Integrated fisheries, RHS and ecological data model for the river Lee

Report to Environment Agency NE Thames Area

P. M. Scarlett
M O'Hare

CEH Dorset

Winfrith Technology Centre
Winfrith Newburgh
Dorchester
Dorset DT2 8ZD
Telephone (01305) 213500
Main Fax (01305) 213600
www.ceh.ac.uk

Integrated fisheries, RHS and ecological data model for the River Lee

P. M. Scarlett , M O'Hare

Project leader: P.Scarlett
Report to Environment Agency NE Thames Area
CEH Project No: C01019
Date: January 2006

INTELLECTUAL PROPERTY RIGHTS

CONFIDENTIALITY STATEMENT

Contents

Figures

Tables

Appendix

1 Background

1.1 Introduction

The Centre for Ecology and Hydrology (CEH) was commissioned by the Environment Agency, Thames Region, to analyse fisheries and River Habitat Survey (RHS) data from the River Lee, Hertfordshire, and five of its tributaries – Mimram, Stort, Ash, Rib and Beane (figure 1).

Three hundred and thirty-five RHS surveys were used for analysis. The surveys were conducted between 2000 and 2004 by different surveyors. Most surveys were done using the most recent (2003) version of the RHS methodology (Raven et al 1997 and 1998).

In order to provide more detailed information of variation along the main river Lee it was split into three sections namely upper (source - Hertford), middle (Hertford - Enfield) and lower (Enfield - Thames).

The project is a continuation of the development of an integrated model to further a strategic approach to maintaining and enhancing local rivers for fish and other wildlife.

1.2 Objectives

The objective of this part of the project is to incorporate a selection of previous analyses placed in reference to fisheries interests within the River Lee Catchment. This work will complement the current efforts to improve fish populations outlined in the Lee Fisheries Action Plan (Lee FAP, 2005).

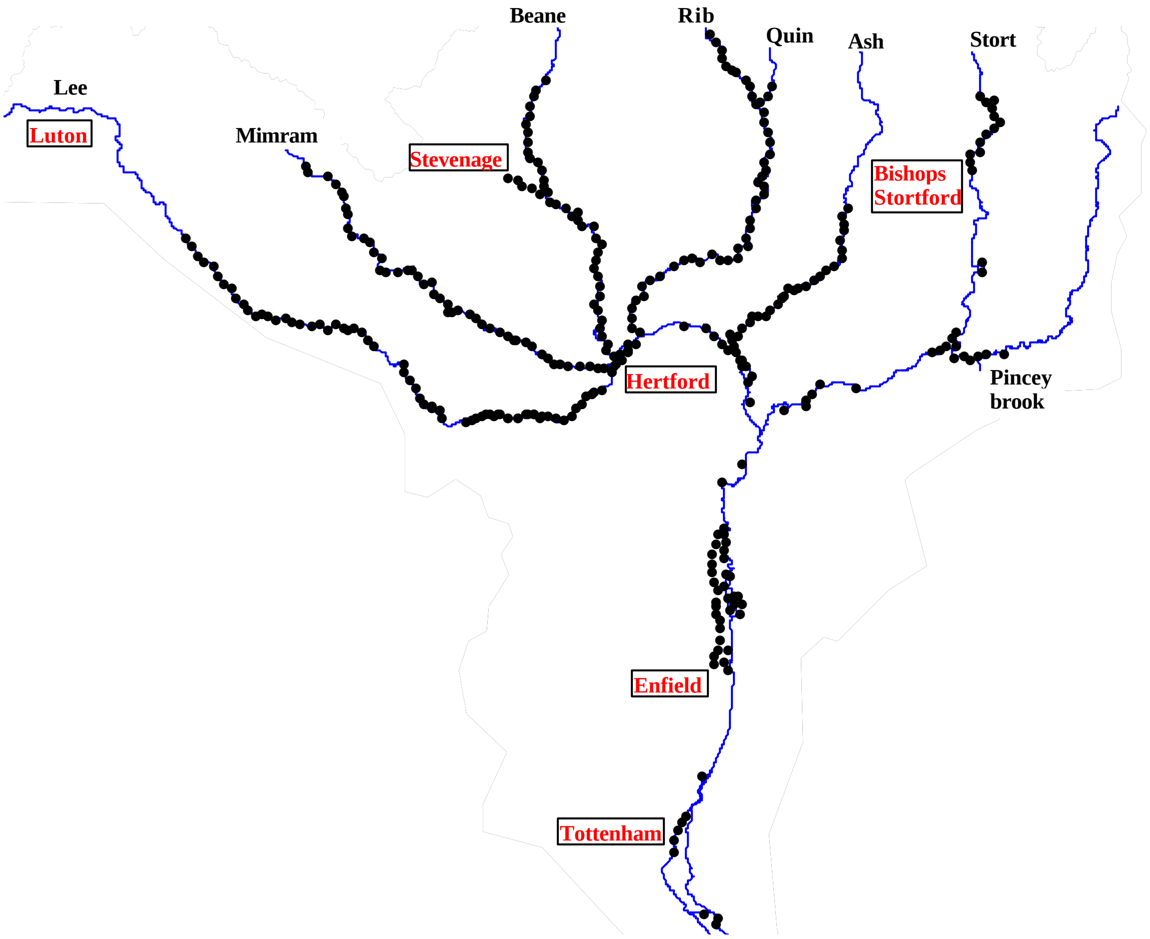


Figure 1. Location of RHS sites on the River Lee catchment

1.3 General Description of the Lee Catchment

The River Lee rises near Luton at an altitude of approximately 120m and flows in a southerly direction for 85 km where it joins the River Thames at Canning Town (Environment Agency 2004). The total catchment area is 1,420 sq. km of which the upper Lee area comprises 1033km^2.

The upper half of the catchment and all of the tributaries mentioned in this report have a solid geology which is based on chalk (figure 2). The lower half of the Lee catchment is based on London clay. As a result, the upper Lee and its tributaries are mostly fed from groundwater, and the flow of the lower Lee is mostly derived from overland run-off from the clay and urban areas. The chalk is only permeable to a limited degree.

The drift geology is more mixed though it is dominated by boulder clay/morainic drift and glacial sand and gravel with river terrace deposits in the lower reaches.

Ground slopes are mostly gentle though there are some steeper areas around the Chilterns in the Luton area. The upper part of the catchment is mostly a shallow valley, which opens out downstream into the floodplain of the Thames.

There are a large number of Sites of Special Scientific Interest in the Lee valley, mainly due to the unique habitats provided by multiple river channels and the areas of standing water provided by flooded gravel workings.

The Lee supports good fisheries especially in the upper reaches. Roach, bream, barbel, chub, eel, tench, dace, perch, pike and carp are all present in parts of the catchment.

Agriculture is the main land use in the Upper Lee area, though urban areas cover 16% (169 km^2) of this area. In the lower part of the catchment, urban areas are more extensive. Water quality of the tributaries is generally better than that of the main river Lee which is impacted by run-off from urban areas. Abstraction has a significant impact on the Lee catchment. Water is abstracted from the Lee at Ware to supply water for London and it is also subtracted further downstream to fill the Lee reservoirs. Some of the water is returned via sewage treatment works. Re-development of urban areas and agricultural intensification also threaten the catchment.

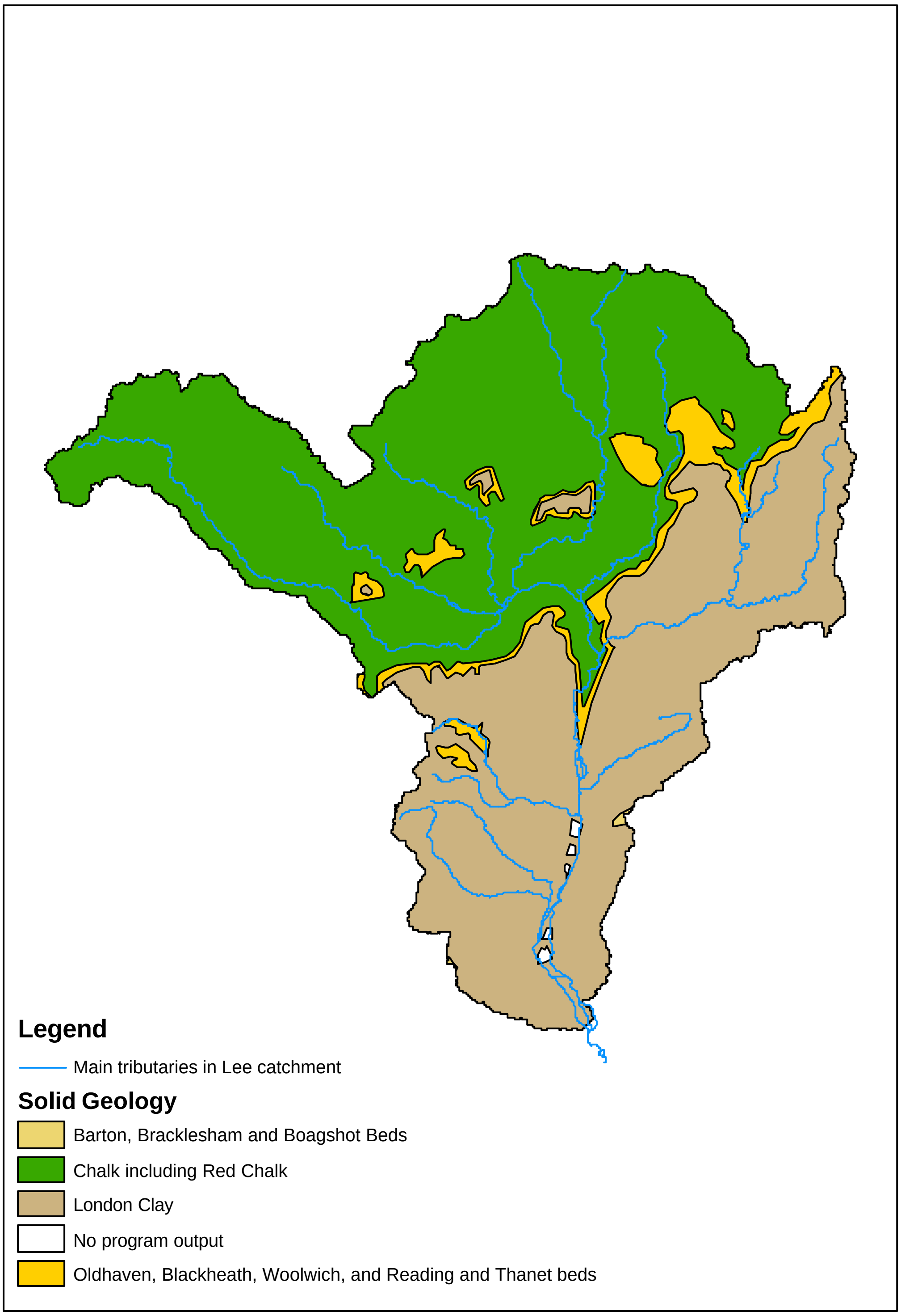


Figure 2a Solid geology of the river Lee catchment

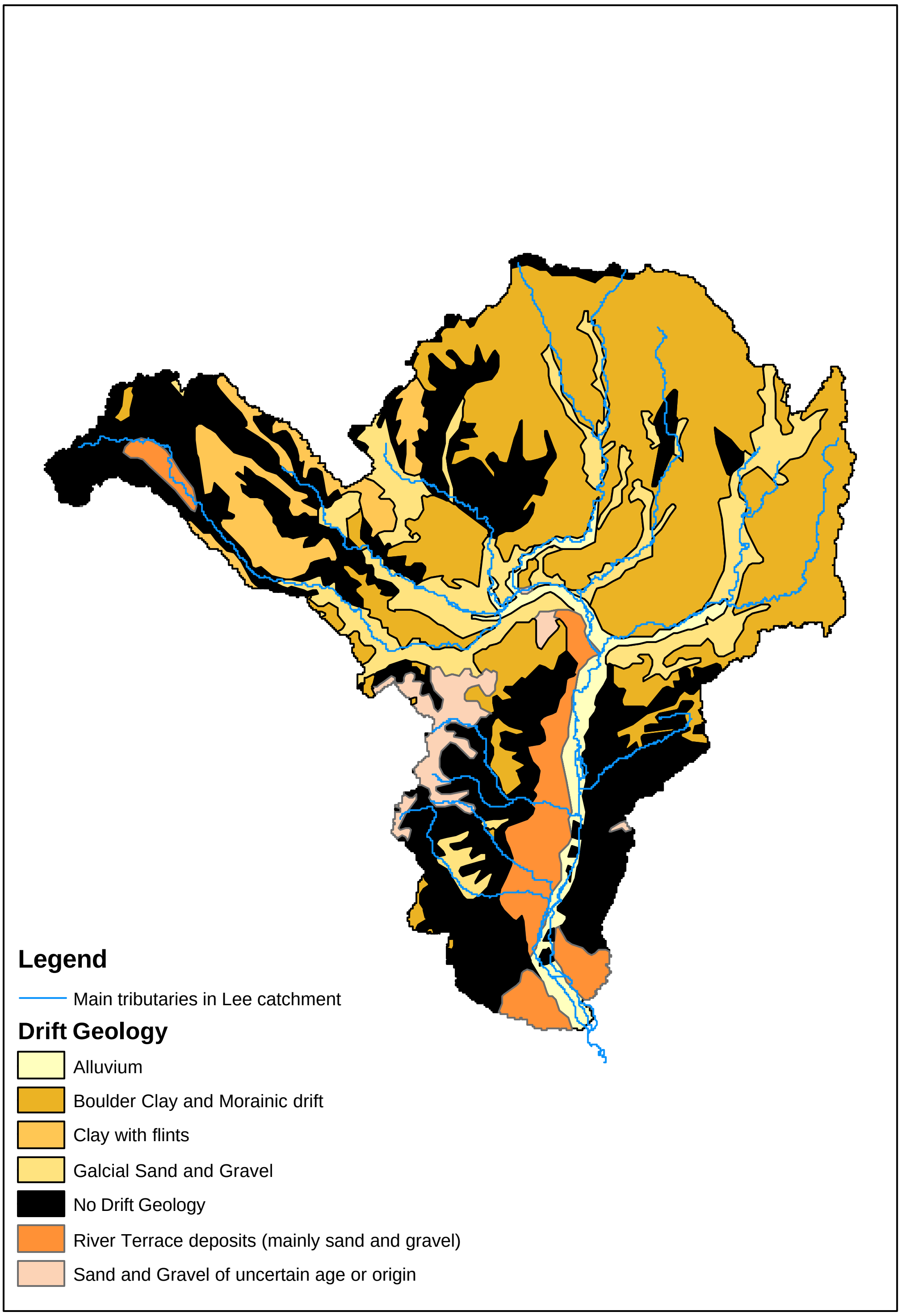


Figure 2b Drift geology of the river Lee catchment

2 Habitat Quality of the catchment

Data collected from the RHS surveys provides detailed information on habitat characteristics of the Lee catchment is available. In order to provide an overview of theses characteristics and to illustrate both areas of high conservation value and areas where enhancement of habitats may be beneficial, a number of maps were generated (appendix 2). These are summarised below.

2.1 Habitat Quality and Impacts

Using RHS data, scores were calculated for each site which indicate the extent of habitat modification and habitat quality.

The Habitat Modification score (HMS) measures artificial modifications to the physical structure of the channel such as resectioning and man-made structures.

The Habitat Quality assessment score (HQA) is based on the presence and extent of habitat features of known value to wildlife.

Much of the catchment shows signs of having been extensively impacted with nearly all sites being designated as either severely or significantly modified. Sites on the upper part of the Lee catchment are the least impacted.

The habitat quality scores show more variation than the impact scores. The river Ash and the lower part of the Mimram have particularly good habitat quality scores in contrast to the river Beane and the upper Lee which had mostly poor scores.

2.2 Land Use

Both banktop and riparian land-uses are mixed throughout the catchment. Tilled land and improved grassland are more common along the tributaries than the main river Lee, where urban landuse is prevalent, especially in the lower reaches.

2.3 Matrix of high quality and degraded sites

In order to distinguish which sites on each tributary and river section are of highest conservation value and those which may require habitat enhancement, a matrix was designed listing sites with the most positive and negative habitat features. These tables are listed in appendix 2.

2.4 Substrates and Flows

Gravel/pebble and silt are the most common substrates in the catchment (figure 3). Gravel is especially common on the upper Lee and silt is common on the Stort and middle Lee. Water depth occasionally prevented assessment of substrate, especially on the lower river Lee.

Lower energy flow types, especially smooth flow are most common on the catchment (figure 4). Higher energy flow types, especially riffles, were comparatively rare

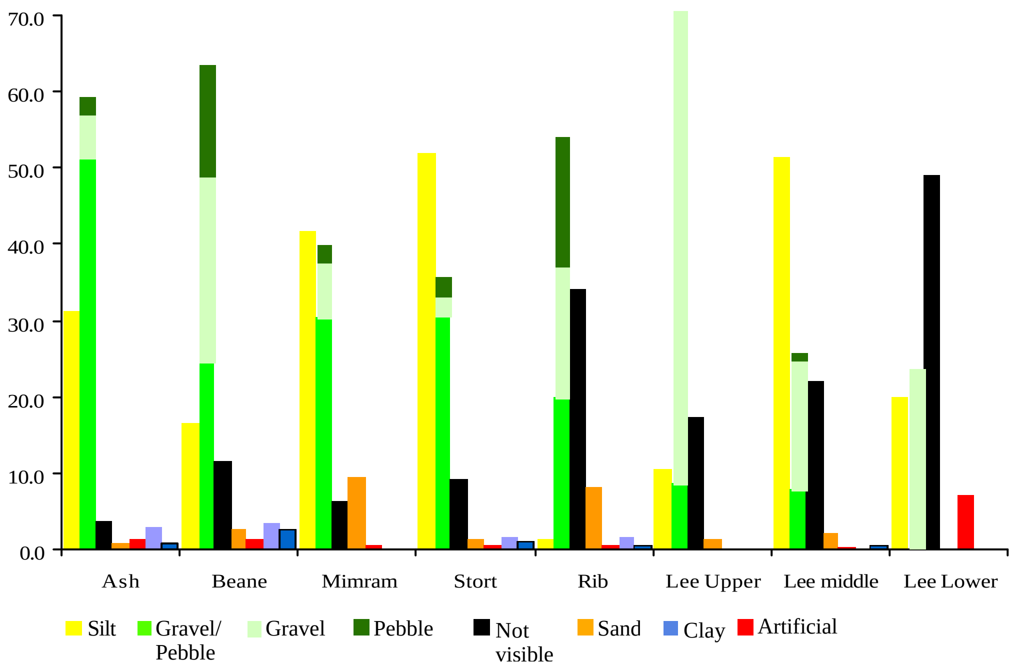


Figure 3 Substrate compositions of the river Lee and tributaries

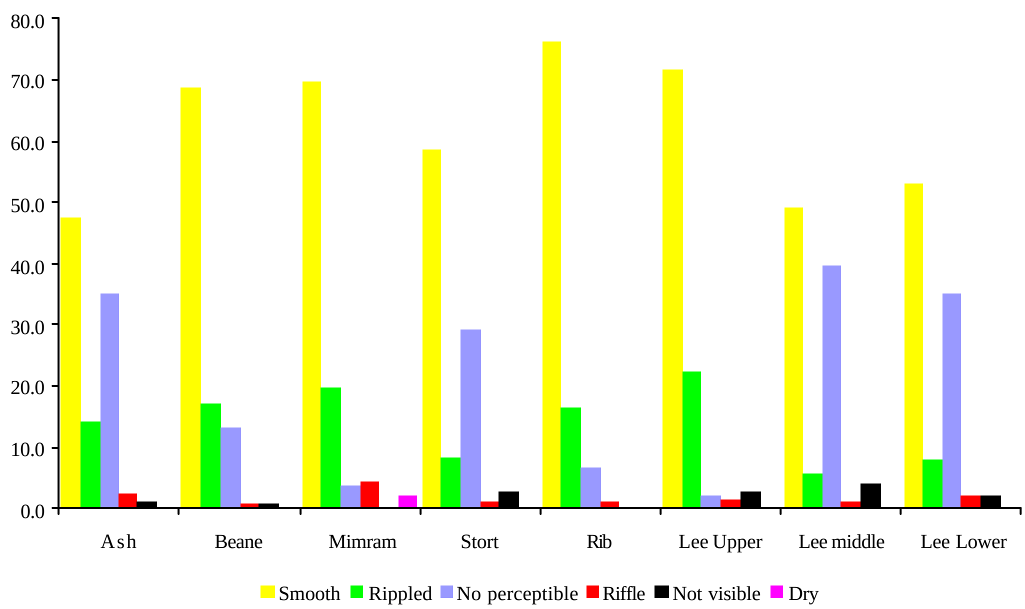


Figure 4 Flow compositions of the river Lee and tributaries

2.5 Stream Power

Basic stream power was calculated using the formula

$$? p= QfS/bw$$

? p = stream power proxy

Qf = flow category average discharge

S = slope (m/km)

bw = water width

Most stream power figures were low, especially on the River Ash. Figures for the upper reaches of the river Beane were noticeably above average. This indicates that these sections are more active than others in the catchment with an increased likelihood of erosion. Sediment is likely to be transported through these areas, rather than deposited.

2.6 Fine Sediment Sources and Bank Sensitivity Scores

These scores are also derived from RHS data.

The Fine Sediment Source Index is a measure of actual and potential input of fine sediment from eroding cliffs, poaching, land use, substrates and deposits.

The scores were especially low on the Upper Lee and the river Beane.

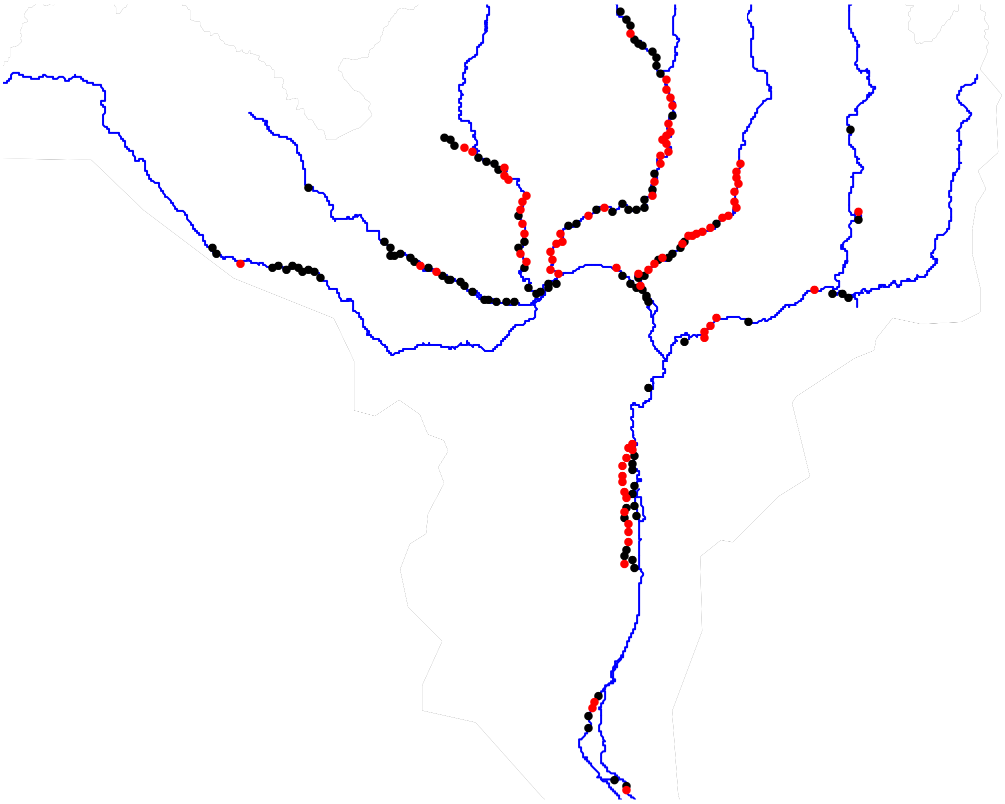
Bank sensitivity to erosion is calculated from existing causes of bank sensitivity such as eroding cliffs and bank material, and from historical causes such as drift geology and sinuosity. These scores were highest on the Rivers Rib and Ash.

Sources of erosion can also be divided into natural and artificial. On the upper Lee and the river Beane artificial sources were prevalent. On the rivers Mimram and the Ash natural sources were a more significant source of erosion.

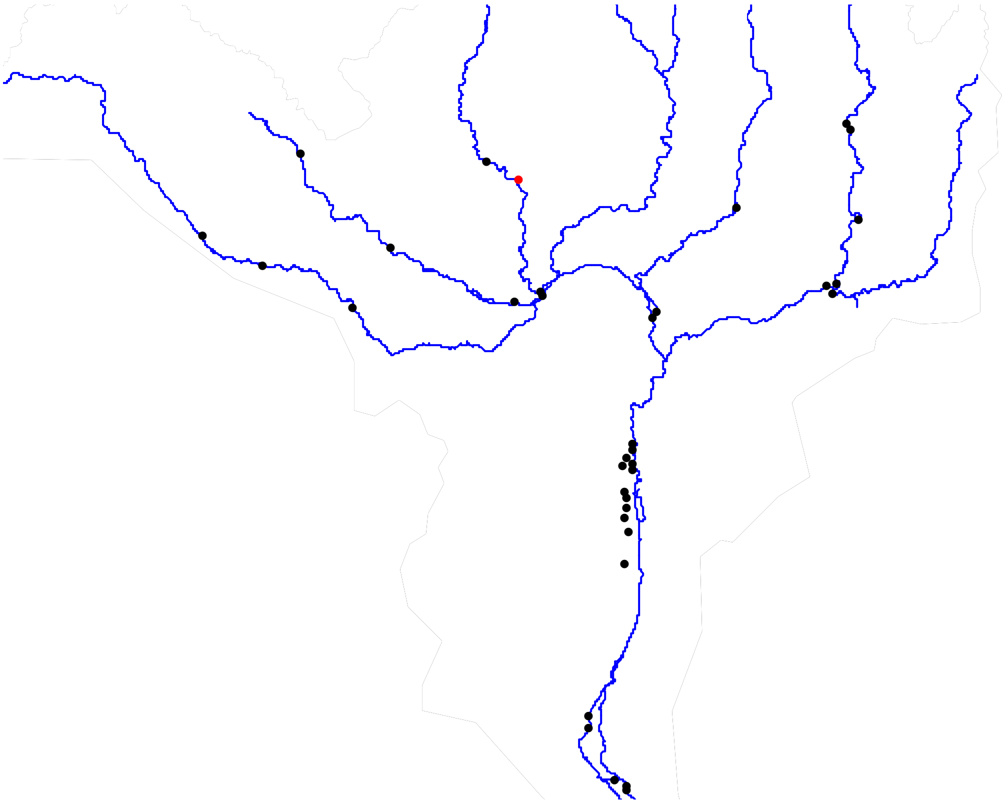
2.7 Nuisance and invasive plant species

Three species were recorded throughout the catchment (figure 5). Himalayan balsam (*Impatiens glandulifera*) and japanese knotweed (*Fallopia japonica*) were recorded on all the tributaries and throughout the river Lee. The distribution of japanese knotweed is scattered in contrast to the himalayan balsam which was recorded as extensive (>33% riparian cover) over large lengths of river bank. Giant hogweed (*Heracleum mantegazzianum*) is mainly confined to the Rib and Beane.

Himalayan balsam



Japanese knotweed



● Present
● Extensive

Figure 5

Distribution of invasive and nuisance plant species on the Lee catchment

Giant hogweed

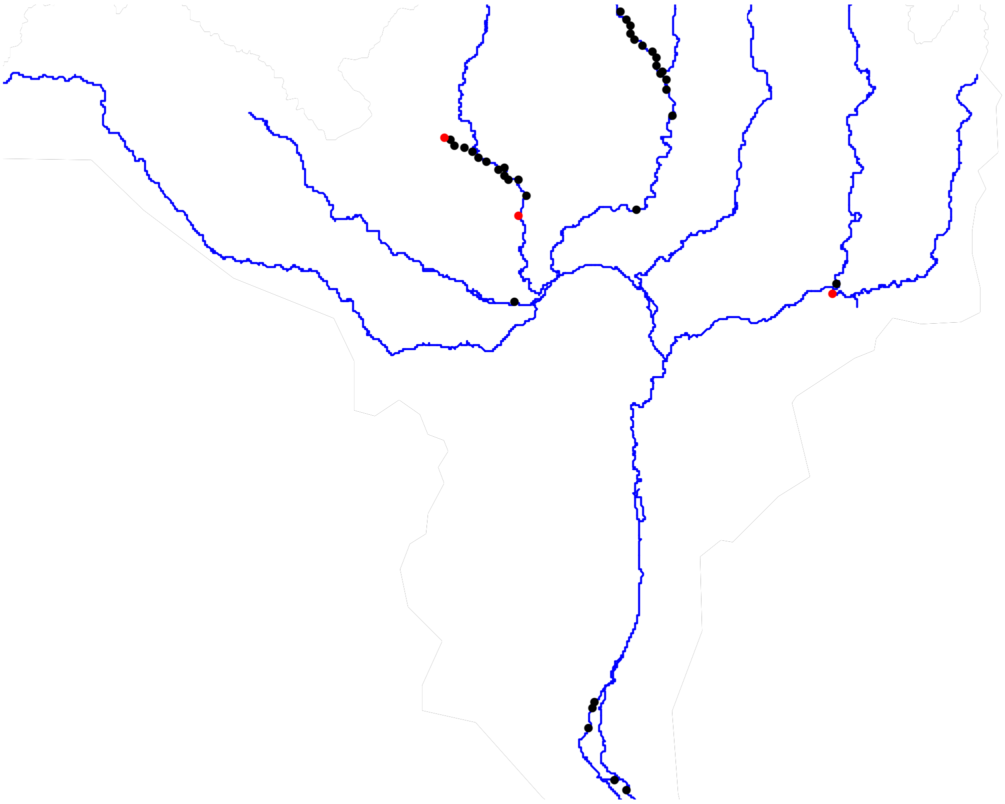


Figure 5 (continued)

3 Analysis of fish data

3.1 RHS data and its relationship with guild composition

Spawning success and the growth and survival of fish in their early life stages are important for recruitment and thus the health of a catchments fish population.

The use of a range of spawning substrates by different species has been used by Balon (1975) to classify fish into a series of reproductive guilds. For simplicity, three guilds were used for analysis in this report (table 1).

Table 1 Species recorded on 37 fisheries surveys on the River Lee catchment, 2003-05, and their relative spawning guilds.

Spawning guild	Species
Phytophils (Eggs adhere to or are laid on submerged plant surfaces)	Common (wild) carp, Crucian carp, Common Bream, Golden orfe, Mirror carp, Perch, Pike, Roach, Roach x common bream hybrid, Roach x rudd hybrid, Rudd, Tench
Lithophils (Eggs adhere to or are laid on to stones and gravel). Generally require higher flow velocities	Barbel, Bleak, Brown / sea trout, Bullhead, Chub, Dace, Grayling, Minnow
Psammophils (Eggs laid on sand or fine roots associated with sand)	Gudgeon
Other (catadromous)	European eel , flounder
Other (nest builder)	10-spined stickleback, 3-spined stickleback
Other (marine)	Sea bass
Other	Brook lamprey, Common goby, Ruffe, Stone loach, Topmouth gudgeon, Zander

Results from 37 fish survey sites throughout the catchment were available (figure 6). These sites consisted of electric fishing surveys, with the exception of site 19 (Gilwell Park Lake) where netting was used. Three passes of the sites were made using catch depletion sampling, and stop nets were placed at the upstream and downstream end of the sites. Twenty-three of these sites were located on the main river Lee. The tributaries had two or three fisheries sites each, with the exception of the river Beane on which only one site is present. Most of the sites had been fished annually from 2002 onwards, though only the most recent data were used in this analysis.

The location of eighteen fisheries sites were close enough to an RHS site to allow comparison of habitat data. Although the number of samples is too small to allow a statistically robust analysis, correlations between the composition of spawning guilds and habitat characteristics, as recorded on the RHS survey, were investigated. As spawning guilds are known to be affected by habitat quality (Balon, 1975) the habitat preferences of reproductive guilds were used in an attempt to highlight areas of good and poor habitat quality for species of different guilds.

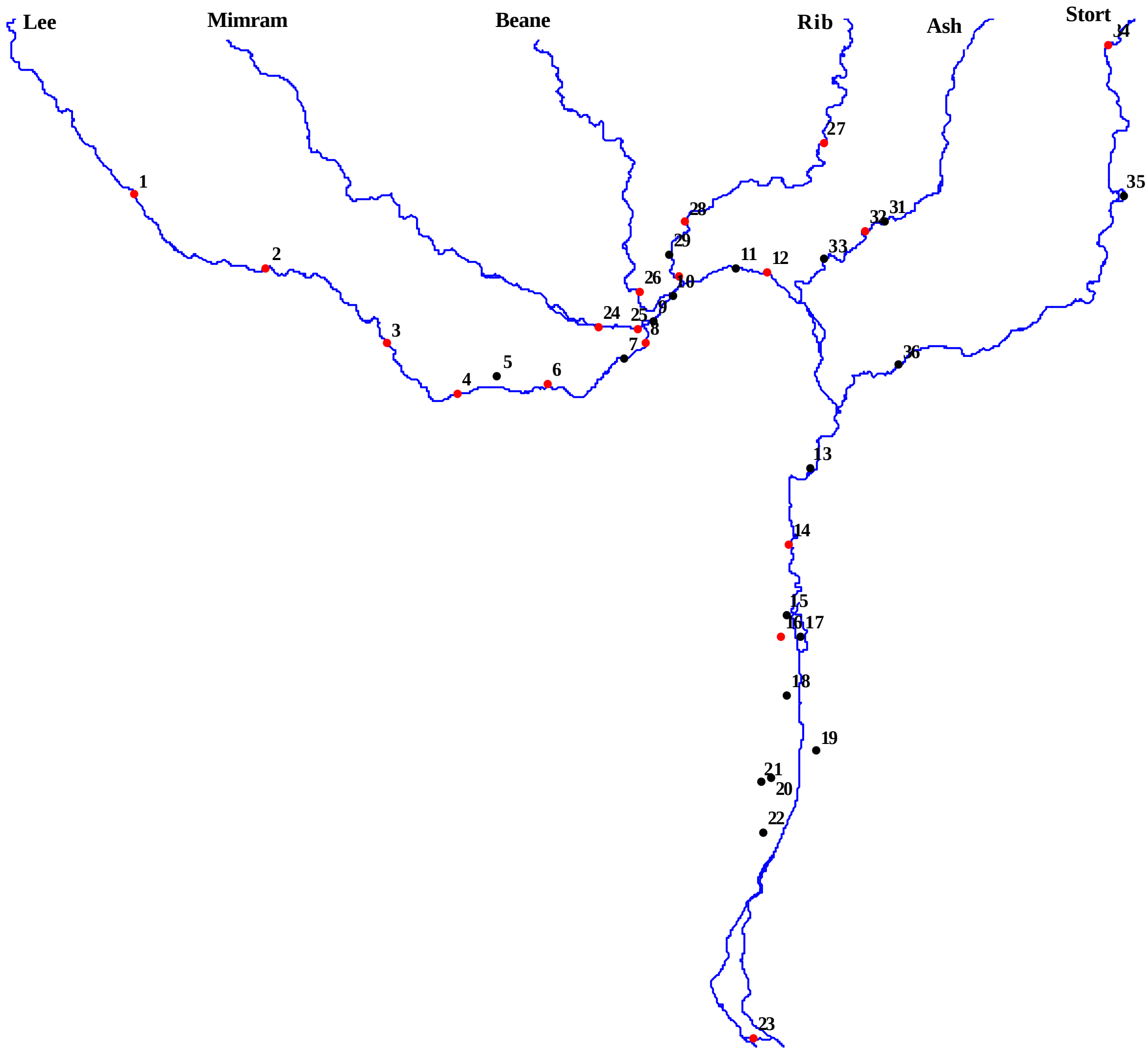


Figure 6 Location of fisheries sites on the river Lee catchment (Sites in red denote those at which RHS data is available)

Table 2a Summary of fisheries data on tributaries of the river Lee

	Headwater streams					Composition of spawning guild (%)		
Site	**River**	**Total catch**	**No. species**	**Density**	**Lithophils %**	**Phytophils %**	**Psammophils**	**Other**
24	Mimram	5	4	0.01	20.0	20.0		60.0
25	Mimram	59	7	0.08	74.6	10.2	5.1	10.2
26	Beane	32	5	0.03	3.1	87.5		9.4
27	Rib	277	9	0.52	94.9	1.1		4.0
28	Rib	20	5	0.03	85.0	5.0	10.0	0.0
29	Rib	51	8	0.08	86.3	2.0	7.8	3.9
30	Rib	48	7	0.07	87.5		4.2	8.3
31	Ash	15	1	0.04	100.0			
32	Ash	66	6	0.26	83.3	12.1		4.5
33	Ash	13	5	0.02	46.2	38.5		15.4
34	Stort	40	8	0.05	30.0	47.5		22.5
35	Stort	158	9	0.28	24.7	58.2	2.5	14.6
36	Stort	230	8	0.27	53.9	39.6	1.3	5.2

Table 2b Summary of fisheries data on the main river Lee

River Lee					Composition of spawning guild (%)		
Site	**Total catch**	**No. species**	**Density**	**Lithophils %**	**Phytophils %**	**Psammophils**	**Other**
1	79	8	0.17	62.0	2.5	2.5	32.9
2	475	8	0.62	79.2		11.8	9.1
3	330	9	0.30	87.9	7.6	3.3	1.2
4	113	8	0.18	21.2	62.8	6.2	9.7
5	159	3	0.29	98.7			1.3
6	141	8	0.23	80.9	9.9	7.8	1.4
7	4	3	0.00	75.0	25.0		
8	421	13	0.54	84.6	3.8	10.0	1.7
9	30	7	0.01	50.0	40.0	10.0	0.0
10	70	7	0.05	88.6	5.7		5.7
11	26	6	0.05	84.6	7.7		7.7
12	325	16	0.46	61.5	26.2	1.5	10.8
13	28	4	0.03	14.3	60.7		25.0
14	21	6	0.02	95.2			4.8
15	136	6	0.13	0.7	89.7		9.6
16	42	10	0.14	52.4	19.0	14.3	14.3
17	60	6	0.07	5.0	45.0		50.0
18	15	4	0.01	26.7	53.3		20.0
19	241	2	0.27		100.0		
20	59	5	0.04	8.5	83.1		8.5
21	76	6	0.07	1.3	32.9	1.3	64.5
22	53	6	0.02	1.9	88.7	3.8	5.7
23	21	6	0.01	19.0	4.8	4.8	71.4

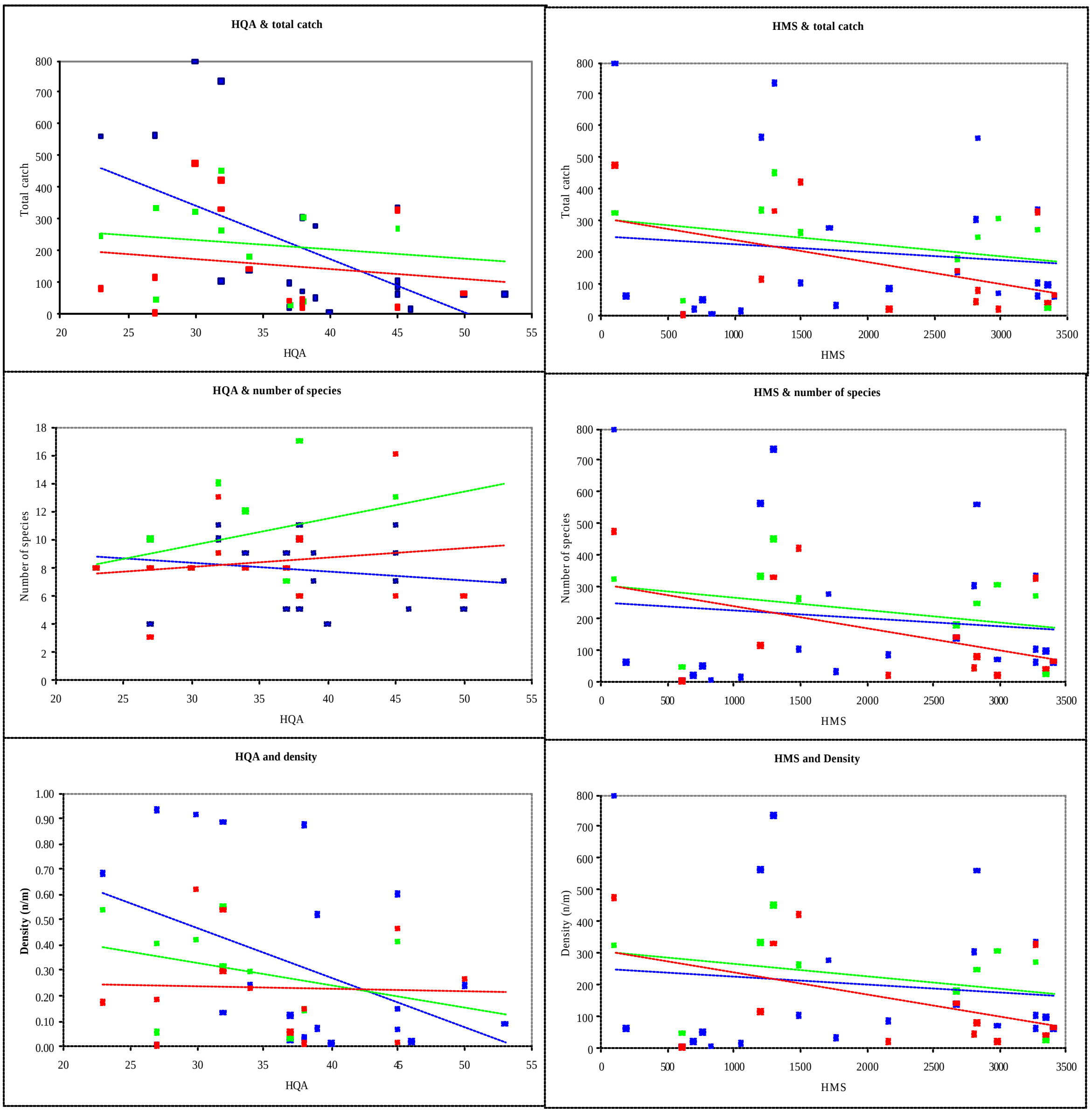
(Sites in red denote those at which RHS data is available)

Table 3 Fish related RHS habitat data and fish survey data from 18 surveys on the river Lee catchment

	Spawning guilds (%)					Tree related features			Flows						Substrates		Channel vegetation				
Site	Lithophils	Phytophils	Psammophils	Other	Density (no./m^2)	U/water roots	Fallen trees	Coarse debris	Flows (total)	Flows (slow)	Flows (fast)	Riffles	Pools	Marginal deadwater	Gravel/pebble	Silt	Choked	Mosses	Reeds	Submerged vegetation	Algae
1	62.0	2.5	2.5	32.9	0.2	P		P	1	10				P	5				4		5
2	79.2		11.8	9.1	0.6	P		P	2	8				P	10				4		
3	87.9	7.6	3.3	1.2	0.3	E	P	P	2		8				10						
4	21.2	62.8	6.2	9.7	0.2		P		2	9					6						
6	80.9	9.9	7.8	1.4	0.2	P			5	5	5	8	3		9			2	3	1	9
8	84.6	3.8	10.0	1.7	0.5	P	P	P	1	10					5				4	1	
12	61.5	26.2	1.5	10.8	0.5				5	8		1	3		7		P	1	7		10
14	95.2			4.8	0.0	P	P		4	6		3	1	P	9			2	3	12	10
16	52.4	19.0	14.3	14.3	0.1	P			4	9				P		8	P		9	1	
23	19.0	4.8	4.8	71.4	0.0				5	7		1			7			1	1	1	7
24	20.0	20.0		60.0	0.0	P		P	1	9						6			5	14	3
25	74.6	10.2	5.1	10.2	0.1	P			3	8						8	P		8	6	1
26	3.1	87.5		9.4	0.0	P			2	10									7	5	1
27	94.9	1.1		4.0	0.5	P			5	6				P	8				6	7	3
28	85.0	5.0	10.0	0.0	0.0				5	10									4	4	
30	87.5		4.2	8.3	0.1	P			3	9									7	6	
32	83.3	12.1		4.5	0.3	P		P	4	7		2	2	P	8			2		7	2
34	30.0	47.5		22.5	0.1		P	P	4	10						7	P		8	13	

3.2 RHS and fisheries data

Relationships between fisheries data and the RHS scores related to habitat quality and modification scores are illustrated in figure 7. Total catch and density of fish per m^2 fell with increasing habitat quality scores, though the number of species showed a slight increase. Habitat modification scores also failed to show a significant correlation with fish populations. This is most likely because the two sets of scores are not derived exclusively from channel and aquatic characteristics, but also include a large component of data relating to riparian habitat features. Total catch of fish is more likely to be associated with the size of the channel and is likely to be related to distance from source.



2003 2004 2005

Figure 7 Relationship between RHS scores and fish survey data (dashed lines are included to indicate trend lines – not statistically significant)

3.3 Identification of suitable sites for guilds using RHS variables

The degree of preference of species for specific habitats at different life stages varies greatly and can be used to identify both relevant and inappropriate habitats with more confidence (table 4). In this table, species with notable preference or ambivalence towards habitats are highlighted. The importance of spawning habitat is reinforced for a number of species. Species with specialised habitat requirements have been found to be more susceptible to anthropogenic influences than generalist species (Balon 1975).

Lithophils

Although optimum gravel size and flow velocities vary between lithophil species, RHS data can be used to highlight sites with predominantly gravel substrate, a lack (or ideally absence) of silt and the presence of predominantly fast flows (represented primarily by riffles).

Phytophils

The presence of sites with submerged vegetation in the form of both macrophytes and submerged parts of trees is easily identifiable using RHS data. However, refinement of the most appropriate sites for species in this guild is made more difficult by the wide range of flow velocities tolerated by these species.

Psammophils

The identification of appropriate sites for psammophils is possible using RHS data. The use of *Fontinalis* as a spawning site by gudgeon also enables potential spawning sites to be identified.

Table 4 Habitat flexibility for different elements of adult habitats, illustrating the strongest preferences or otherwise of selected species – x indicates a strong preference, • represents ambivalence. Amended from Grandmottet, 1983

	Overall	Refuge	Feeding	Spawning
Bream		x		
Bleak				
Barbel	x	x	x	x
Carp		x		x
Gudgeon				x
Chub			•	
Dace			•	x
Minnow				x
Rudd	x	x		x
Tench				x
Pike	x	x	•	x
Perch		x	•	
Zander		x	•	

On the river Lee catchment lithophils and psammophils are generally more abundant in the upper reaches of the main stem of the river and in the headwater streams. Further downstream, phytophils become more dominant (table 2b). This may be partly due to the change in underlying geology of the river from chalk to clay and the associated impacts on macrophyte communities and substrates. The change in guild composition occurs roughly at this point.

An analysis of all the sites in the catchment selected the most appropriate sites for limnophils, phytophil and psammophil spawners returned four, six and seven sites respectively (table 5).

Table 5 Sites most suitable for Lithophils, Phytophils and Psammophils

Lithophils

Site	River	Riffles	No. flow types	Fast flows	Slow flows	No. of substrates	Gravel/ pebble	Silt	Choked
24002	Mimram	5	5	10		3	8		
24003	Mimram	6	6	9		3	7		
30412	Ash	6	5	6		4	10		
30525	Lee	7	6	8		3	9		

Phytophils

Site	River	Riffles	No. flow types	Gravel/ pebble	No. of substrates	Submerged veg.	U/water roots	Choked
24001	Mimram	4	4	8	4	9		
24028	Mimram	1	4	8	4	15	P	
24031	Mimram	3	5	9	2	12	P	
30452	Pishiobury brk	2	5	8	5	4	P	
30983	Rib	4	4	8	5	2	P	
31057	Beane	1	4	10	2	5		

Psammophils

Site	River	Riffles	Count of sand	Sand deposits	U/water roots	Fast flows	Mosses	Algae
24003	Mimram	6	2	P	P	9	1	
24002	Mimram	5	2	P	P	10	1	
24001	Mimram	4	2	P	P	8		
24006	Mimram	4	4		P	4		5
24016	Mimram	4	5	P	P	3	2	
24041	Mimram	3	2	P	P	3	2	1
31001	Rib	1	4		P	2		1

3.4 Migration and movement

The movement of adult fish, which is frequently associated with travel to and from spawning grounds, may be severely impeded by natural barriers and artificial structures such as weirs (figure 8).

3.5 Siltation

This may cause egg losses through decreased oxygen uptake and is a possible threat to fish species in some areas on the Lee catchment, especially in the headwaters where flows levels may be more erratic and spawning areas on shallow gravel beds more common. Berkman and Rabeni, (1987) found an inverse relationship between simple lithophil spawners and the proportion of silt in stream. Siltation may also be caused by impoundment of water due to artificial structures such as weirs (figure 9). Over 140 major weirs were recorded on the sites throughout the Lee catchment and silting was recorded as a major impact at 36 sites (table 6).

Table 6 Count of potential barriers to migration and areas of silting on the river Lee catchment

River	Major weirs	Major fords	Culverts	Silting
Lee	32		4	16
Mimram	28	8	5	
Rib	22	3	1	
Beane	17		3	9
Ash	13	2	1	
Stort	4			
Tributaries				
Stevenage brook (Beane)	4		3	
Pincey brook (Stort)	3		2	
Quin (Rib)	3	2	1	
Small river lee	3			
Stanstead mill stream (Lee)	4		1	5
Cornmill stream (Lee)	2		1	3
Amwell loop (Lee)	1			1
Ware lock stream (Lee)	1			
Horsemill stream (Lee)	1			
Harlow lock loop (Stort)	1			
Parndon mill stream (Stort)	1			
Pishiobury backwater (Stort)	1			
Roydon marsh ditch (Stort)	1			
Roydon mill stream (Stort)	1			
Tednambury millstream (Stort)	1			
Pishiobury brook (Stort)			2	
Old river lee				2
St. Andrews ditch (Lee)				
Tollhouse stream (Lee)				
Woodhall farm tributary (Lee)				

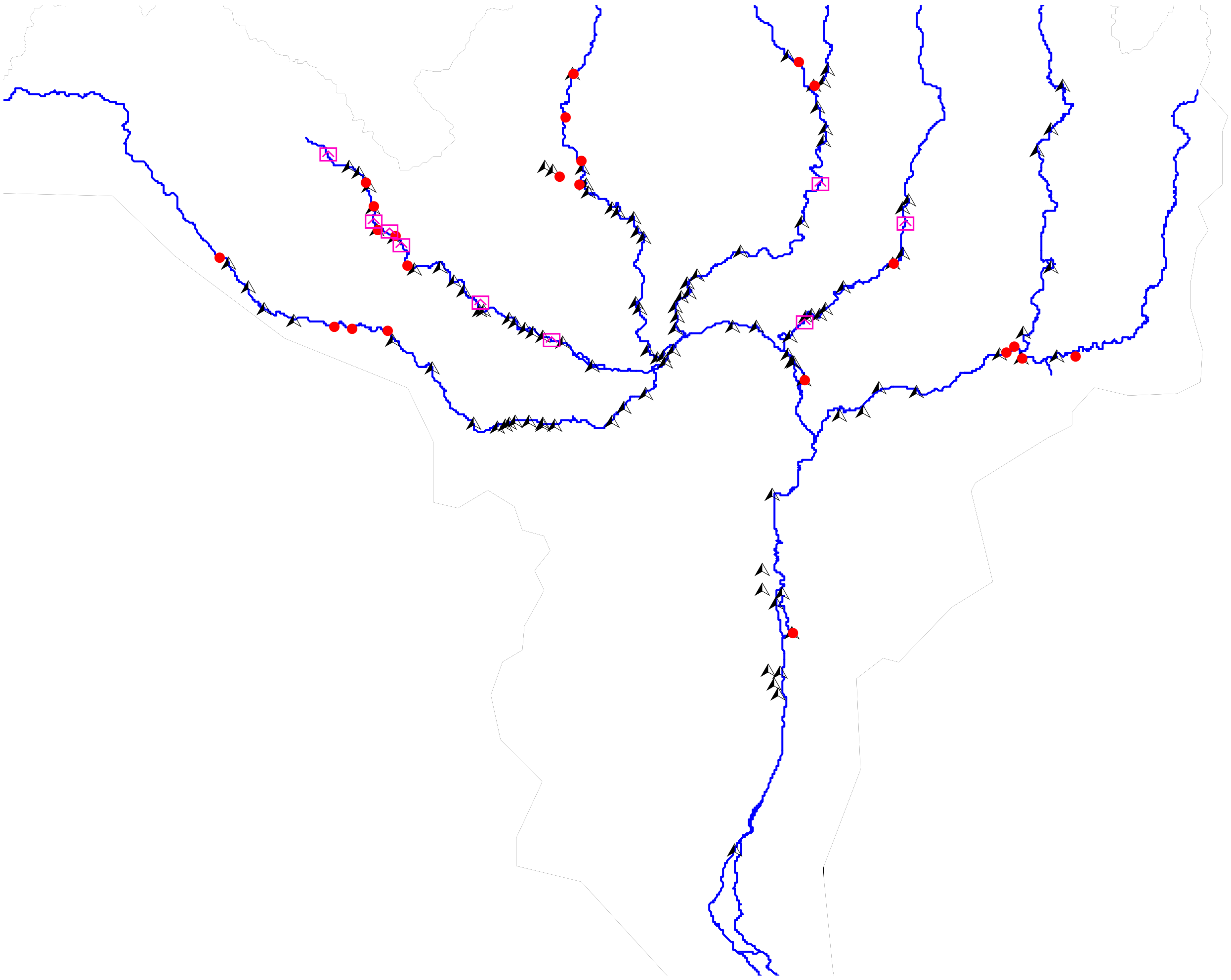


Figure 8 Distribution of weirs (⮝) culverts (•) and fords (⊠)

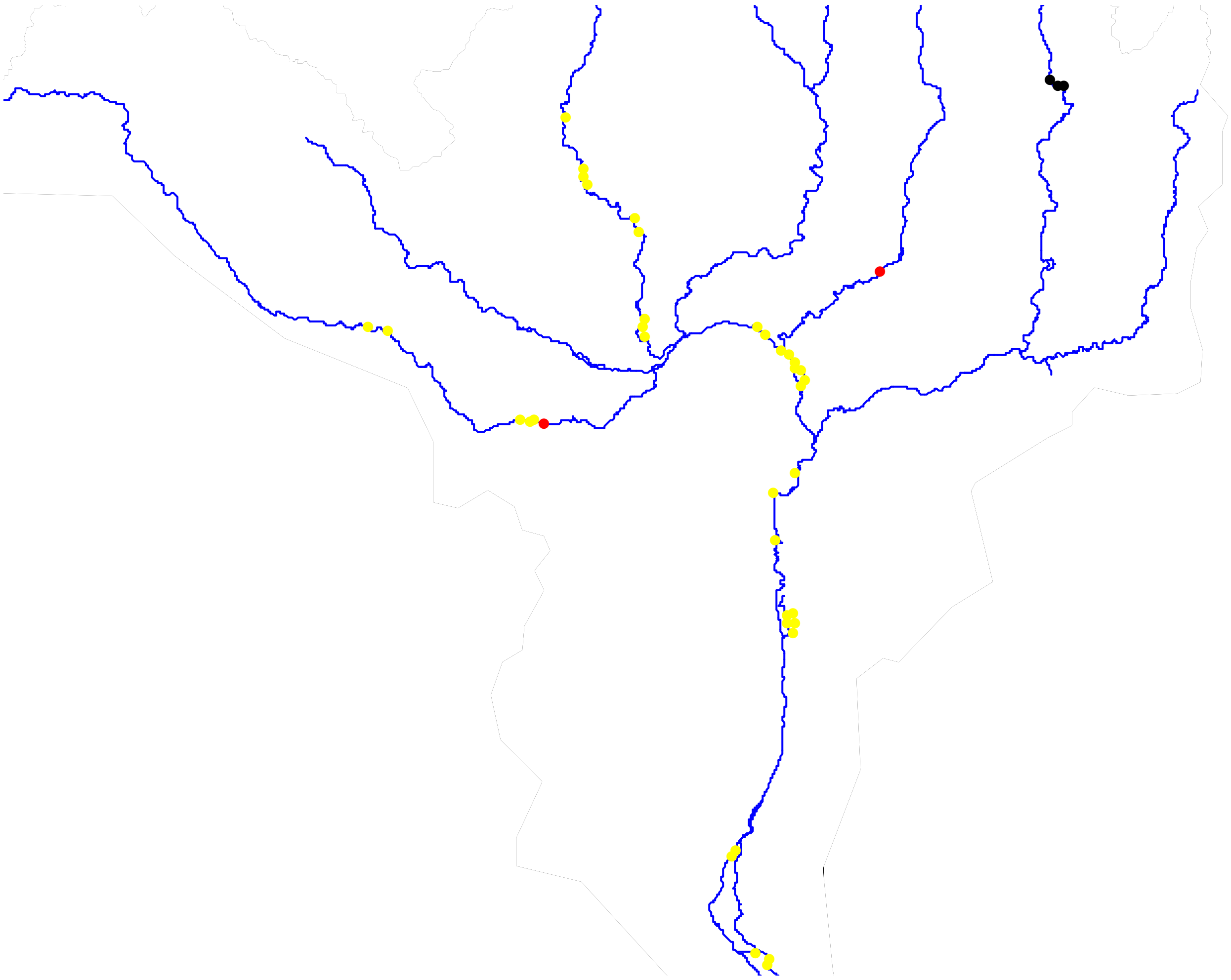


Figure 9 Distribution of abstraction (•) silting (•) and drought (•)

3.6 Channel morphology and habitat quality

It has been demonstrated that the topography of river sections can influence the degree of movement of perch (Bruylants et al, 1986). The degree of movement was found to be correlated with habitat diversity with more homogenous habitats related to lower densities of perch and greater mobility of the fish present. Therefore extensive channel resectioning, and to a lesser extent, bank resectioning may be regarded as negative impacts on habitat quality for both adult and juvenile fish.

This is especially relevant in sites with higher flow velocities and where no refuge is provided by instream channel macrophytes or other refuges. RHS data does not record flow velocity, instead recording flows as a series representing increasing energy ranging from no perceptible to chute flow, allowing for these to be used with some confidence as an indicator of likely velocity. On the River Lee catchment the most numerous flow types were smooth and rippled with some areas of unbroken wave (riffle) flow and none perceptible.

3.7 Early life stages

Suitable habitats are also critical for fish in their early life stages. A number of cyprinid larvae attach themselves to vegetation to resist displacement by strong currents. Areas of refuge from strong flow are also important as they provide feeding zones. The use of macrophyte stands as areas of refuge from rapid flows is well known as is the use of still or very slow flowing marginal zones (Mills, 1991). Such areas may only occupy a small percentage of the rivers total area and may be recorded on the RHS form as marginal dead water.

The importance of backwaters (both connected and disconnected) and sheltered bays as well as gravel banks and rip rap have been highlighted by Scheimer & Waidbacher, 1992.

3.8 Water levels

Because the eggs of many phytophils are laid on substrates near the water surface, species in these guilds may be especially susceptible to sudden drops in the water level (Man, 1996). Such sudden drops may be caused by weed cutting or water abstraction and this is particularly relevant to the smaller headwater streams of the Lee and its tributaries. RHS data cannot be reliably used to designate such sites, although abstraction points and dense growth of aquatic weed can be identified. The operation of locks and sluices associated with navigation is another potential cause of exposure of fish eggs, though this is likely to be only a limited problem and confined to the lower parts of the catchment where such structures are used.

3.9 Chemical water quality

The young stages of fish are usually the most sensitive to chemical quality.

The RHS survey does not include measurement of chemical water quality, however for the purpose of this report data were obtained. Availability of chemistry data was irregular on the different rivers of the catchment, though coverage was sufficient to suggest that chemical quality of the tributaries is better than on the main river Lee with a few localised exceptions. Phosphate and nitrate levels were classified as high or very high on sections of the Lee, Stort, Ash and Rib. According to the Environment Agencies designation system, the general water chemistry of all of the sites for which data was available was sufficient to support good cyprinid communities and very good salmonid fisheries. Biochemical oxygen demand and dissolved oxygen (percentage saturation) where classified as good or very good at nearly all sites for which data was available.

3.10 Species specific habitat requirements

Copp (1992) found chubb and bleak larvae were most often found in still water with a silted gravel substrate and associated macrophytes and woody debris. Four sites best fitted such criteria, with a combination of gravel, silt, slow flows vegetation and woody debris (table 7).

Table 7 Sites with habitats suitable for chubb and bleak larvae, derived from RHS data.

Site	River	NGR	Silt deposits	Slow flows	Pools	Gravel/ pebble	Choked	Submerged vegetation	Woody debris
24011	Mimram	TL267139	P	6	P	8		v	P
24016	Mimram	TL248149	P	7	P	5		v	P
31038	Stevenage Brook	TL286203	P	10	E	7		v	P
30485	Lea	TQ374979	P	7		7	P	v	P

In work on the River Great Ouse, Garner (1995) found optimal conditions for roach to include a coarse substrate, very slow flow and floating or submerged broadleaf plant cover. Fifteen sites on the Lee catchment had suitable habitat characteristics.

Table 8 Sites with habitats suitable for Roach, derived from RHS data

Site	River	NGR	Gravel Pebble	Slow flows	Pools	Marginal deadwater	Submerged broad leaved	Floating leaved rooted	Free-floating
30421	Ash	TL429193	7	9	P	P	3	3	4
30415	Ash	TL425169	6	6	P	P	5	1	2
30420	Ash	TL429189	9	10	P		6	4	7
30413	Ash	TL418165	9	8	P		7	3	6
30414	Ash	TL421168	8	6	P	P	8	3	4
30502	Lee	TL372043	9	6	P	P	7	3	6
30503	Lee	TL372046	6	9	P	P	8	3	5
24011	Mimram	TL267139	8	6	P	P	2	6	3
24030	Mimram	TL212174	6	6	P		3		10
24016	Mimram	TL248149	5	7	P	P	5		
23999	Mimram	TL310123	10	7	P		9		
30985	Rib	TL362172	5	10	P	P	3	2	
31003	Rib	TL394223	6	9	P		5		
30967	Lee	TL165145	10	10	E		6		
31042	Stevenage brook	TL271211	10	7	E		5		

Copp and Mann (1993) found that backwaters are important for tench and that juveniles avoid open water, instead preferring dense beds of *Myriophyllum* and *Ceratophyllum* (recorded on the RHS form as submerged fine leaved vegetation). Only two sites with backwaters and dense growth of submerged fine leaved vegetation were recorded on the river lee catchment (site 30460 on the Lee and 31043 on the Rib)

Dace were found to avoid woody debris, instead preferring macrophytes and attached periphyton. No preference for water depths was shown.

Bless (1992) found minnow favoured some horizontal plant cover and a water depth greater than 15cm.

4 Conclusion

The RHS data suggests that much of the Lee catchment is heavily impacted, though there are some areas of good habitat, especially on the middle Lee, the river Ash and the lower parts of the Mimram. The protection of these areas should be a priority for any management plan.

The habitat quality of a number of sites is enhanced by features of special interest such as fringing reed banks, coarse and leafy debris, carr (wet woodland) and the large number of flooded gravel pits.

Flow variability on the catchment is generally poor with lower energy flows such as smooth flow dominating most of the water courses. This lack of energy may be partly due to the large number of weirs on the catchment.

The change of underlying geology from chalk to clay (which occurs near the confluence with the Stort) would be expected to alter substrates and macrophyte communities and an increase in the percentage composition of phytophils in this area may be related to this.

Landuse is mixed throughout the catchment. Tilled land and improved grassland are abundant in the upper reaches, urban land is more prevalent further down the catchment especially in the lower Lee area.

Landuse is the greatest source of fine sediment into the system. Poaching was not considered as being a significant source though in some areas eroding cliffs are likely to contribute to fine sediment input.

Nuisance and invasive species are common on the catchment, especially himalayan balsam which is so widespread that its eradication is impractical. However, the scattered occurrence of japanese knotweed and giant hogweed suggests that there control or eradication is more feasible.

Fish populations on the river appear diverse and healthy. However, it is difficult to judge whether the large number of weirs on the catchment are a significant barrier to migrating fish species. Siltation, low flows (abstraction) and poor chemical quality are additional threats to fish populations in the catchment.

Relations between RHS data and data from the fish surveys were poor. However, the use of RHS as a tool for selecting areas with appropriate habitat for specific spawning guilds, habitat guilds or species has potential.

References

Balon E. K. (1975) Reproductive guilds of fishes; a proposal and definition. J. Fish. Res. Bd. Can. 32:821-864

Berkman, H.E., and C.F. Rabeni. (1987) Effect of siltation on stream fish communities: Environmental Biology of Fishes. 18 (4): p. 285–294

Bless, R. Einsichten in die Ökologie der Elritze - Phoxinus phoxinus (L.) Schr. Landschaft. Natur. 35, 57pp

Bruylants, B., Vandelannoote, A. Verheyen, R (1986) The movement pattern and density distribution of perch, perca fluviatilis l., in a channelized lowland river aquacult. fish. manage. Vol. 17, no. 1, pp. 49-57

Copp, G.H. 1992. Comparative microhabitat use of cyprinid larvae and juveniles in a lotic floodplain channel. Environmental Biology of Fishes 33: 181-193

Copp G.H. & R.H.K. Mann, 1993. - Comparative growth and diet of tench Tinca tinca (L.) larvae andjuveniles from river floodplain biotopes in France and England. Ecol. Freshw. Fish., 2: 58-66.

Environment Agency, 1999, Upper Lee Local Environmental Agency Plan, 90pp

Environment Agency, 2000, The Lee fact file, 6pp

Garner, P. (1995) Suitability indices for juvenile 0+ roach (Rutilus rutilus (L.) Using point abundance sampling data. Regulated Rivers: Research & Management. 10, 99-104.

Grandmottet, J. P. (1983) Principales exigencies des teleosteens dulcioles vis-à-vis de l'habitat aquatique> Annls scient. Univ. Besancon 4: 3-32

Mann, R.H.K. (1996) Environmental requirements of European non-salmonid fish in rivers. *Hydrobiologia*, 323, 223–235

Mills C. A. (1991) Reproduction and life history. I. J Winfield & J. S. Nelson (eds) Cyprinid fisheries: Systematic, biology and exploitation. Chapman and Hall, London 483-508

Raven, P.J., Fox, P., Everard M., Holmes H.T.H., & Dawson F.H. (1997) River Habitat Survey: a new system to classify rivers according to their habitat quality.

Raven P.J., Holmes, H.T.H., Dawson F.H., Fox P.J.A., Everard M., Fozzard, I. & Rouen K.J. (1998) River Habitat Quality The physical character of rivers and stream in the UK and Isle of Man. River Habitat Survey Report No. 2. Environment Agency, 86pp

Appendix

1 Habitat Quality – High quality and degraded sites of each tributary and section of the main river Lee

2 Summary maps of each tributary and section of the main river Lee

Appendix 1 Habitat Quality – High quality and degraded sites (tributaries)

Ash

Site	HQA	HMS	No. Flows	No. Subs	FSSI	BSI	Invasives	Choked	Silt	Algae	Biology	Chemistry	Nitrate	Phosphate	Special features	Major impacts
30405																
30404																
30397																
30411																
30410																
30415															Leafy debris	
30395															Fringing reeds	
30418															Leafy debris	
30409															Natural open water	
30420																

Rib

Site	HQA	HMS	No. Flows	No. Subs	FSSI	BSI	Invasives	Choked	Silt	Algae	Biology	Chemistry	Nitrate	Phosphate	Special features	Major impacts
30998																
30990																
30992																
31002																
31001																
31020																
31009																
31018																
31010															Coarse debris	
31012																

Beane

Site	HQA	HMS	No. Flows	No. Subs	FSSI	BSI	Invasives	Choked	Silt	Algae	Biology	Chemistry	Nitrate	Phosphate	Special features	Major impacts
31061																Silting
31045																Housing
31029																
31026																
31049																Silting
31054																
31065																Housing
31059																
31058															Coarse debris	
31022																

Mimram

Site	HQA	HMS	No. Flows	No. Subs	FSSI	BSI	Invasives	Choked	Silt	Algae	Biology	Chemistry	Nitrate	Phosphate	Special features	Major impacts
24032															Fringing reeds	
24039																
24043															Fen	
24033															Marsh	
24020																
24003															Coarse debris, Leafy debris, Carr	
24037															Coarse debris, Fringing reeds, Marsh	
24002															Leafy debris, Carr, Marsh	
24008															Water meadow Carr	
24001															Leafy debris, Marsh	

Appendix 1 Habitat Quality – High quality and degraded sites (tributaries)

Stort

Site	HQA	HMS	No. Flows	No. Subs	FSSI	BSI	Invasives	Choked	Silt	Algae	Biology	Chemistry	Nitrate	Phosphate	Special features	Major impacts
30426	[red]	[red]	[yellow]	[green]	[green]	[red]		[red]	[orange]		[green]	[green]	[orange]	[orange]		
30442	[red]	[red]	[orange]	[yellow]	[orange]	[orange]			[orange]		[green]	[blue]	[orange]	[orange]	Coarse debris	
30455	[green]	[red]	[yellow]	[green]	[yellow]	[yellow]	[orange]	[red]	[red]		[grey]	[grey]	[grey]	[grey]		Dam , Overdeepening
30427	[yellow]	[red]	[yellow]	[yellow]	[yellow]	[orange]		[red]	[red]		[green]	[green]	[orange]	[orange]	Fen	
30433	[orange]	[red]	[green]	[yellow]	[yellow]	[orange]		[red]	[orange]		[green]	[green]	[orange]	[orange]		
30437	[green]	[red]	[yellow]	[yellow]	[red]	[orange]	[red]		[orange]		[green]	[blue]	[orange]	[orange]	Leafy debris, Marsh	Dam, Garden
30453	[green]	[red]	[green]	[cyan]	[blue]	[green]	[orange]				[grey]	[grey]	[grey]	[grey]	Leafy debris	
30423	[blue]	[red]	[green]	[orange]	[green]	[orange]					[grey]	[grey]	[grey]	[grey]	Coarse debris, Leafy debris	Drought
30439	[blue]	[orange]	[cyan]	[orange]	[orange]	[yellow]	[yellow]				[green]	[blue]	[orange]	[orange]	Coarse debris	
30452	[blue]	[red]	[cyan]	[cyan]	[green]	[green]					[grey]	[grey]	[grey]	[grey]	Leafy debris	Tipping, Industry

Key to tables

Code	HQA	HMS	No. flows	No. subs	FSSI	BSI	Invasives	Choked	Silt	Algae	Biology	Chemistry
[red]	Extremely poor	Severely modified	1	1	201-320	481-600	3	Y	9-10	9-10		
[orange]	Poor	Significantly modified	2	2	151-200	361-480	2		7-8	7-8		
[yellow]	Moderate	Obviously modified	3	3	101-150	241-360	1		5-6	5-6	C	C
[green]	Good	Predominantly unmodified	4	4	51-100	121-240					B	B
[cyan]			5	5								
[blue]	Excellent	Semi-natural	6 +	6 +	0-50	0-120					A	A
[grey]	No data										No data	No data

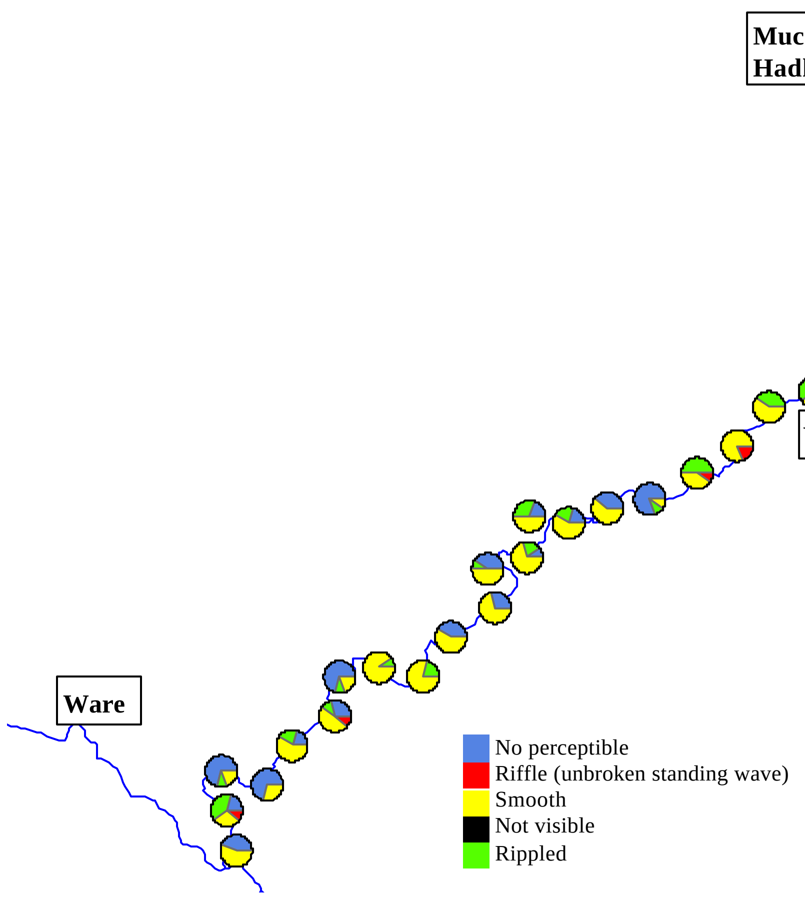
Appendix 1 Habitat Quality – High quality and degraded sites (Main river Lee)

Upper Lee

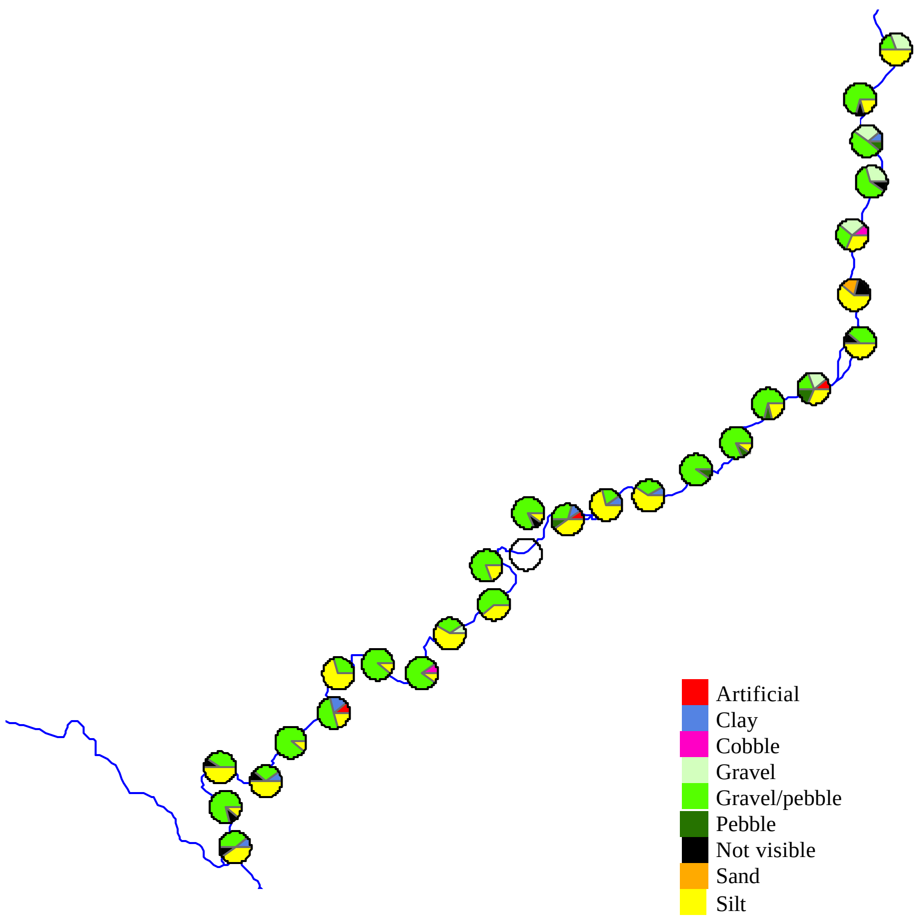
Site	HQA	HMS	No. Flows	No. Subs	FSSI	BSI	Invasives	Choked	Silt	Algae	Biology	Chemistry	Nitrate	Phosphate	Special features	Major impacts
31159																Industry
31147															Fringing reeds	O/deepening
31096																
31092															Fringing reeds	
31143																Mill
31137																
30963															Marsh	
31104															Coarse debris	
31140																O/deepening
31128															Fringing reeds	
31098																
30966															Coarse debris Fringing reeds	
30530																O/deepening, Fisheries
30524																Mill, Road, O/deepening
30525																Abstraction, O/deepenin g
30529																O/deepening, Fisheries
31106															Coarse debris	
30965															Coarse/Leafy debris, Fringing reeds, Carr	
30961																
31101																
Middle Lee																
30467																
30517																
30509																
30493															Fringing reeds, Marsh	
30518															Fringing reeds	
30497															Marsh	
30474															Fringing reeds	
30473															Leafy debris, Fringing reeds	
30510																
30511																
30461															Leafy debris	
30462																
30463															Coarse debris	
30464																
30470															Leafy debris	
30471																
30459															Coarse/Leafy debris	
30460															Coarse/Leafy debris, Backwater	
30501																
30508															Fringing reeds, Marsh	
Lower lee																
30475																
30484																
30479																
30483																

Ash

Flow types

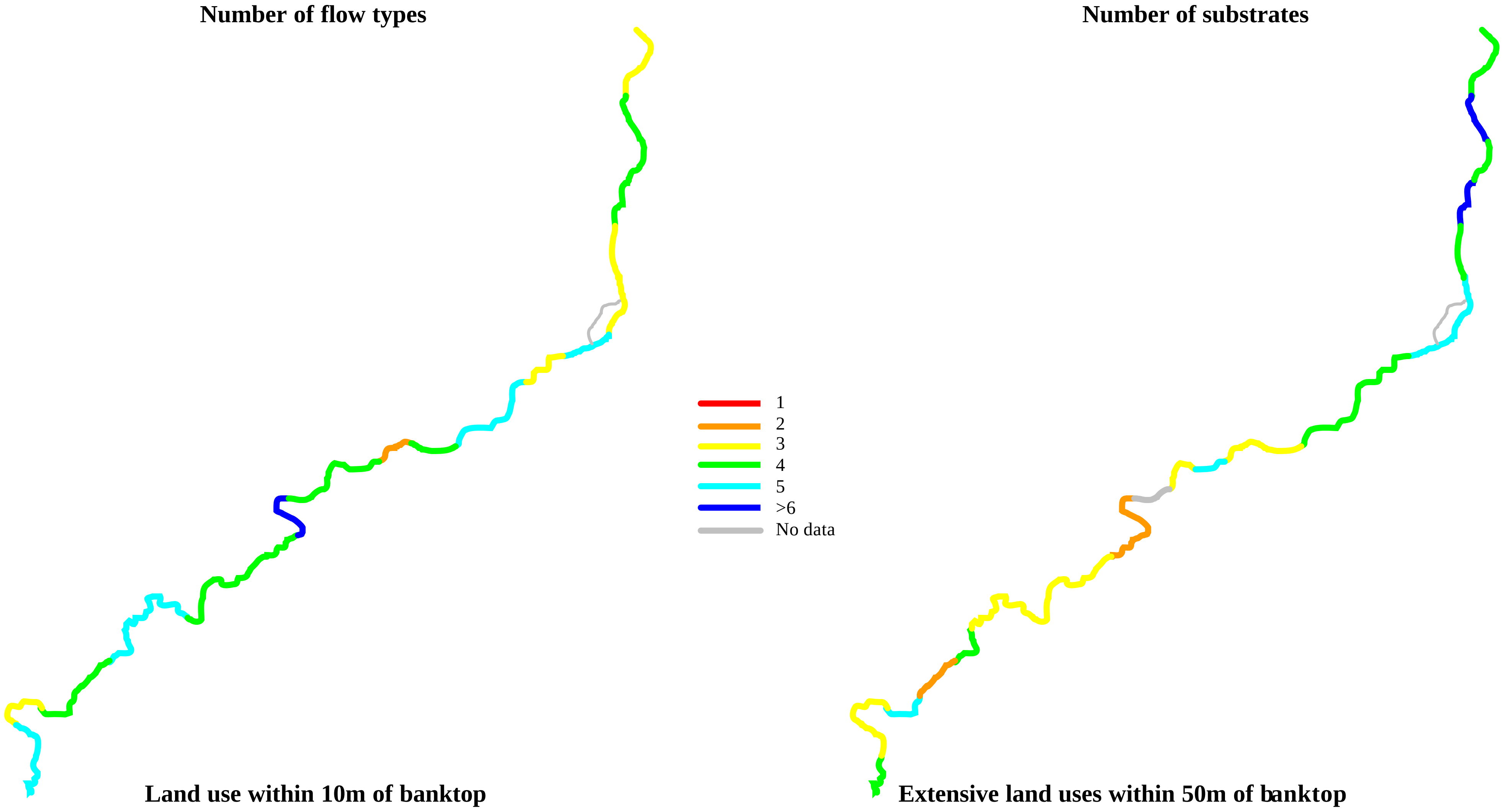


Substrates

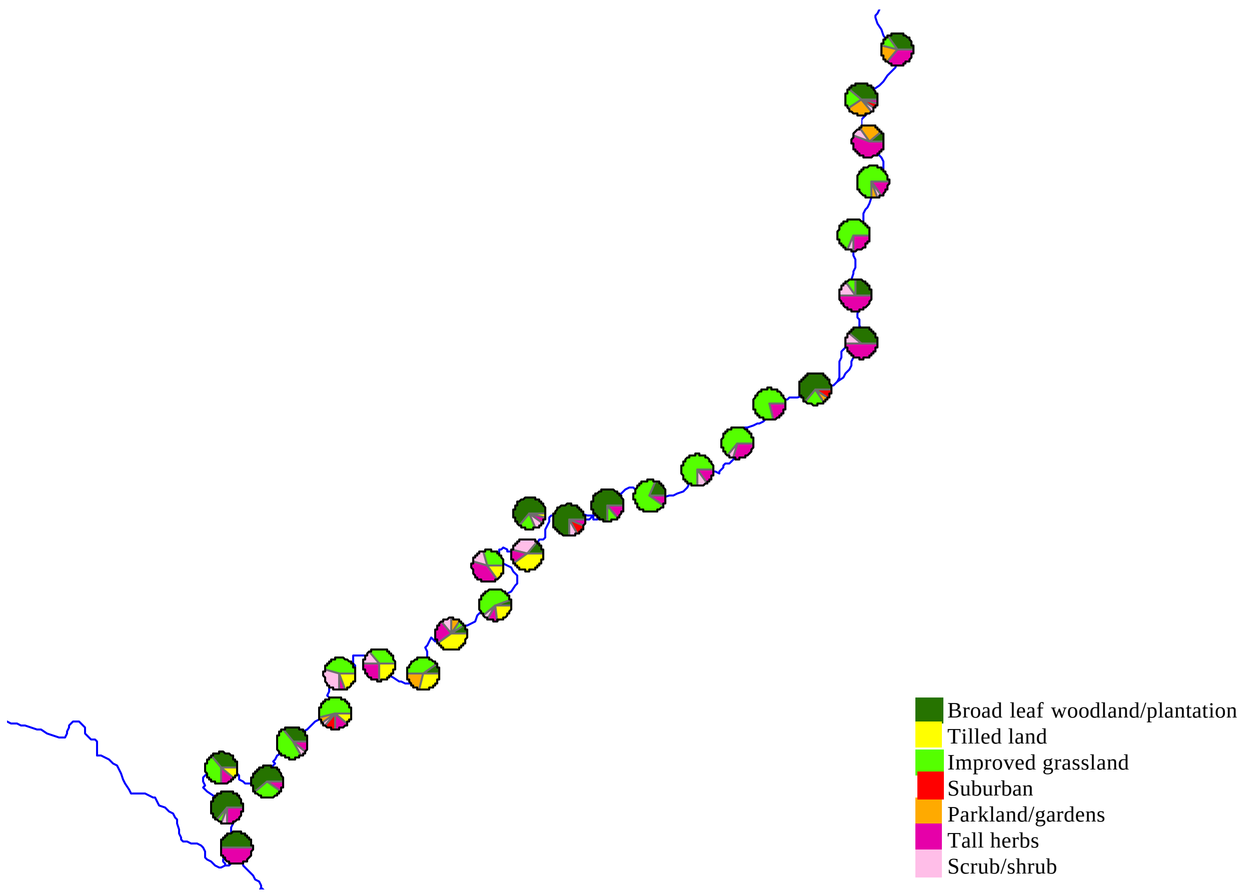


Number of flow types

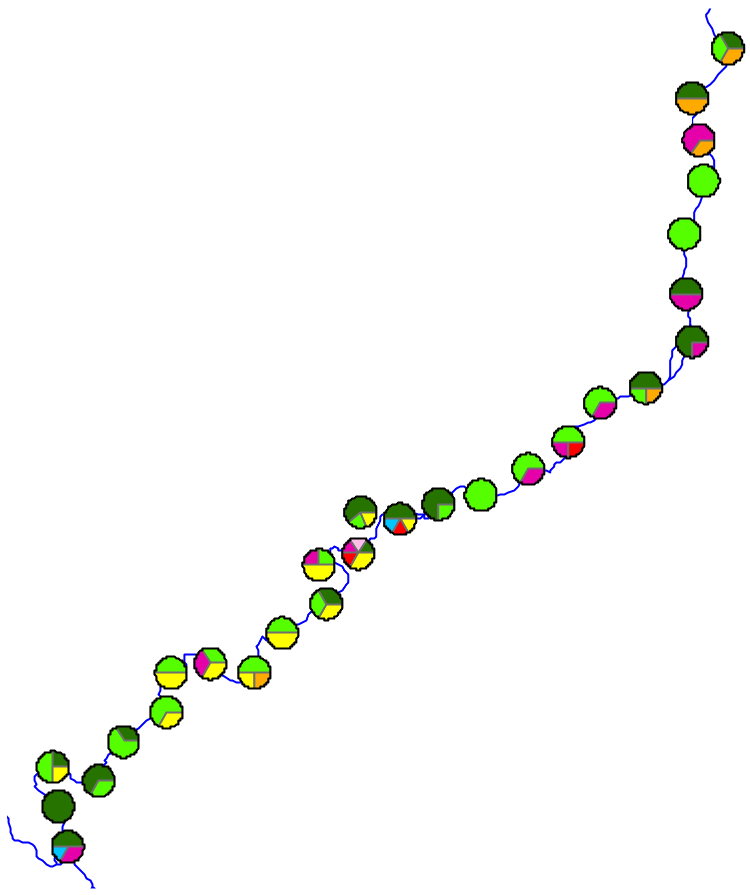
Number of substrates



Land use within 10m of banktop

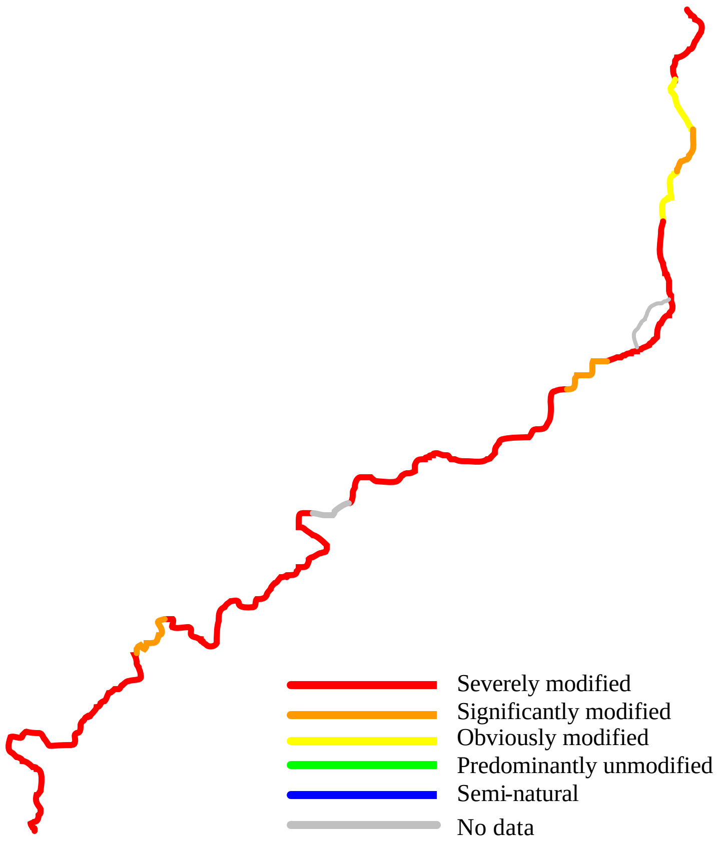


Extensive land uses within 50m of banktop

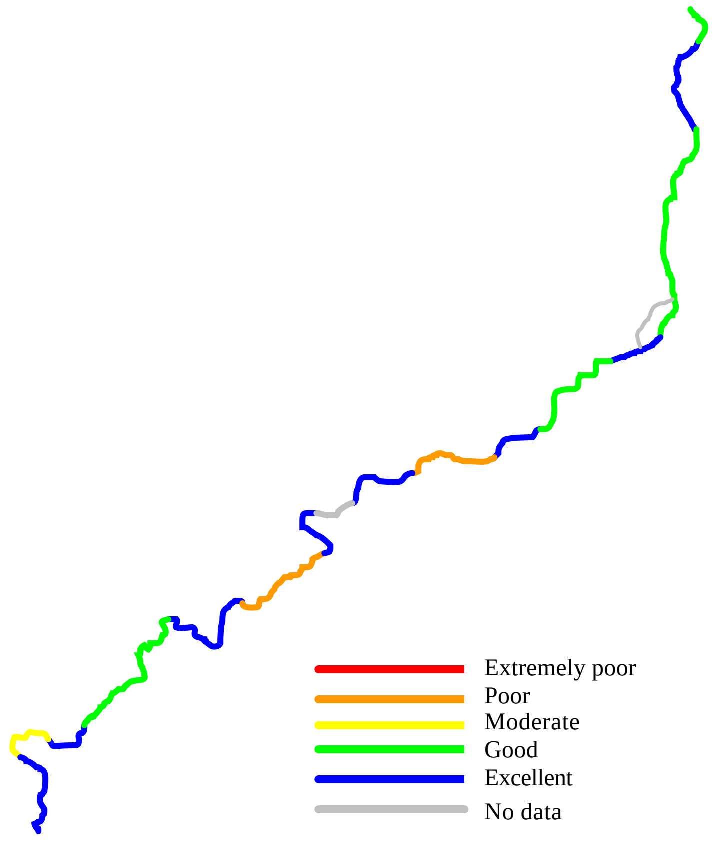


Ash

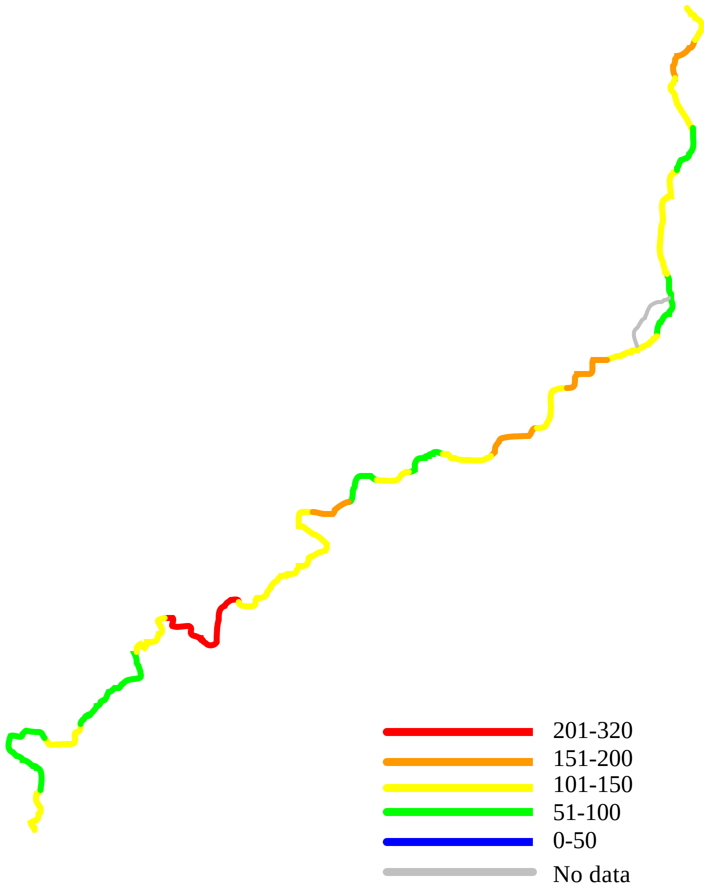
Habitat Modification Class



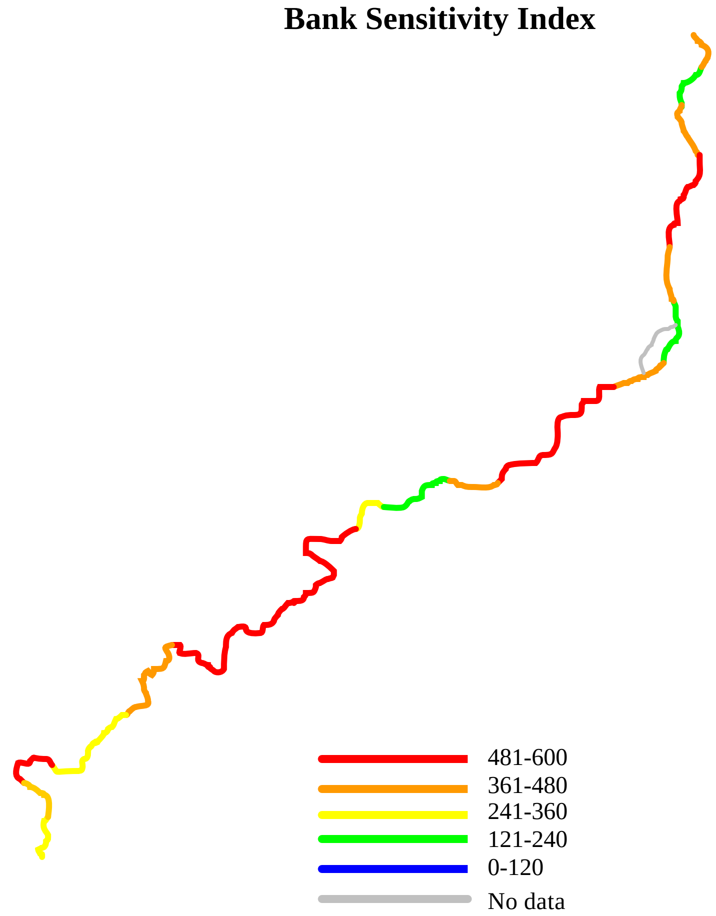
Habitat Quality Class



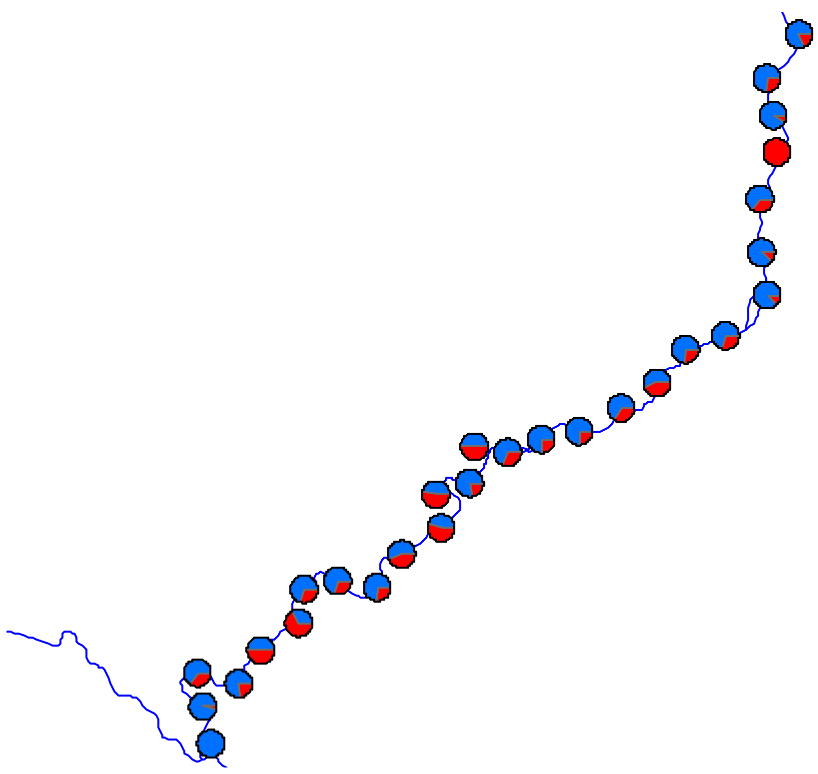
Fine Sediment Source Index



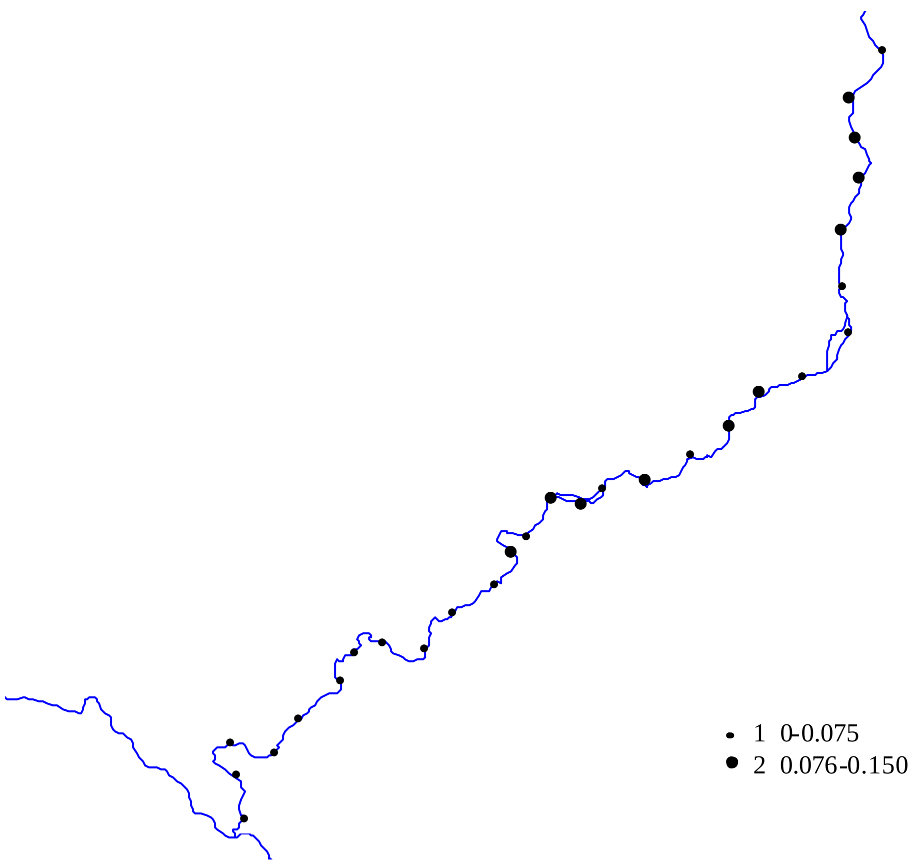
Bank Sensitivity Index



Natural and artificial sources of erosion

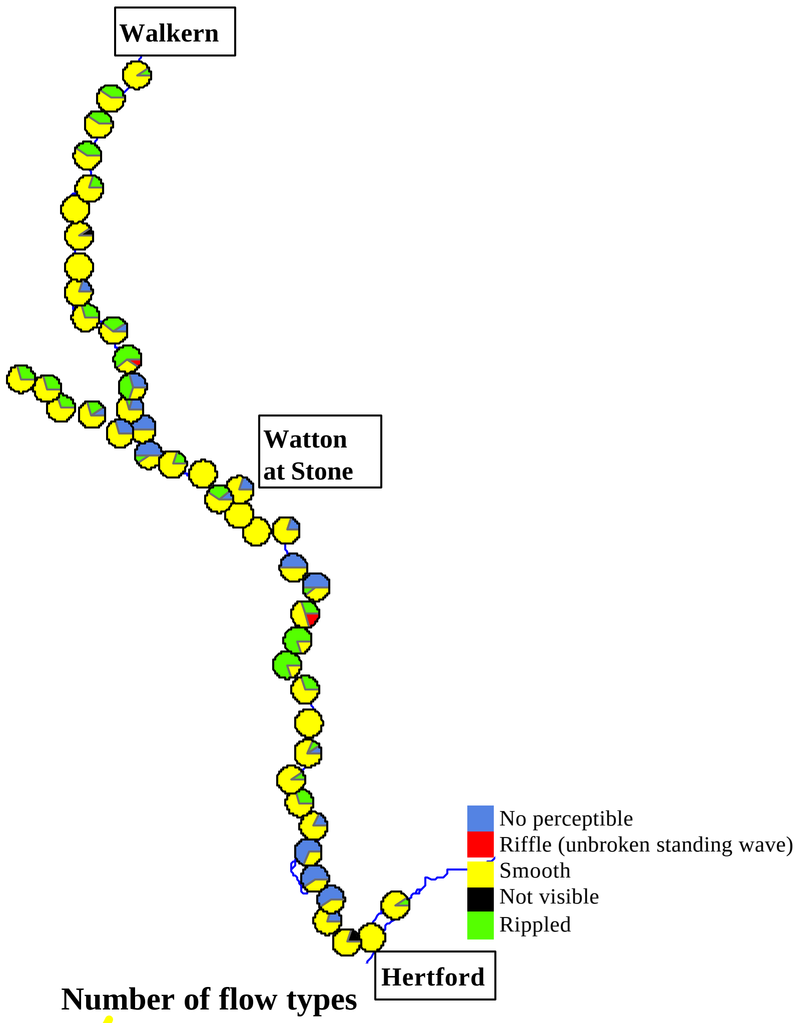


Stream Power

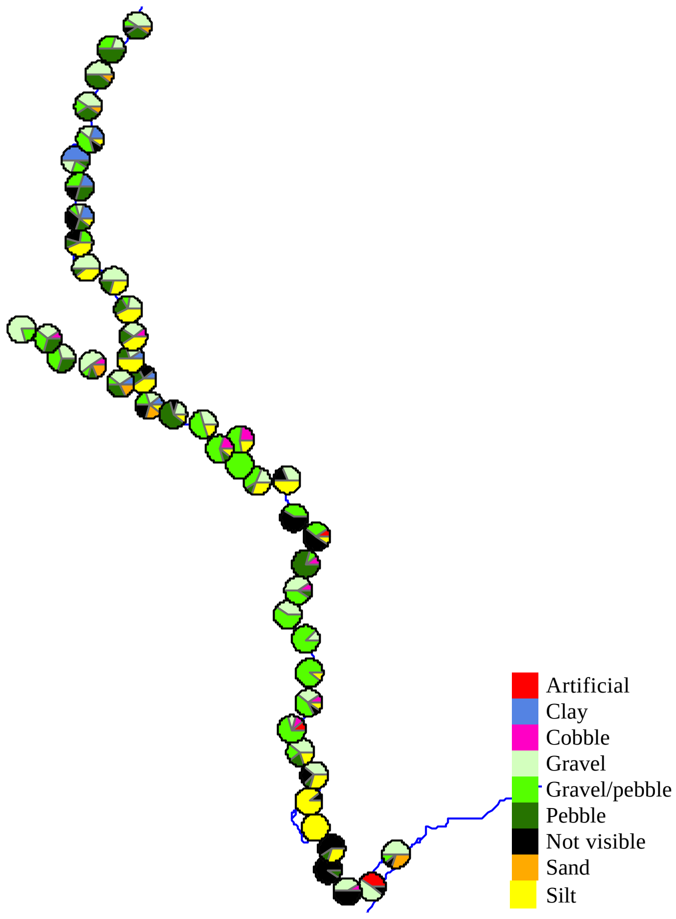


Beane

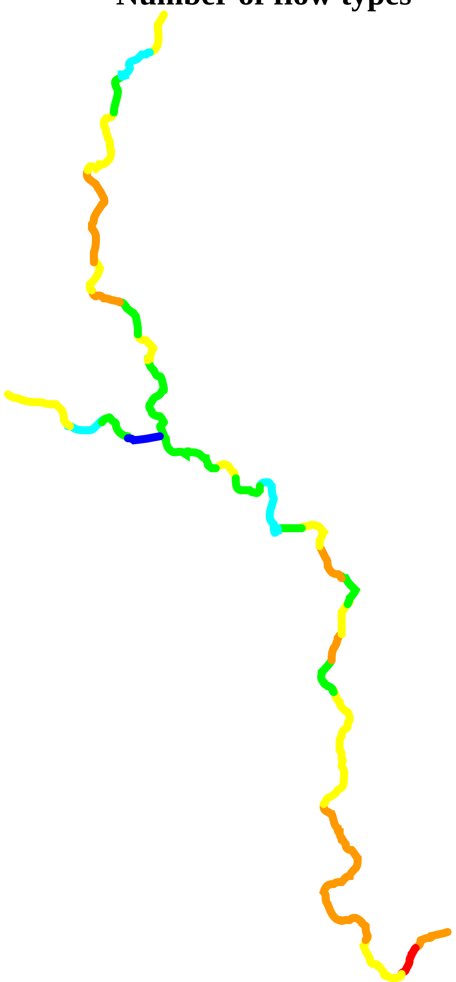
Flow types



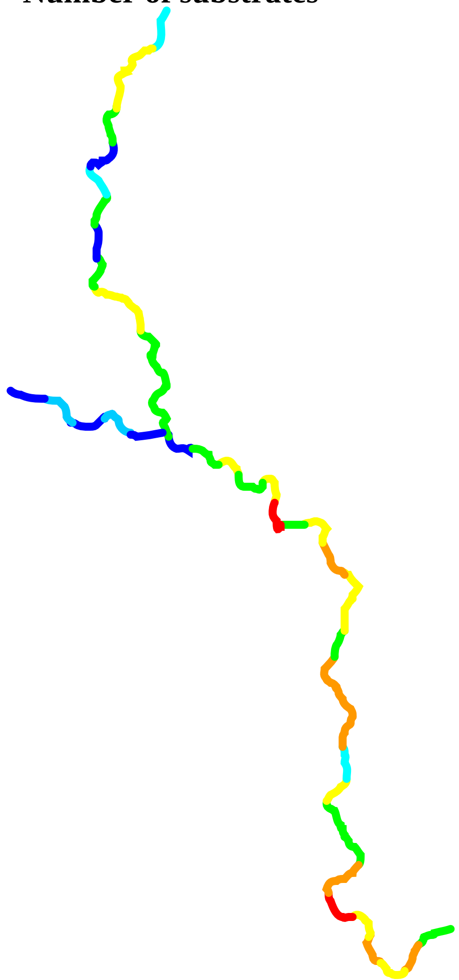
Substrates

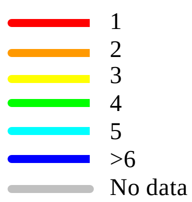


Number of flow types

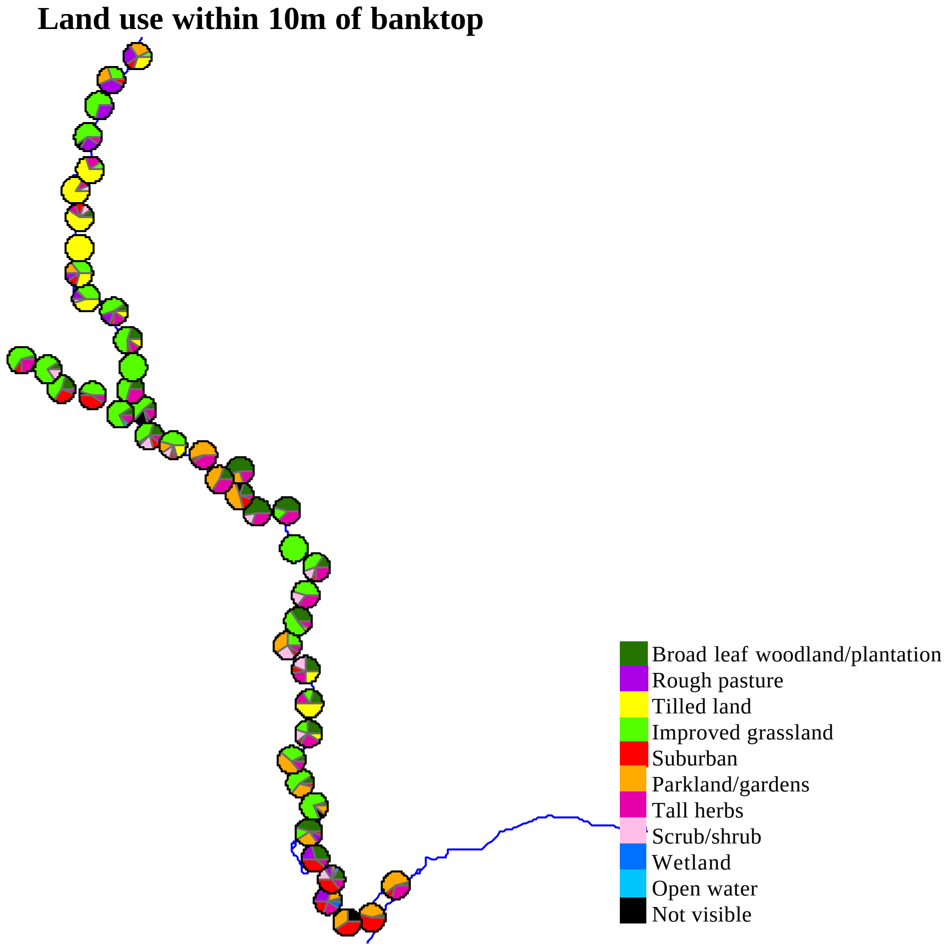


Number of substrates

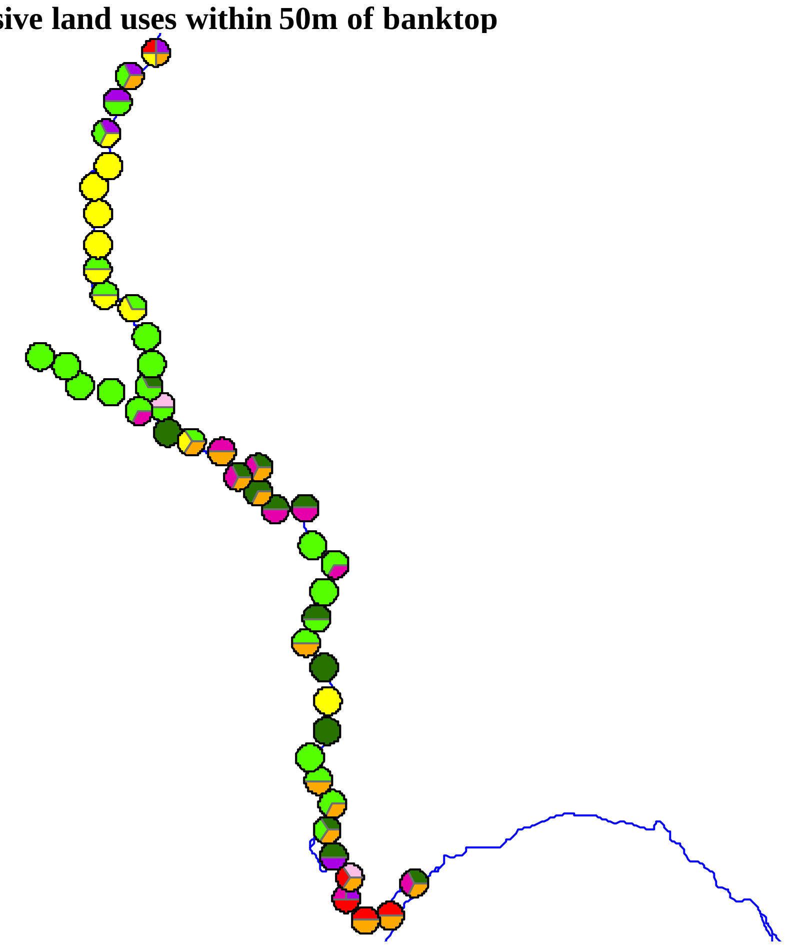




Land use within 10m of banktop

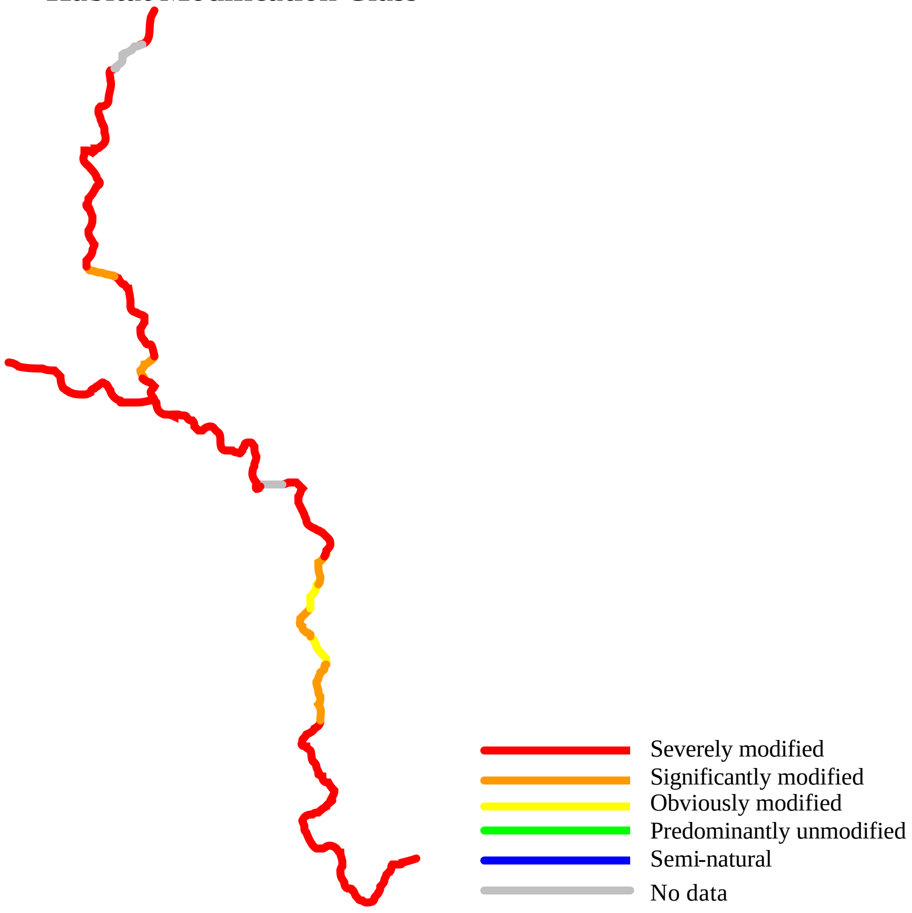


Extensive land uses within 50m of banktop

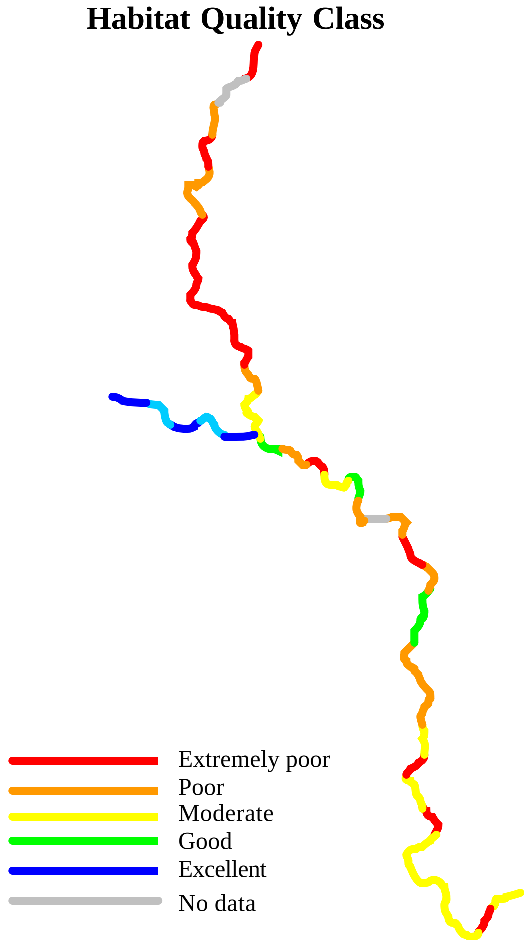


Beane

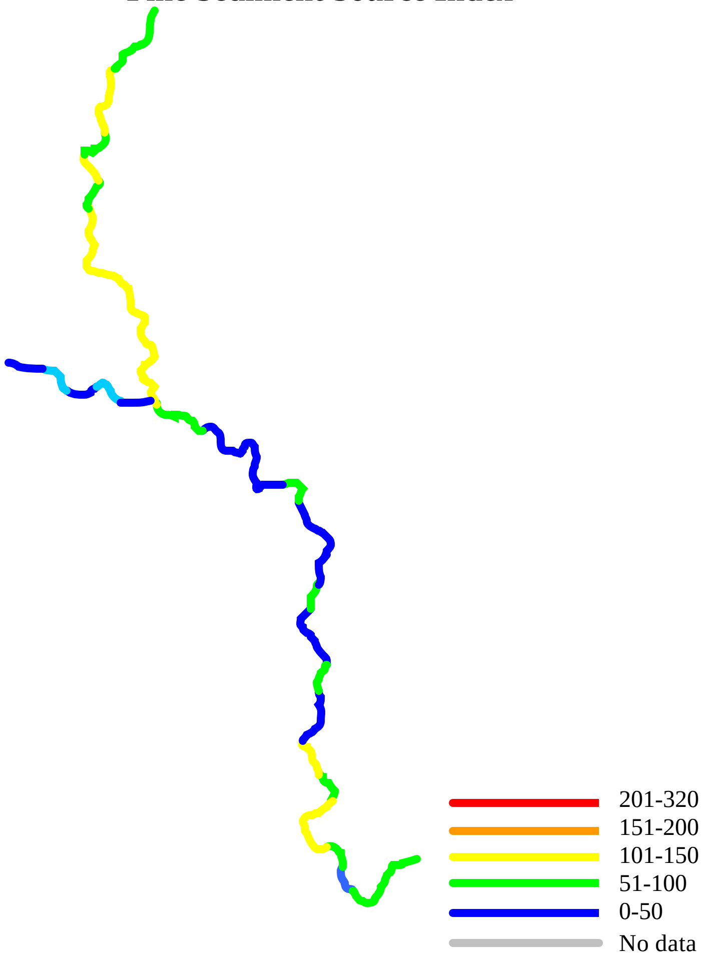
Habitat Modification Class



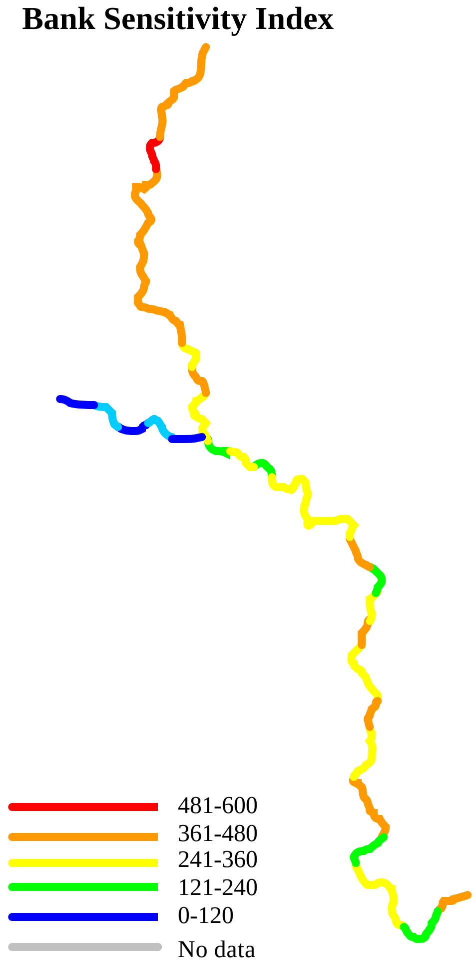
Habitat Quality Class



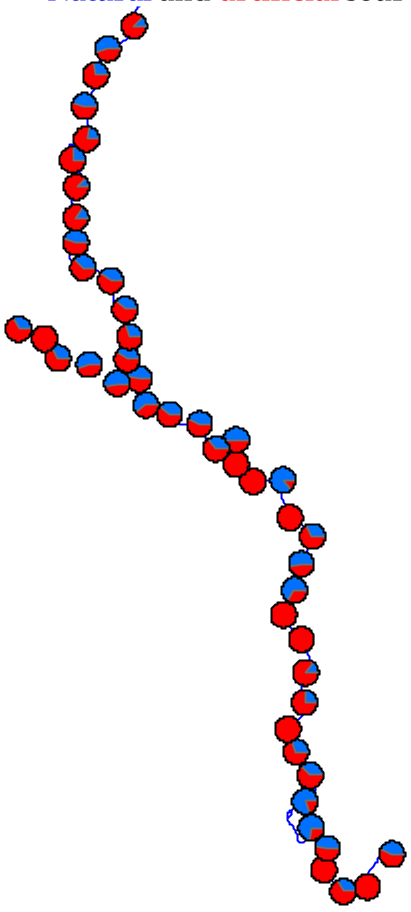
Fine Sediment Source Index



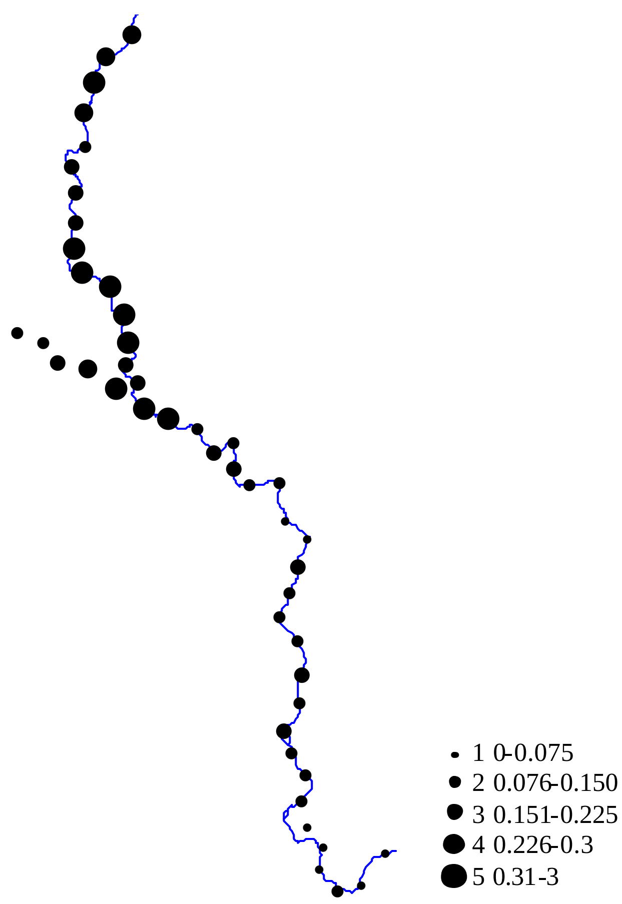
Bank Sensitivity Index



Natural and artificial sources of erosion

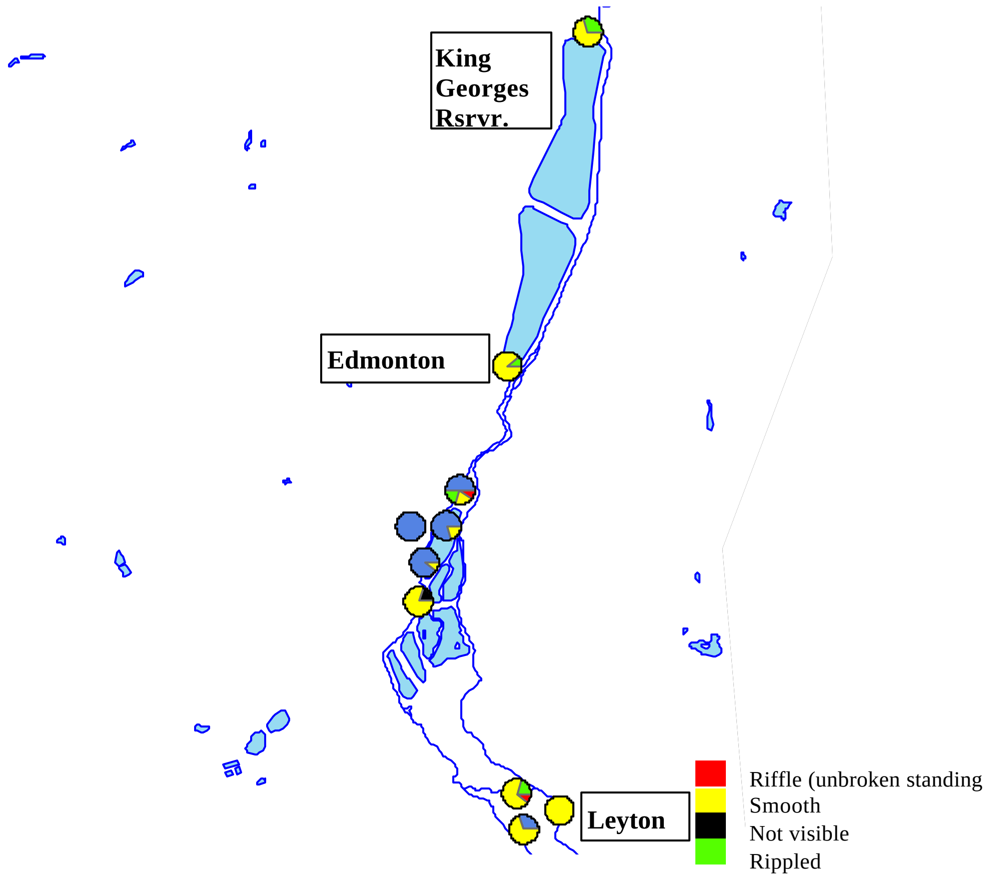


Stream Power

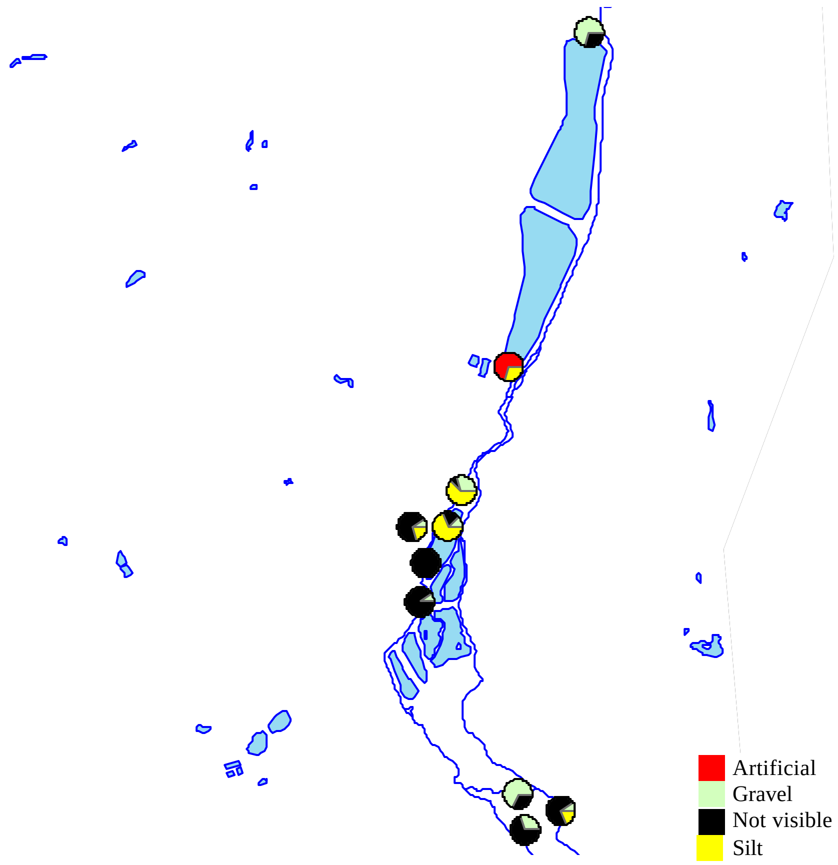


Lower Lee

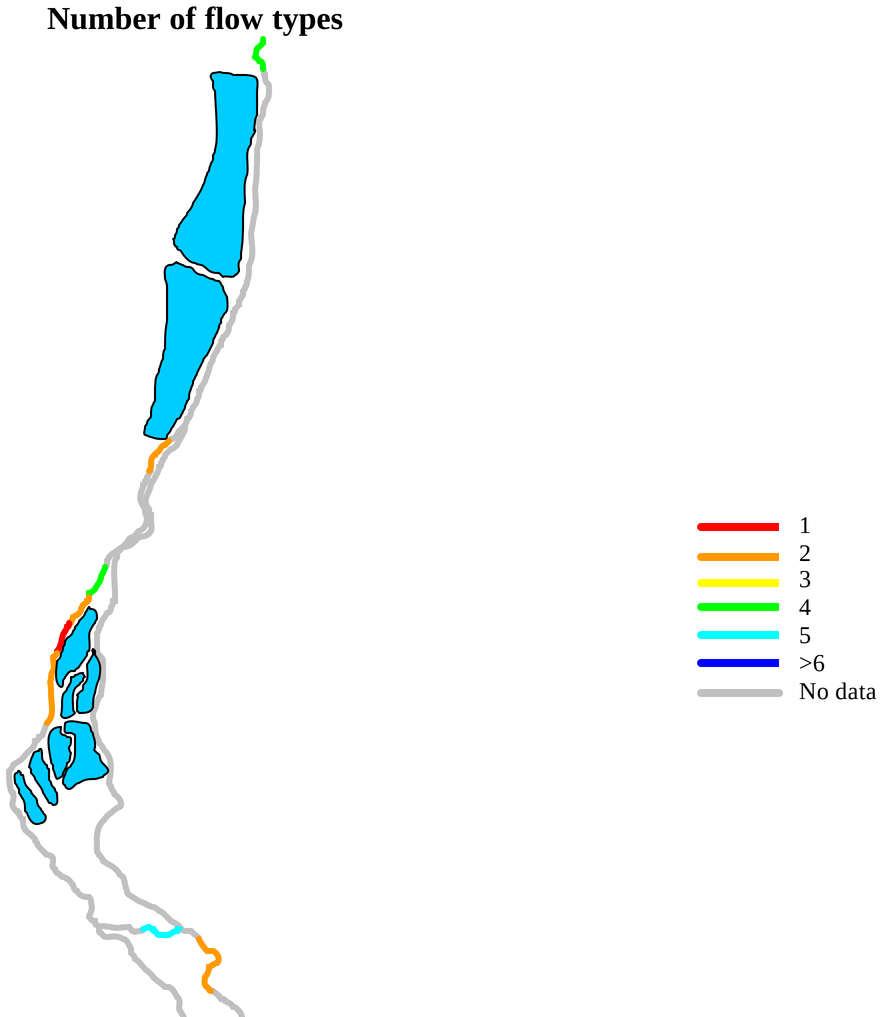
Flow types



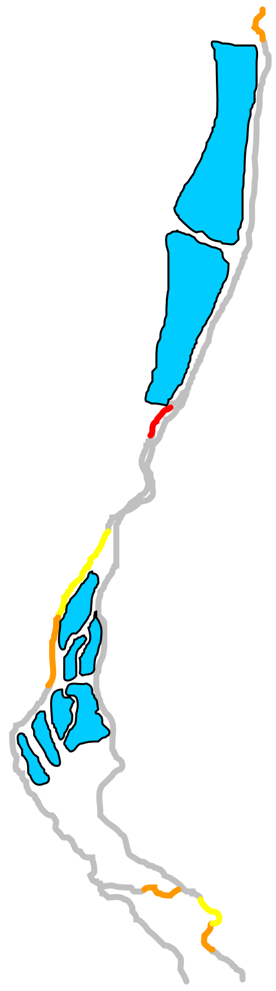
Substrates



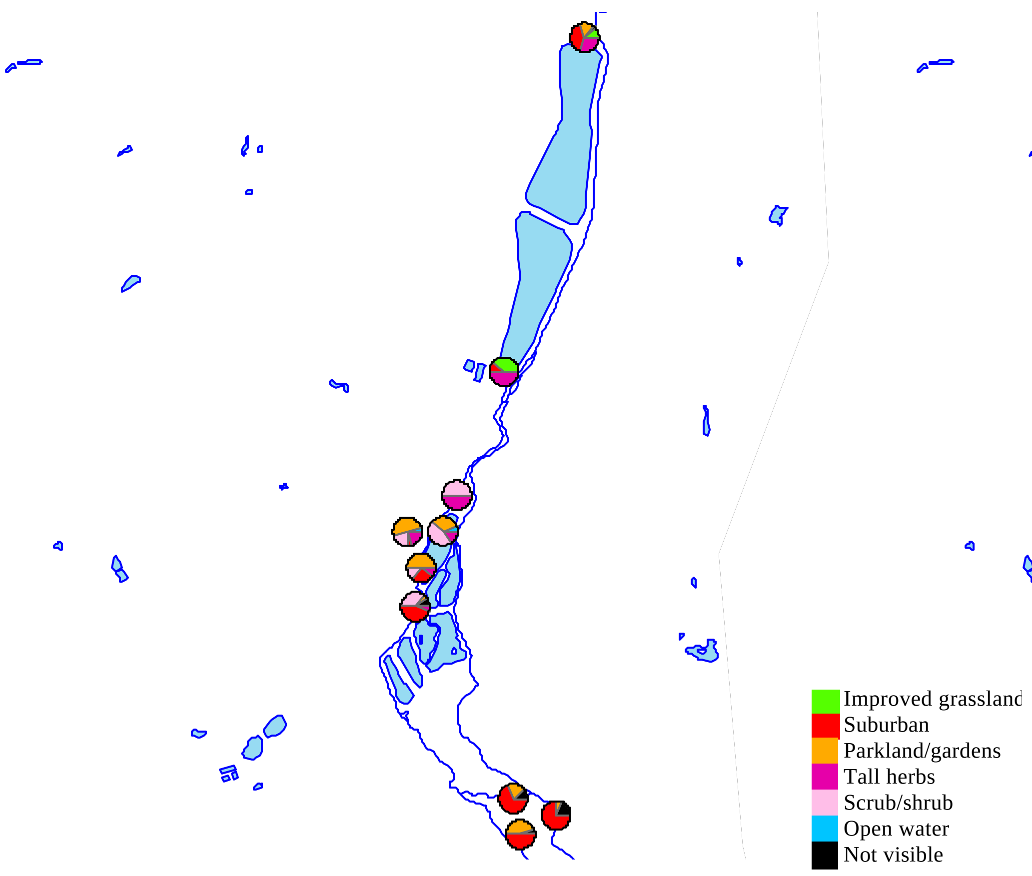
Number of flow types



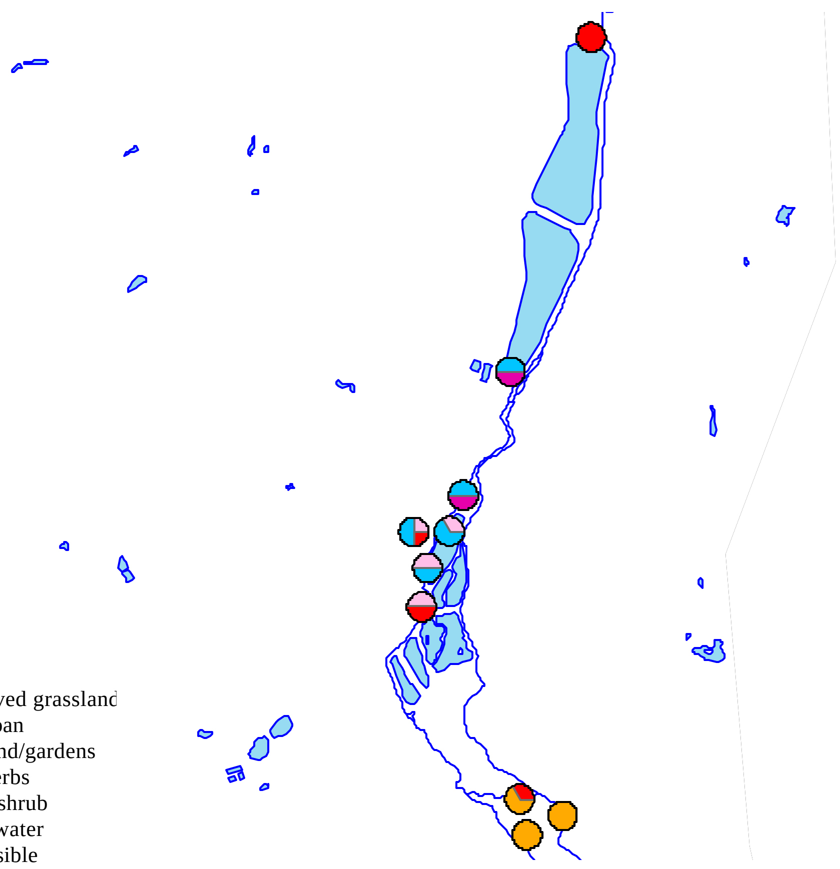
Number of substrates



Land use within 10m of banktop

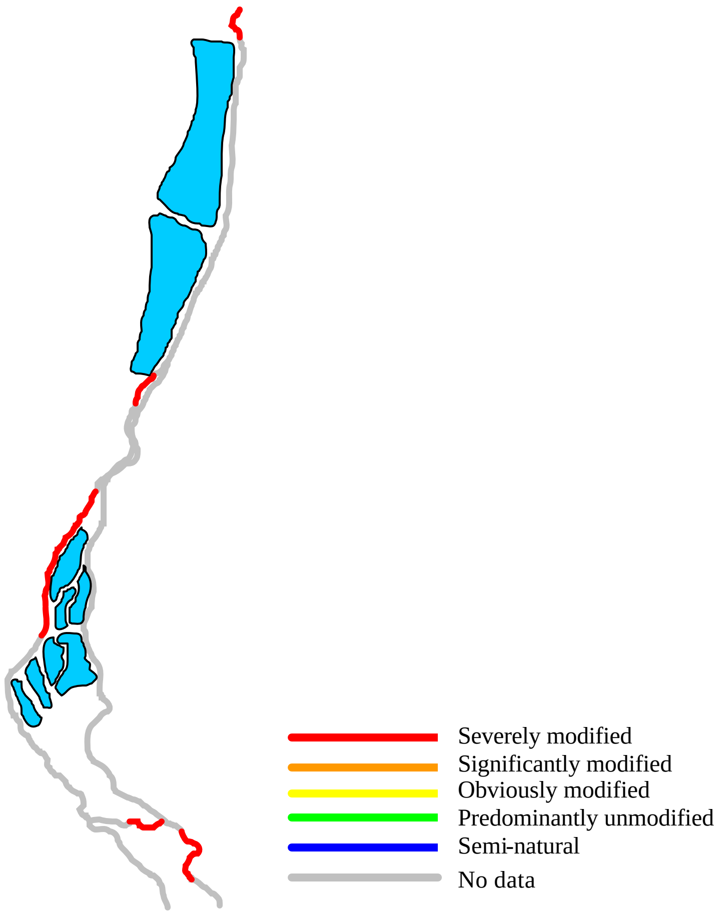


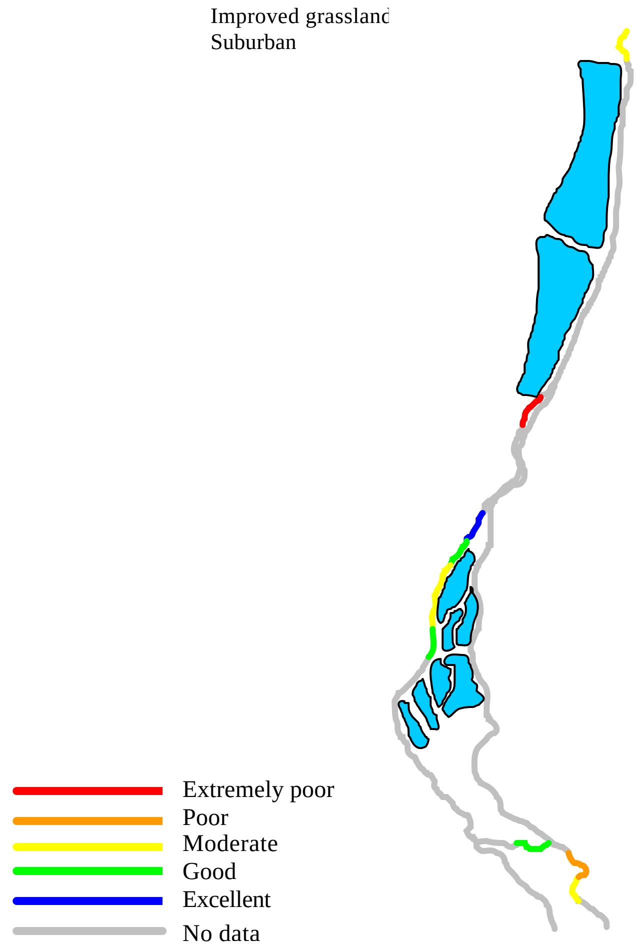
Extensive land uses within 50m of banktop



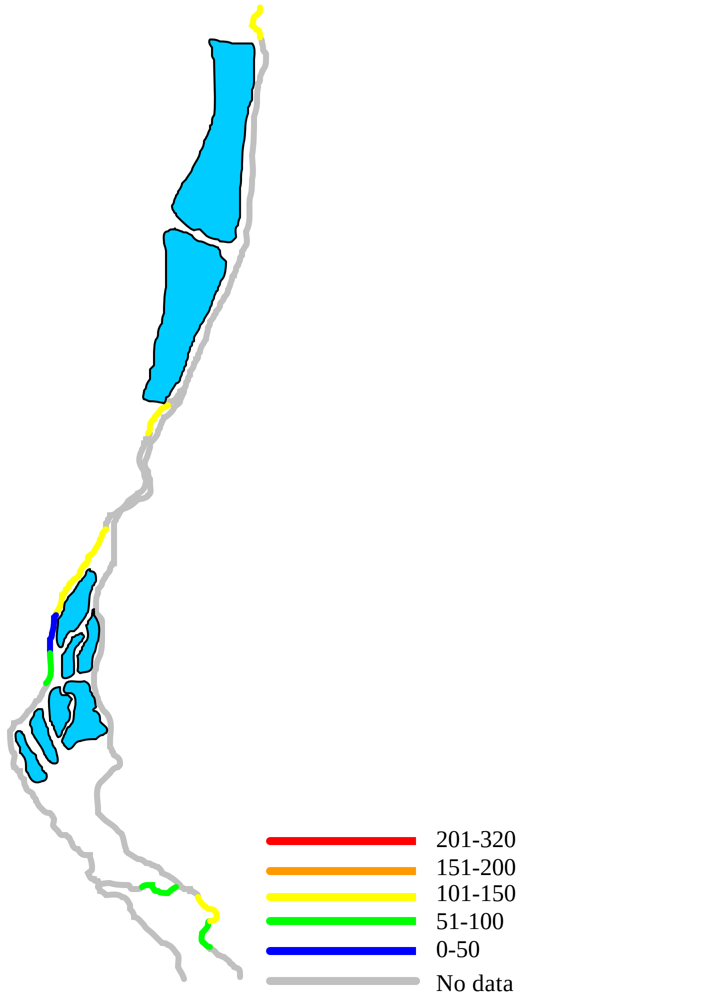
Lower Lee

Habitat Modification Class

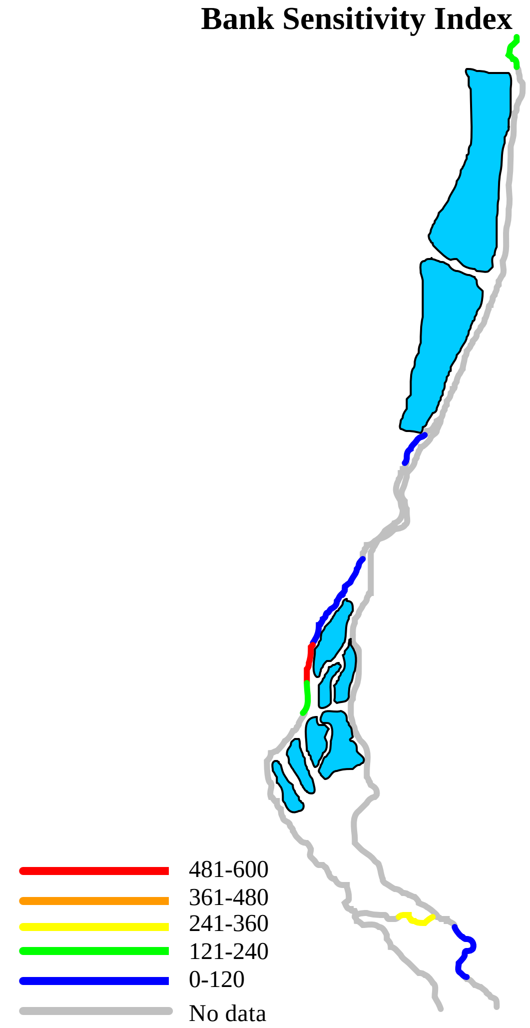




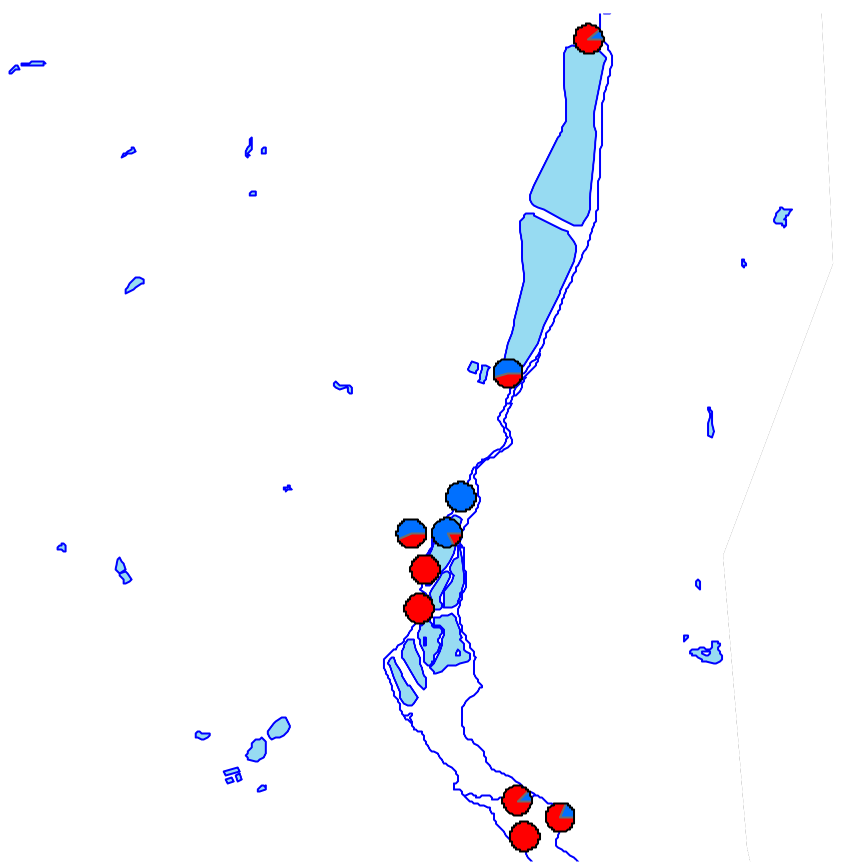
Fine Sediment Source Index



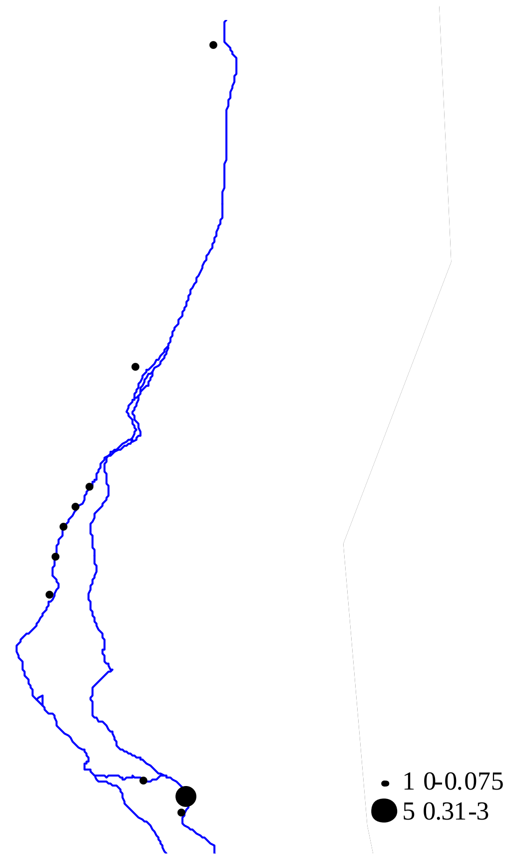
Bank Sensitivity Index



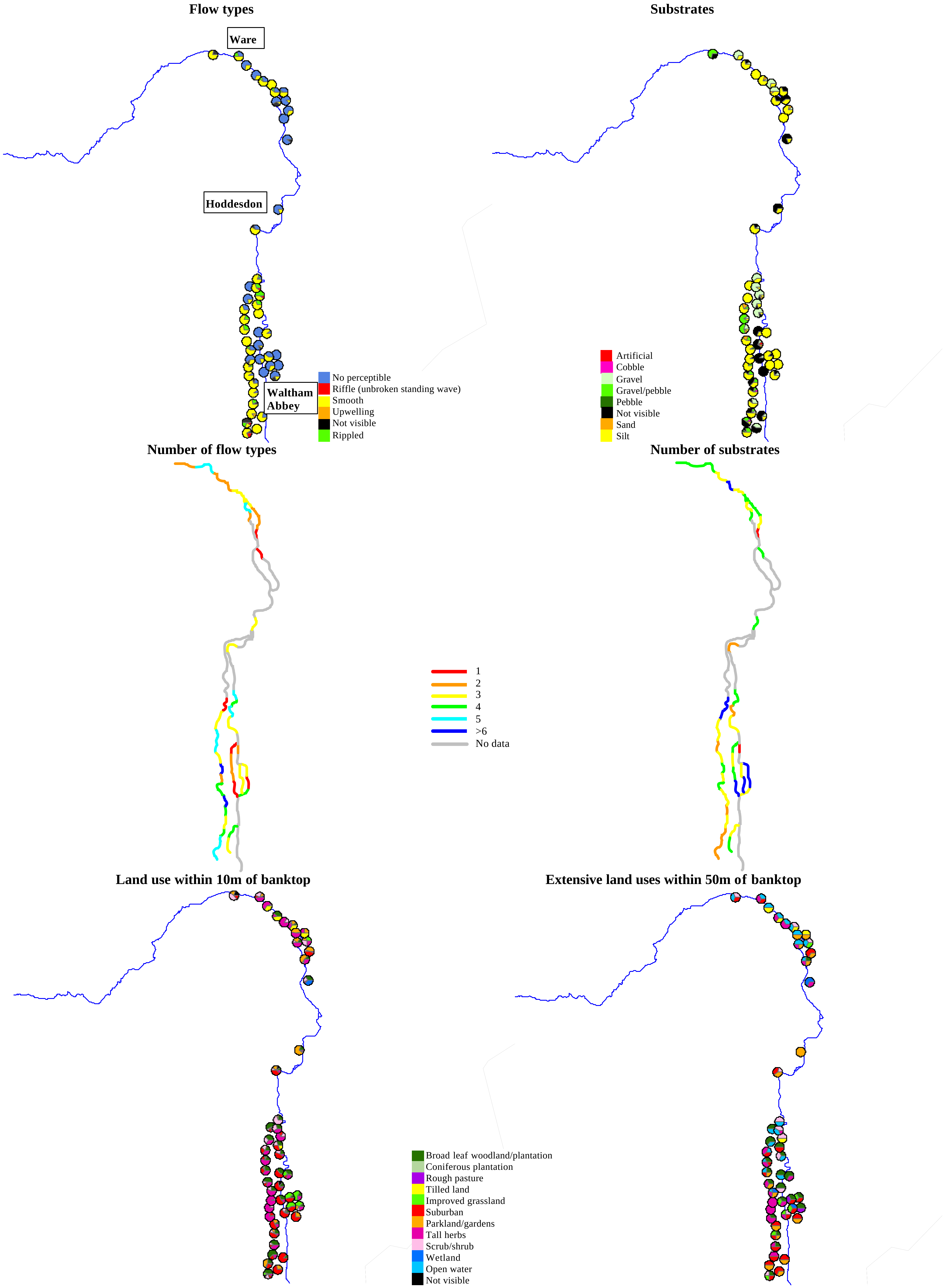
Natural and artificial sources of erosion



Stream Power



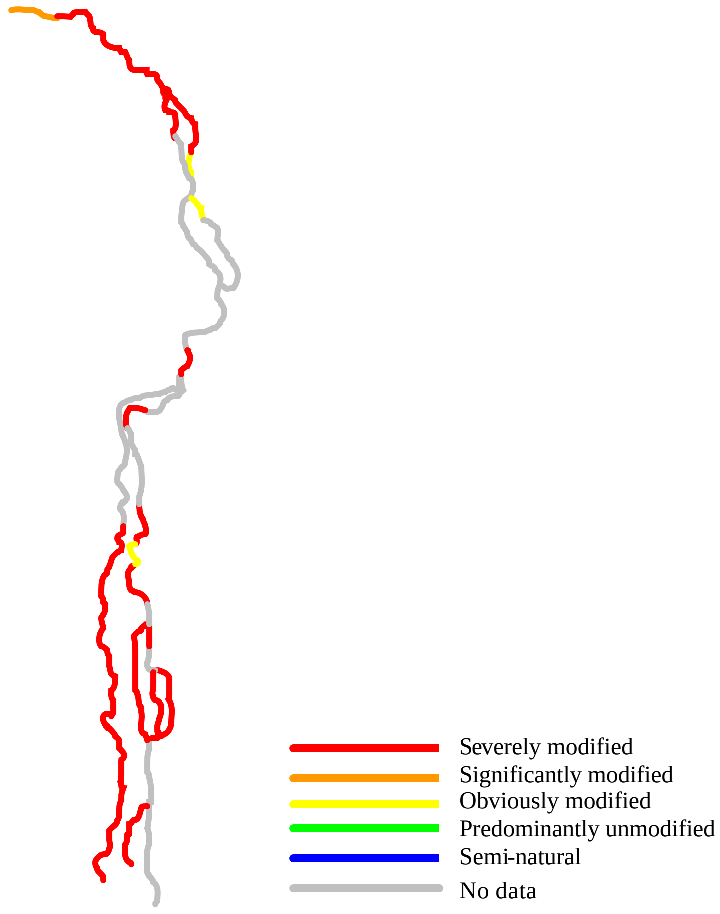
Middle Lee



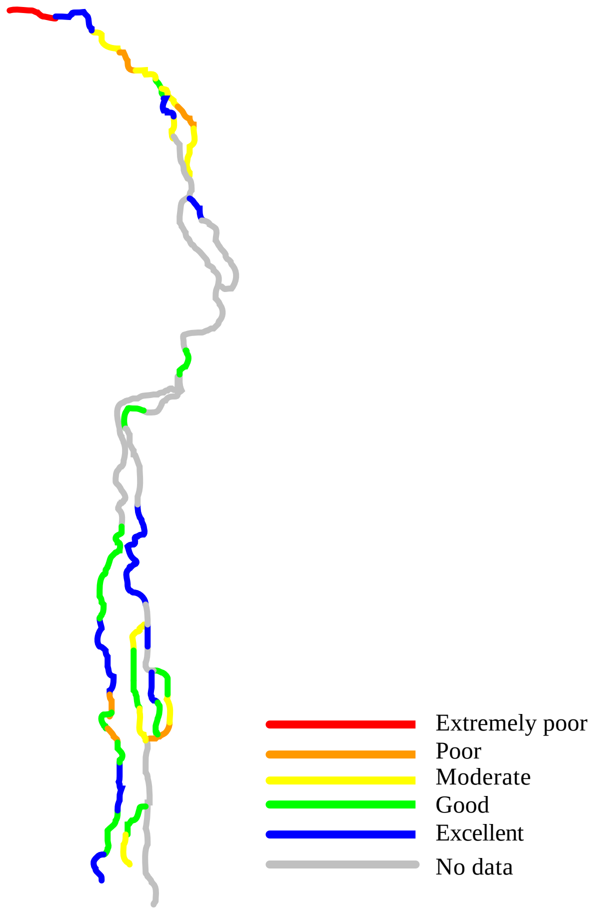
Flow types
Ware
Hoddesdon
Waltham Abbey
No perceptible
Riffle (unbroken standing wave)
Smooth
Upwelling
Not visible
Rippled
Substrates
Artificial
Cobble
Gravel
Gravel/pebble
Pebble
Not visible
Sand
Silt
Number of flow types
Number of substrates
1
2
3
4
5
>6
No data
Land use within 10m of banktop
Extensive land uses within 50m of banktop
Broad leaf woodland/plantation
Coniferous plantation
Rough pasture
Tilled land
Improved grassland
Suburban
Parkland/gardens
Tall herbs
Scrub/shrub
Wetland
Open water
Not visible

Middle Lee

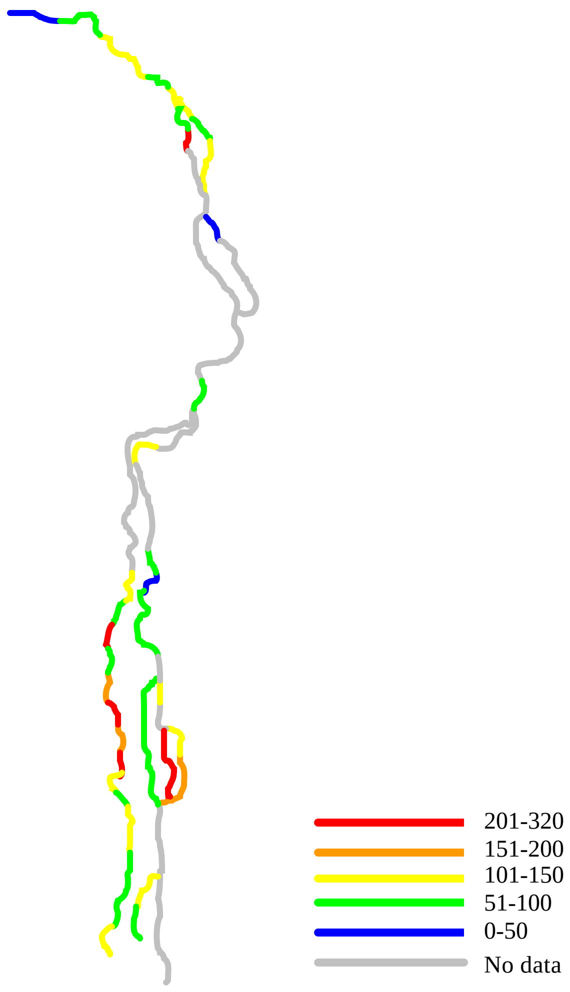
Habitat Modification Class



Habitat Quality Class

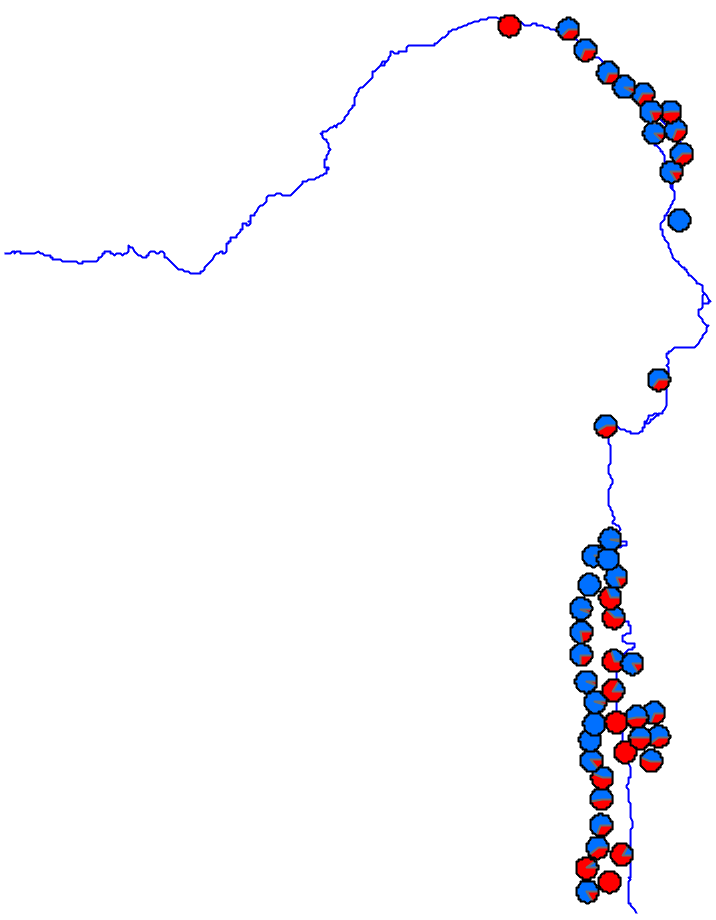


Fine Sediment Source Index

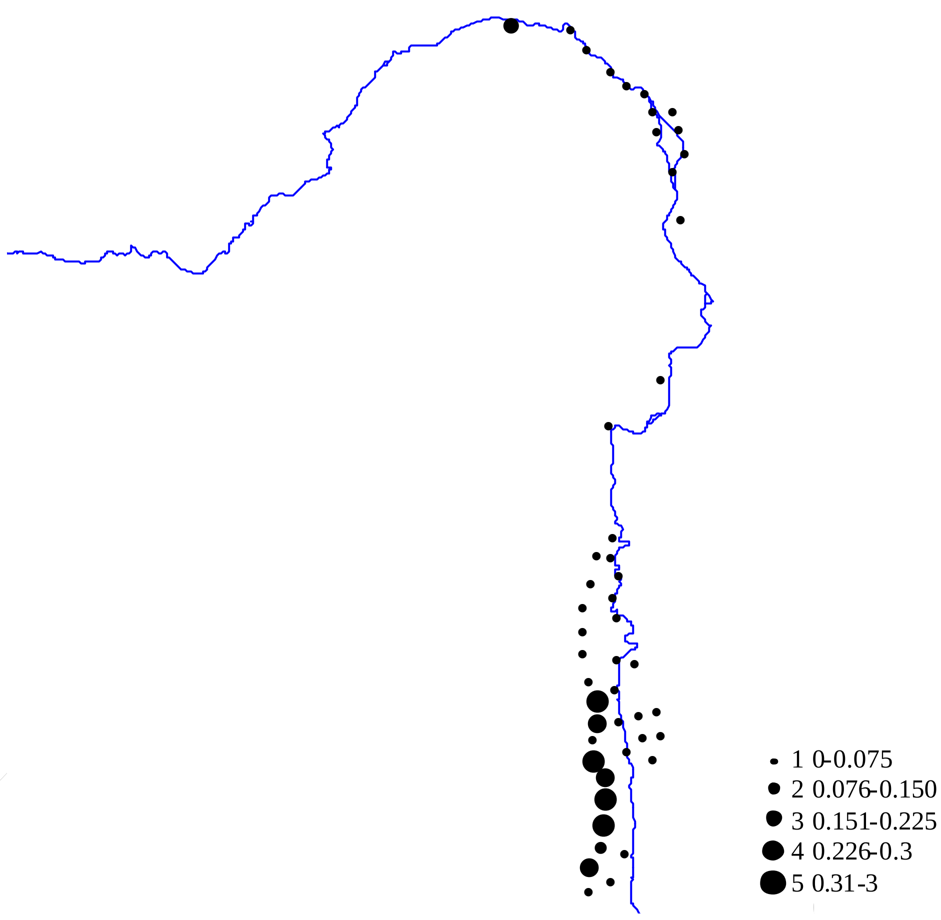


Bank Sensitivity Index

Natural and artificial sources of erosion

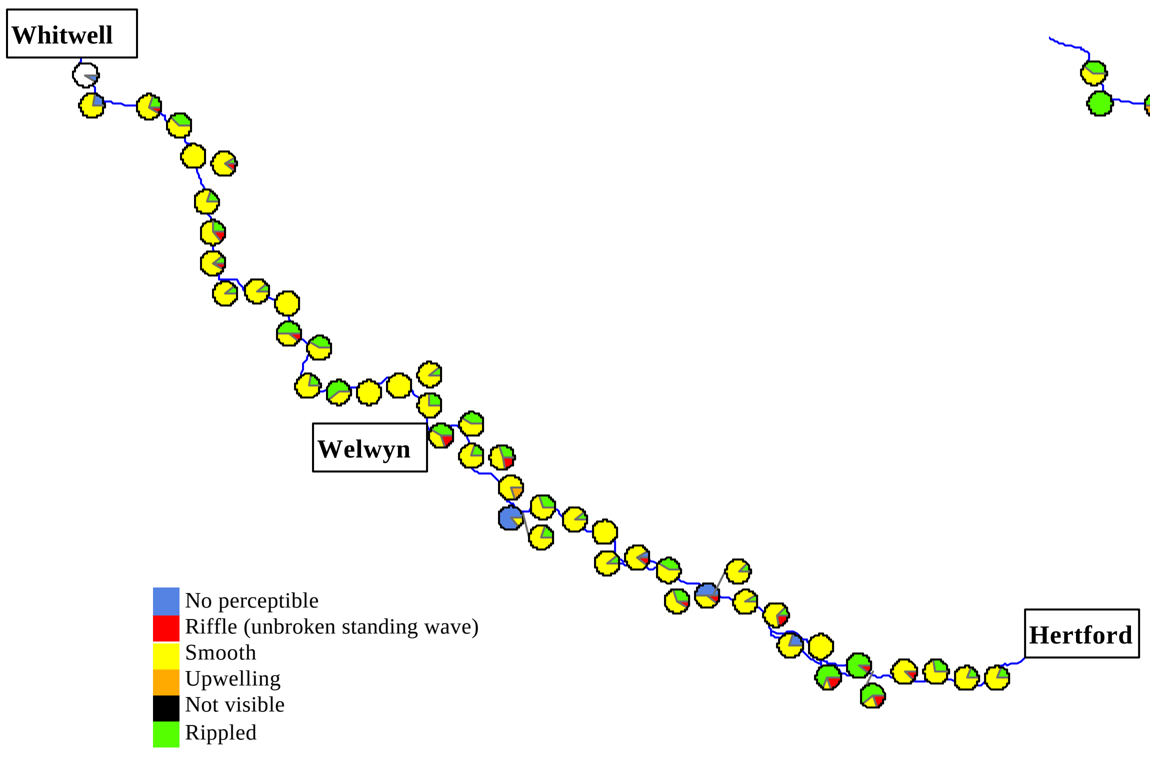


Stream Power

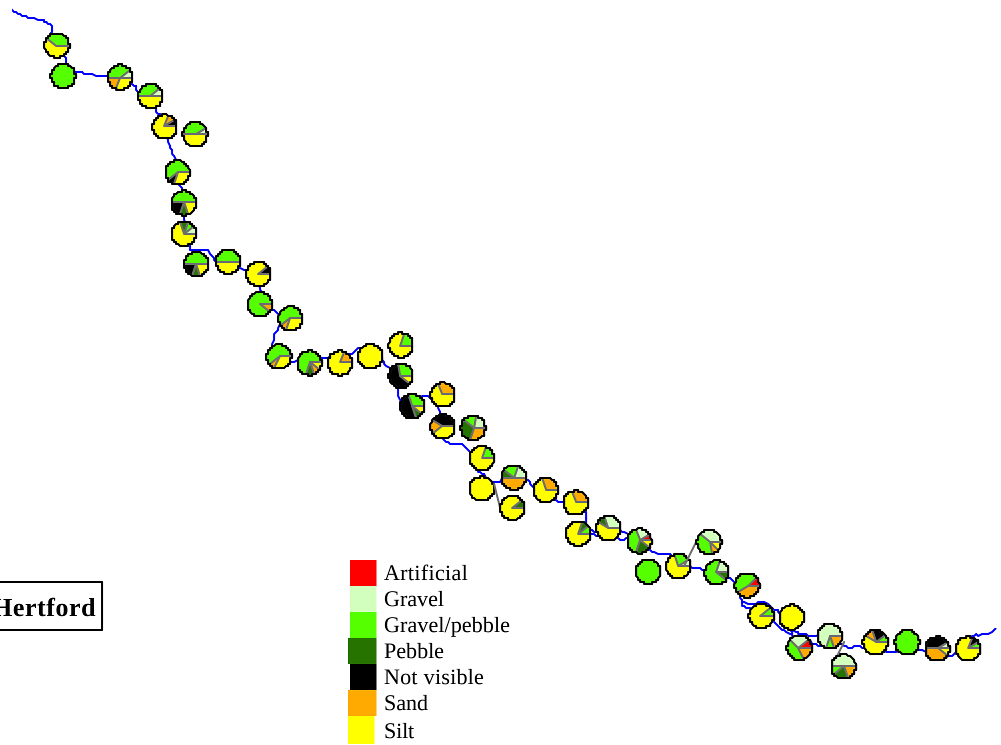


Mimram

Flow types

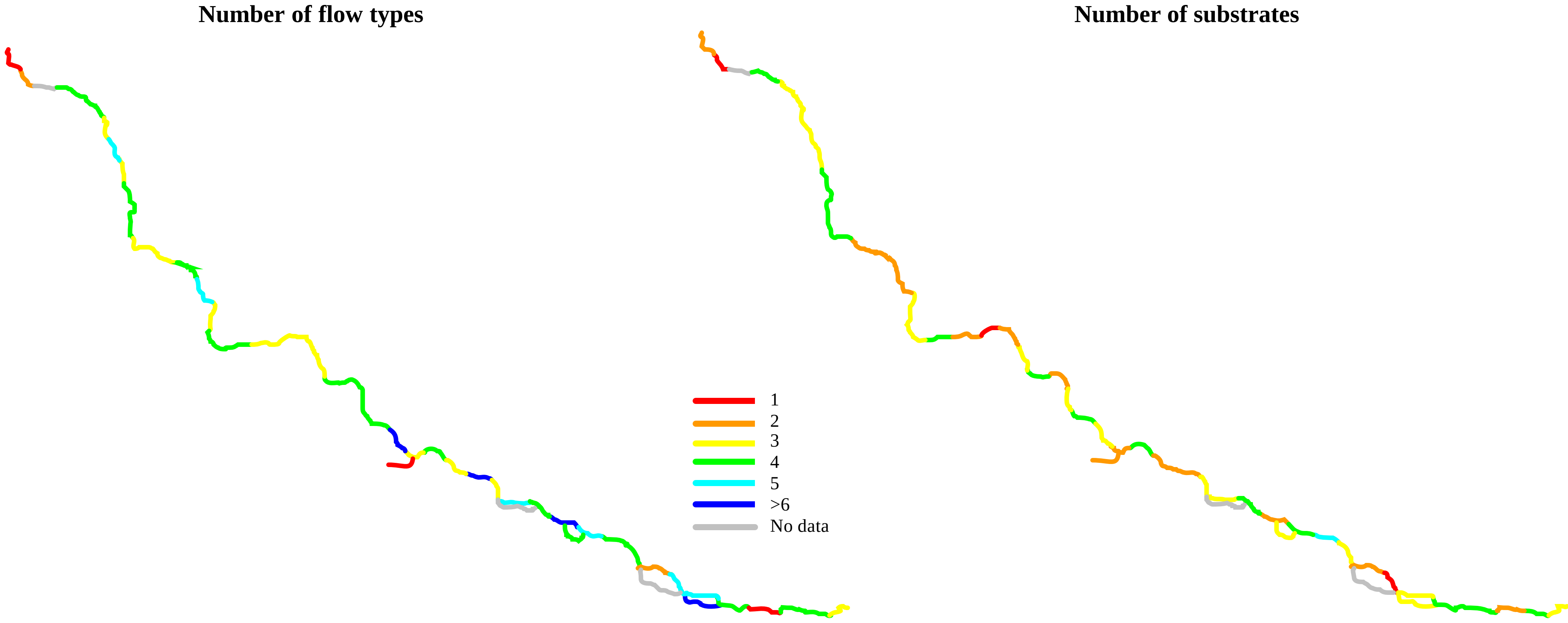


Substrates

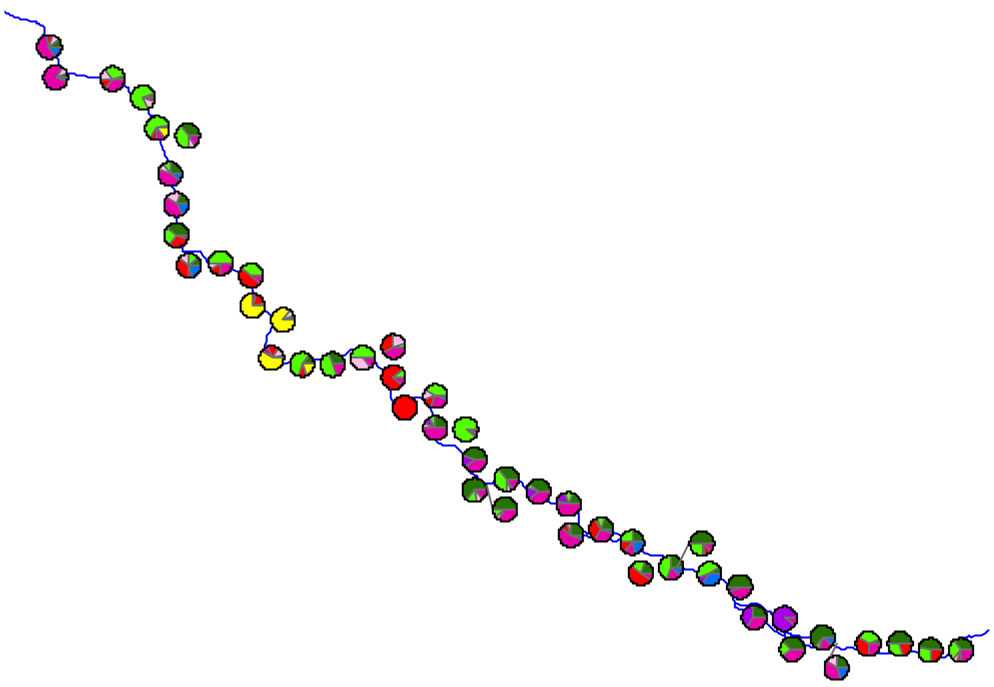


Number of flow types

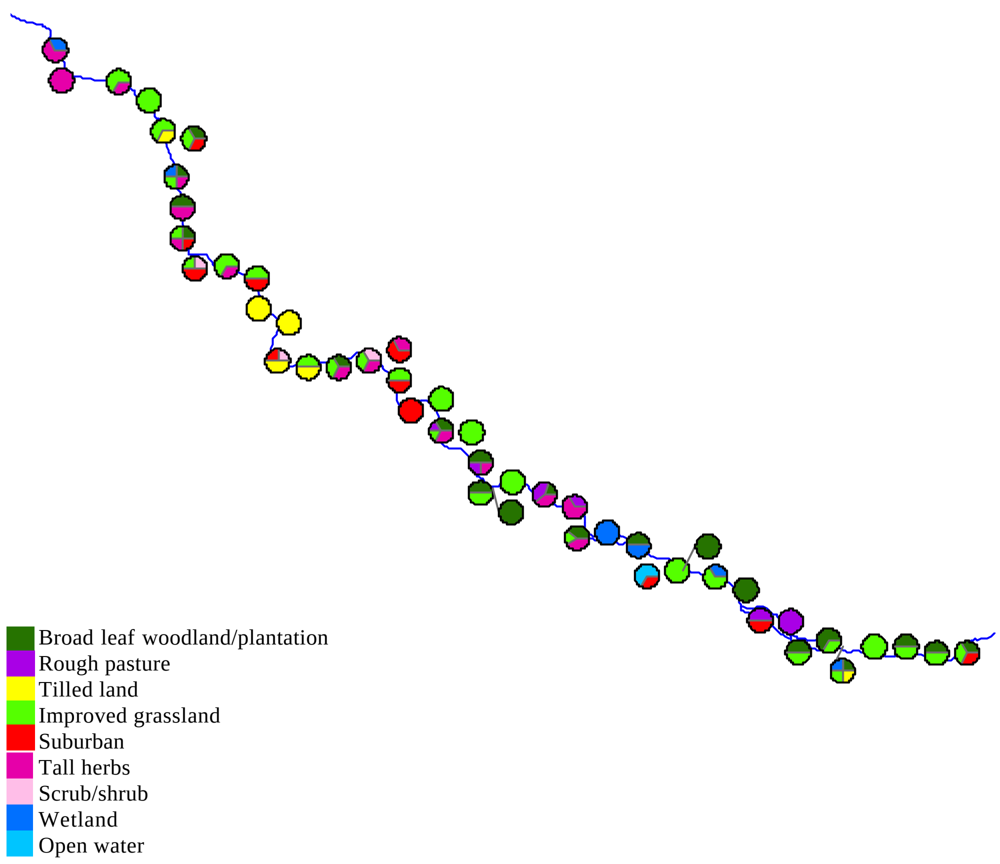
Number of substrates



Land use within 10m of banktop

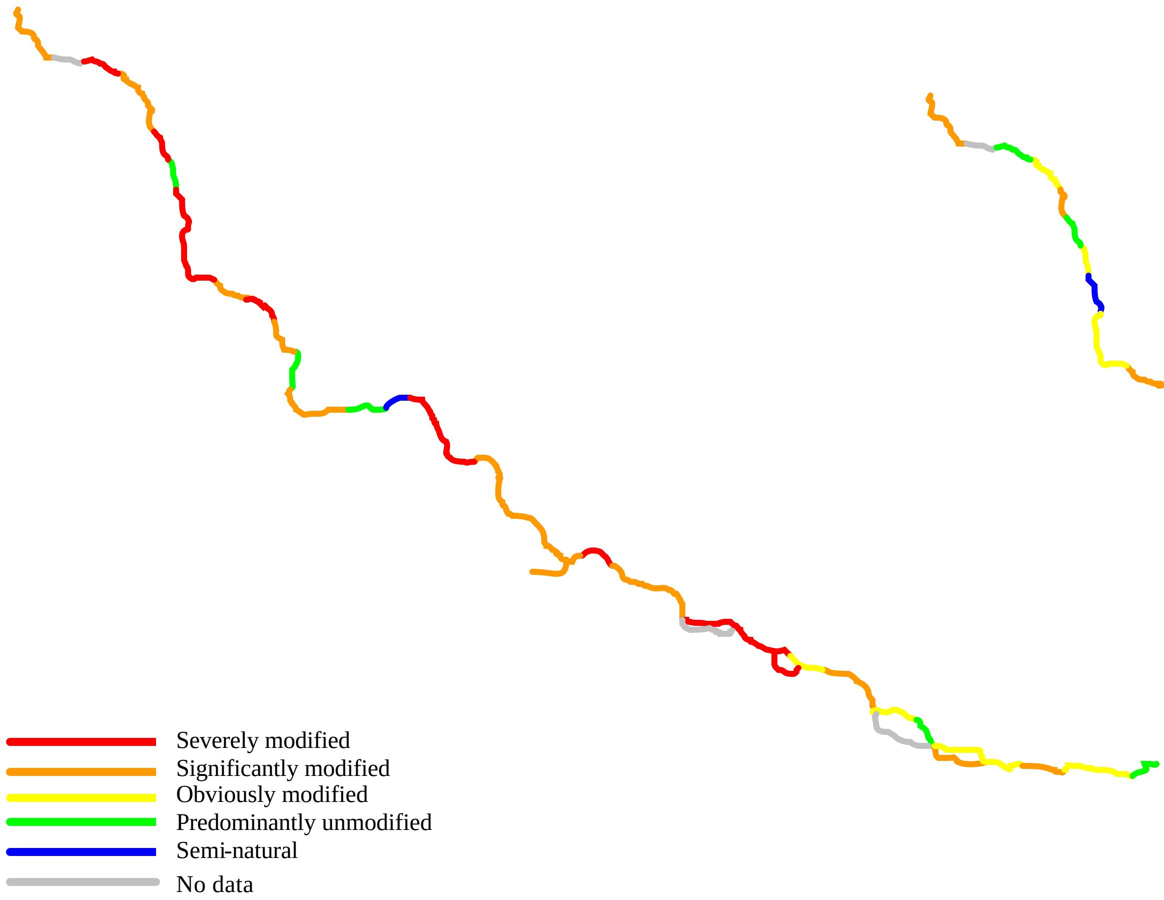


Extensive land uses within 50m of banktop

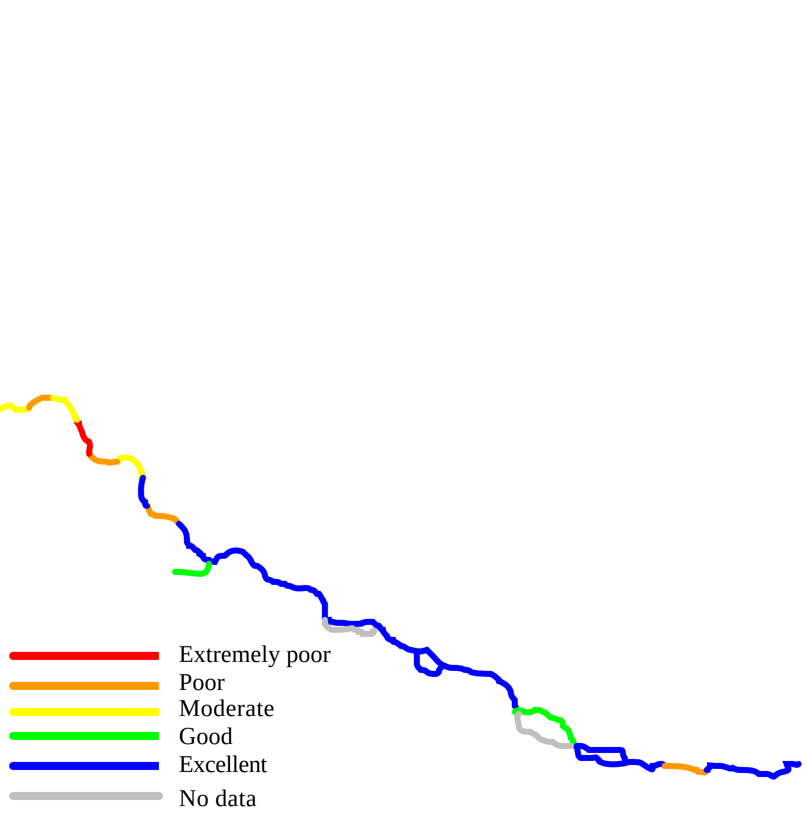


Mimram

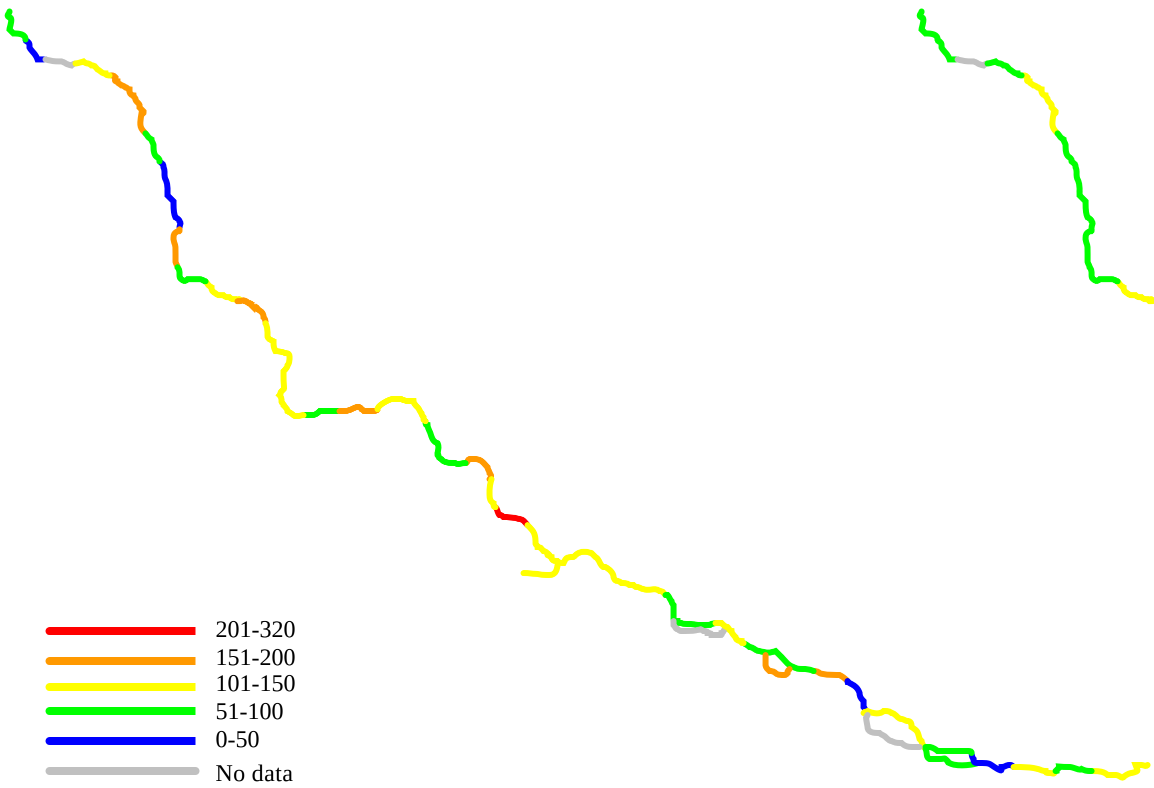
Habitat Modification Class



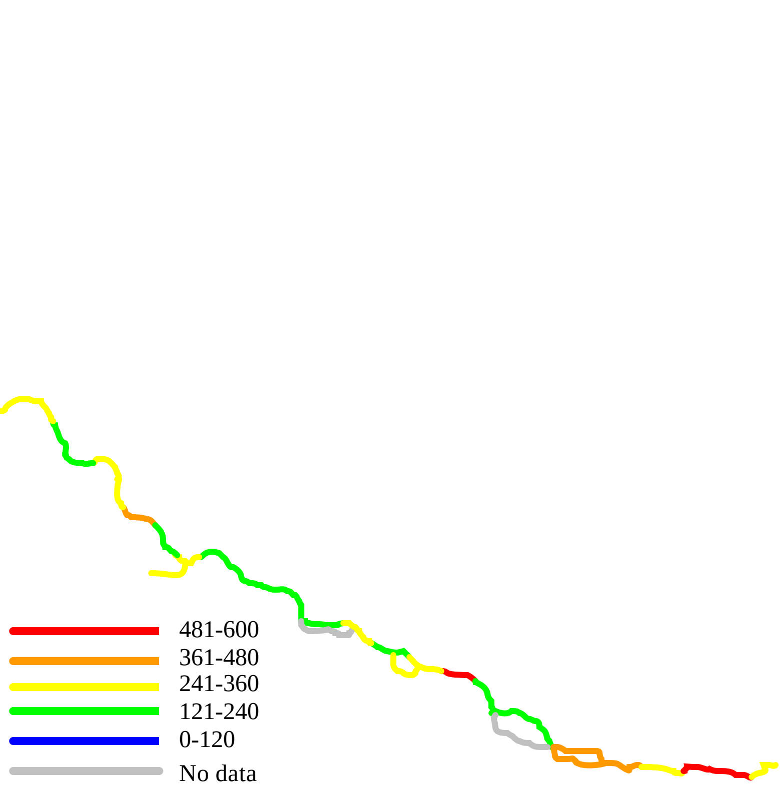
Habitat Quality Class



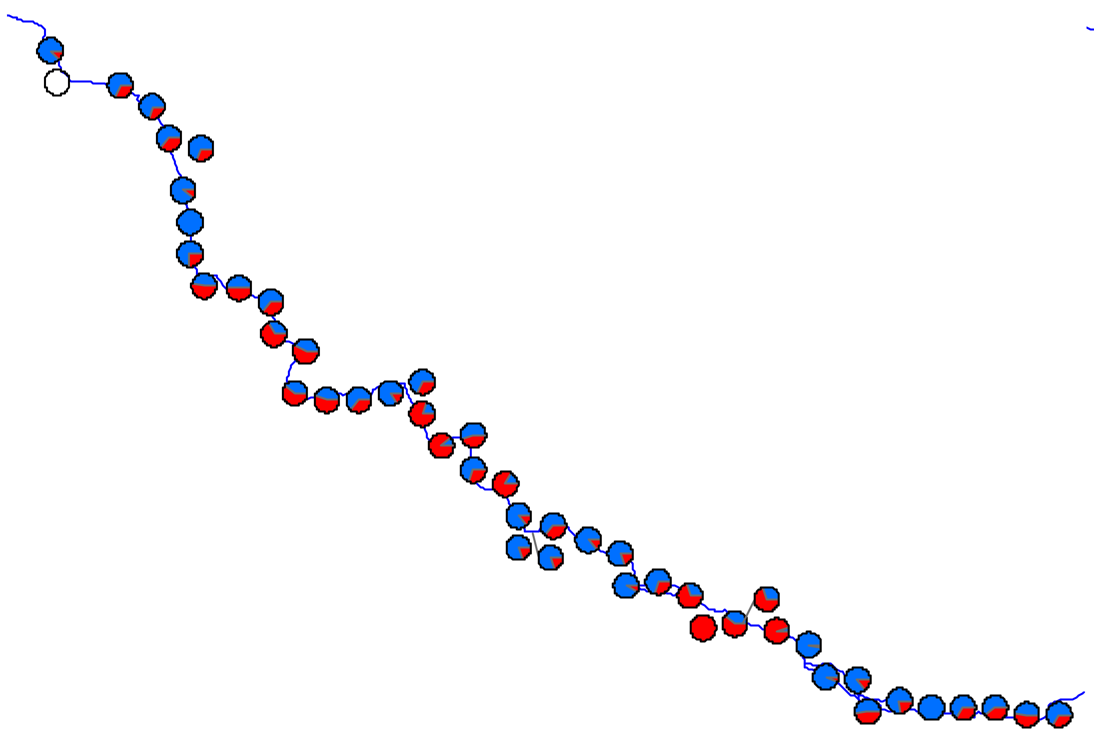
Fine Sediment Source Index



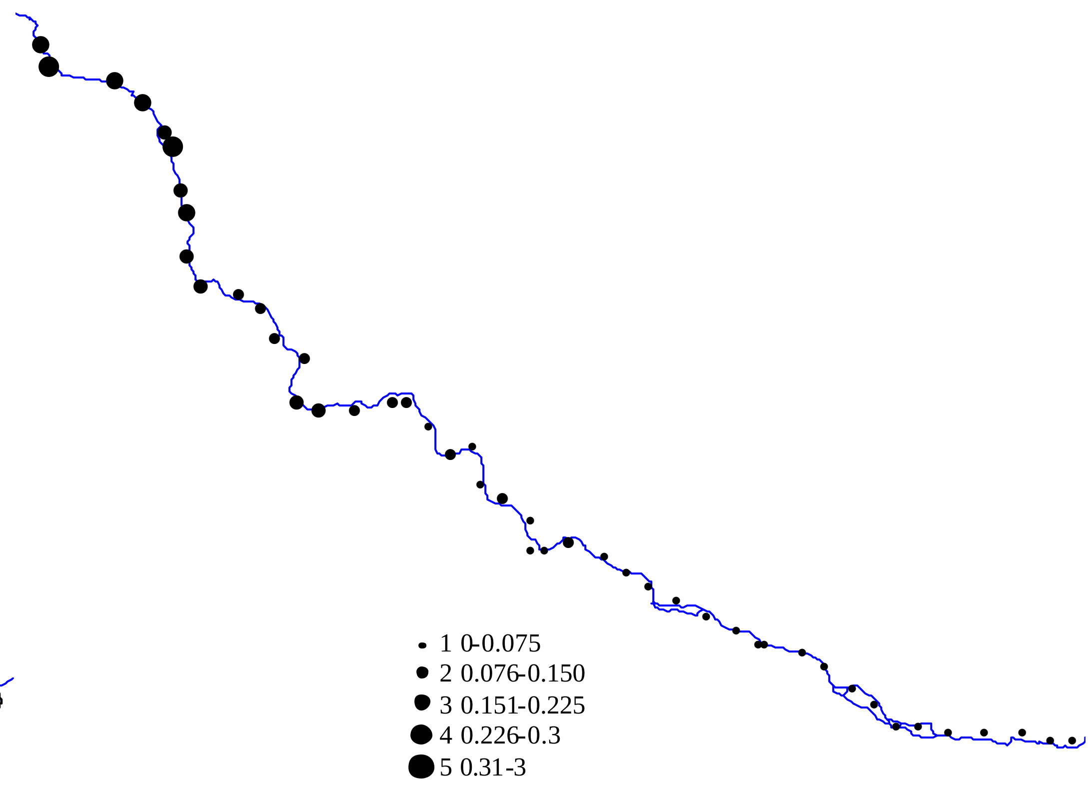
Bank Sensitivity Index



Natural and artificial sources of erosion

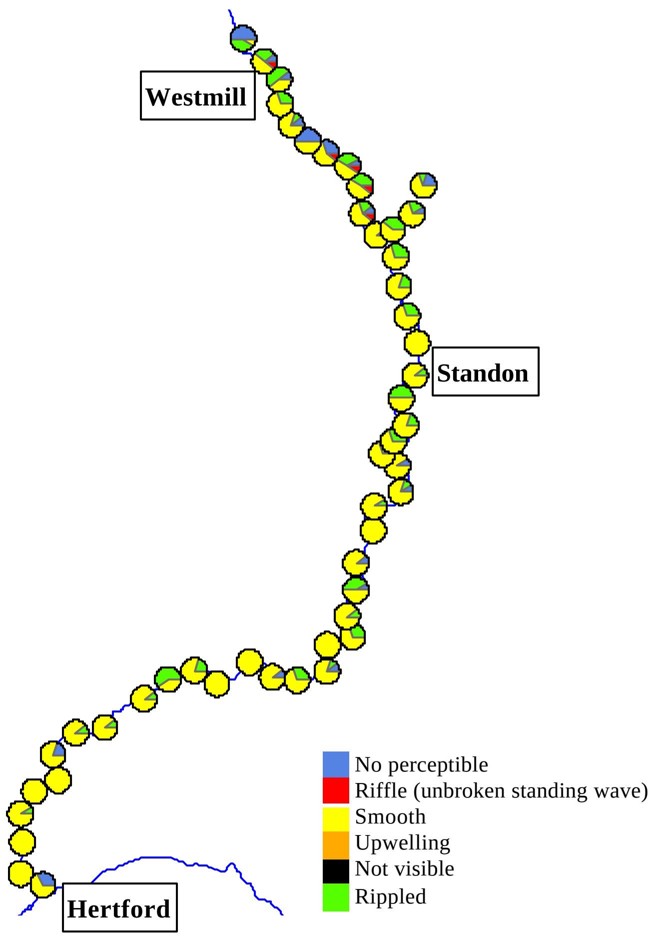


Stream Power

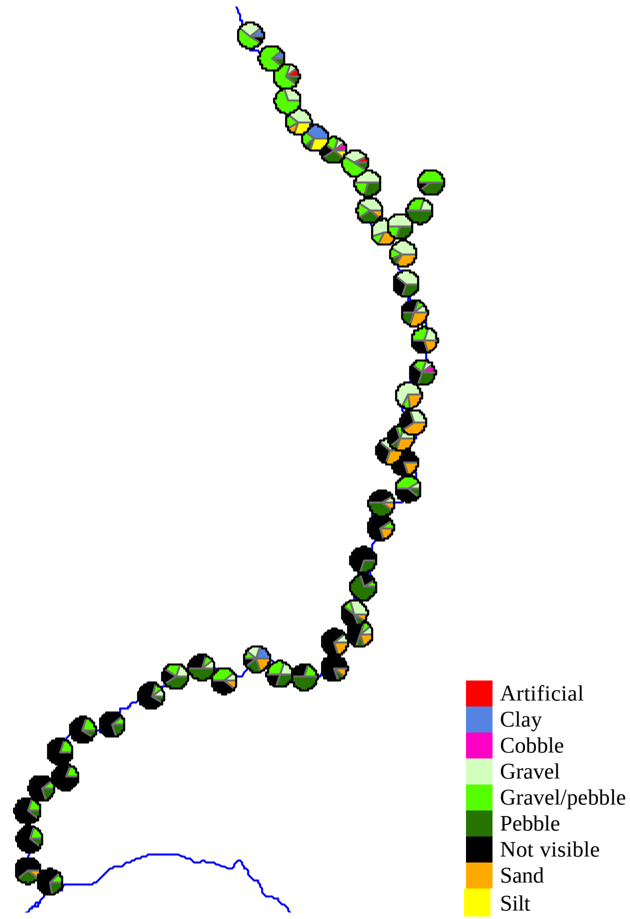


Rib

Flow types

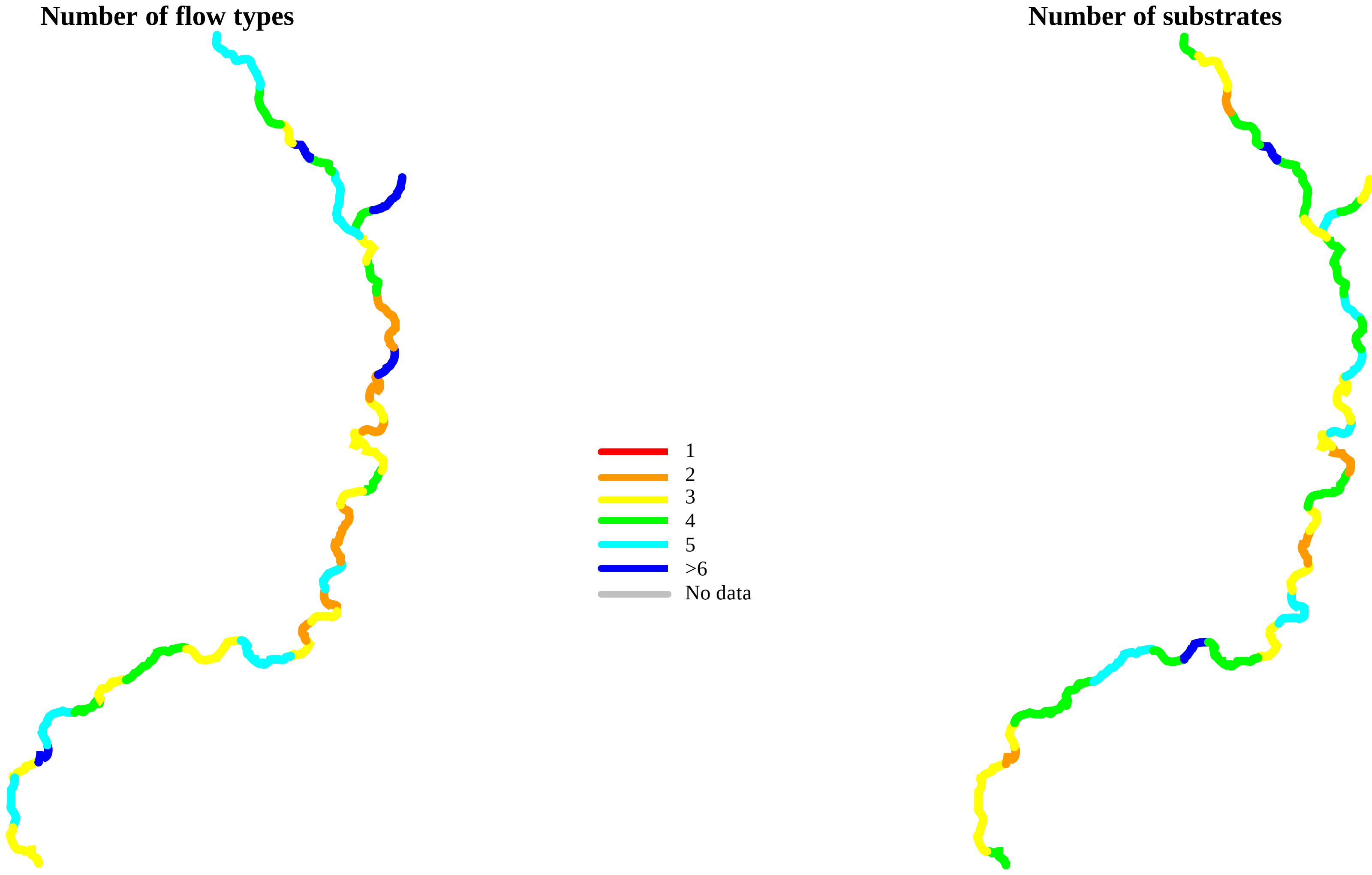


Substrates

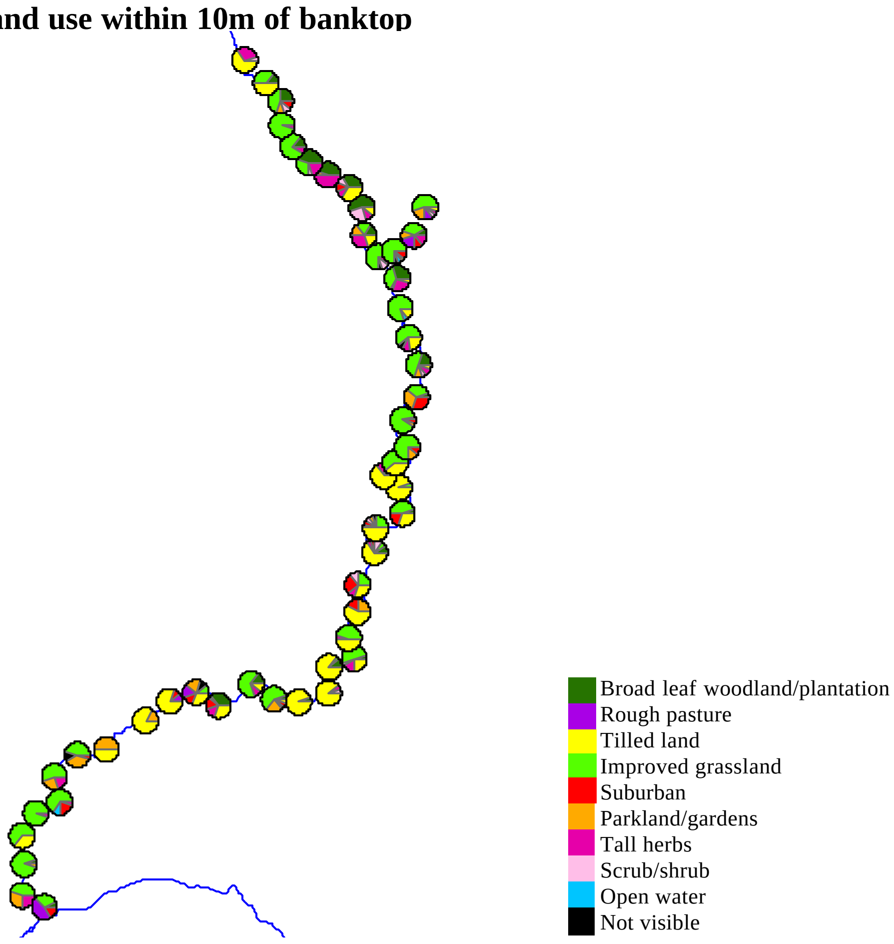


Number of flow types

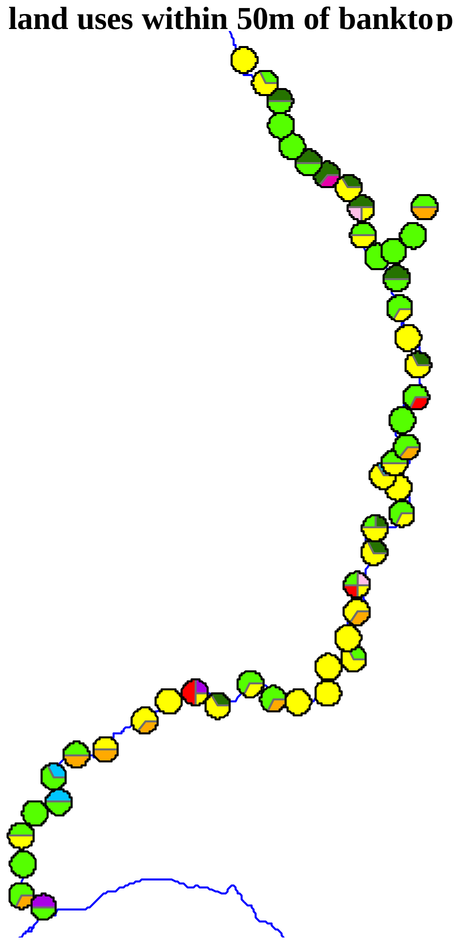
Number of substrates



Land use within 10m of banktop

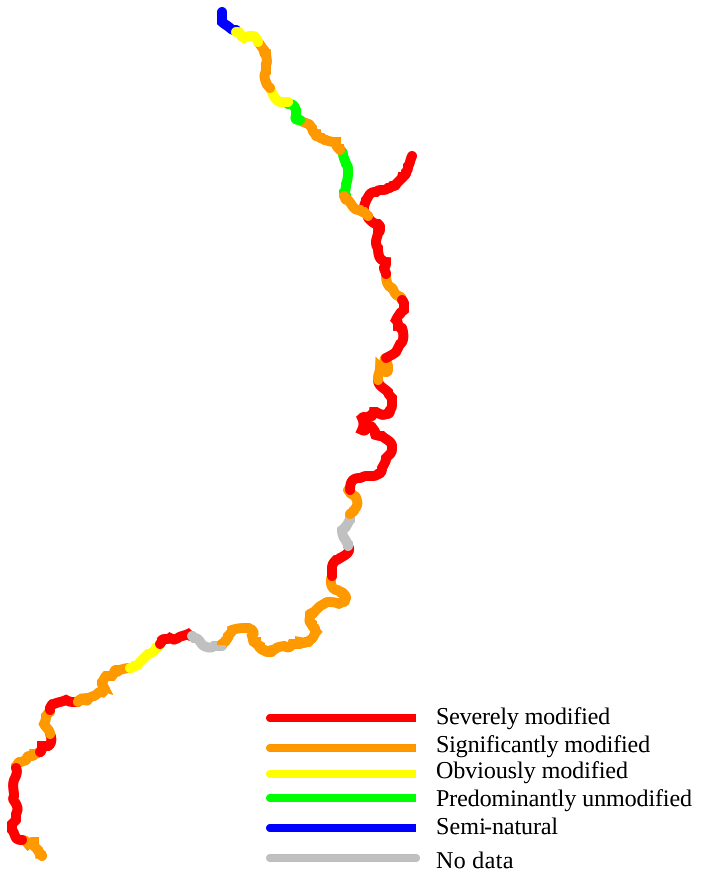


Extensive land uses within 50m of banktop

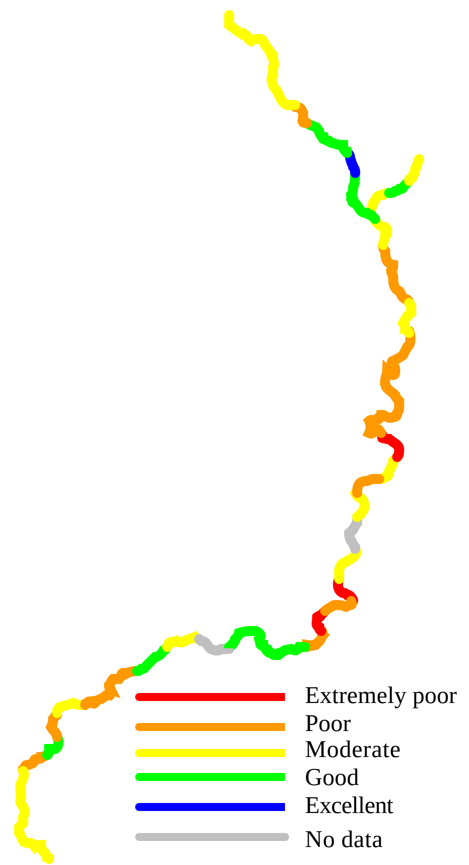


Rib

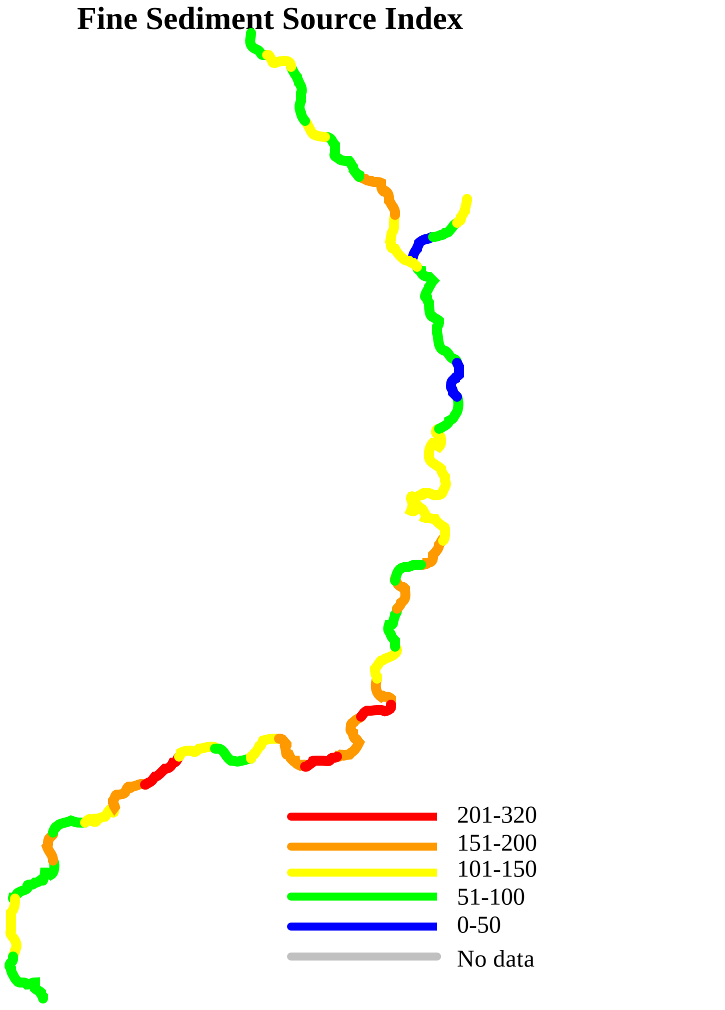
Habitat Modification Class



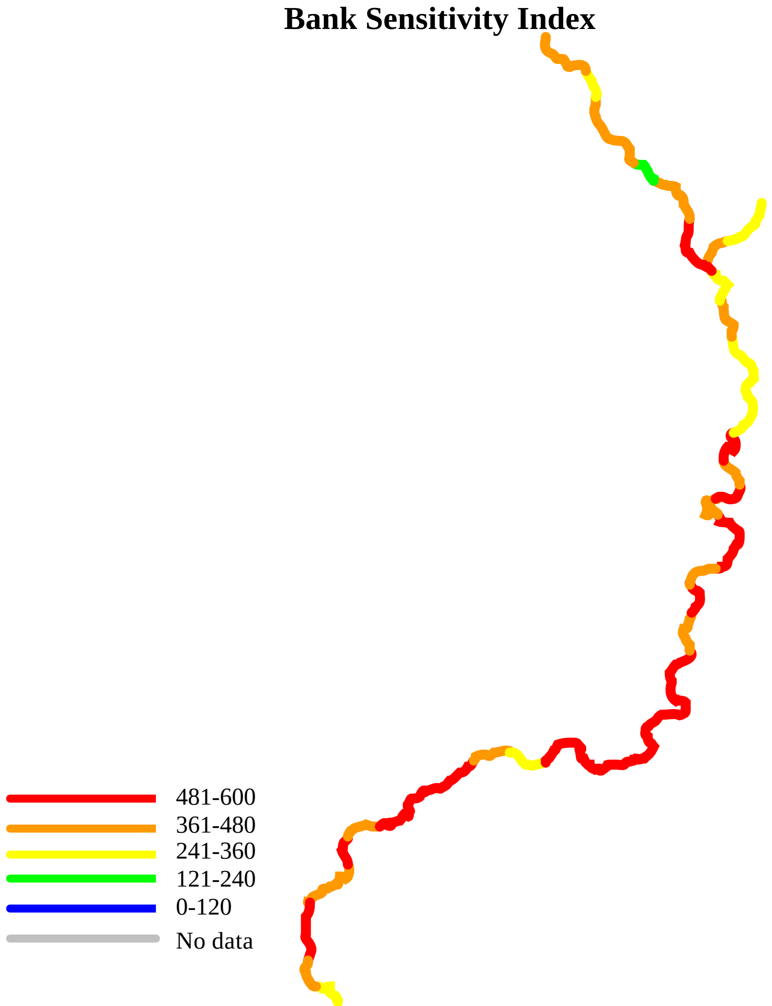
Habitat Quality Class



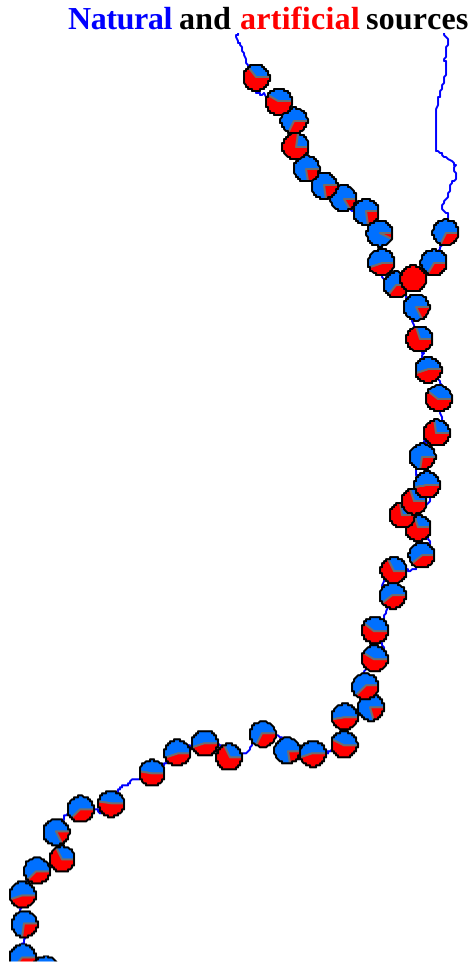
Fine Sediment Source Index



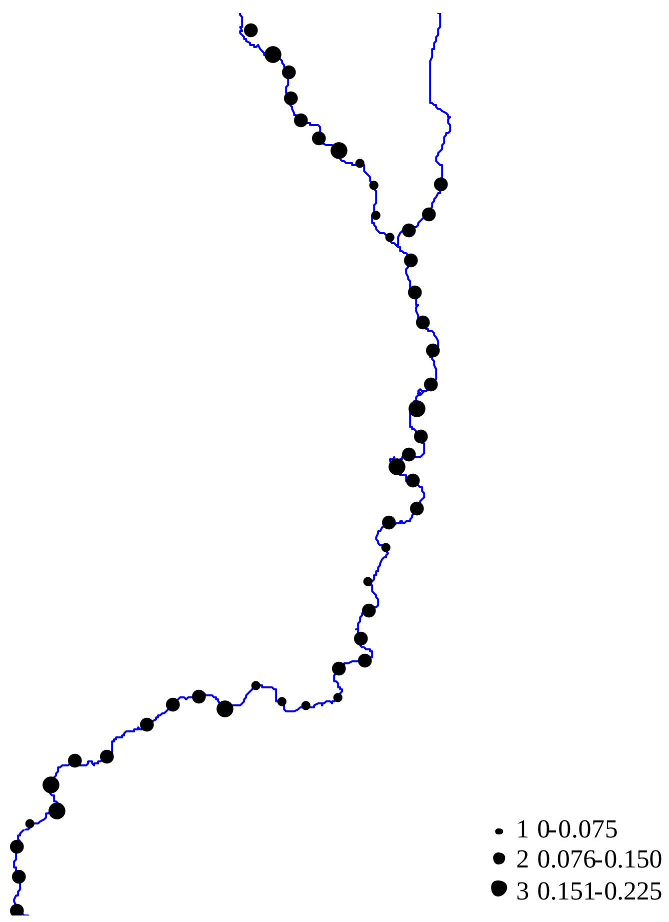
Bank Sensitivity Index



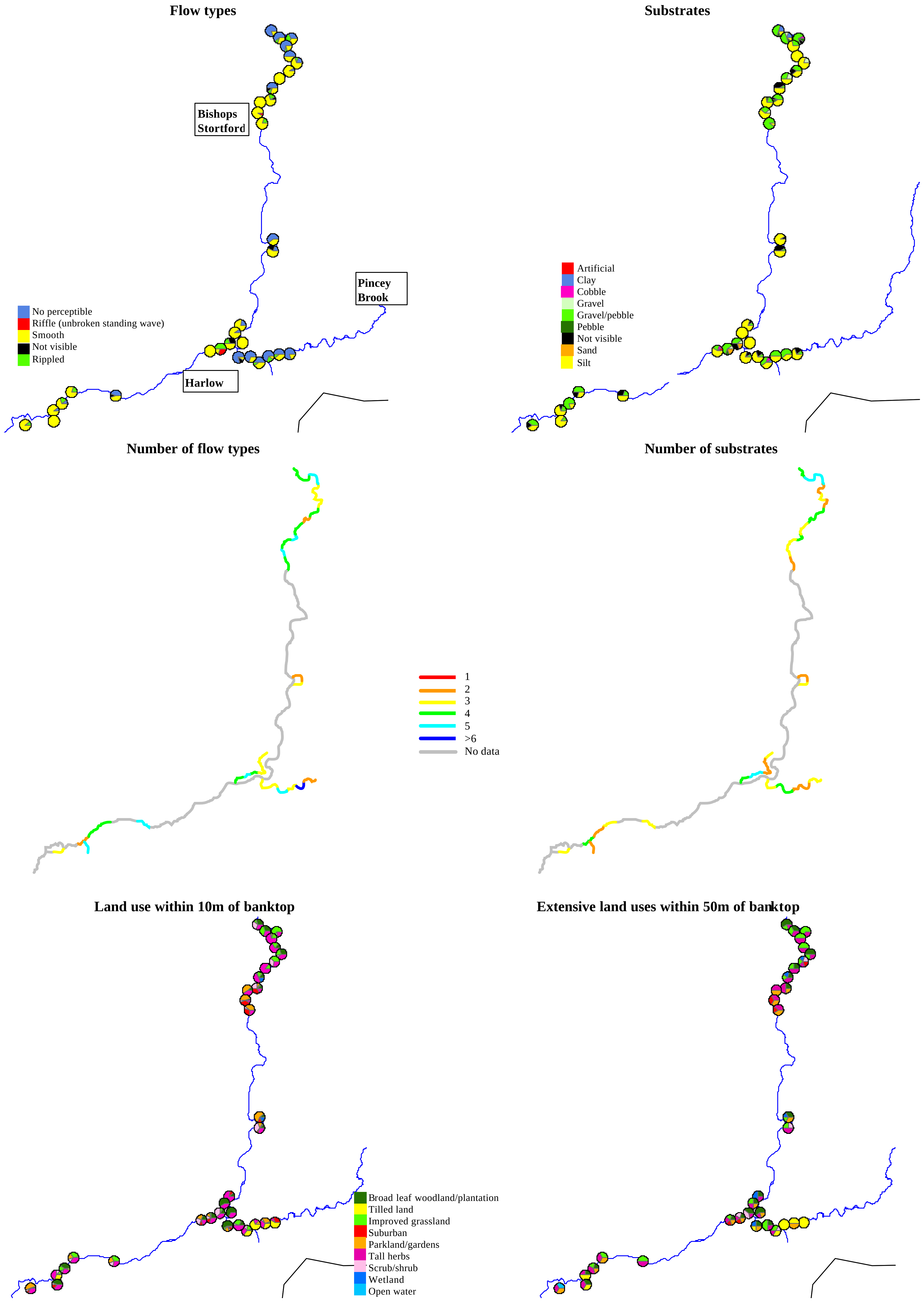
Natural and artificial sources of erosion



Stream Power



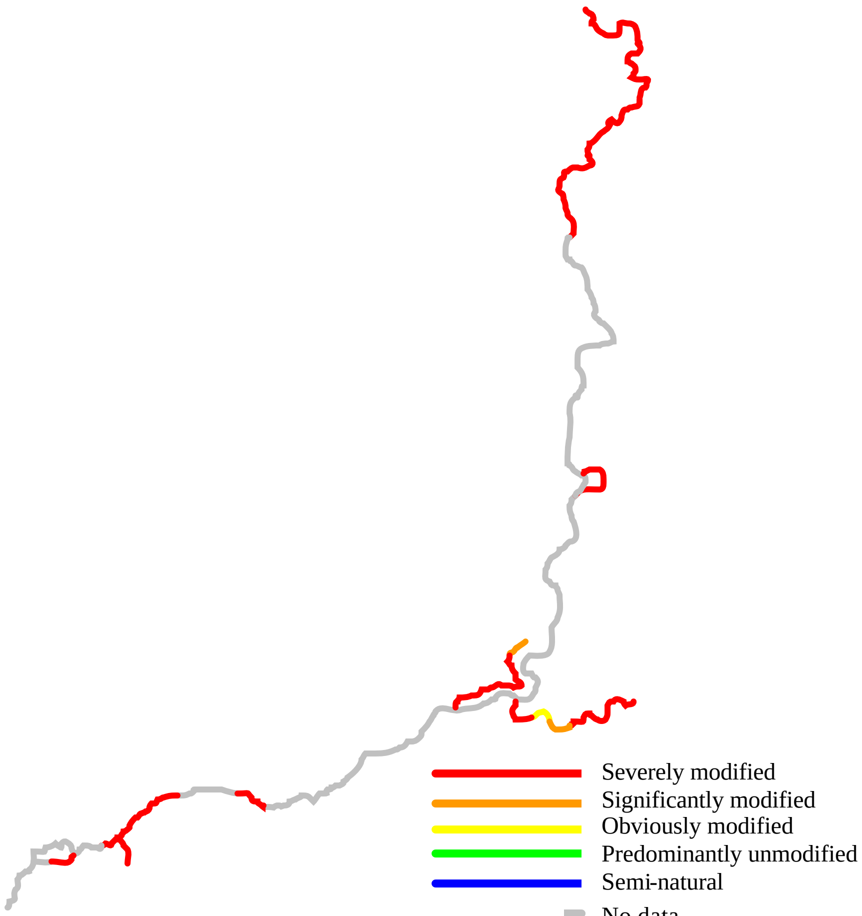
Stort



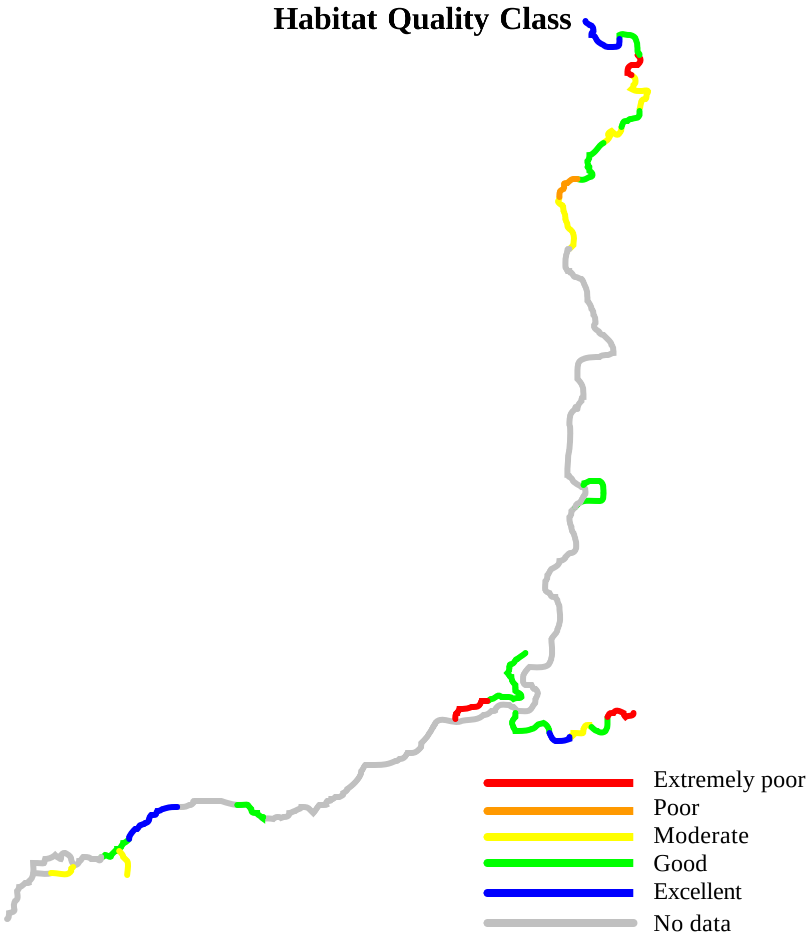
Flow types
Bishops Stortford
Pincey Brook
Harlow
No perceptible
Riffle (unbroken standing wave)
Smooth
Not visible
Rippled
Substrates
Artificial
Clay
Cobble
Gravel
Gravel/pebble
Pebble
Not visible
Sand
Silt
Number of flow types
Number of substrates
1
2
3
4
5
>6
No data
Land use within 10m of banktop
Extensive land uses within 50m of banktop
Broad leaf woodland/plantation
Tilled land
Improved grassland
Suburban
Parkland/gardens
Tall herbs
Scrub/shrub
Wetland
Open water

Stort

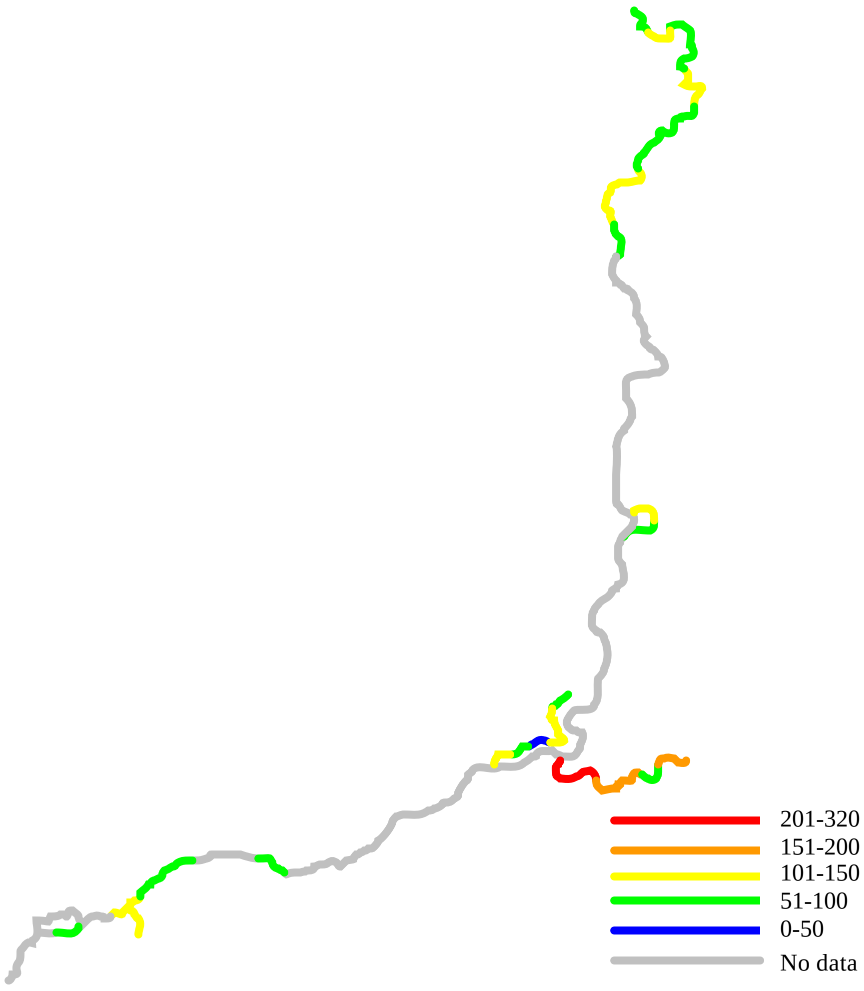
Habitat Modification Class



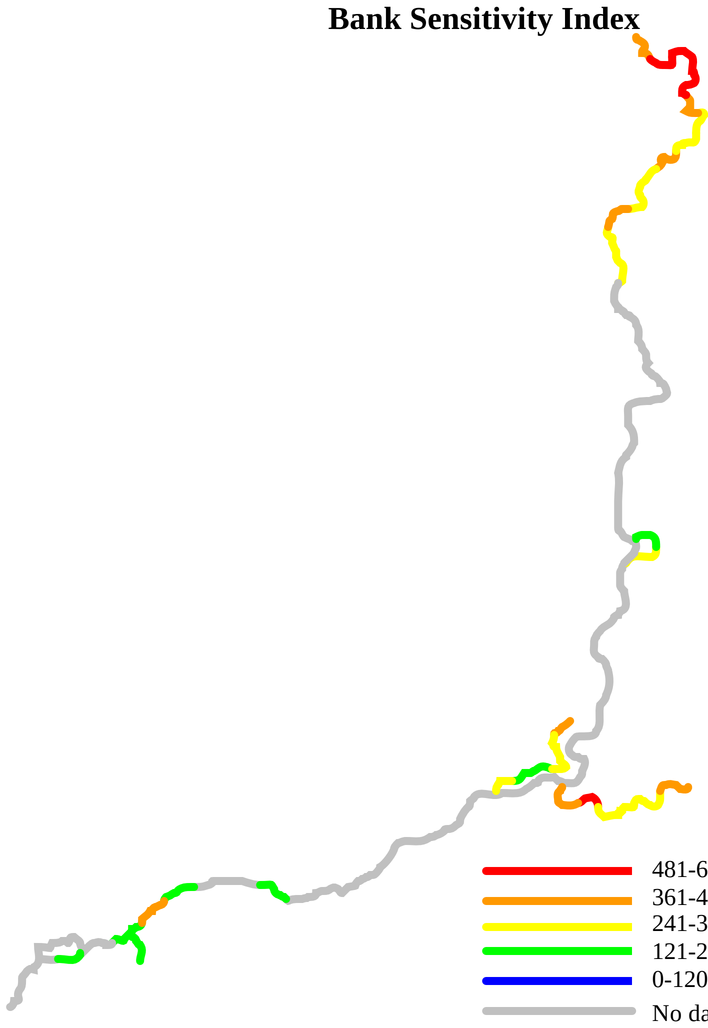
Habitat Quality Class



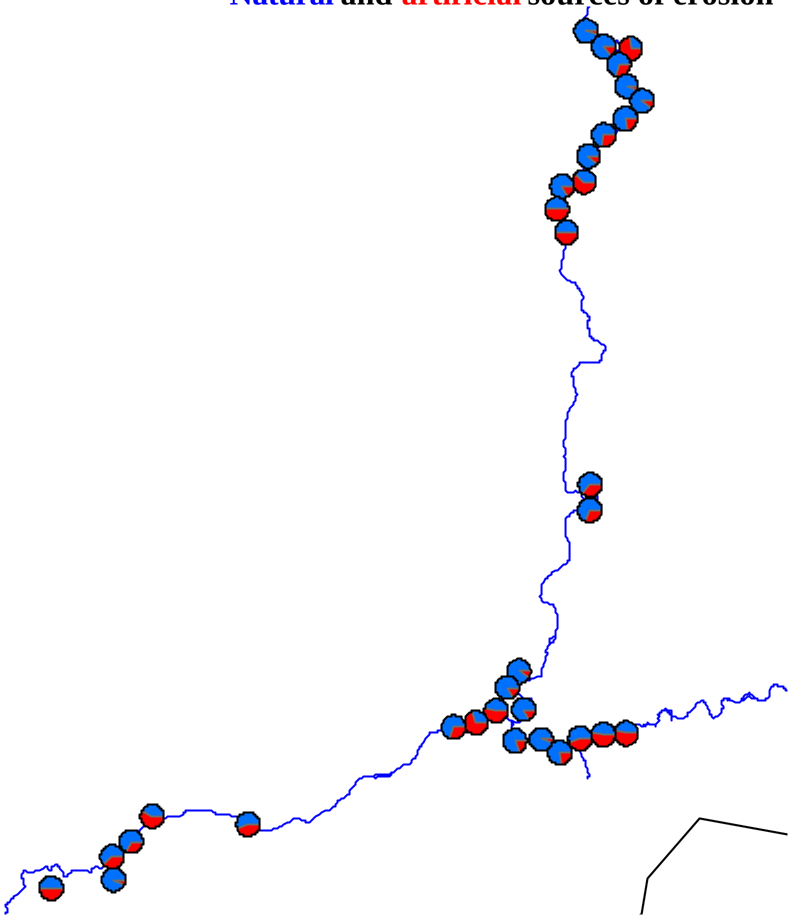
Fine Sediment Source Index



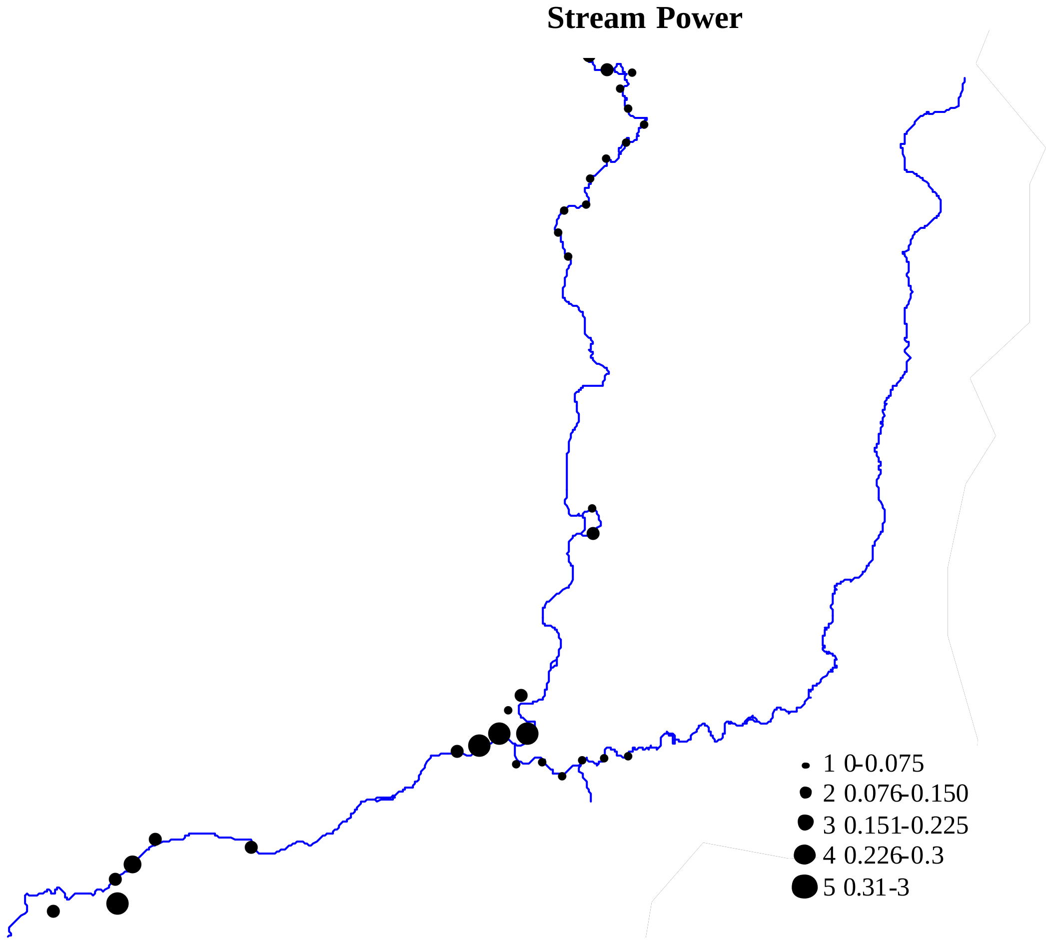
Bank Sensitivity Index



Natural and artificial sources of erosion

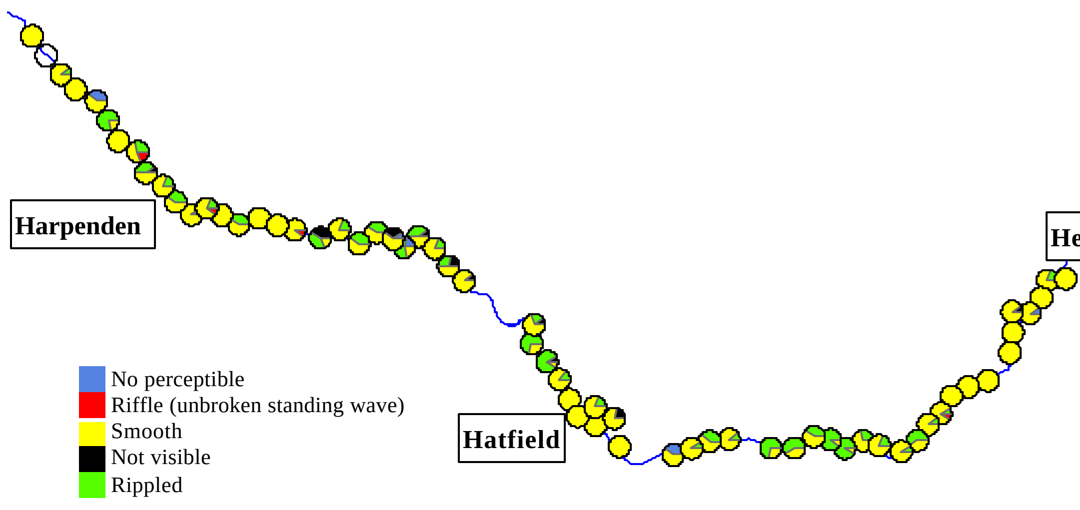


Stream Power

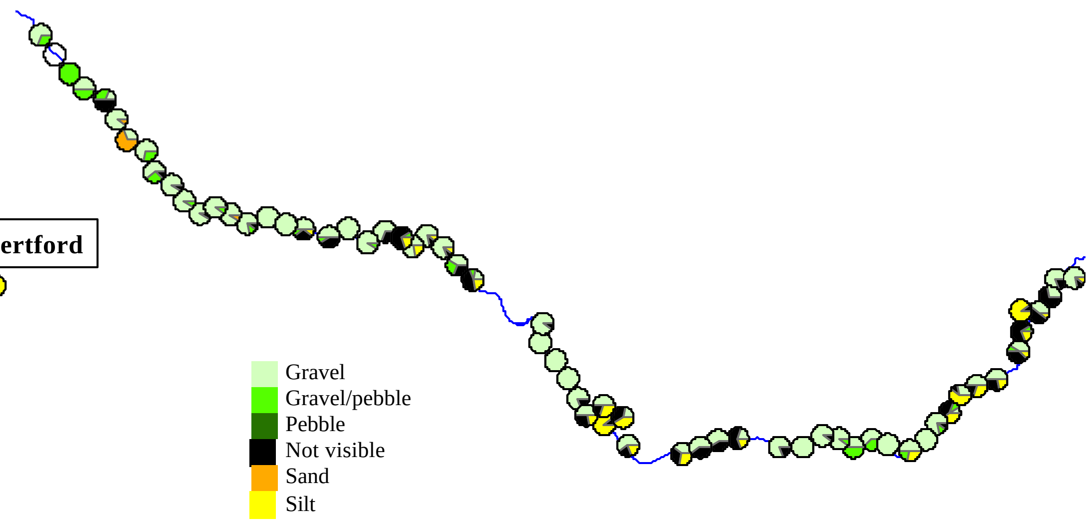


Upper Lee

Flow types

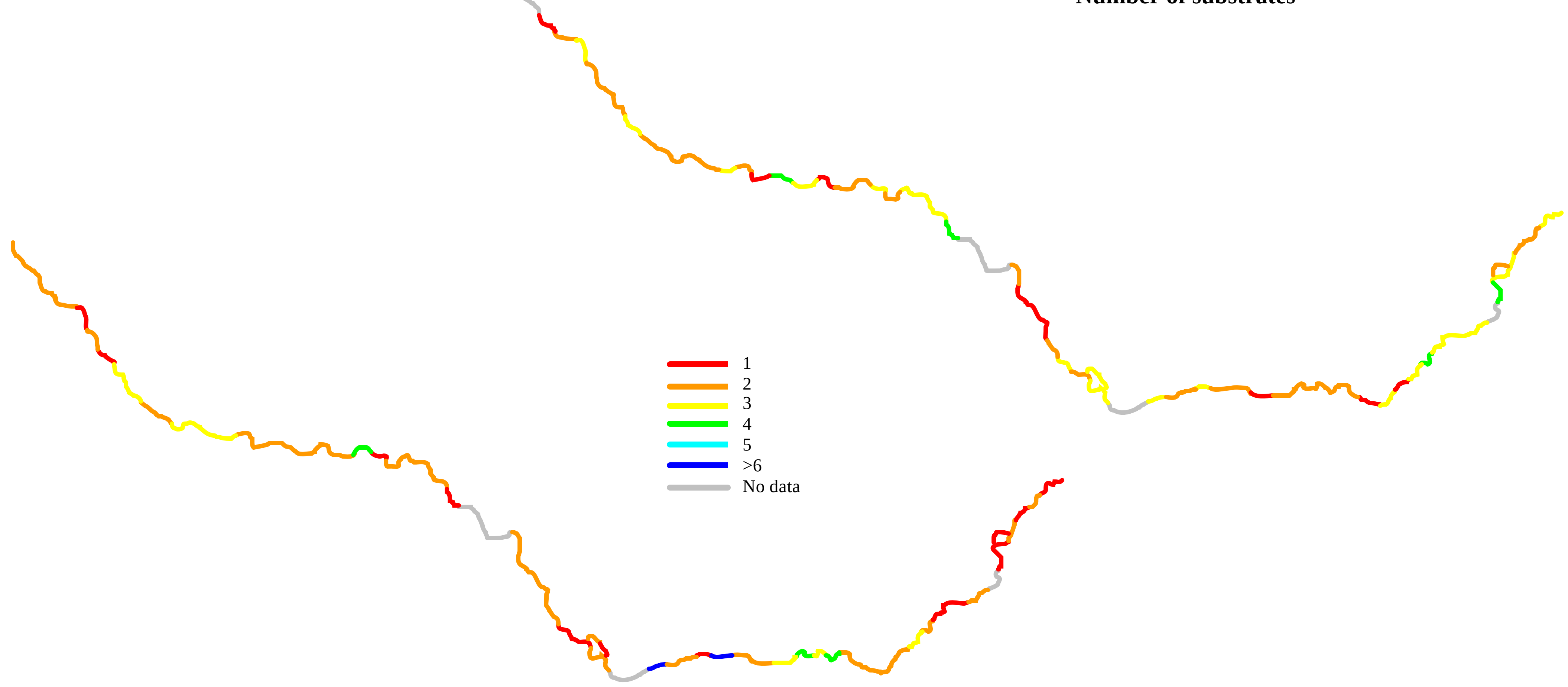


Substrates

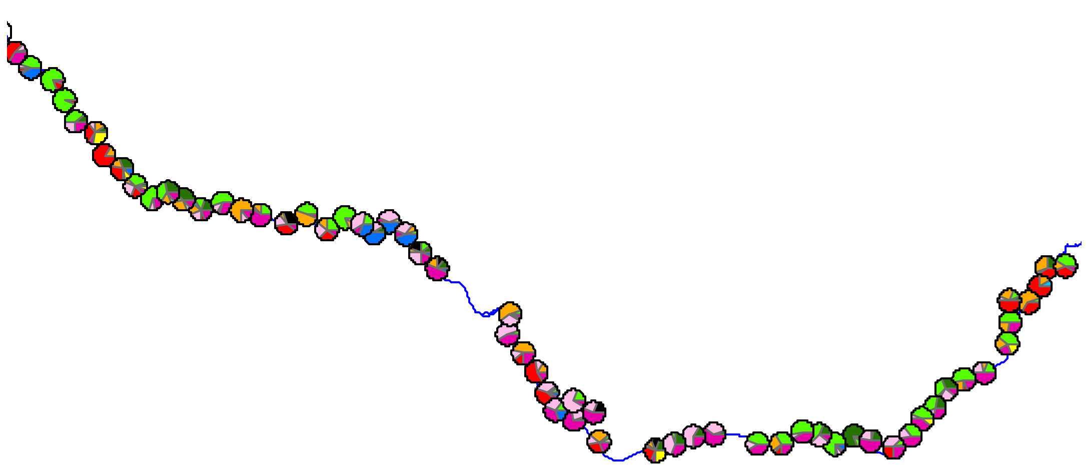


Number of flow types

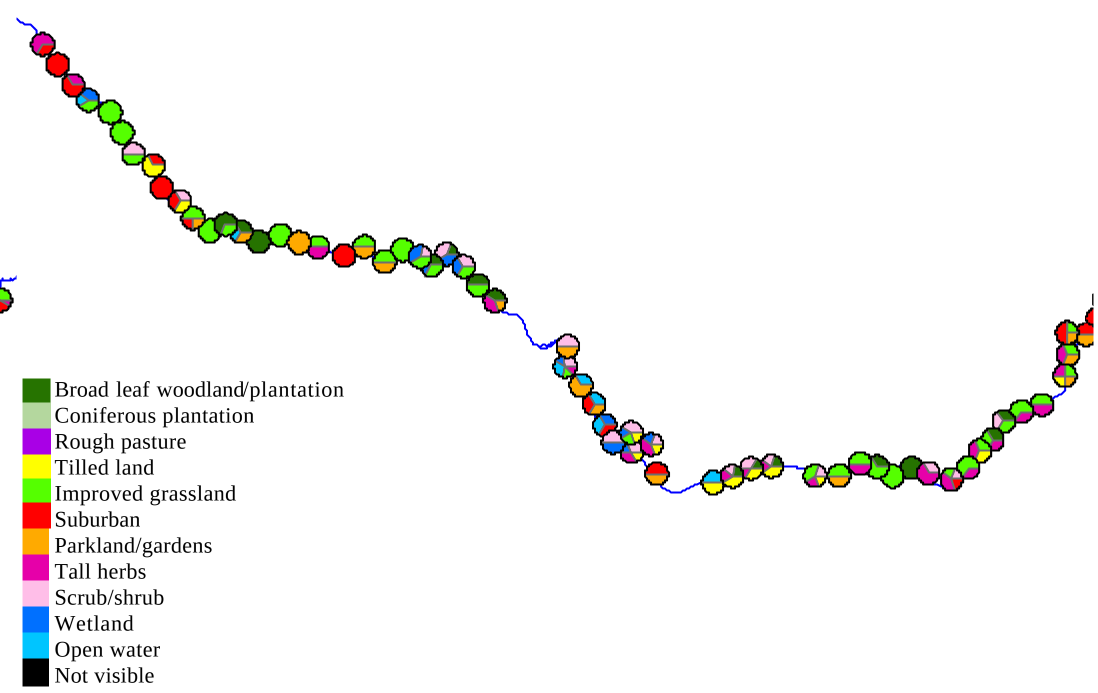
Number of substrates



Land use within 10m of banktop

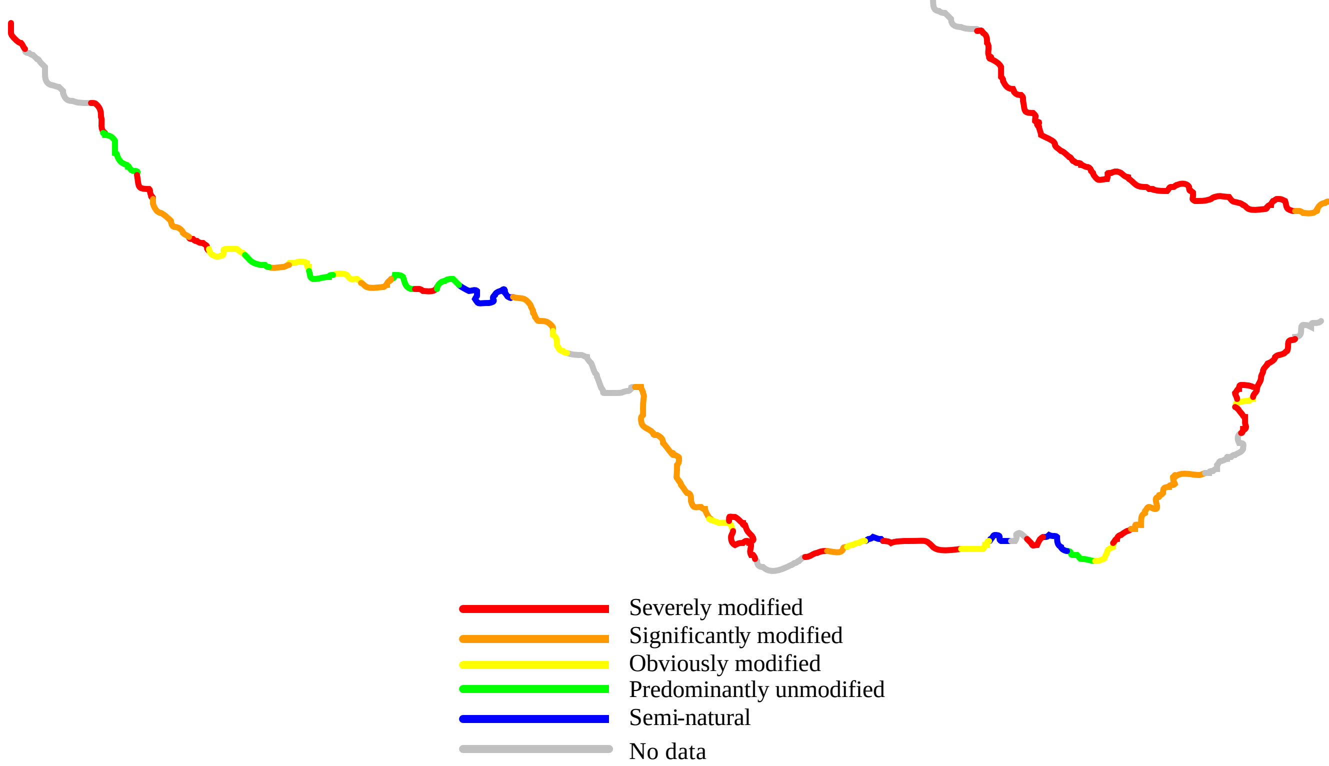


Extensive land uses within 50m of banktop

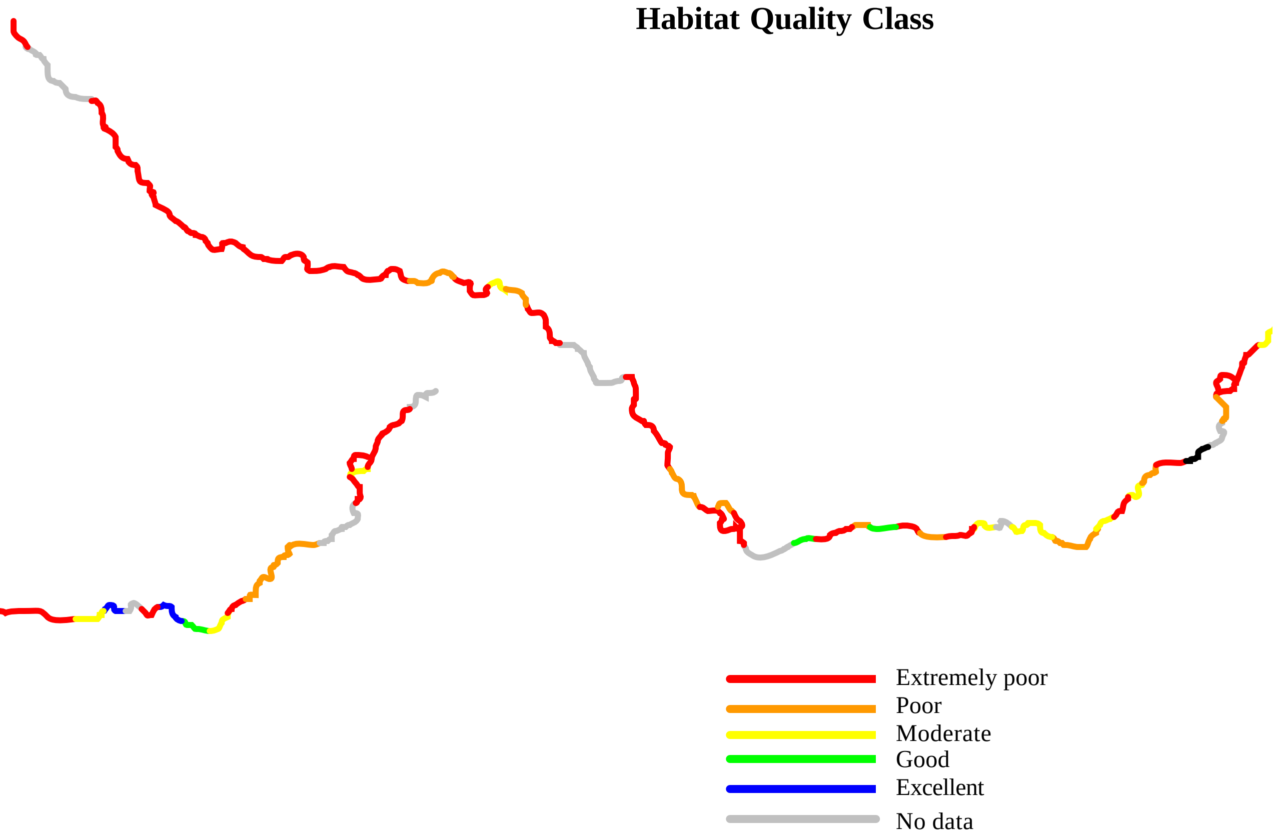


Upper Lee

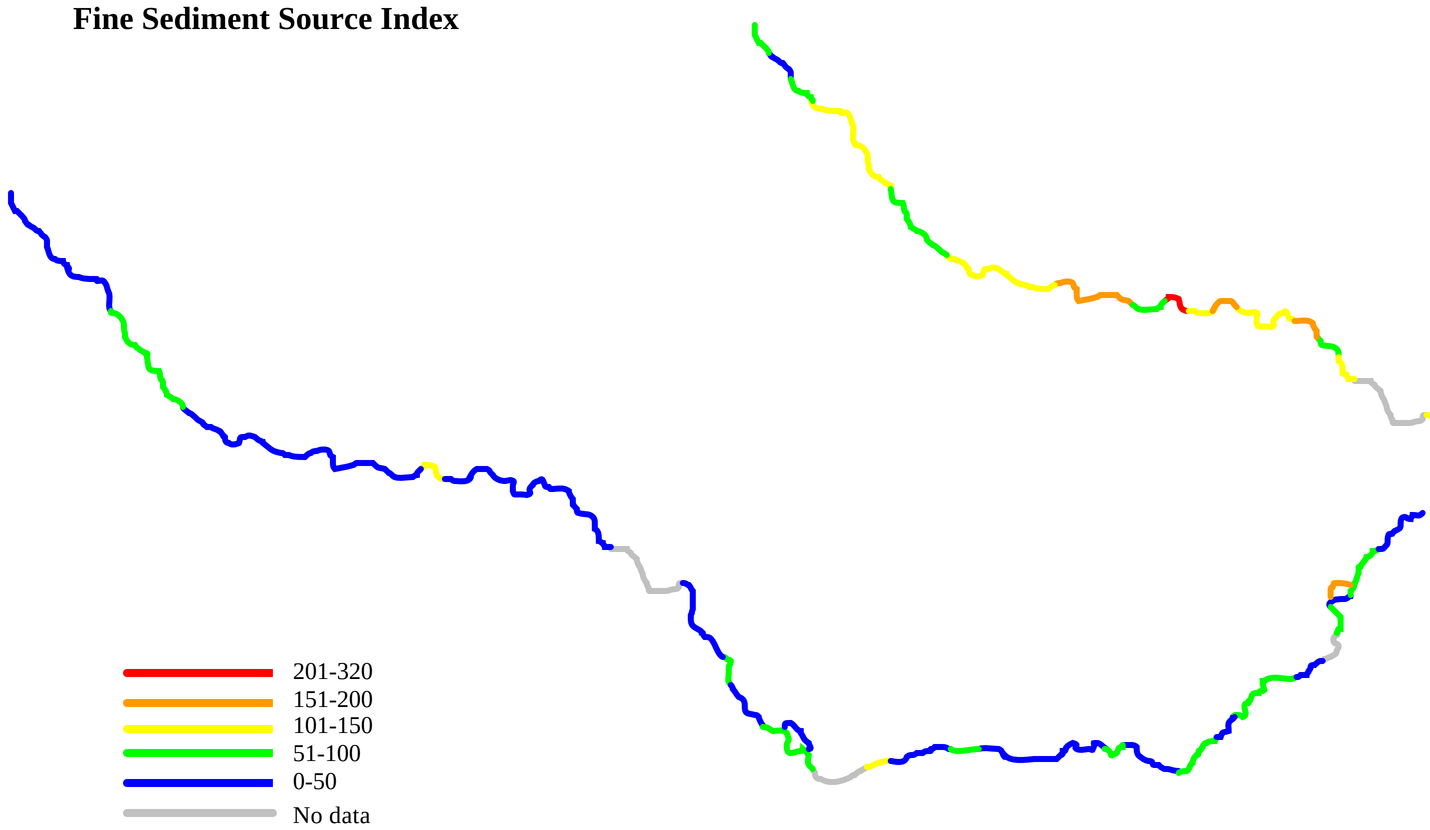
Habitat Modification Class



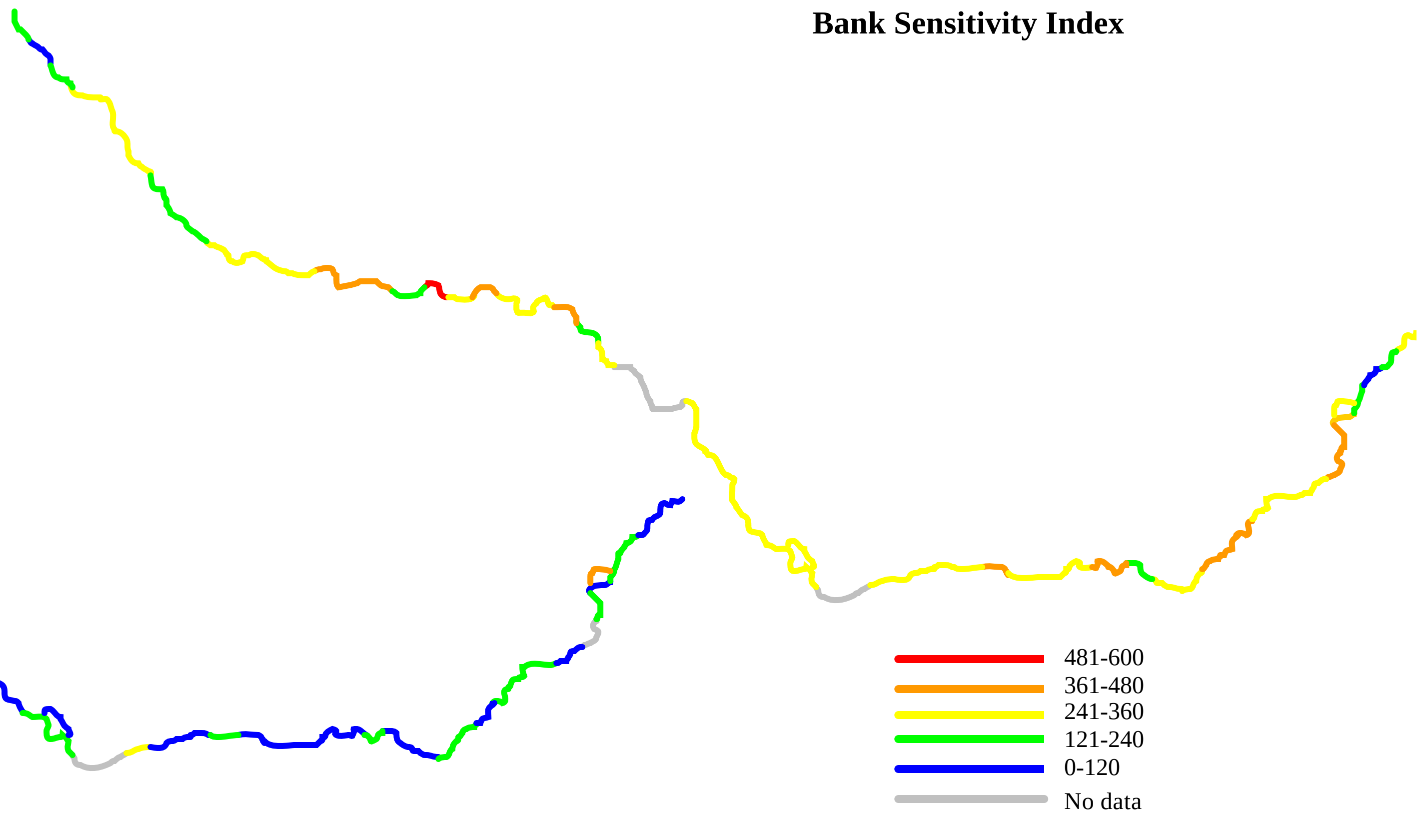
Habitat Quality Class



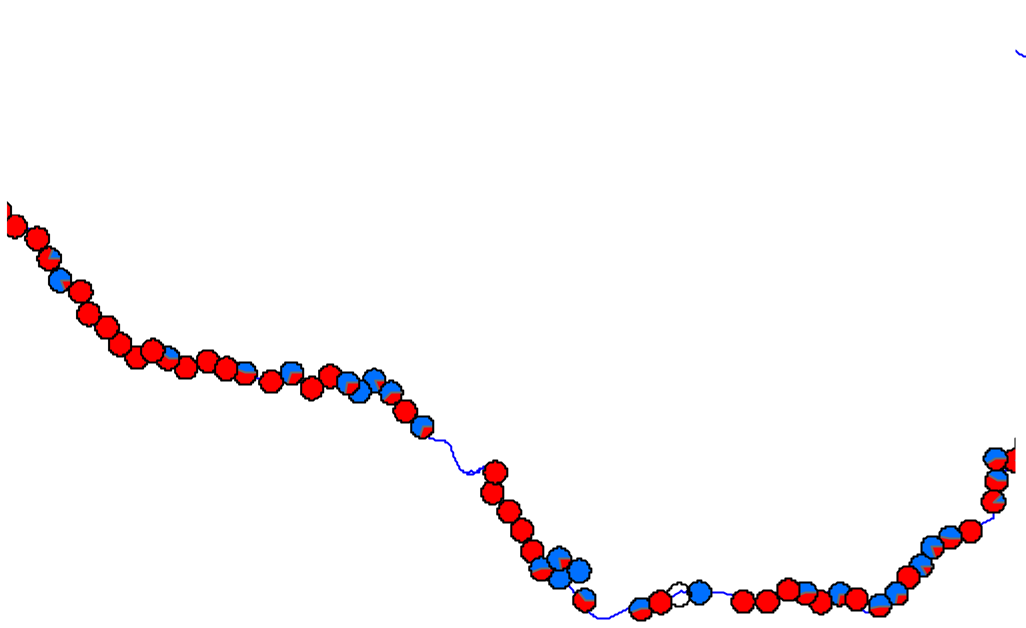
Fine Sediment Source Index



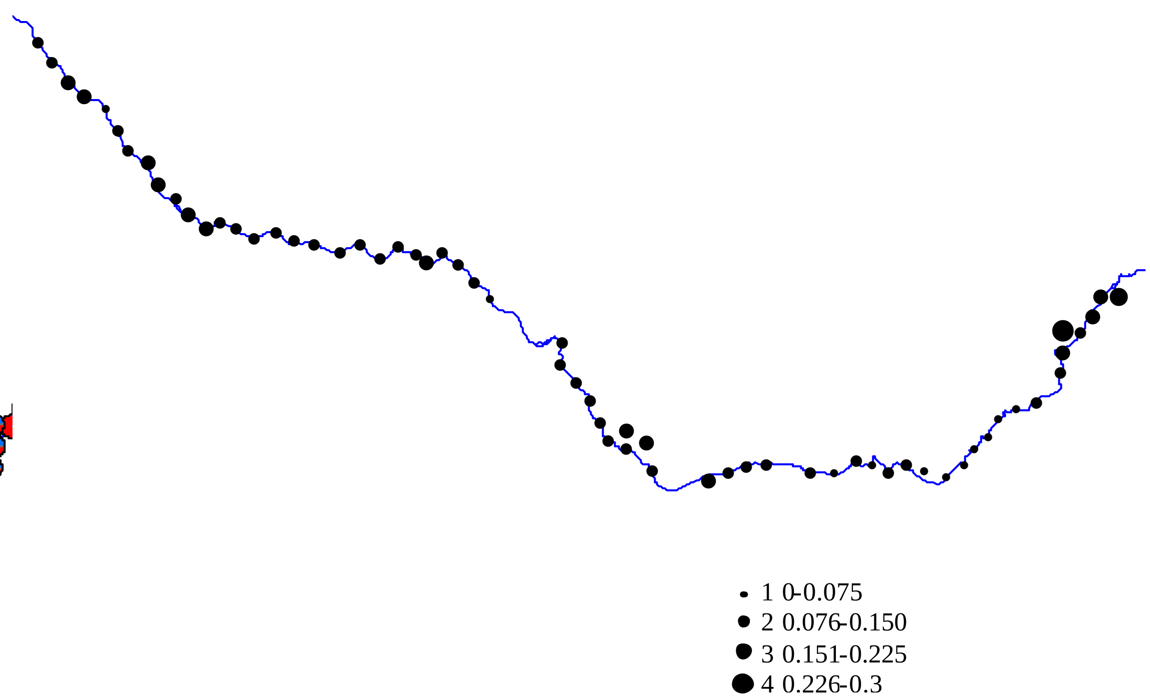
Bank Sensitivity Index



Natural and artificial sources of erosion



Stream Power



Distribution Sheet

To be completed by all Project Leaders producing commissioned research project reports. Please bind a copy of this distribution sheet as the final page in all internal CEH Dorset copies of the report.

1.	Title:	Integrated fisheries, RHS and ecological data model for the River Lee	
	Authors:	Scarlett P. M., O'Hare, M.	
	Project No:	C01019	
	Master copy held by:	P Scarlett	
	Report access code (assign a suitable code from list below):	N	

2.	DISTRIBUTION LIST [A-E standard, F other]	No. copies	Date
A.	Contract customer: Environment Agency (NE Thames Region)	4	Jan 2006
B.	CEH Library Lancaster, 1 digital copy	1	
C.	CEH Dorset Library	1	
D.	Project leader:	1	
E.			
F.			
1.			
2.			
3.			
	Total number of copies made	7	

REPORT ACCESS CODES

S **In strict confidence - restricted access** - Access to named customer(s) - (could be named restricted access individuals), CEH Directorate, Project Leader and all authors.

C **In confidence - restricted access** - Access to customer, CEH Directorate, Project Leader, all authors, and CEH staff with permission of Project Leader.

N **Normal access** - Access to customer and all CEH staff. Access to visitors and general public with permission of Project Leader.

G **General access** - General access to anyone as required.