpment); Gradient c1:45

Land-use: Dominated by rough pasture on right, and arable and improved grassland on left; some natural woodland close to source, as is common elsewhere. Riparian woodland strip of variable width along much of the course - the two maps suggest there is more today than a century ago.

Stream morphology: The stream is extremely modified. The historic map shows a large on-line mill pond upstream of a corn mill. The watercourse was obviously greatly enlarged to hold water for milling – today water is only present in the lower third, the rest developing into willow carr. Downstream of the old mill the watercourse is a steep-sided, narrow, ditch. Four weirs and two culverts were noted.

Diversity of physical structure: Morphology is varied due to huge historical manipulations, but there are no geomorphological features. Key habitat diversity is due to woody debris and habitat associated with developing willow carr. Silt is by far the predominant substrate.

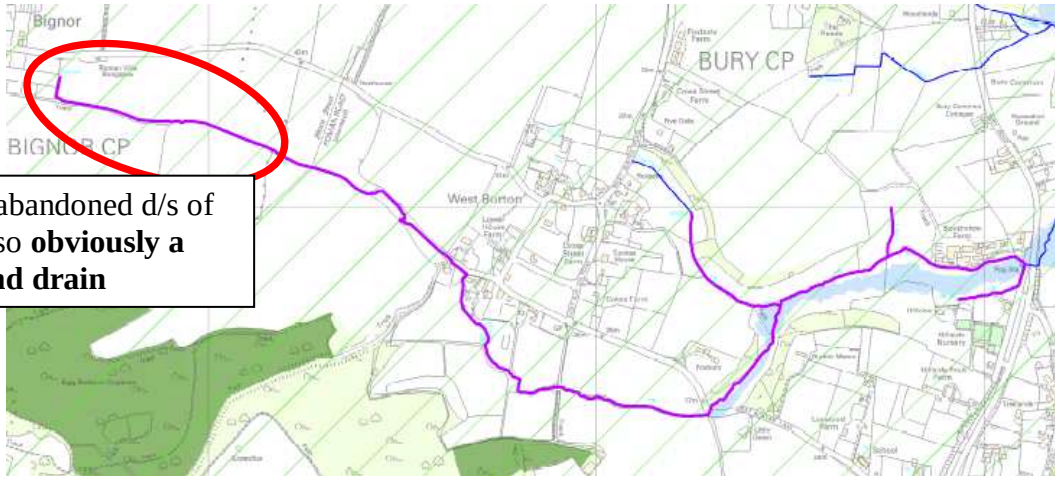
Vegetation character: Atypically very rich, due to the range of habitats from wet peaty silt at the start, an on-line lake, and then a ditch. The lake had a rich flora including two *Potamogeton* species, *Myriophyllum, Callitriche,* ***Ranunculus*** (likely *R trichophyllus*) and the alga *Nitella.*

Hydrogeology: Dry or damp only in the upper section, and then a permanent on-line pond (old mill head) before there being a trickle flow in the ditch leading to a gauge at the road. Gauged flows should provide information on reliability of present-day discharge, and perhaps an insight into historical conditions. There are certain to be impacts from abstraction (pump house at source) combined by the physical impacts of the historic mill ponds. Flora does not suggest perennial stream, but only very strong winterbourne. See 66, Fulking Stream).

Naturalness of Morphology	**1**
Diversity of Habitat	**4**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**2?**
OVERALL TOTAL (max 25)	**11**

Recommendation: The overall score is poor due to the great extent of modifications. The flora is unnaturally rich. The carr habitat that is forming in the upstream part of the upstream historical mill pond is considered to be a very valued and rare habitat, and should be encouraged to develop naturally – restoration to permanent lake conditions would impoverish the wildlife habitat as this habitat is now much rarer than open water. Possible rehabilitation options are proposed to be developed in the future with the water company, SE Water.

West Burton Stream (Bignor) II.7.2



Survey abandoned d/s of here as so **obviously a farmland drain**

Land-use: Arable cultivation totally dominates.	
Naturalness of Morphology: Featureless **ditch.**	**1**
Diversity of Habitat: No diversity with steep, ruderal occluded, banks.	**1**
Vegetation Character: Good winterbourne flora present locally where ruderals do not totally dominate, with both *Apium & Rorippa* abundant locally.	**3**
Perceived naturalness of Hydrology: Appears to have winterbourne spring flows augmented by surface flows and land drains.	**3**
OVERALL TOTAL (max 20)	**8**

Recommendation: Note very low morphology/naturalness score, but the watercourse had a winterbourne community with ruderals as has obvious influenced of springs on flow regime. Structure therefore dictates it is classified as a drain, but it does have a spring-influenced hydrology. Nothing recommended as functions simply as a farm drain, and has some value as it is in this very intensively farmed landscape.

Tangmere III.1.2a

Land-use: Arable cultivation and then houses, with the watercourse running down the side of the road for most of its length	
Naturalness of Morphology: A totally featureless ditch.	**1**
Diversity of Habitat: No diversity and steep, often recently dredged, trapezoidal banks.	**1**
Vegetation Character: Classic strong **winterbourne indication** (dominant *Apium & Rorippa*) and absence of taxa indicative of perennial chalk streams. Sluggish sections with duckweed	**3**
Perceived naturalness of Hydrology: Appears to have reasonable spring flows, but would expect to fail in prolonged drought. May be kept with water from seepage and flow from adjacent land drains.	**3**
OVERALL TOTAL (max 20)	**8**

EX01 Spring Barn Channel (OS Square TQ4008/09; 1:50,000 Map 198) Source 15m; Gradient 1:65 at start; along road <1:200

Land-use: Grazing marsh on the right, road, properties and gardens on the left.

Stream morphology: Straight ditch. At Spring Barn Farm the ditch has shallow banks; alongside the road it has steep trapezoidal banks, rising >2m on the left. At the end the watercourse has standing water in a ditch.

Diversity of physical structure: Minimal variation other than depth the ditch cut, and whether holding water, damp or dry.




No flow but damp in the low-banked channel near the source: *Apium*
Watercourse is ditch alongside the road, ending with standing water with macrophytes and reed

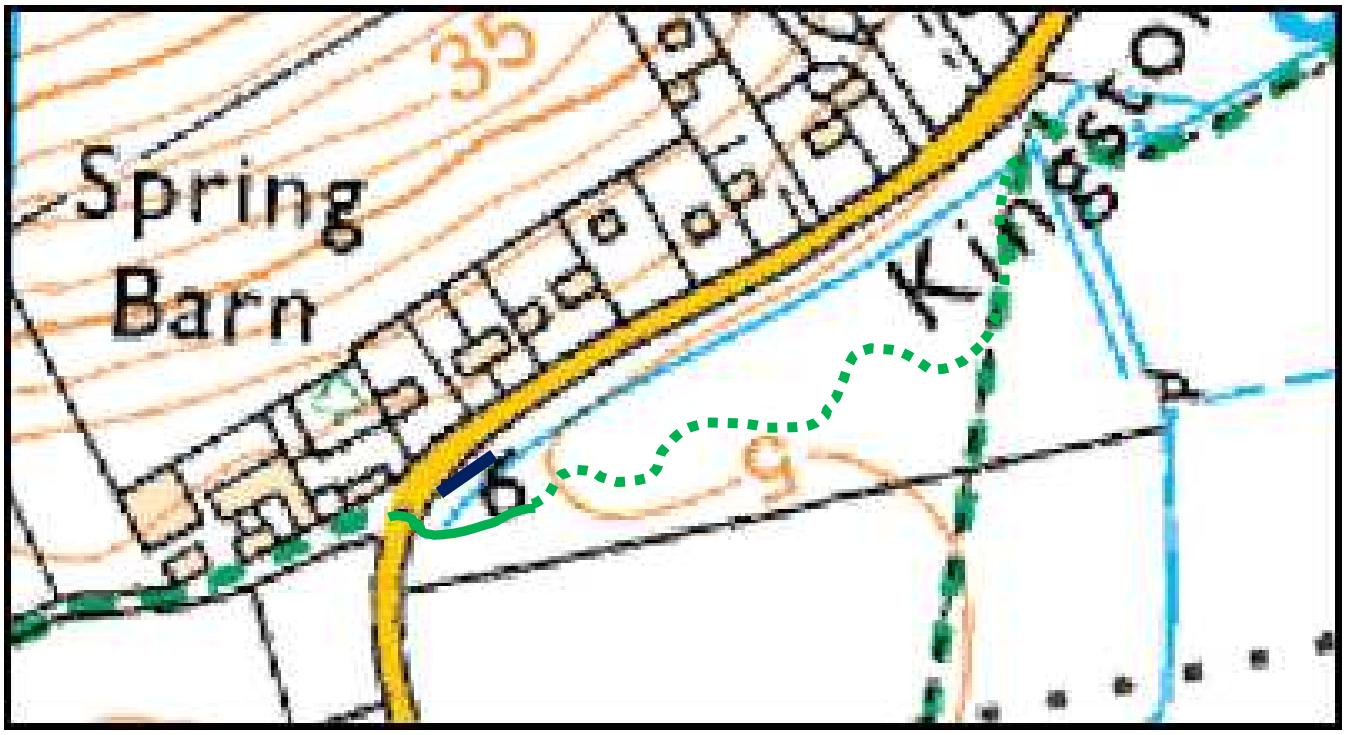
Vegetation character: Alongside Spring Barn Farm there is *Apium* indicating a typical intermittent winterbourne flow. The ditch alongside the road just had non-aquatic ruderals and some *Phalaris*. With the tidal influence holding water at the downstream end, *Phragmites* was common, and aquatics such as *Callitriche & Apium*.

Hydrogeology: Holds water at the downstream end only. Is a winterbourne at the start, but leaks water to the ground in low flow periods where it is perched above the floodplain. Thus a winterbourne (naturally), but heavily impacted.

Naturalness of Morphology	**1**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**3**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**2**
OVERALL TOTAL (max 25)	**10**

Recommendation: Cannot do anything to the watercourse of any benefit if it is left in its present location, as hydrology is severely compromised by the majority of the length being diverted above the floodplain alongside the road. See below for a radical option to be at least considered if there is remote interest from the landowner.

The map below shows the course of the Spring Barn Channel hugging the roadside to the north of open grassland. As has been stated on the previous page, the channel is totally man-made and is perched above the floodplain.



A radical habitat enhancement would be to block the drain at the western end (▬), and divert the flow (when there is any) into a channel to the south (⌒) and divert it through a narrow meandering channel in the grassland (┈┈) and returning it to the wet ditch system to the east.

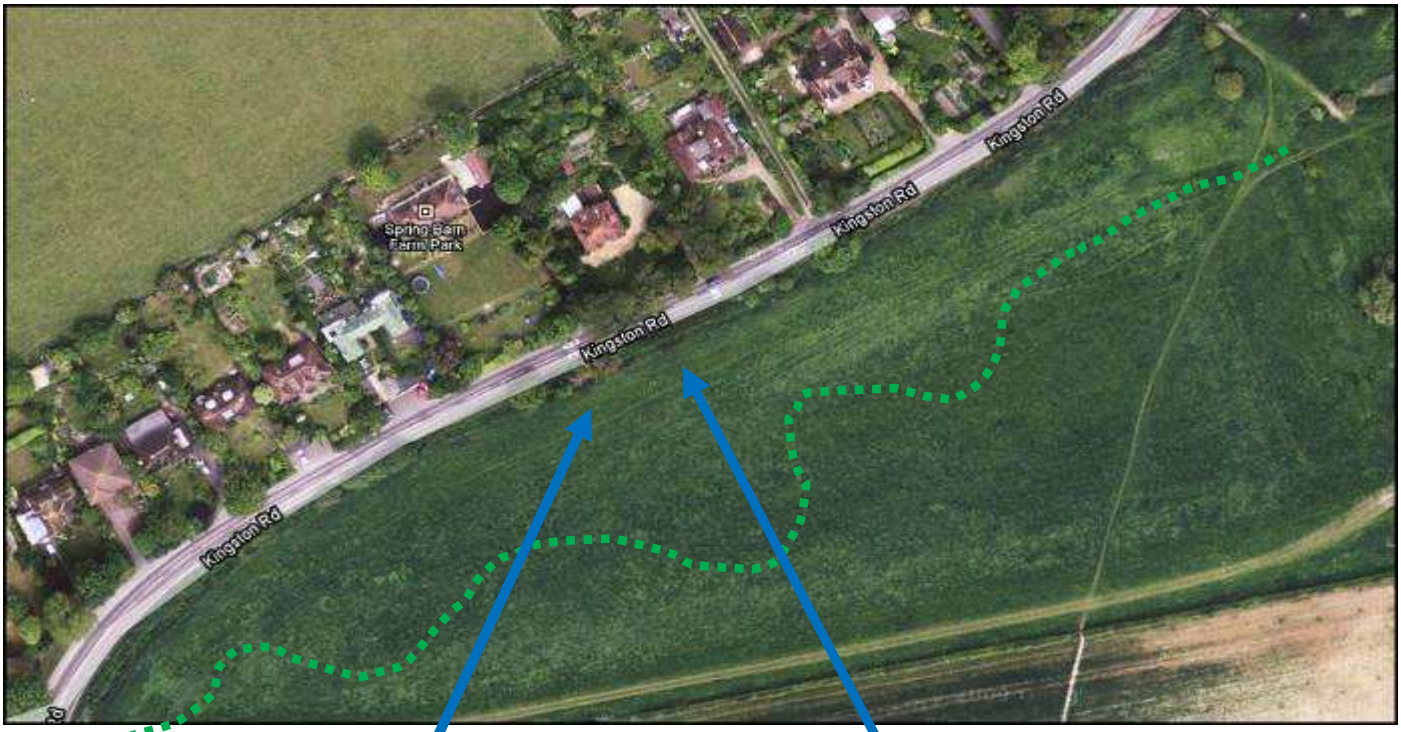
This would be totally dependent on the landowner accepting this, and there may be a need to put the new channel through a short culvert to maintain footpath links. By retaining the existing ditch to the north, drainage for the houses, gardens and road to the north would be retained.

An even more radical option would be to simply divert the winterbourne flow away from the ditch, and allow it to seasonally flood the grassland, with the water finding its way to the drainage channels to the east. This would create a large wet grassland and flooded wetland habitat.

The options simply stated above have not been discussed with the owner, but are presented for consideration and discussion. More study would be needed to assess feasibility once contact has been made with the landowner, and in principle support to investigate further. There is no point in assessing feasibility until such a contact has been made. Simple visual investigations should determine if there may be problems with land levels that might make this difficult to achieve in practice.

Images below show ditch looking from Kingston Rd across the grassland through which a new, meandering, course, might be dug.

The recommendation to divert the channel, rather than do *in situ* modifications, is because it is impossible to do anything to the watercourse of any benefit if it is left in its present location. This is because its hydrology is severely compromised for the majority of the length as it has been diverted above the floodplain alongside the road. Any loss of flow through natural causes is likely to be accentuated by loss of water through the bed.

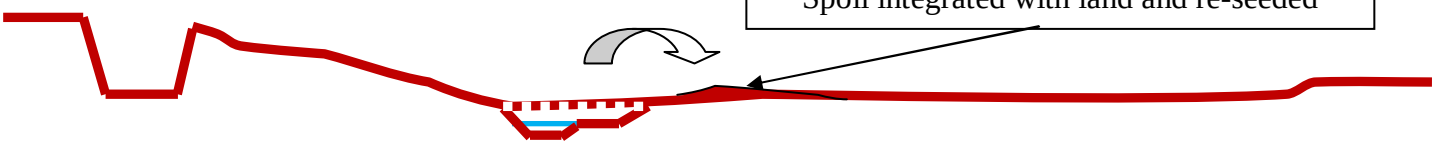


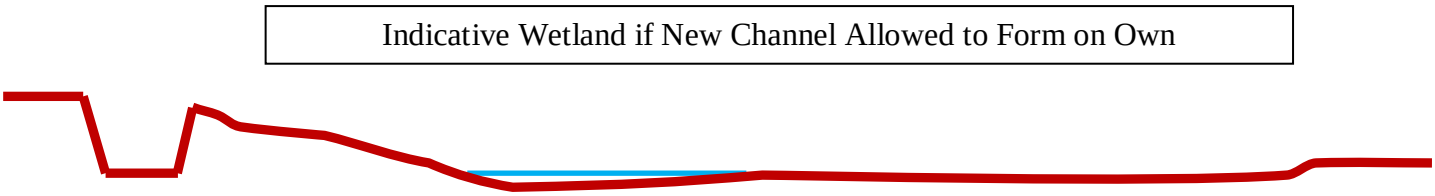
Existing Watercourse – perched above the floodplain and hugging the south side of Kingston Road

Indicative Existing Ditch and Floodplain (NOT to scale)

Indicative New Floodplain ‘Stream’

Spoil integrated with land and re-seeded





Note the new channel is ideally constructed in the lowest-lying areas of the floodplain. If a small channel is dug, it would generate only small volumes of spoil. This would be used to block the upstream end of the present ditch, and the rest spread on the land to the south of the newly created stream and re-seeded.

Reach 55 – Bell Lane to Garden Street.

Land-use: Totally dominated by urban surroundings, including properties, gardens, parks and at times flowing under all of them in culverts.

Stream morphology: Either in culverts or longer open, engineered channels, many with concrete/brick walls, and often with engineered beds too.

Diversity of physical structure: Minimal. No morphological features, but some minor variation where loose sediment present. Going from wet to dry channel provides some habitat diversity.

Vegetation character: The channel close to the start of the reach (Winterbourne Mews) held water; here classic winterbourne species such as *Apium, Rorippa nasturtium-aquaticum & Callitriche stagnalis* were present, indicating regular and prolonged flow, but drying would be expected in autumn in most years. In the concrete-lined channels there only drying algae and terrestrial species were present. Although they had died back in the later summer, it is probable the channel is choked with waist high hemlock water dropwort in early summer.

Hydrogeology: water was present at the start, with virtually no sign of any flow. The majority of the channel downstream was dry.


At the start the Winterbourne holds water, and flows adjacent to parkland



The over-riding character is engineered channels or culverts with periodic flow only

Recommendation: There is nothing that can be done to this watercourse without a partnership approach with the local authority. For simple options, see end for summary for whole river.

Naturalness of Morphology	**1**
Diversity of Habitat	**1**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**3**
Perceived naturalness of Hydrology	**3**
OVERALL TOTAL (max 25)	**9**

57 – Glyndebourne (OS Square TQ4510; 1:50,000) Source 20m; Gradient c1:60

Land-use: Improved grassland dominates, with a key feature being the formation of long, on-line, lacustrine habitats. There is woodland on the right bank.

Stream morphology: The stream totally lacks any natural character, being either converted to a lake, or a ditch (dry at the time of survey). There are three culverts associated with the lakes.

Diversity of physical structure: Upstream the channel is a linear lake, and downstream it is a structurally impoverished ditch, with nothing other than a silt bed too. At the time of survey it was dry, so there were no habitats associated with different flow types.

Vegetation character: Extremely impoverished. Not as impoverished as might be expected due to the presence of silt that retains moisture on the bed to allow plants such as fool's water-cress to be present; in the lakes there branched bur-reed is present. Insufficient species were present in the channel to allow a MTR survey to be undertaken.

Hydrogeology: At time of survey flow was absent. The name also indicates it is not a perennial stream (Glynde**bourne**), but a winterbourne.

Naturalness of Morphology	**1**
Diversity of Habitat	**2**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**1**
Perceived naturalness of Hydrology	**4?**
OVERALL TOTAL (max 25)	**9**

Recommendation: An extremely modified channel that has virtually no characteristics of an intermittent chalk stream (historically it must once have been). The overall score is very very low to reflect this. There is little point in trying to rehabilitate this 'ditch' and lake complex as the latter has more landscape, than ecological, interest. The only reason anything should be contemplated would be if the landowner(s) wish to change the lake landscape to one of an intermittent stream again.

87 – Watercourse Wannock (South): (OS Square TQ56/703; 1:50,000). This watercourse flows into watercourse 88 – and downstream of this it joins with watercourse 86 to the north, joining c2km from their sources. Single RHS and JNCC survey from source. Source c35m; Gradient c1:110

Land-use: At the start, the river runs alongside a road on the right (above it on a steep bank). To the left is extensive improved grassland. From this relatively rural setting, the stream then passes through wet woodland, properties with several on-line lakes and then through housing estates. There are very attractive wooded banks and slopes in the ravine. There is a pumping station at its source, and its source is a piped flow.

Stream morphology: The watercourse flows for almost 500m in a deep ravine. It has what appears to be an unnaturally wide channel at the bottom of the ravine, and there are several remnants of structures indicating past modifications (see image adjacent). Rarely does the stream bed width appear appropriate (see image below left for rare example), as it is wide and shallow upstream, made into on-line lakes in places, and flows in revetted straight-channels and culverts downstream. Impacted by holding weirs for on-line lakes (see photo below) and culverts.

Diversity of physical structure: The upper section is interesting and has some semblance of naturalness in terms of variety of substrates and connectivity with wet woodland. Swamping habitats are juxtaposed with shallow channels. The downstream half is very impacted and poor in habitat diversity, but the narrowed channel results in a scoured, coarse, river bed in contrast to the predominantly fine gravel and silt (with sand) bed upstream.

Vegetation character: The flora is less impoverished than was noted as the norm for this group of the most eastern watercourses surveyed. Bryophytes were common on rocky substrates (including *Thamnobryum*) and hard revetments of the banks in the urban areas. As was often common in watercourses further west, the shaded ravine resulted in *Carex pendula* being dominant again, and it was common on the valley floor. The site was noteworthy for the presence of *Carex acutiformis*, a sedge typical of perennial chalk streams.

Hydrogeology: At time of survey there was a small flow throughout. The flora suggests that flow would rarely fail, but the absence of typical species of perennial chalk streams suggests possible failure at times upstream, and perhaps historically not a perennial stream? It must be impacted by the abstraction, and with a piped augmentation flow there is a suggestion that a perennial flow is being artificially maintained.

Naturalness of Morphology	**1**
Diversity of Habitat	**3**
Freedom from Obstructions to Flow	**1**
Vegetation Character	**2**
Perceived naturalness of Hydrology	**2?**
OVERALL TOTAL (max 25)	**9**

Recommendation: The overall score is very low, due to impacts, but the stream is interesting. The hydrology and character is different to watercourse 85 (as starts as a perennial stream – genuine or contrived?), and also exhibits some diversity. The ravine section going into wet woodland represents reasonable habitat already that could be enhanced, and it might be worth assessing options for making it more natural. A public footpath alongside would make any improvements visible to the public too. No formal proposals are made here, but it is recommended that options for enhancement are considered through involvement of the local authority, and SE Water. The main report recommends that all potential impacts from public water supply should be assessed, reported upon, and where possible remediation undertaken.

5 Summary

5.1. Summary of 2009/2010 surveys

3.1.2 Group A Streams – Ems & Lavant Catchments

Box 3.1.2A summarizes the key characteristics of the watercourses surveyed near Chichester. The group has several features in common with the others, but in other ways they are distinctive in several respects. These are summarized in a standard format below. The Ems and Lavant were not surveyed as they have been the subject of a previous investigation (reports held by the EA).

Altitudinal sources: Generally very low, some extremely so. Lower than was typical elsewhere.

Gradient: Generally very low (flat) gradient, and much lower than the others in the county.

Presence of mills: A single mill – almost at sea level. Mill pond fed primarily by *in situ* springs but historically it appears it could have been fed by at least one watercourse (No 8 that combines flows of 19, 16 and 6).

Presence of cress-beds: None.

Presence of riparian carr: None.

Extent of modifications – on-line lakes: None. A key reason would appear that the flow is deemed to be very unreliable, gradient to dam a lake upstream is small, and the lakes would have to have been 'puddled' as it is predicted water would have leaked underground naturally.

Extent of modifications – 'ditching': Very extensive – just a few hundred metres of near natural stream morphology.

Flow character: Only area with tidal channels. Only area where some of the upstream sections seem far removed from the groundwater aquifer and therefore would be deemed non-groundwater ditches. Only in and around Fishbourne Mill Pond could flow in watercourses be considered perennial and from the chalk aquifer, the rest being winterbourne.

Stream No	Stream Name	**BOX 3.1.2A Group A Streams – Ems & Lavant catchments Summary of Physical Characteristics**
2	Manor Farm	👎 Source c5m; Gradient >1:150. Extremely poor ditch habitat throughout; mostly dry.
19	Salthill	👎 Source c20m; Gradient c1:100. Extremely poor ditch habitat throughout; dry for most of length most of time.
16	West Chichester	👎 Source c25m; Gradient c1:90. Very poor ditch habitat throughout; dry in upper reaches; winterbourne.
6	Fishbourne East	👎👍 Dry ditch to winterbourne to almost perennial in short length – d/s 16. Mostly very poor habitat throughout.
8	Fishbourne South	👎👎 Mixture of modified and **very good semi-natural habitat** – d/s confluence of 19 & 6 (d/s of 16 itself).
Mill P(S)	Mill Pond South	👍 Tidal creek with freshwater springs. Historic mill.
Mill P(E)	Mill Pond East	👍 Historic link FROM stream 8 TO mill pond, now TO stream FROM mill Pond!! Totally artificial.
10	West Fishbourne	👎👍 Source c15m; Gradient c1:60. Dry, deep, narrow, physically impoverished, ditch to start; almost perennial, but still ditch, d/s.
9(7)	Tidal W Fishbourne	👍**Tidal from watercourse 10.**

👎 Considered to be poor physical habitat	👍👍 **Considered to be reasonable or good physical habitat**

3.1.3 Group B Streams – River Rother & Arun Tributaries

Box 3.1.3A summarizes the key characteristics of the watercourses surveyed north of the Lavant catchment; the streams draining into sub-catchments of the Rother/Arun. There were nine 'reporting lengths' in only five catchments surveyed, with the watercourses within the same catchments highlighted in the same colour in Box 3.1.3A.

Altitudinal sources: Typically sources are higher than elsewhere, opposite to those in Group A to the south.

Gradient: Most have steep gradients; some have extremely steep gradients, such as the Treyford Stream (c1:30) and one of the Sutton Arms of the Bignor Mill Streams complex (c1:20).

Presence of mills: Three out of the five catchments had mills – Cocking (Costers Brook), Duncton and Bignor.

Presence of riparian carr: Present in three of the nine survey units.

Presence of cress-beds: Only one in the entire survey area – top of Costers Brook (Cocking, watercourse 90).

Extent of modifications – on-line lakes: Many of the watercourses had lakes – obviously in three locations these were for storing water for historic mills. In others, notably Treyford and the Lavington Arm of the Duncton complex, there were many for visual amenity or for fish rearing and angling.

Extent of modifications – 'ditching': Less obvious agricultural ditching on many watercourses than seen elsewhere; urban constraints clearly evident at Cocking, and Barlavington Stream the most degraded rural 'ditch'.

Flow character: Highest proportion of perennial chalk streams. The reason appears clear – sources are very close to the base of the steep northern escarpment of the South Downs. Reliability of spring flows reflected in presence of three mills on five catchments, with a cress-bed on one of these too. Others are winterbournes.

St No	Stream Name	**BOX 3.1.3A Group B Streams – River Rother & Arun Tributaries Summary of Physical Characteristics**
89	Treyford	Source c95m; Gradient c1:30. Ditched and on-line lakes at start. Very steep gradient. **Good Chalk Stream (wooded) habitat downstream**.
90	Cocking (Costers Brook)	Source c65m; Gradient c1:66. Historic mill. Greatly modified in places with on-line lakes (source); steep gradient. **True perennial chalk stream (only site with historic cress-beds)**.
91	Duncton – Lavington arm	Source c50m; Gradient c1:55. Many modifications with on-line lakes (source); **True chalk stream. High energy sections and very good meandering woodland sections, and some riparian carr downstream.**
92	Lavington side arm	Source c50m; Gradient c1:35. Small watercourse; ditched; reedbed adjacent with small area of carr.
93	Duncton Mill arm	Source c35m; Gradient c1:70. Very ditched and with on-line lakes (source). Historic mill. Very obviously **perennial springs in source pond (old mill pond) – note very low altitude at base of escarpment.**
94	Barlavington	Source c55m; Gradient c1:45. **Source area of carr.** Mostly degraded ditch and winterbourne. **Weird c50 perennial section in middle.**
95/96	Sutton Arms - Bignor	Source c100m; Gradient c1:20. Source c60m; Gradient c1:50. **Wooded & dynamic streams with wooded riparian areas common – note extreme steep gradient.** Weak spring-fed ± perennial.
97	Salters Arm - Bignor	Source c60m; Gradient c1:60. Major modifications with on-line lakes, but some locally good stream habitats; perennial?
98	Bignor	Downstream 95/97 confluence. **Exceptionally good natural woodland stream** with chalk spring groundwater flow from u/s. Historic mill u/s, located d/s of 95/6 and 97.

3.1.4 Group C Streams – Lower Adur Tributaries

Box 3.1.4A summarizes the key characteristics of the watercourses surveyed that have catchments flowing into the tributaries of the Lower Adur. There were 10 discrete catchments surveyed, some of which had tributaries and/or had such contrasting features on passing downstream that they were made into separate 'reporting lengths' (15 in all); reporting units within the same catchments are highlighted in the same colour in Box 3.1.4A.

Altitudinal sources: Intermediate heights, with Poynings with the highest source (75m), and the majority of the rest rising around 50-60m AOD. Steyning has an exceptionally low source, at just 30m AOD.

Gradient: Most have steep gradients, typically in the range 1:50.

Presence of mills: Clear evidence for mills has only been found on one stream; Poynings. Literature points to two mills being on the stream when the Domesday Book was written.

Presence of riparian carr: Six of the 15 survey units have riparian carr habitat, several of which are sites with shallow, indistinct rivulets flowing through wet woodland with peat soils.

Presence of cress-beds: None.

Extent of modifications – on-line lakes: Mixture. Washington Stream, Wiston Park and Fulking Streams have just small on-line ponds/lakes (Wiston Park Stream flows into a huge on-line lake at the d/s limit), and several streams have no evidence of ponds at all – e.g. the Buncton complex, Pyecombe, virtually the whole of the Clayton/Hassocks catchment, and Keymer. Poynings is heavily impacted by historic ponding for milling (but the upper pond, drained in the 1950s, has developed fabulous carr), and many small ponds cascade down the first 250m of the Edburton stream.

Extent of modifications – 'ditching': Agricultural ditching is common on many watercourses. The Shirley Arm of the Buncton system is relatively natural, and some parts of the stream are near natural within woodland. The impacts of past ditching are showing signs of recovery in several streams due to the high energy resulting from the steep gradients. Downstream of Poynings the stream has a diversity of near natural characteristics, and the wooded sections of the Clayton/Hassocks stream (72), combined with a tributary there in Lag Wood, represent extremely natural stream morphology. In contrast the upper stretch of the Pyecombe stream is a featureless ditch.

Flow character: There is a good range of hydrological types. To the west the Buncton streams are clearly winterbournes in their upper reaches. The Steyning Stream is clearly perennial, and probably has the strongest and most reliable perennial chalk spring flow of all. It has a perennial flow because springs come out of the chalk at just 30m, much lower than the norm, even though the source is not far from the escarpment. Perhaps, historically, Poynings to the east may have had an equally reliable flow before abstraction began at the base of the escarpment at its source. Between them are the Edburton and Fulking Streams, both of which appear to be just perennial, and would not be expected to fail except in the severest of droughts, and may well sustain a trickle then too. The reason these three streams have perennial flow also appears clear – sources are very close to the base of the steep northern escarpment of the South Downs within local 'ravines'.

This area is blessed with streams with perennial chalk flow, as well as a unique flush habitat. Despite the source of the Pyecombe watercourse being totally ruined, downstream springs appear adjacent to the stream and form an extensive flush area with a pond, downstream of which the stream has a perennial flow with good habitat diversity within woodland. South of Clayton/Hassocks, the Lag stream appears to have a perennial flow (very weak in droughts; very strong after re-charge) in a channel with really natural morphology within woodland.

The other watercourses are thought to be winterbournes.

St No	Stream Name	**BOX 3.1.4A Group C Streams – Lower Adur Tributaries Summary of Physical Characteristics**
EX04	Washington	Source c60m; Gradient c1:50? Ditch - very poor habitat with tiny on-line pond.
36/7	Buncton Manor West	Source c65m; Gradient c1:50. Greatly modified winterbourne for most of length. **Some good woodland stream habitat d/s**
38	Shirley House Arm	Source c65m; Gradient c1:50. Very small and slightly modified, but some near-natural sand-bedded stretches; winterbourne.
39/40	Buncton Manor arm	Source c55m; Gradient c1:50. **Carr source.** Small ditched watercourse otherwise; winterbourne.
41	Wiston Park	Source c50m; Gradient c1:40. **Limited carr habitat at source.** Historic ditching and with on-line lakes (one small close to source; other very large at d/s limit). Steep gradient reflected in habitats associated with energetic streams. May be weakly perennial, but probably strong winterbourne.
42/3	Steyning	Source c30m; Gradient c1:50. **Very small area of carr at source.** Very degraded: ditched agricultural, lakes and urban constraints. **Perennial – note key is low altitudinal source close to escarpment.**
44	Edburton	Source c50m; Gradient c1:50. **Tiny area of carr at source.** Modified – source with lakes, downstream with some ditching. Reasonable habitat diversity. **Considered just perennial – note key is source at very base of steep escarpment.**
66/7	Fulking	Source c55m; Gradient c1:66. Major modifications, but some locally good stream habitats. **Probably perennial.**
68/69	Poynings	Source c75m; Gradient c1:50 **Carr woodland stream at source in old on-line lake.** Historic mill. Much degraded by on-line lakes but more natural, near perennial, chalk stream downstream of village. Abstraction must affect morphology too.
70	Pyecombe	Source c60m; Gradient c1:50. Dry and totally degraded ditch at start. **Good Chalk flush habitat adjacent d/s and good chalk-fed (wooded) stream habitat downstream**.
71	Clayton/ Hassocks	Source c60m; Gradient c1:75. Greatly modified ditch with on-line lakes. **Winterbourne.**
72 u/s Lag	Clayton/ Hassocks	Rare example of open ditch with very shallow margins and riparian wetland. **Winterbourne.**
72 Lag St	Clayton/ Hassocks	Source c55m; Gradient >1:50. **Small perennial chalk stream in woodland – 5*. ?? Same sub-compartment of chalk black as 70.**
72 d/s Lag	Clayton/ Hassocks	**Weak perennial woodland stream d/s Lag – High quality at start** deteriorates to impoverished morphology d/s.
74/3	Keymer	Source c65m; Gradient c1:66. **Source area of carr.** Degraded ditch with good recovery of habitat features. Weak flow through most years, winterbourne in droughts?

3.1.5 Group D Streams – Bevern & Upper Ouse Estuary Tributary Catchments

Box 3.1.5A summarizes the key characteristics of the watercourses surveyed that have catchments flowing into the tributaries of the Bevern and Upper Ouse Tributary Catchments. There were just five discrete catchments surveyed, some of which had tributaries and/or so contrasting character on passing downstream they were made into separate 'reporting lengths' (nine in all); reporting units within the same catchments are highlighted in the same colour in Box 3.1.5A.

Altitudinal sources: Mostly higher than those to the west in Group C, with five out of eight starting at c75m AOD or above. On passing east, source elevations reduced considerably, with the Arlington system at 40m.

Gradient: Most have steep gradients, typically in the range 1:50, with the gradient least in the Arlington Stream.

Presence of mills: Very limited and associated primarily with the Plumpton Stream. This has a massive lake at its source that was a mill pond for Plumpton Mill just below it; further downstream is Lower Mill, where a shallow, wide, lake has now become a willow/alder carr, yet the mill is still present with wheel intact

downstream. A little way downstream the Plumpton mill stream is joined by the Westmeston streams – there is a mill on this watercourse just upstream of the confluence.

Presence of riparian carr: Limited compared with streams in areas B & C. Only the western arm of the Ditchling stream had carr at its source, and this was limited. Very interesting carr has developed upstream of Lower Mill on the Plumpton Stream where the previous mill pond has silted up and turned into carr. The Westmeston stream, downstream of the Gote stream inflow, has a woodland stream character through woodland, but this is not carr.

Presence of cress-beds: None.

Extent of modifications – on-line lakes: On-line lakes of any size in relation to the watercourses are mostly associated with the two streams with near (or perhaps definitely) perennial flow – the Gote and Plumpton streams. Minor on-line ponds are found on the Ditchling West, and Arlington, Streams. The ponds on the Gote Stream are amenity garden ponds, and those on the Plumpton Stream, mill ponds. On the Plumpton Stream the upper one is now a large garden amenity pond, and the downstream one has naturally silted and open water is no longer evident (except the river flowing through it).

Extent of modifications – 'ditching': Agricultural ditching is a common feature of many of the watercourses. Chillington Stream is a featureless ditch, Ditchling lives up to its name, and the source 500m of the Westmeston Stream is similarly degraded. In between very featureless ditch stretches on the Arlington system is a short, more natural, woodland section. Parts of the Plumpton Stream show signs of ditching, but there are near natural sections on this watercourse. The short section of the Westmeston Stream downstream of the Gote inflow also is not ditched.

Flow character: On such a cursory investigation, and with no streams having a flora typical of perennial chalk stream headwaters, it is impossible to be sure if any of the watercourses have perennial spring flows. The Plumpton Stream must be very close to having a perennial flow, as must the Gote Stream. Both of these may be expected to fail in droughts, despite the former having a mill so close to its source, and both having further mills downstream (upstream of their confluence). All others are deemed to be winterbournes, and mostly in association with ditch morphology.

St No	St Name	**BOX 3.1.5A Group D Streams – Bevern & Upper Ouse Tributary Catchments Summary of Physical Characteristics**
75-77	Ditchling West	Source c80m; Gradient c1:50 Ditched, but shaded, winterbourne; then more reliable flow and NOT chalk stream. **Carr habitat at source.**
80 (78/9)	Ditchling East	Source c80m; Gradient c1:50 Modified and very ditched channel – winterbourne; then more reliable flow and NOT chalk stream. Two small on-line lakes.
81	Westmeston	Source c75m; Gradient c1:50 Mostly poor ditch; source dry. Winterbourne.
82	Middleton Manor	Source c80m; Gradient c1:33 Very ditch-like; dry winterbourne. Then V good woodland stream after Gote inflow – may be just perennial?
82A	Gote Stream	Source c75m; Gradient c1:35 Almost perennial spring feed at source. Ditch or series of lakes; no semblance of chalk stream morphology.
83		Ditch and not chalk stream downstream of 82, and fed by 81 d/s before a mill c3km from source.
84	Plumpton place	Source c60m; Gradient c1:50 Modified channel at start with massive lake (mill pond) with mill and another weir d/s **Semi natural watercourse in woodland followed by extensive carr in area of second mill pond** (thus two mills). 83 and 84 join d/s of mills on each. Close to perennial flow?
45	Chillington	Source c55m; Gradient c1:50 Very poor ditch; no impoundments and winterbourne.
46-49	Arlington	Source c40m; Gradient c1:90 Predominantly a very poor ditch habitat; moderate quality spring fed woodland stream for short stretch in middle, then not a chalk stream. One minor on-line pond.

3.1.6 Group E Streams – Lewes to Eastbourne Streams

Box 3.1.6A summarizes the key characteristics of the watercourses surveyed that have catchments flowing from the South Downs between Lewes and Eastbourne. There were 14 discrete catchments surveyed, one of which had significant tributaries (north and south Wannock streams).

Altitudinal sources: In general the sources were low, being lower than in the main core area of the Downland chalk headwater streams in areas B-D.

Gradient: Most have shallow or very shallow gradients, four with gradients of c1:100. The higher sources of streams in the Charleston Farm, and Alciston Streams, areas typically gave rise to the steepest gradients of 1:35-1:50.

Presence of mills: None. This reflects lack of perennial discharge for the most part, and the shallower gradients.

Presence of riparian carr: Limited compared with streams in areas B & C, and even D. The source of the Offham Stream is surrounded by the best example of carr, and almost certainly of ancient origin (many of the others are carr developed from in-filled, man-made, ponds). On the Preston Farm stream there is a small amount of carr, and small areas associated with the lakes on the Firle Park Stream and on the Charleston Farm Stream.

Presence of cress-beds: None.

Extent of modifications – on-line lakes: The watercourse in Hampden Park ends in a huge lake, and there are numerous on-line lakes on the southern branch of the Wannock Stream. Lakes are also a key modification on the Firle Park Stream and the Glyndebourne. One of the Alciston watercourses has a series of small lakes too.

Extent of modifications – 'ditching': Agricultural ditching is a common feature of most of the watercourses unless they are heavily constrained urban systems. Ancient shallow ditching is evident at Offham, with all other watercourses more deeply dug, and generally straight unless forming lakes. The southern Wannock stream has a widened channel within a deep gully near its source, where it partially meanders through silty/fine gravel deposits.

Flow character: None are considered to be guaranteed to have perennial flow. Despite several having lakes, these are almost certainly puddled to hold water as flow fails. The springs at Offham appear to sustain a near perennial flow, and this may also be true on the South Wannock stream. It is perhaps not surprising that groundwater abstraction sites are only associated with these sites.

St No	Stream Name	**BOX 3.1.6A Group E Streams – Lewes to Eastbourne Summary of Physical Characteristics**
50	Offham	Source <5m; Gradient <1:100 **True chalk stream spring head – one of most natural examples in the UK. Source in Carr.**
51-56	Lewes Winterbourne	Source 20m; Gradient <1:100 Heavily degraded urban winterbourne.
Ex01	Spring Barn	Source 15m; Gradient <1:65 then <1:200 Degraded rural winterbourne ditch.
57	Glyndebourne	Source 20m; Gradient <1:60 Not very stream-like and with amenity lake.
58	Preston Farm	Source 25m; Gradient <1:66 Historically widened; CARR at top. Ditched but recovering.
59/60	Firle Park	Source 15m; Gradient <1:60 Lakes and ditches – no semblance of chalk stream - small area of carr associated with lake.
63	Charleston Farm	Source 50m; Gradient <1:35 Predominantly winterbourne ditch character; small wooded area verging on carr.
62	NW Alciston	Source 50m; Gradient <1: 50 Ditched – small area of interesting winterbourne in woodland (tufa substrate). No carr.
61	E Alciston	Source 40m; Gradient <1:50 Ditch and impounded to form small on-line ponds.
64	E Wilmington	Source 25m; Gradient <1:80 Ditched rural winterbourne.
65	Folkington	Source 25m; Gradient <1:100 Ditched rural winterbourne.
EX03	Friston	Source 15m; Gradient <1:65 Very short winterbourne then grazing marsh ditch.
85(6)	N Wannock	Source <30m; Gradient <1:80 Winterbourne ditch to ?perennial at confluence with 88.
87(8)	S Wannock	Source 35m; Gradient <1:110 Upper 500m in ravine. Many online lakes. ?Perennial (perhaps due to flow support?). Abstraction Issue.
EX02	Hampden Park	Source 25m. Urban ditch in parkland – not chalk stream character. Huge lake d/s.

Apart from the obvious fact that the streams were all small headwaters, and often had little or no flow within them, a general observation once the surveys were completed was that most watercourses had gravel/pebble, or even cobble, substrates. Where watercourses had not been obviously very straightened, and especially in wooded sections, several showed evidence of small morphological adjustments causing local areas of bank erosion to form true cliffs, and deposition of material to form (admittedly often small) point bars (rarely side bars). In general the watercourses appeared more energetic than headwater chalk streams of Hampshire, for example. The impression in the field was often of watercourses in the hilly areas of the Derbyshire Dales, not the rolling lowland landscapes typical of Hampshire or Sussex.

3.2 Characterisation of Watercourses Based on Flora

Species recorded in the 500m 'JNCC' surveys are given in Appendix 3B. Five separate tables give the information for the areas A-E. The data collected in these surveys was entered on to the JNCC database, and the sites were classified into '*River Community Types*' by the JNCC Freshwater Co-ordinator (Paul Taylor). The 'Types' for each watercourse surveyed using this method will be presented in a short follow-up Addendum (1) to this report once the information is provided from JNCC.

Where sites contained at least five aquatic taxa on the original MTR check-list, a 100m survey using the MTR methodology was carried out. Such surveys were undertaken on all sites where at least five MTR taxa were present within a 100m length of **watercourses**; such surveys were not undertaken where more MTR taxa were present within on-line lakes. The data furnished from these surveys are given in Appendix 3C.

The macrophytes have been used as key indicators of historical and contemporary flow character. Table 3.2a at the end of this section of report summarizes the key taxa that characterise flow (see 2.2[d]). It is important to note that the flora in winterbourne streams varies greatly from season to season, and from year to year, depending on contemporary, and recent historical, flow; the recorded taxa in the 2009 survey is thus an indicative 'snapshot' of possible long-term character. A number of key points can be gleaned from Table 3.2a however.

Few streams in the entire area have a community that is truly characteristic of perennial chalk streams.

- Only stream 8, close to the Mill at Fishbourne, had a macrophyte community indicating near perennial groundwater flow from chalk aquifers in Area A – the most reliable indicator of such flows, *Ranunculus penicillatus* subsp. *pseudofluitans* (crowfoot) and *Berula* were NOT present. The latter was present in the Mill Pond itself, and the discharge watercourse from the pond (Mill Pond East) had a perennial chalk stream community.
- Within Area B was the highest proportion of watercourses with perennial chalk stream flora. Watercourses 90 (Cocking), 93 (Duncton) and 97 (Salters Farm; Barlavington) had crowfoot and many other watercourses had *Berula* (lesser water-parsnip) and *Groenlandia* (opposite leaved pondweed) was present at three sites.
- Of the many watercourses surveyed in Area C, only a single site had crowfoot (70 - Pyecombe), three had *Berula* (Pyecombe, Steyning [43] and Keymer [74]) with Steyning and Pyecombe also having *Callitriche obtusangula* (blunt-fruited water-starwort) recorded.
- Only four sites in Areas D and E had species indicative of perennial chalk streams, and confidence in three being perennial chalk streams is low because these sites only had the starwort present, the weakest indicator of perennial flow in the list. The Gote tributary (82A) - not on the list for streams to survey – and 46.1 (Arlington Farm) were the sites in Area D, and the downstream, not chalk-stream section of Spring Barn Channel (EX01), was the only site in Area E. Only watercourse 50 at Offham had a truly perennial chalk stream community.

It is important to note the extent of bryophytes in many sites. Some heavily shaded sites may well have perennial, groundwater, flow but not have the 'characteristic' perennial chalk stream flora. This is clearly the case in watercourses such as the Lag Wood Stream (tributary of watercourse 72 and not on the original list – Area C) that has a weak perennial flow, but has a naturally impoverished woodland stream flora that does not include higher plants. There are many other examples, but without landowners giving an historical perspective to flow, this cannot be categorically stated here. Table 3.2a shows that bryophytes dominate in many streams - this is the case in shaded systems only. Many have virtually bare beds due to shade, but also because many have stony substrates and the watercourses are more dynamic than is the norm for lowland, larger, chalk rivers.

In clearings within wooded streams, or those with predominantly dense bankside or riparian tree cover, the nature of the higher plant flora is evident. Table 3.2a shows that the overwhelming indication is of intermittent (winterbourne) flow. The 'winterbourne indicator' *Apium nodiflorum* (fool's water-cress) is present in most watercourses except those that are evidently dry for extremely long periods. The other two winterbourne indicators, *Rorippa nasturtium-aquaticum* (water-cress) and *Veronica anagallis-aquatica* agg. (water-speedwell) are less common; both are less indicative of 'ditches' than *Apium*.

Stream No	*Chiloscyphus*	*Pellia endiviifolia*	*Cratoneuron filic*	*Hygroamblystegium*	*Platyhypnidium*	*Thamnobryum*	*Fontinalis antipyp*		*Apium nodiflorum*	*Rorippa nasturtium*	*Veronica a-a* agg.		*Callitriche obt*	*Berula erecta*	*Ran pseudof*	*Groenlandia*	*Catabrosa*		*Ceratophyllum*	*Zannichellia*	*Potamogeton*	*Elodea*	*Myriophyllum*	*Carex acutiformis*	*Carex panic*	*Hippurus*
	Bryophytes								Winterbourne				Perennial						True aquatics (ponds!!)							
Group A Streams – Ems & Lavant catchments (Chichester Harbour)																										
2									o																	
19.1																										
6		r	o	r					a	o																
8		r	r	r					a	o	r		o				o								r	
MPS									r	r	r		r													p
MPE									a	o	o		a													
10.1									a																	
10.2									a	o	r															
16									a																	
Group B Streams – River Rother & Arun Tributaries																										
89		r	r	o	o				o	r	r													o		
90	o	r	o	o	r				o	a	r			a	a											
91.1	a	o	o	o	o				o	o				a						o					r	o
91.2	a	r	r	o	r				a	r				a												
91.3	o	a	r	o	r				o	r				r												
93	r	o	r	r	r				a	a				o	r	a								o		a
94.1		r	r	r	r				a							o										
96.1		a	r	r					o																	
95.1		o	r	r	o				o																	
97.1		o	r	r	r				o	r			a	r	a	a					o			r		
98		r		r	r				Absent																	
Group C Streams – Lower Adur																										
EX04									o																	
36																										
38					r				a																	
39/40																										
41					r				r																	
42.1					r				o																	
43.1				r					o	o			o	a												
43x		o		r					o	r																
44									o																	
66		a	o	o	r				o																	
67		r	r	r					r																	
68		r	r	r	r				o												r	r	r			
69.1		r		r					a	r																
69.2		r							a	r																
70.2		r		r	r				o				r	a	r							a				
71					r				r													r				
72X		r			r	r			o																	
72P		a			r	r			o	r																
74		r	r		r	r			r	r				o												
73		r		r	r	r			o																	

Stream No	*Chiloscyphus*	*Pellia endiviifolia*	*Cratoneuron*	*Hygroamblystegium*	*Platyhypnidium*	*Thamnobryum*	*Fontinalis*		*Apium nod*	*Rorippa nasturtium-*	*Veronica a-a* agg.		*Callitriche obt*	*Berula erecta*	*Ran pseudof*	*Groenlandia*	*Catabrosa*		*Ceratophyllum*	*Zannichellia*	*Potamogeton*	*Elodea*	*Myriophyllum*	*C acutiformis*	*Carex paniculata*	*Hippurus*
	Bryophytes								Winterbourne				Perennial						True aquatics (ponds!!)							
Group D Streams – Bevern Stream tributaries & Upper Ouse Estuary Tributaries																										
75		a	r	r					o																	
76		o		r					o																	
80		r			r				o										o							
81				r	r				a																	
82		r	r	r																						
Gote		r	o	r	r		o		a	r			r									a				
84.1		a	r	r	r		r		a	r																
45									o																	
46.1									a	o	r		r													
47		o			r				r	r																
Group E Streams – Lower Ouse Estuary and Cuckmere Area Tributaries																										
50									a	o				o												
51																										
52/3		o	r	r	a	r			o	r																
EX01									a				o											r		
57		o		r					o																	
58		r		o					a	r																
59		r		r	r	r			a																	
63		r		r	r	r			o																	
62		o				r			r																	
61									r																	
65									o																	
64		r	r						r																	
85		r		r					o																	
87		r	r	r	r	r			r															r		
EX03		r	o	r	o				r																	

Table 3.2a Summary of the recorded distribution of the key taxa that characterise flow (see 2.2[d]).

Area A – Chichester Harbour Streams.

The only strong indication of perennial chalk spring flows is found in Fishbourne Mill pond. The pond had *Berula, Callitriche obtusangula & Hippurus* present within it, and the watercourse flowing from it to the east (MPE) has healthy and abundant growth of the starwort throughout the year. Flowing from the east, and to the south of the mill pond, is watercourse 8.1. It has a near perennial chalk stream flora, with *Catabrosa* (whorl-grass) present – the only site where it was encountered. Stream 8.1 is downstream of the confluence of streams 19 and 6 (which is itself downstream of watercourse 16). The lowest reaches of 19 and 6 have good winterbourne communities.

The majority of watercourses in Area A had very impoverished floras. Unlike many other watercourses surveyed, this was not because they flowed in wooded areas, but because they are so ditched, and are dry for very long periods in their upper reaches (especially 2, 16 and 19). Closer to their discharge to the estuary, they have floras reflecting winterbourne flow and ditch morphology. Aquatic bryophytes are rare (only being found in the better habitats of watercourses 6 and 8.1). Watercourse 10 had a flora indicating more reliable

winterbourne flow than 19 and 16. Watercourse 9 (downstream of 10) is influenced by tidal back-up; none of the other watercourses in the other four survey areas are similarly affected.

Area B – River Rother/Arun Tributaries.

This Area, south of Midhurst, is more or less north-east of the Lavant, with the streams flowing north and east. Streams are fed by what is assumed to be the Chichester Chalk Block on the opposite side of the escarpment to the Lavant itself. Interestingly, the previous surveys of the Lavant indicate this system has, and always has had, a winterbourne flora, but some of the streams fed by chalk springs to the north and east have a flora indicative of perennial streams.

As can be seen from Table 3.2a, several streams have aquatic taxa that indicate permanent water, but are not necessarily indicative of perennial chalk streams – these sites are associated with the many on-line lakes present. Many of the watercourses in Area B, however, have macrophyte communities that reflect true perennial chalk character, with three streams having crowfoot, and one (97.1 – Barlavington – Salters Farmhouse) having all the key characteristic perennial chalk stream species present.

Where watercourses do not have perennial chalk stream flora present, modifications due to ditching and impounding result in all but one having a combination of ditch and winterbourne flora. In general, the watercourses in Area B had far more JNCC taxa recorded than in the watercourses surveyed in the other four Areas.

Bryophytes were commonly found in most of the watercourses – indicative of the energetic flow regimes and coarse substrates in many parts of these streams. In contrast to all other Areas, many streams had the liverwort *Chiloscyphus* present, and in some cases it was the dominant species. This is a species indicative of shaded, often upland, Mesotrophic streams in the UK (Holmes *et al.* 1999b).

Area C – Adur Catchment Tributaries.

The general Area is directly north of Brighton, and east of the A24. Many watercourses in this area were surveyed, but few had a flora indicative of perennial chalk streams. Most had impoverished floras, either due to ditching, or because of dense shade. Bryophytes were common in a few rivers, and present in most.

The two streams with two indicator species of perennial chalk streams were 43 (The Steyning stream through the town) and the downstream section of 70, the Pyecombe stream. The latter had a strong, perennial, spring creating a flush and artificially widened and deepened channel (off the main channel); this was the only site in the Area where brook water-crowfoot (assumed species) was found, as well as the alga *Batrachospermum*. Only *Berula* was found in watercourse 74 (Keymer) where it is suggested from other observations that flow would fail in drought years. This watercourse had a very strange succession of species on passing downstream, with only a short section indicating near perennial flow.

Sufficient taxa to enable a MTR survey to be carried out were present in only a few streams other than those with a 'chalk stream' flora. The only additional rivers included the downstream sections of the Poynings Stream (68/9) and stream 66 (Fulking). Both streams appear to have near-perennial spring flow, but a flora that does not reflect perennial spring flow. The former has historically been impacted by abstraction, and has a semi-natural planform downstream of the village. The latter has a short section upstream of the bridge that appears to have perennial flow, with an abundance of *Pellia endiviifolia*, a liverwort that thrives in perennial chalk streams (as well as occurring in intermittent ones).

Many watercourses had ditch floras with damper/flowing open areas with *Apium*. Water-cress was the only other species typical of winterbournes present in these watercourses, and rarely so. In the many shaded sections, macrophytes were virtually absent. The tributary of watercourse 72 (Clayton) – the Lag Wood Stream, had few macrophytes but is considered the most natural headwater perennial chalk stream; it flows energetically and shallowly through woodland, and is densely shaded.

The lake on the Poynings Stream was rich in higher plant aquatics, indicating this (part of old mill pond) holds water at all times, but this does not indicate perennial spring flows, merely water retention.

Area D – Bevern and Upper Ouse Tributary Catchments.

This Area is south-east of Burgess Hill and north-west of Lewes. As can be seen from Table 3.2a, the Area does not have streams with a flora that obviously points to a perennial chalk stream flow. Only the weakest indicator species of perennial chalk streams (*Callitriche obtusangula*) was present in these rivers, and only in the Gote stream (82A – not on the survey programme) and watercourse 46 – Arlington. The former has strong spring flows that discharge into very artificial amenity lakes; the flow appears almost perennial, but drops to virtually nothing in drought years, and fails in extreme droughts. The latter has a woodland section that may have a weak perennial flow.

Ditch species, in combination with winterbourne taxa, prevail, with the latter most prevalent in the Middleton Manor complex of streams (81-83), Plumpton Place stream (84) and the Arlington Farm stream (46). Bryophytes were common in some watercourses, with *Fontinalis antipyretica* (the nationally ubiquitous willow-moss) present in the Gote Stream and the Plumpton Place stream. Remarkably, these were the only watercourses in the entire study area where they were recorded.

Area E – Ouse Estuary Tributaries and Cuckmere Area.

The Area includes Lewes, and spring fed streams directly east to Polegate. It was noted that the streams in Area A, to the extreme west of the study area, were generally poor in macrophytes (and especially those indicative of perennial spring flow); the streams to the extreme east, are similarly impoverished.

Only one watercourse, No 50 at Offham, had *Berula* present. This was found within the swampy area through which springs discharge into carr, and indicate near perennial groundwater flow. It is concluded that this tiny watercourse is the only one in this Area where a true headwater perennial chalk stream flora exists.

Only EX01, the Spring Barn Channel, had a single species indicative of perennial chalk streams – *Callitriche obtusangula*. This was present only where the 'ditch' is not winterbourne, and flows through the coastal alluvium, and it is not a perennial chalk stream. The only other watercourses that appear to hold water permanently are the Hampden Park Stream (EX03) and the extreme lowermost part of the Lewes winterbourne (51-56). All three examples are assessed as having permanent water due to alluvial groundwater levels, and a flora that has no affinity to having chalk spring feeds.

The majority of the watercourses are very impoverished ditches with mostly intermittent flow. Only One (Offham) was assessed as being a woodland stream, so others are not naturally impoverished through shade. Most, as was commonly found throughout the entire study area, had *Apium* in open areas where the bed was damp or holding water, and generally ruderals were not only dominant on the bank, but were dominant on the channel bed too (50% of sites formally surveyed). The exceptions were where bryophytes or *Apium* were recorded as dominant.

4. Discussion - Overall Assessment of Watercourses

4.1 Introduction

This section of the report draws together and discusses some of the information given in the previous sections to provide an over-view of the character of the watercourses surveyed across the whole area investigated.

4.2 Characterisation of Perennial Chalk Streams (Based on Flora, Cress-beds and Mills)

Based on a single survey it is not possible to definitively determine the discharge characteristics of watercourses. This is because, depending on the time of survey, you could be reporting conditions ranging from a severe drought to an atypically good re-charge period. That said, the flora generally is a good indicator of long term conditions, and may even reflect accurately discharge characteristics spanning centuries.

Figure 4.2a illustrates the raw data on the presence or absence of key 'perennial' and 'winterbourne' taxa given in table 3.2a. Based on this alone, it could be considered that only those watercourses with at least two of the key indicators of 'perennial' chalks streams could be considered to have perennial spring flows. In order of number of taxa, these five watercourses are:

- 97 Salters Farm/Bignor Mill stream;
- 93 Duncton Mill stream;
- 70 Pyecombe stream;
- 90 Cocking (Costers Brook) stream;
- 43 Steyning stream.

Based on the flora, and also with other observations made during field work, these watercourses should be considered perennial chalk streams with a characteristic headwater flora.

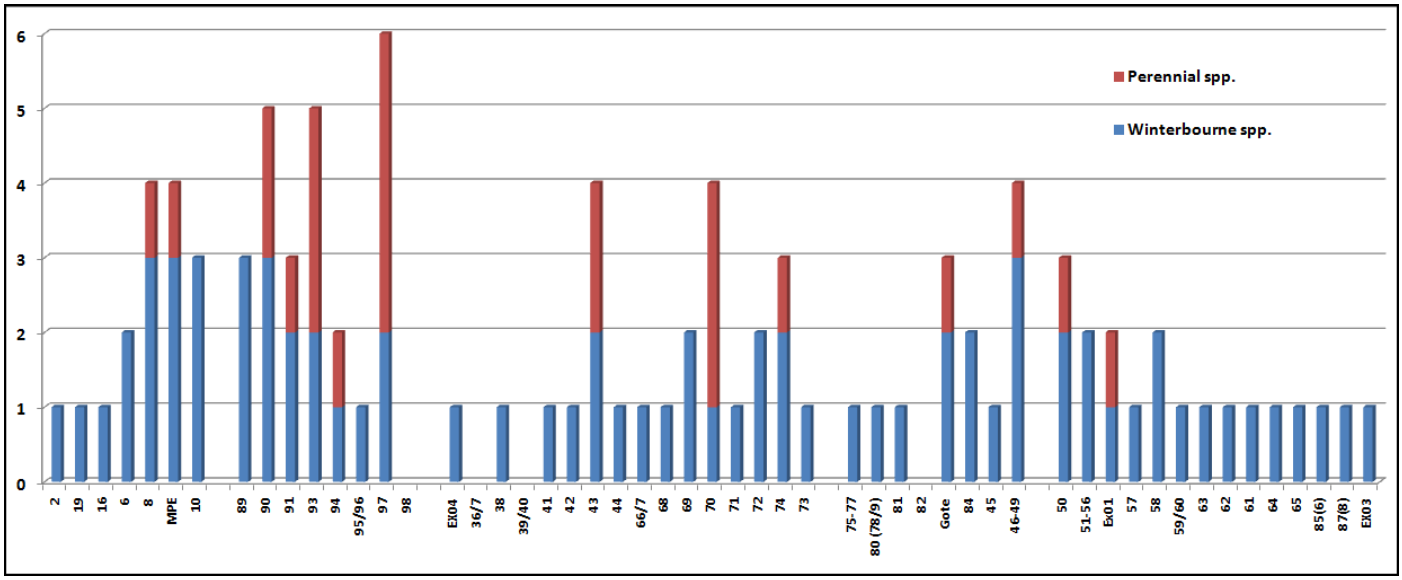


Figure 4.2a Number of characteristic 'perennial' and 'winterbourne' species found in each watercourse

Watercourses with a single macrophyte indicator of perennial streams are:

- 8 Fishbourne;
- MPE Mill Pond Over-flow from Fishbourne Mill Pond;
- 91 Duncton Mill Stream;
- 94 Barlavington;
- 74 Hassocks;
- Gote;
- 46-49 Allington;
- 50 Offham;

- EX01 Spring Barn.

If this single species present is not *Berula, Groenlandia* or *Ranunculus* then much less reliance can be made of predicting these watercourses would have perennial spring flows. None of the watercourses listed above had *Ranunculus* present. *Groenlandia* was present just in the Barlavington stream; this is a very bizarre watercourse with a section c50m long which appears to have a constant spring feed, with the rest classed as a ditched winterbourne. The Duncton Mill Stream, the Fulking Stream and the Offham spring source were the only sites with *Berula.* There is near certainty that the Duncton stream has a perennial spring flow and can be described as a genuine headwater chalk stream. The Hassocks Stream probably has a perennial flow in a short section, but this may fail in extreme drought events, or dwindle to a trickle (it is like the Barlavington in being dry upstream and downstream). The Offham site barely forms a channel, and is characterised by springs breaking in many locations to form swamping conditions in wet woodland. Only after c200m has a defined channel been formed artificially; the presence of *Berula* suggests near perennial discharge from the springs, or the water would be retained close to the surface at all times at Offham.

The Spring Barn channel is not a perennial chalk stream; it only has *Callitriche* in the lowermost reaches due to water held by the floodplain alluvium. The same species was present in the Allington Stream and the Gote; the former is not considered to have a perennial discharge, but the latter appears to almost certainly retain flow in most years. The Fishbourne complex is more difficult to assess; the Mill Pond itself looks to have perennial (or virtually so) spring feeds, but spring-fed flow elsewhere may well fail in extreme droughts. Watercourse 8 has many characteristics of a 'natural' open chalk stream as well, and considering this is possibly the only perennial chalk stream in the area, classification as a perennial chalk stream should be made for now unless disproved with other information.

There is a need to be careful not to consider all other watercourses to be intermittent just because they do not have a flora typical of chalk streams previously subjected to macrophyte surveys. Many of the more 'natural' streams surveyed were in woodland, and so would have a flora impoverished by shade. The most natural chalk stream encountered comes into this category – the Lag Wood Stream (72X), a tributary of the Clayton/Hassock Stream, had no macrophyte species typical of perennial chalk streams present, yet it probably has a perennial spring flow. Part of the Clayton/Hassock Stream downstream, and parts of other watercourses surveyed might have a weak perennial discharge but do not have the flora to indicate this.

The presence of watercress beds on a watercourse is an extremely good indication of historical perennial spring feeds (the author has only found one watercress bed that may not be associated with perennial springs – at the head of the Little Stour, Kent. There was only one found on all the watercourses surveyed – on the Cocking (Costers Brook) stream. This was the only watercourse surveyed that had four typical macrophytes of chalk streams, and therefore confirms its status as the watercourse with the most reliable groundwater flow from the chalk aquifer.

Mills are also associated with many chalk streams, but unlike cressbeds, are also associated with other river types. Mills that occur within 1km of the source of a spring-fed watercourse are more likely to be associated with perennial flow. Based on very limited research and cursory looks at maps, the following might be concluded.

- In Area A, west Chichester, there is just one mill. This is within a few metres of Chichester Harbour mud flats, and its main source of water today is from *in situ* springs. Thus no streams have their sources within 1km of a mill.
- In Area B there is a mill on watercourse 90 (Cocking) and 93 (Duncton Mill) within 1km of the source springs; both of these watercourses were assessed as having perennially flowing springs based on the flora. Other watercourses (91 – the East Lavington arm of the Duncton Mill stream and the Bignor Mill streams - 95-98) had mills but not within 1km of the source – these were both assessed as possibly having near perennial flow without having the flora to indicate this.
- The Poynings stream (68) was the only watercourse in Area C with confirmed mills within 1km of the source; clearly there is not a perennial flow now, and there are clear issues relating to abstraction in this catchment.

- Two mills have clearly been present on the Plumpton Mill stream (84) in Area D for centuries, the first virtually at the source springs. The flora does not indicate perennial flow. Mills are not clearly evident on other watercourses in this Area.
- No mills have been found associated with Area E to the east.

Based on all information gleaned from maps and the field investigation, broad categorisations of the flow character that most simply describes each watercourse has been given in summary form in Section 4.4. Figure 4.5a. simply shows summary information on the flow type that most aptly describes each watercourse. Figure 4.5b shows on more detailed maps the flow characterisation information given alongside brief morphological descriptions. Finally, Figure 4.5c tabulates all summary data, including the interpretation of flow from the flora and other factors.

4.3 Morphological Characterisation

The morphological characterisation of the watercourses aimed primarily to give an indication of how 'natural' the watercourses are. Inevitably such assessments cannot be truly objective as we now do not know what a truly natural chalk stream should look like as all have been degraded to some degree, and many to a massive degree. In the summary 'scoring' system used to help describe the watercourses, four of the five attributes (not [d] flora) can be considered to represent 'hydromorphology', as applied to the Water Framework Directive – naturalness and diversity of the channel form, and naturalness of the flow regime, judged by potential impacts from impounding structures and abstraction.

Information given in Appendix 1 descriptions of watercourses has been summarized into histogram form in Figure 4.3a. This shows the component scores for each of the five scoring attributes assigned subjectively by the author to each of the watercourses, with the maximum aggregate score being 25 if all attributes were considered to be in good status. It is very important to note that just because some watercourses do not score very well for some attributes, and therefore have a relatively poor overall score, they may be very important in other respects. Showing where watercourses have good and poor scores helps target both efforts to protect the best, and where most appropriate to apply restoration resources.

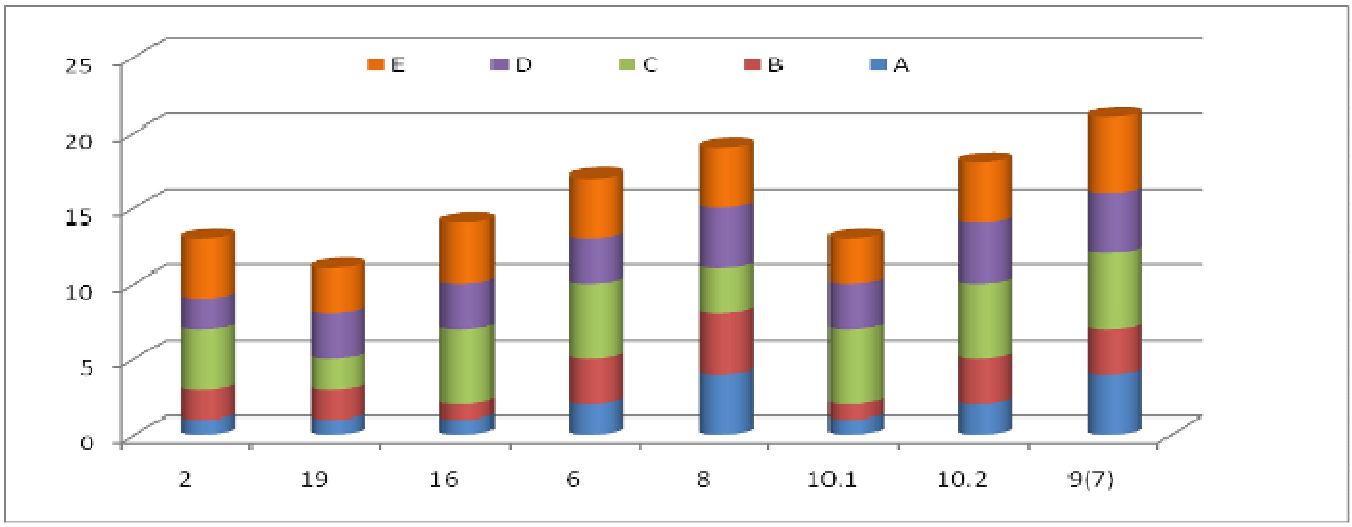


Figure 4.3a(1) Aggregate 'Scores' for Watercourses in Area A

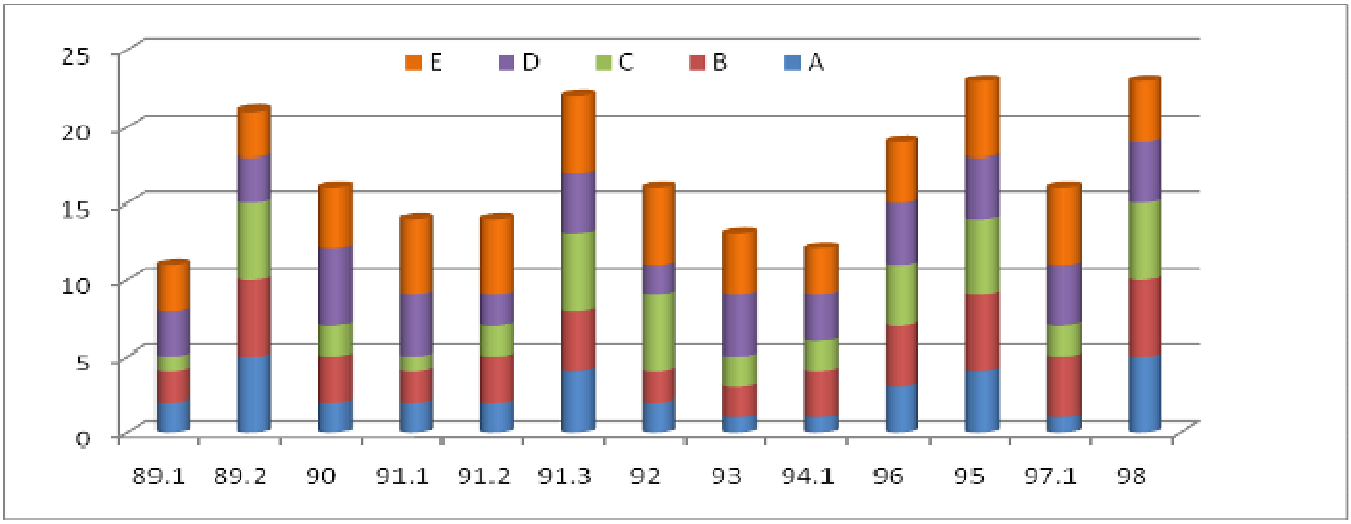


Figure 4.3a(2) Aggregate 'Scores' for Watercourses in Area B

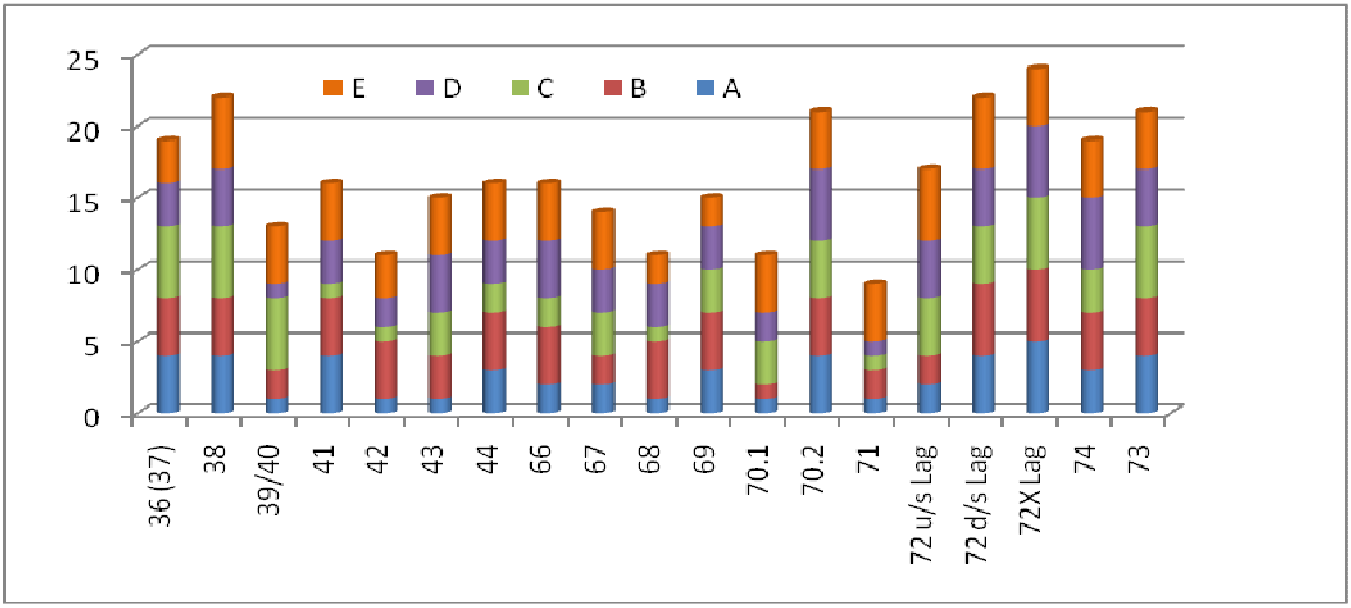


Figure 4.3a(3) Aggregate 'Scores' for Watercourses in Area C

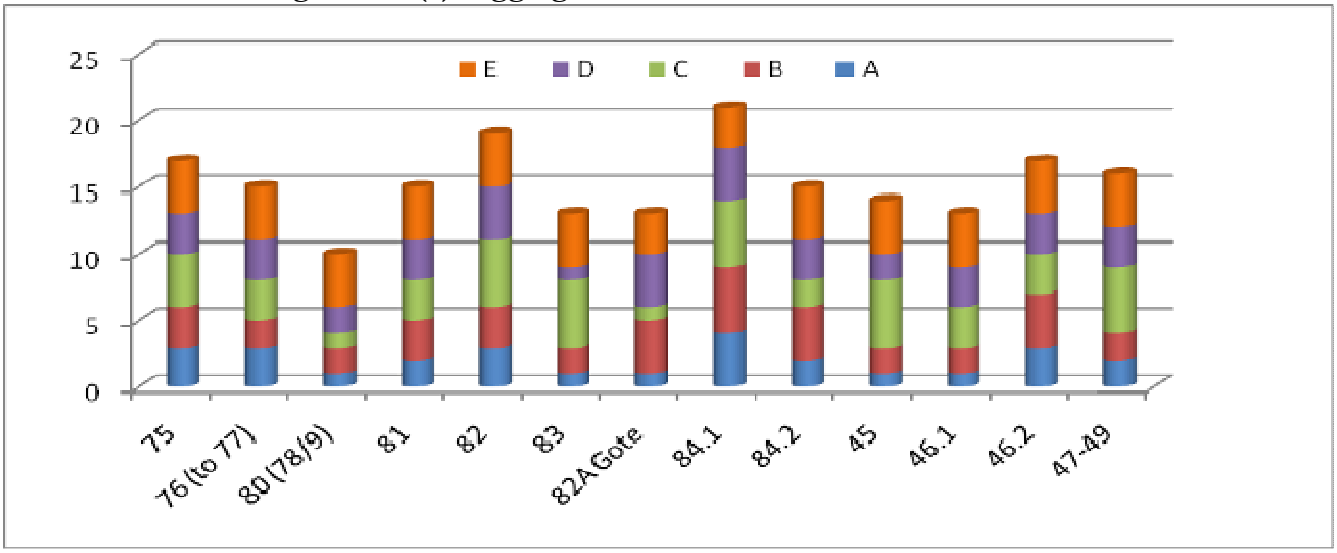


Figure 4.3a(4) Aggregate 'Scores' for Watercourses in Area D

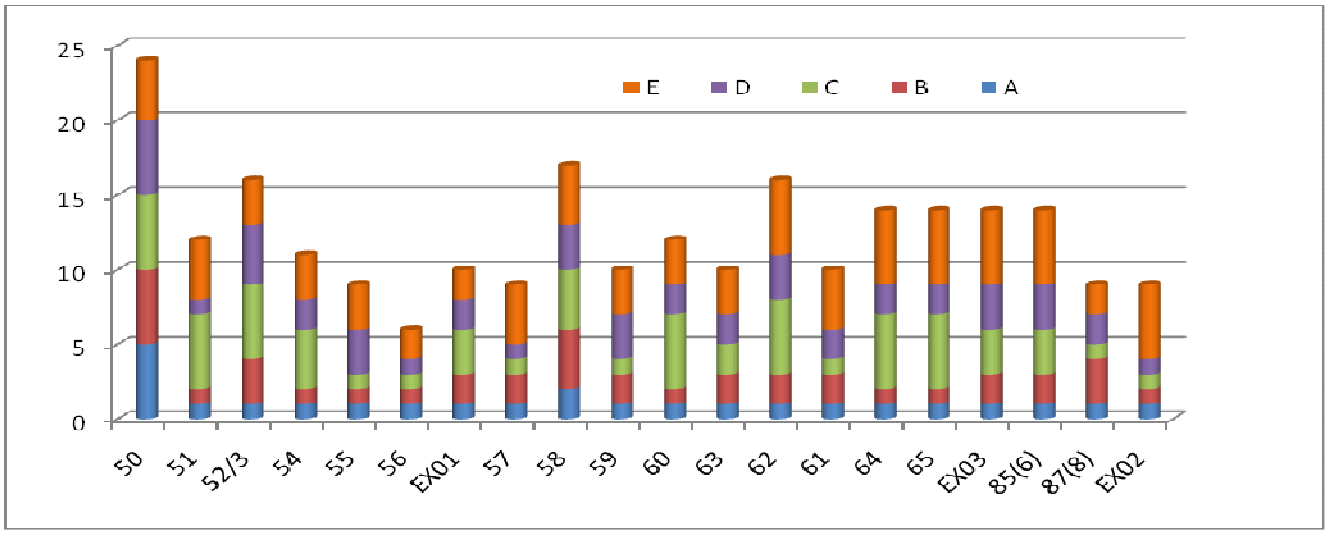


Figure 4.3a(5) Aggregate 'Scores' for Watercourses in Area E

Figure 4.3a 'Scores' for Watercourse Character (Maximum 5 points (best) for each of the 5 Attributes: Blue = Morphological naturalness; Red = Morphological Diversity; Green = Freedom from Obstructions to Flow; Purple = Naturalness of flora; Orange = Naturalness of Discharge.

A relatively small proportion of sites scored 20 or more 'points' – meaning these watercourses, or at least parts of them, were considered to be relatively un-impacted. The watercourses in this category, ordered from the highest scorer, were:

- ✓ 72X (24 points) Lag Wood Stream – by far the most natural chalk stream (in woodland) encountered;
- ✓ 50 (24 points) Offham – score applies only to a short 200m section of near pristine spring heads in carr;
- ✓ 95 (23 points) Upper Bignor stream – high energy stream in narrow ravine;
- ✓ 98 (23 points) Lower Bignor stream – downstream of several watercourses and mill – losing chalk stream character but natural morphology;
- ✓ 91.3 (22 points) Duncton – only relevant for lower river; highly modified upstream;
- ✓ 38 (22 points) Shirley House Stream – very small winterbourne – feeds into good stretch of 37;
- ✓ 72 (22 points) Clayton/Hassocks – very good wooded section d/s Lag Wood inflow – open grazing u/s;
- ✓ 73 (21 points) – Keymer – unusual mix of tree-lined and open, trampled, shallow margins;
- ✓ 70.2 (21 points) Pyecombe – short natural wooded section d/s degraded stretch with exceptional flush;
- ✓ 84.1 (21 points) Plumpton Mill – extremely natural woodland, energetic, diverse section d/s mill;
- ✓ 89.2 (20) Treyford Stream – score only reflective of conditions downstream; heavily impacted u/s;
- ✓ 9 (20) Tidal downstream section at Fishbourne – not chalk stream.

In terms of geographical distribution of the 'highest scoring' watercourses, these are primarily found in Areas B and C, the streams flowing off the escarpment over the Downs from the Lavant, and draining into the Rother/Arun, and streams north of Brighton draining into the Adur. Only one reach of a watercourse in the Fishbourne Area (A) reached a score of 20, and this is tidal and not a chalk stream. To the extreme east, only the Offham site scored 20 or above, and this was applied to just the upstream 200m to ensure recognition of this extremely important area (had the whole section been scored, as was the norm, the score would have been much lower). In Area D there was also only a single site scoring ≥20; the Plumpton Mill stream – this has some very interesting morphology, with a geomorphologically active wooded section downstream of large lakes and the mill. In contrast, more than 25% of classified watercourse lengths in Areas B and C (9 of 32) scored ≥20.

'Naturalness' of the morphology (attribute 1) might be considered the best indicator of the least physically impacted reaches surveyed. Unfortunately this is also subjective, and relies on interpretation of many factors. Despite this, it is considered that some sections surveyed were very natural, but rarely throughout a whole 500m, or the length of watercourse investigated (be it a shorter or longer length). Based on the scores given for this attribute for complete sections (shown as the bottom blue section of the histogram), the following can be concluded:

- ➢ no watercourses in Area A scored '5' – the best being streams 8 (near perennial chalk stream) and 9 (tidal);

- two lengths in Area B scored '5' for naturalness of morphology – 89.2 (the downstream section of the Treyford stream) and 98 (the lower section of the Bignor stream complex, downstream of the mill);
- The Lag wood Stream scored '5', and is considered a 'reference condition' site for a chalk spring fed stream;
- No complete sites scored '5' in Areas D and E, but the Offham source has been scored this highly to ensure it is recognised as being special.

The subjective broad categorisation of the hydromorphological character that most simply describes each watercourse has been given in summary form in Section 4.5. Figure 4.5b shows on maps the brief morphological descriptions that most aptly sums up the physical character alongside flow characterisations.

Finally, Figure 4.5c tabulates all summary data.

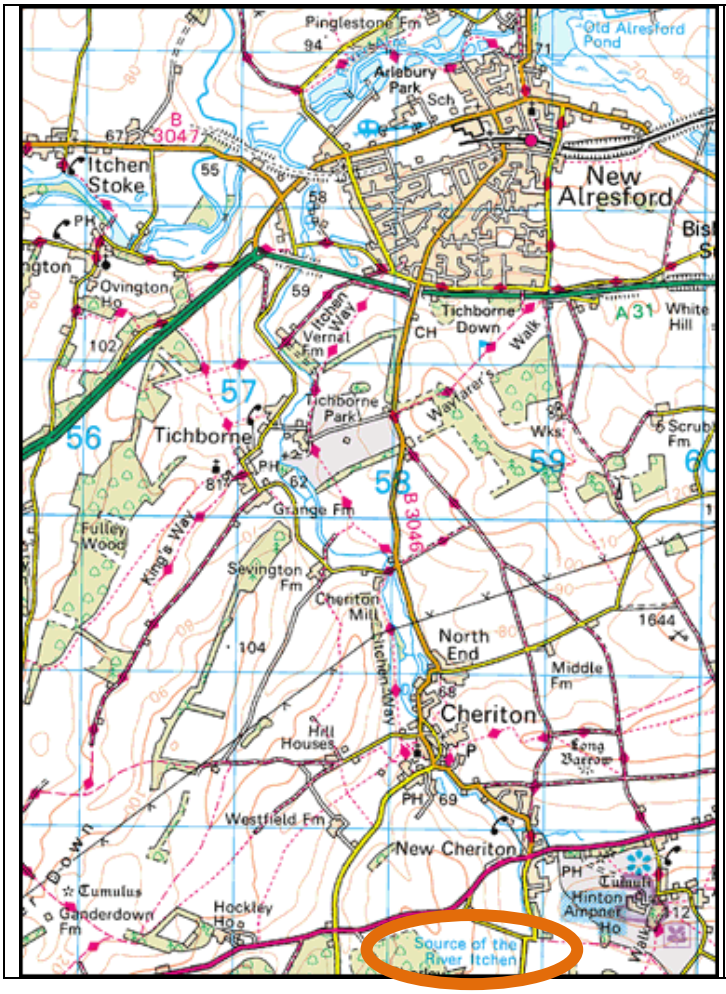
4.4 Other Noteworthy Information

The following brief notes highlight some aspects of the watercourses investigated that are important when considering: a) the range of chalk stream types in the UK (effectively England); key factors affecting the character (both natural and anthropogenic); how best to protect and enhance the local resource in the future.

One of the most compelling features of most of the watercourses investigated that set them apart from virtually all other headwater chalk streams seen in the UK, was their greater dynamism and presence of hard pebble beds, often with some geomorphologically formed features such as sediment bars or erosion. This was most evident where watercourses had not been straightened and there was at least some meandering, however small.

Investigation of maps confirmed the view in the field; the key is the steepness of the channel gradient. To illustrate why many of the South Downs chalk streams are so different from such classic chalk streams as the Itchen, information on the height at which each stream has its source, and their gradients in the top 1km (or between 5m contours if longer) has been gathered and presented in three figures.

Figure 4.4a provides information on the height and gradient character of the source of the Itchen, as well as how this translates into channel character.



The headwater stream of the Itchen rises at <75m. It then flows c7.5km to its confluence with other channels in the valley floor at New Arlesford. The gradient is 1:375. For the South Downs Streams it is most commonly in the range 30-60.

Figure 4.4a Upper Itchen

In Figures 4.4b and 4.4c histograms show the height at source of the watercourses surveyed coming from the South Downs (with the Itchen shown also for comparison), and also the gradient of each of these watercourses in their headwaters.

It is firstly noteworthy that the height at source of the Itchen is within the normal range of the South Downs streams. The sources of watercourses in Areas A and E are markedly lower than in the middle sections B, C and D – the latter is closer to that of the Itchen than the former. If the height of source alone was a key factor in shaping channel morphology there would be little difference between the Itchen and the more dynamic South Downs watercourses. But there is a great difference, confirming the statement '*rivers do not know what height they rise*!! (Professor Mike Clarke, Southampton University).

Looking at Figure 4.4c reveals dramatic differences between the South Downs watercourses and the Itchen in relation to channel gradient. The majority of the South Downs watercourses, and especially those where morphology is most diverse and natural in Areas B, C and D, have gradients six times steeper than the Itchen. As stream power (the ability for a stream to make geomorphic adjustments) is related to channel cross-section, discharge and gradient, the gradient is concluded to be the key factor that sets the South Downs chalk streams apart from the normal perception of chalks stream morphology. It has such a fundamental effect as to justify giving rise to a whole new 'chalk stream' type. Some examples of the dynamic natural character of some South Downs streams are shown in Figure 4.4d to illustrate character that would be unimaginable on the Itchen or Test.

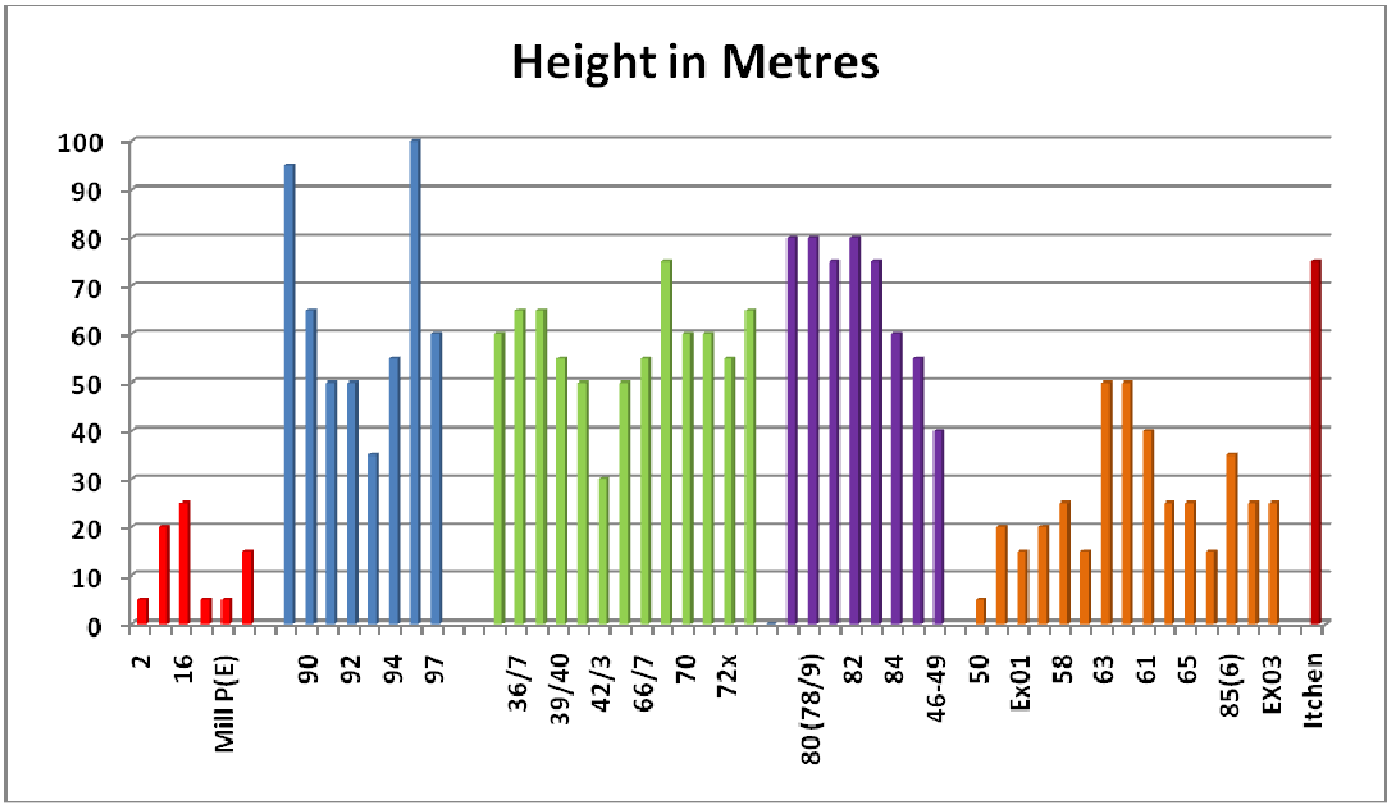


Figure 4.4b Height of Source of Each Watercourse Surveyed – to the Right the Itchen is Shown for comparison

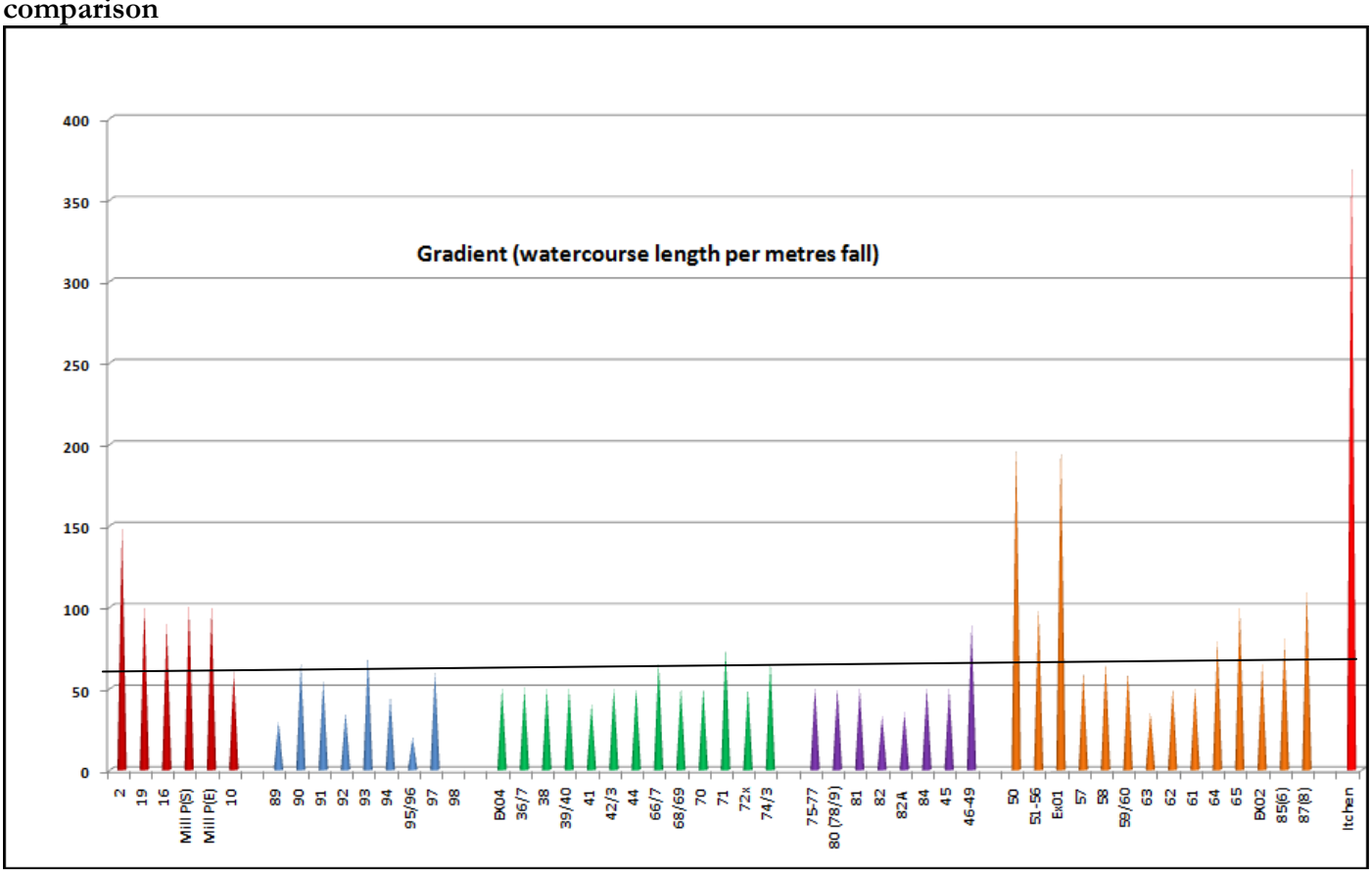


Figure 4.4c Gradient of Each Watercourse Surveyed – to the Right the Itchen is Shown for Comparison. Note the shorter the 'spike', the steeper the gradient.

Figure 4.4d Illustration of the Dynamic Character, and Resultant Formation of Geomorphic Features, in Some of the South Downs Headwater Chalk Streams

The extent of riparian woodland alongside many of the watercourses is much greater than the norm associated with other UK headwater chalk streams. Even where riparian woodland is absent, many of the streams have extremely dense bankside tree cover. This high level of tree cover results in many unusual characteristics being manifest in quite a high number of watercourses, including:

- dense shade, naturally reducing vegetation cover, therefore the common association of dense macrophyte growth with chalks streams is absent and more natural than if it was luxuriant;
- morphological adjustments occurring as a direct result of trees on the banks;
- tree roots often form significant habitat diversity within the streams in their own right;
- woody debris is relatively common – directly this provides habitat diversity, and indirectly it stimulates habitat creation through influencing flow patterns locally.

Photos below illustrate the above four points.






As has been stated previously, impoundments on watercourses were found commonly, with minor structures backing water up only a small distance, and other major structures in place that create much larger on-line waterbodies. Historically, the largest were created for water storage to drive the wheels of downstream mills. Today some of these mill ponds exist almost in their entirety, but now have different uses. This is the case for the two examples illustrated below. The left image is the Duncton Mill pond, now associated with a commercial fishery. The right image shows the historic impoundment for Plumpton Mill which now forms a focal ornamental pond in an extensive landscape garden.


More numerous than historic mill ponds are on-line ponds created for visual amenity (landscape features) within parks and gardens, and as fishing lakes. The former are much more prevalent than the latter, and within the latter there are both angling lakes as well as ponded sections of watercourse used for fish rearing (as on the East Lavington arm of the Duncton Mill stream. Examples are illustrated below.




Of significant nature conservation interest, despite developing from modified lengths of watercourse, are the historic on-line ponded sections that have developed into swampy woodland (carr). As seen at Offham, this

type of habitat is associated with near natural chalk stream sources where springs discharge through woodland before forming a discrete channel. Many examples were found where the impounding structures have been removed or become dilapidated, and carr habitat has formed - where present these have been summarized in Figure 4.5c. Whilst these habitats are not 'natural', over time many have developed the type of habitat that has been lost in virtually all other chalk stream systems. To restore them to ponded habitat would be considered to be environmental degradation, whatever the potential for improving habitat for some species.

The bottom two photos show what can happen over a long period of time. They show what was once the mill pond for Lower Mill on the Plumpton Mill stream (84); since the mill was abandoned the mill pond has filled with silt and carr has developed; the stream now meanders through this habitat that was once an on-line lake.






Away from urban areas the predominant riparian land-use is woodland, arable cultivation and improved grassland. Most improved grassland is cut, or grazed by animals fenced off from the watercourse itself. The typical non-woodland/non-urban land-use adjacent to most watercourses surveyed is illustrated below.

Grazing adjacent to watercourses that allows animals to freely access the stream, in locations other than drinking bays, is very rare. Two examples are illustrated below (left is watercourse 58 – Preston Farm stream; right is watercourse 73, Keymer). The grazed and open edges of the ditched areas often had a much richer flora than where they were fenced and the banks had become colonized by tall herbs and shrubs.

5.2. Summary of 2010/2011 surveys
Vegetation

Vegetation is critically important in making assessments of whether the watercourses surveyed have close affinity to chalk aquifers, and hence their ecology and character is primarily driven by flow from springs discharging from the chalk aquifer. In the most natural streams there will be heavy shade, and very little macrophyte growth. When the channels are not shaded, what species are growing in the channels can be of great value in assessing their hydrological regime.

- If there is perennial flow from chalk springs, the most likely species to be present are *Berula erecta* (Lesser water-parsnip), *Callitriche obtusangula* (Blunt-fruited water-starwort), and more rarely in headwaters, *Ranunculus penicillatus* (Brook water-crowfoot) – either subspecies *vertumnus* or *pseudofluitans*. In exceptional cases *Groenlandia densa* (Opposite-leaved pondweed) may be present. If two of these taxa are present, it is highly unlikely that the chalk springs will fail. If none are present, and the watercourse is not heavily shaded, it is probable the watercourse is a winterbourne, and will fail to have springs discharging to the watercourse either on a regular basis most years, or springs will fail in extreme drought periods and the bed will become bone dry at some time, even if this only happens very rarely.

- In shaded headwaters fed by springs, one alga and two bryophytes are very typical of watercourses with near perennial spring flows. The taxa are: *Hildenbrandia rivularis*, a red encrusting alga, and moss *Cratoneuron filicinum*, and the liverwort *Pellia endiviifolia*. The presence of these taxa are a sure sign of strong springs that rarely if ever fail, but perennial flow (i.e. discharge 100% all the time) cannot be guaranteed.

- Groundwater-fed, intermittently flowing, winterbournes in open areas also have distinctive communities, but also tend to have more 'ditch' species obscuring the picture. *Apium nodiflorum* (Fool's water-cress) is a good example of the latter as it is a common component of winterbourne communities as well as very degraded ditches. The same is also partially true for *Rorippa nasturtium-aquaticum* (true watercress), but this is more characteristic of winterbournes. The 'iconic' species of winterbournes is *Ranunculus peltatus* (Pond water-crowfoot); it thrives when annual drying allows seeds to mature, and re-growth can then occur on damp soil in late autumn. Sadly this is an extremely rare taxon in Sussex rivers. Also rare, and typical of winterbournes (but also streams with perennial flow) is water speedwell (*Veronica anagallis-aquatica* agg.).

Tables 4.1a-f summarize the occurrences of key taxa that enable an assessment of the character of all the watercourses surveyed.

Group I watercourses to the west of Chichester had markedly contrasting characters. Eight sections of the Rowland's Castle watercourse were surveyed, and all had no botanical interest at all. Several contrasting watercourse lengths were surveyed as the 'Bosham' complex, that discharge to Chichester Harbour. Of the 15 lengths surveyed, seven had rich macrophyte communities that strongly indicate that 'perennial' springs (that may not fail in droughts) feed these watercourses. One system, Bosham 1b-d (south of Funtington) had luxuriant growth of crowfoot, and near its source, opposite-leaved pondweed was recorded, the only site in which it occurred in over 110 sites surveyed this year. A tributary (1a) had a classic winterbourne community. Two other sub-catchments supported communities indicative of perennial spring flow.

The flora of the Bosham stream from Funtington is considered to be the richest and most 'typical' perennial chalk stream flora in the whole of Sussex.

Group II watercourses are north of Chichester and the River Lavant, and drain the northern escarpment of the South Downs, stretching from the A27 in the west to the River Arun in the east. Seven areas were subject to further investigation, and for the purpose of survey, watercourses were further sub-divided into 31 units.

Only two watercourses showed clear evidence of probably being subject to perennial spring flows, and several others indicated that there was a strong possibility of near perennial spring flow. Several streams in this area had been surveyed in 2009, and *Ranunculus* was found in several watercourses surveyed. None of those surveyed in

2010 had *Ranunculus,* but Stream 2 at Harting and Stream 2 at Sutton both had *Berula* present, and Stream 3 at Bepton had *Callitriche obtusangula* present.

The downstream section of the stream at Nersted had a community typical of rocky, steep gradient, chalk streams that might have reliable spring flows. The same was true for Stream 6 at Harting, Stream 2 at Graffham, Streams 2 and 3 at Sutton and Stream 1 at Burton. Stream length 4A at Harting had no classic winterbourne taxa present, but was highly rated as it was naturally bare within a very shaded, physically diverse, near-natural, channel.

This group of watercourses thus exhibited a wide range of floral characteristics, with some stream lengths at Nersted, Harting and Sutton rated highly for their flora. In contrast, some stream lengths in most of the seven target areas had rank vegetation communities.

Group III coastal watercourses comprised just four locations between Chichester and Arundel. Fifteen survey units were assessed. Most of the survey units had water-cress present, and many either had ditch or winterbourne communities only. Tangmere 2C had a classic winterbourne community, sustained within open grazed and trampled channels. Three sites at Eastergate had interesting macrophyte communities. In 1A the flora was typical of a winterbourne but within a heavily managed and degraded channel. Watercourse 1E had a rich community, and like 1A, had *Callitriche obtusangula* present; this stream was like a headwater Hampshire chalks stream!! Watercourse 1C was noteworthy for having bryophytes present suggesting strong spring flows for much of the time in most years, but lacked any higher plants indicative of reliable spring flows.

At Binsted, watercourses were either dry and bare, or had no species indicative of links to groundwater derived from the chalk; indeed one stream with water had *Eleogiton fluitans* present, and classic indicator of very acid waters!! The most interesting flora within the area was found in the two watercourses surveyed in Arundel where *Ranunculus & Callitriche obtusangula* were present in both. In addition to having rich macrophyte communities, the assemblages indicated strong spring flows are maintained at all time.

Group IV watercourses draining the north-facing escarpment of the Downs east of Amberley had only very limited botanical interest. Within the 21 survey units within six catchment areas, none had floral assemblages suggesting perennial spring flow. At Amberley, Ditchling, Cook's Bridge and East Chillington, the communities were impoverished, and often dominated by terrestrial species. At Storrington (2A) there was a flora within a near-natural section of river that suggested near perennial spring flow. At Poynings three sections of the seven surveyed had interesting plant communities. At Poynings 1A ditches and flushes were present with luxuriant macrophyte growth suggesting strong winterbourne flow, and irregular failure to flow only. At 2A parts of the channel runs through woodland where the flora was sparse save for luxuriant growths of the liverwort *Pellia.* In Poynings 2D bryophytes were common on tufa bed-rock and cobbles.

Group V coastal watercourses east of Arundel were generally of limited or had no botanical interest at all. Eight survey units were assessed, and only those in the River Adur tidal floodplain had any botanical interest. At Poling and Sompting, all sites had ditch floras, and only Poling 1d had water-cress present; links between the recorded flora and a chalk aquifer feed were absent. The two sites either side of the Adur were more interesting, especially Adur 1. This is a very sluggish drain which is occluded by reeds, but the macrophyte community clearly shows a strong influence from chalk springs. In addition to the presence of typical species of perennial chalk streams, water lilies, hornwort, milfoil and even stonewort, were present. Adur 2 had less botanical interest, with blunt-fruited water starwort suggesting a retained water level in the lower reaches.

Group VI watercourses east the River Ouse had extremely impoverished, and generally uninteresting, macrophyte communities apart from one. The exception was Newhaven 2 where *Ranunculus peltatus* was recorded. This was the only site in over 200 watercourses surveyed in 2009 and 2010 to support this classic indicator of shallow gradient, shallow-banked, winterbournes within grasslands. Site 1B at Firle was notable for its natural lack of flora in the shaded, diverse and dynamic section through deciduous woodland – here the shade tolerant liverwort *Pellia* thrived in the bed and on the banks.