Catchment Characterisation Survey

Electrofishing Report, Summer 2016

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Author:	Rosie Law – Project Officer	*Rosie Law*
Reviewed by:	David Calvert – Chairman	*David Calvert*
Approved by:	Jodie Mills – Director	*Jodie Mills*

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1   Introduction

1.1   Background

1.1.1   West Cumbria Rivers Trust (WCRT) undertook a second year of catchment characterisation and electrofishing surveys in River Derwent catchment during the summer of 2016. This project is the second year of a long term study to obtain scientific data on fish numbers in the River Derwent catchment and yearly surveys will be carried out as part of WCRT's priority activities. This type of fisheries surveys are ideal for providing information to characterise and provide a general indication of the health of stretches of river and will inform where habitat improvement works are required and elicit future funding to carry out necessary measures.

1.1.2   The River Derwent is designated as a SSSI and SAC with Atlantic Salmon making up one of the key species for this designation. Other species included in this are brook lamprey, river lamprey and otters.

1.1.3   The Environment Agency (EA) is the statutory body responsible for fish, rivers and the environment in general and their fisheries monitoring programme provides comprehensive coverage of the catchment at a level appropriate to current legislative responsibilities. Monitoring by the EA has however been greatly reduced due to funding cuts and WCRT aims to share all the results, experience and knowledge from this project with them and interested parties. WCRT had also designed its programme to complement, rather than duplicate, the EA's programme and collaboration will take place to deliver many aspects of this work.

1.1.4   The project has been funded by a variety of sources including the Rivers Corridor Group, Derwent Owners Association, the EA, plus fishing organisations from Cockermouth and Keswick.

1.2   Project Objectives

1.2.1   This project aims to determine the state of the Derwent Catchment with science based evidence along with investigating the effectiveness of habitat improvement work that has been completed or is planned for the future. This will be informed by assessing the status and distribution of the juvenile salmonid population, namely salmon (*Salmo salar*) and Trout (*Salmo trutta*) fry - aged at less than one year.

1.2.1   The project objectives which were set out in the Project Plan were to undertake the following:

- Collect, analyse and record data for juvenile salmonid fry populations (and other fish species) to determine their distribution within the Derwent catchment at approximately 130 sites during the summer of 2016 (following the floods of December 2015)

- Use the data collected to characterise the habitat in the catchment to determine what habitat improvements could be done to encourage greater fish numbers. This will be split into the categories of '*maintain*' the current habitat, '*repair*' the existing habitat to enhance its future survival and '*restore*' the river to having appropriate habitat where this is currently missing.

- Work in collaboration with the EA to calibrate the different survey methods used in order to ensure wider application of the results and to enable the River Derwent results to be categorised using the National Fisheries Classification Scheme.

2   Methodology

2.1   Survey Method

2.1.1   Licences were applied for and granted by the Fish Movements Team within the EA to carry out surveys and fish rescues within the Derwent Catchment over the summer of 2016.

2.1.2   Volunteers were recruited from a variety of sources including local fishing clubs, local secondary education institutions, University students and any other interested parties.

2.1.3   Suitable sites were identified and land custodian consent was asked for permission to access the river and carry out the surveys at each of these sites. A risk assessment of each site was compiled with safe parking and safe river access points noted, along with land custodian contact details for use by the survey team.

2.1.4   A standard semi-quantitative fish survey method was followed using a back pack electro fishing set. A five minute time period is programmed into the kit which only times when the electric pulse is being used. All fish species captured in the survey were then identified and recorded with the size of salmonid varieties also recorded. Salmonid fry were identified from parr following the method of Scottish Fisheries Co-ordination Centre, (2007) whereby the frequency of each fish length in discrete areas were plotted as histograms and the point where the distribution bell curves intersect is the cut-off point between fry and parr for Salmon and Trout individually.

2.1.5   In 2016 the WCRT team also worked with the EA to carry out calibration at 26 sites. This involved fully quantitative surveys which are area based to calculate the number of fish per 100m^2, which is the nationally used unit and allows comparison with the data collected by other researchers. To do a fully quantitative survey, a 100m^2 stretch of river is netted off at both ends and the whole area is fished multiple times (usually three) until no fish remain and the total number of fish per 100m^2 is discovered.

2.1.6   Habitat survey data were collected for each site and included: type of channel substrate (boulders, cobbles, gravel, silt etc.), occurrence of plant life, and large wooded debris (LWD). For each bankside, details of erosion and damage, fencing, vegetation, and adjacent land use were also recorded along with any signs of invasive species. Other details such as potential pollution sources, human activity in the river and signs of terrestrial species such as otter were also recorded. All the habitat survey data were scored, with a weighted scoring system to give an overall habitat condition for each site surveyed. Then additional in house knowledge of each tributaries overall condition and potential for habitat improvements was added to the site score to determine an overall tributary habitat score.

2.1.7   Data analysis consisted of statistically assigning the recorded fish densities to the national fisheries classification scheme (NFCS) using the calibration results obtained from working with the EA. The results from 2015 were also converted into density per 100m^2 to allow comparison with other areas in the country and also in an attempt to understand the effects of storm Desmond in December 2015. (Please note that a direct comparison of sites is not statistically robust as fish densities are extremely variable in space and time, and multiple years' worth of data are required to build up a picture of trends in fish density) The NFCS has classifications ranging from A to F as shown in Figure 1.
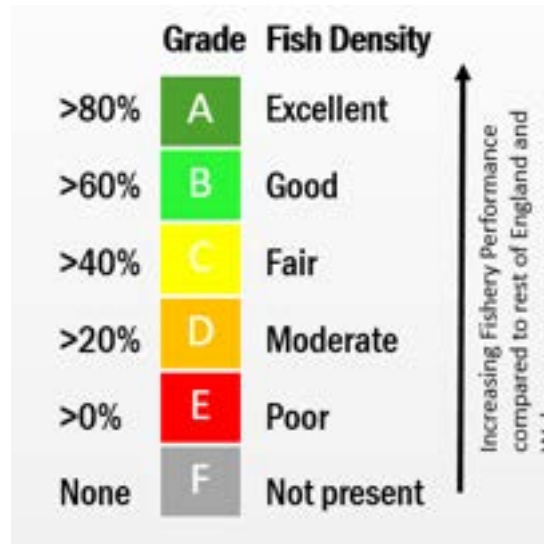
Figure 1. NFCS grades from A (the top 20% of fisheries performance in England and Wales) to E (the bottom 20% of fisheries performance in England and Wales), with F as no fish present.

2.1.8   All of the data collected were plotted using Geographical Information System (GIS) software to provide maps of the distribution of survey results.

2.2   Survey Locations

2.2.1   The survey sites were all within the River Derwent Catchment. The majority of tributaries were surveyed, access permitting, usually with multiple sites per tributary. All of the tributaries from the 2015 survey were repeated with additional locations included in the 2016 survey.

2.2.2   In 2016 a new approach was trailed for main river sites. This involved locating areas of the main Rivers Derwent and Cocker where it was shallow enough to use the backpack in order to estimate the fry distributions there.

2.2.3   The EA carried out additional surveys on Helvellyn Gill which have also been included in one of the maps in this report.

2.3   Survey timings

2.3.1   Surveys were undertaken between August and September 2016 when the salmonid fry were of a reasonable size to capture without damage.

3 Results

3.1 Summary

3.1.1   138 sites were surveyed by WCRT in the River Derwent Catchment during the summer of 2016 using a semi quantitative method. 26 of these sites were also calibrated with the EA by completing fully quantitative, area based surveys. An additional 10 sites on Helvellyn Gill were surveyed by the EA.

3.1.2   All fish numbers in 2016 were lower than in the summer of 2015 likely due to the effects of Storm Desmond. Notwithstanding the storm many sites still had salmonids present.

3.1.3   There were only two sites where no fish of any species were found, one of these is known to have historic mine pollution (Coledale beck) and the other was above a large barrier (Mill Beck). Brokkle Beck which drastically altered course due to the storms in December 2015 and has been allowed to remain in its new course, was already home to a large number of stoneloach (109 per 100m^2) and minnow (64 per 100m^2) by the summer of 2016.

3.1.4   In total 1165 salmonids were caught in the summer 2016 surveys, 911 of these were fry with approximately equal numbers of Trout and salmon overall (451 and 461 respectively).

3.1.5   61 sites or 44% of those surveyed had salmon fry present, whilst 92 sites or 67% of those surveyed had Trout present.

3.2 National Fisheries Classification Scheme

3.2.1   The calibration of semi quantitative five minute surveys to the EA's fully quantitative area based surveys involved plotting the five minute surveys on a graph against the fully quantitative surveys and using the resulting trend lines to give the following equations which had randomly distributed residuals:

Table 1. Calibration trend lines with coefficients of determination which can be used to convert numbers of fish per 5 minute survey to number of fish per 100m^2.

	Calibration trend line	Coefficient of determination (r^2)
Trout	Y = 3.8712 x - 1.7945	0.6137
Salmon	Y = 3.0923 x - 05313	0.6326

3.2.2   Using the equations in Table 1, the number of fish per 100m^2 could be calculated and therefore the NFCS could be used to classify fry numbers in the River Derwent for both the 2016 results (Table 2 and Figure 3) but also to convert the 2015 results (Table 2 and Figure 2).

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Table 2. Number of sites within the River Derwent catchment in each category of the National Fisheries Classification Scheme for both 2015 and 2016, including ten sites surveyed by the EA.

Classification	Trout		Salmon	
	2015	2016	2015	2016
A	25	15	4	4
B	24	29	7	3
C	15	12	10	16
D	10	22	8	22
E	6	22	7	23
F	9	48	53	80
Total	89	148	89	148

3.2.3   Figure 4 shows only the 2016 results which were in categories A, B and C, or the top 60% of fisheries in England and Wales according to the NFCS. This includes 49 sites for Trout and 19 sites for Salmon. Conversely Figure 5 shows the 2016 results which were in categories D, E and F, or the lower 40% of fisheries in England and Wales.

3.2.4   Figures 6 to 11 show the NFCS results for both Trout and Salmon broken down by tributary area for more clarity.

3.2.5   In 2016 the EA were only able to survey 10 sites on Helvellyn Gill in addition to the 25 sites which they calibrated with WCRT due to time constraints. The results for the September survey on Helvellyn Gill are shown in Figure 12 and the number of sites in each category have been added to Table 2.

3.3   Main river sites

3.3.1   Figure 13 shows only the main river sites which was a novel approach for the 2017 surveys. The results show that Trout were not present in high numbers, with 10 of the 13 sites having no Trout fry present. Salmon fry numbers however, were higher, with only 7 of the 13 sites having no Salmon fry present, whilst 7 sites (over half of the main rivers sites surveyed) were in the top 60% of Salmon fisheries in England and Wales according to the NFCS.

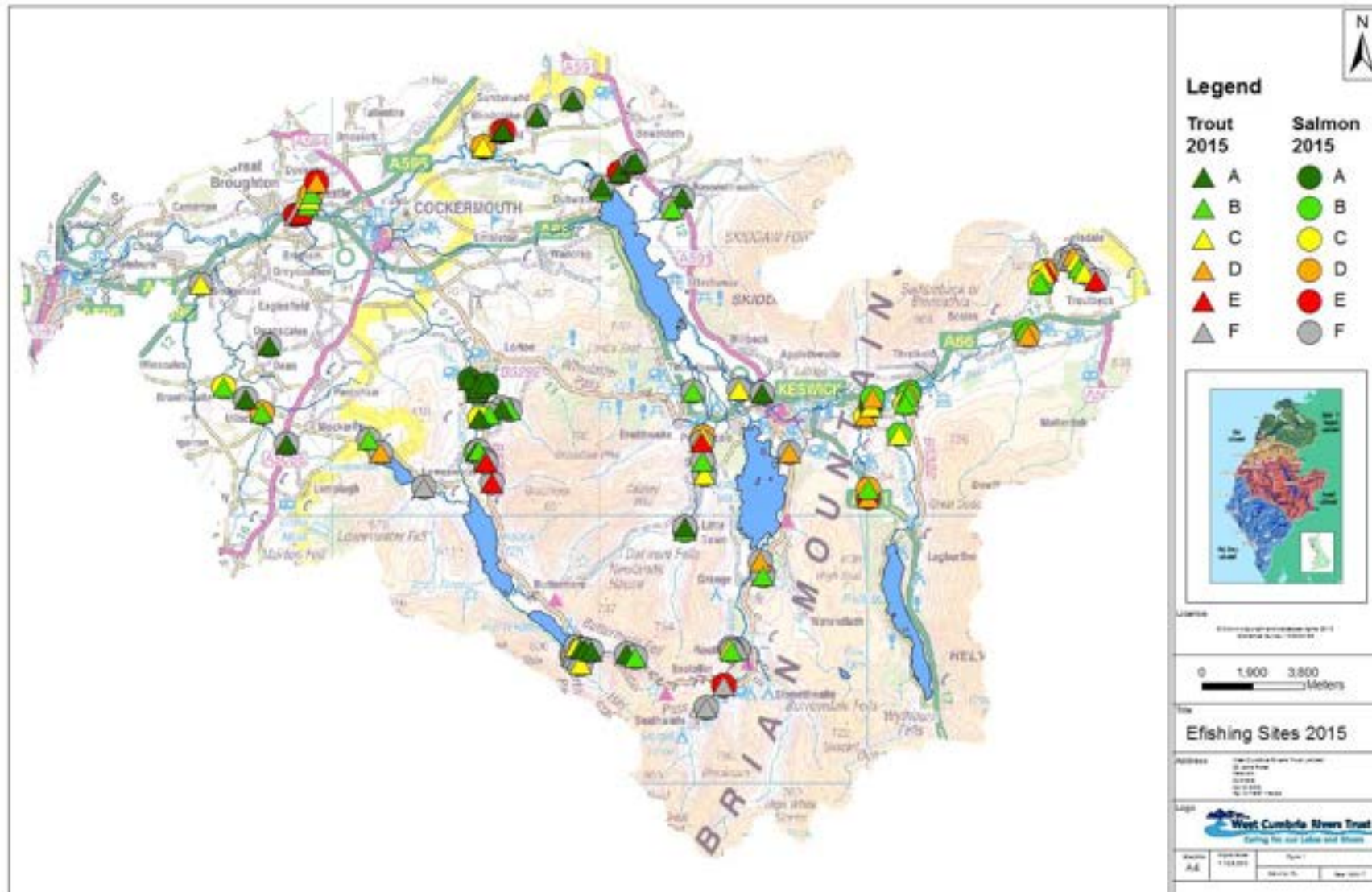*Figure 2*. 2015 Results converted into NFCS
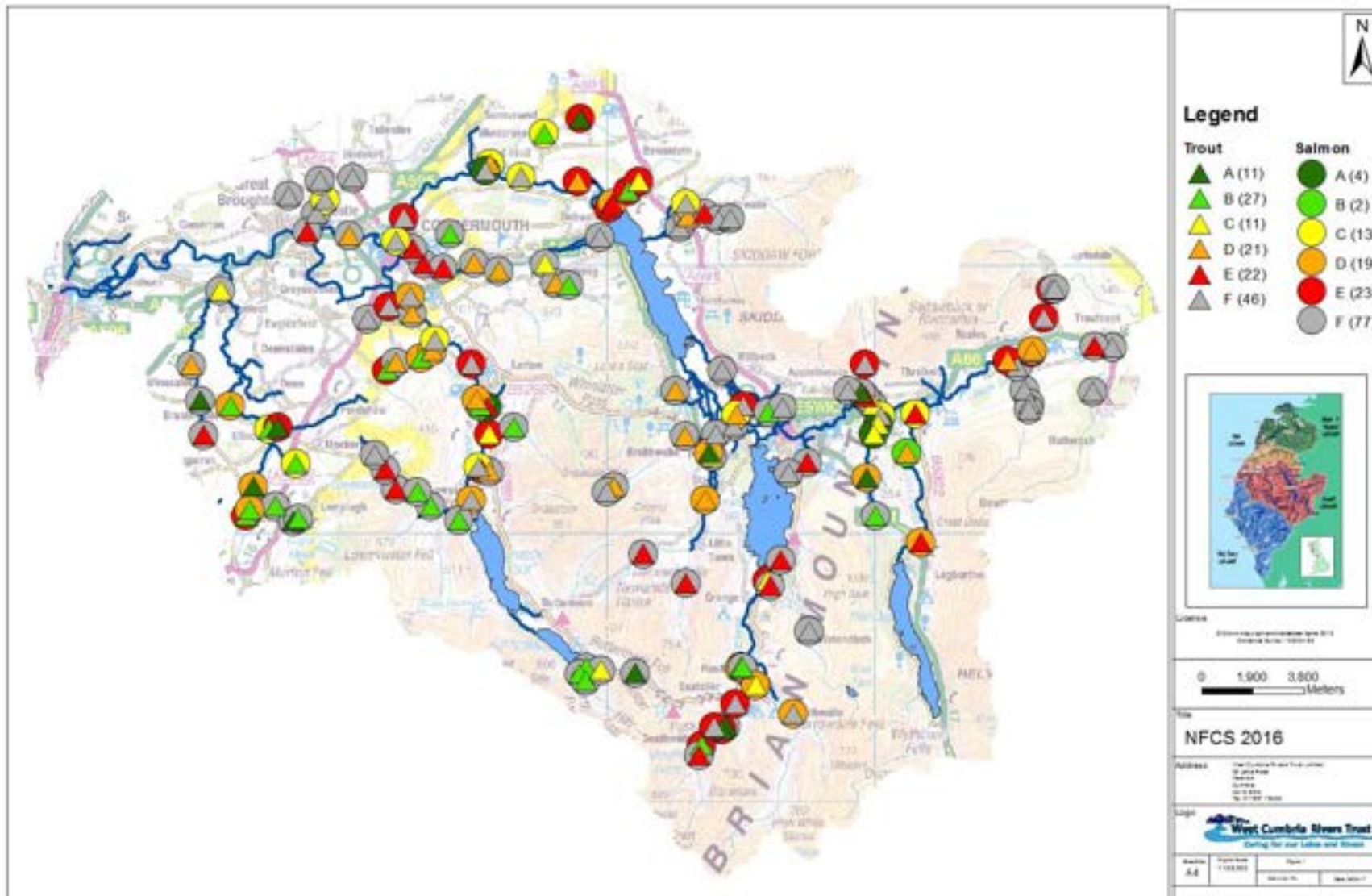
Figure 3. 2016 NFCS results

Figure 4. 2016 results showing all the scores in the river Derwent which are within the top 60% compared to the rest of England and Wales.
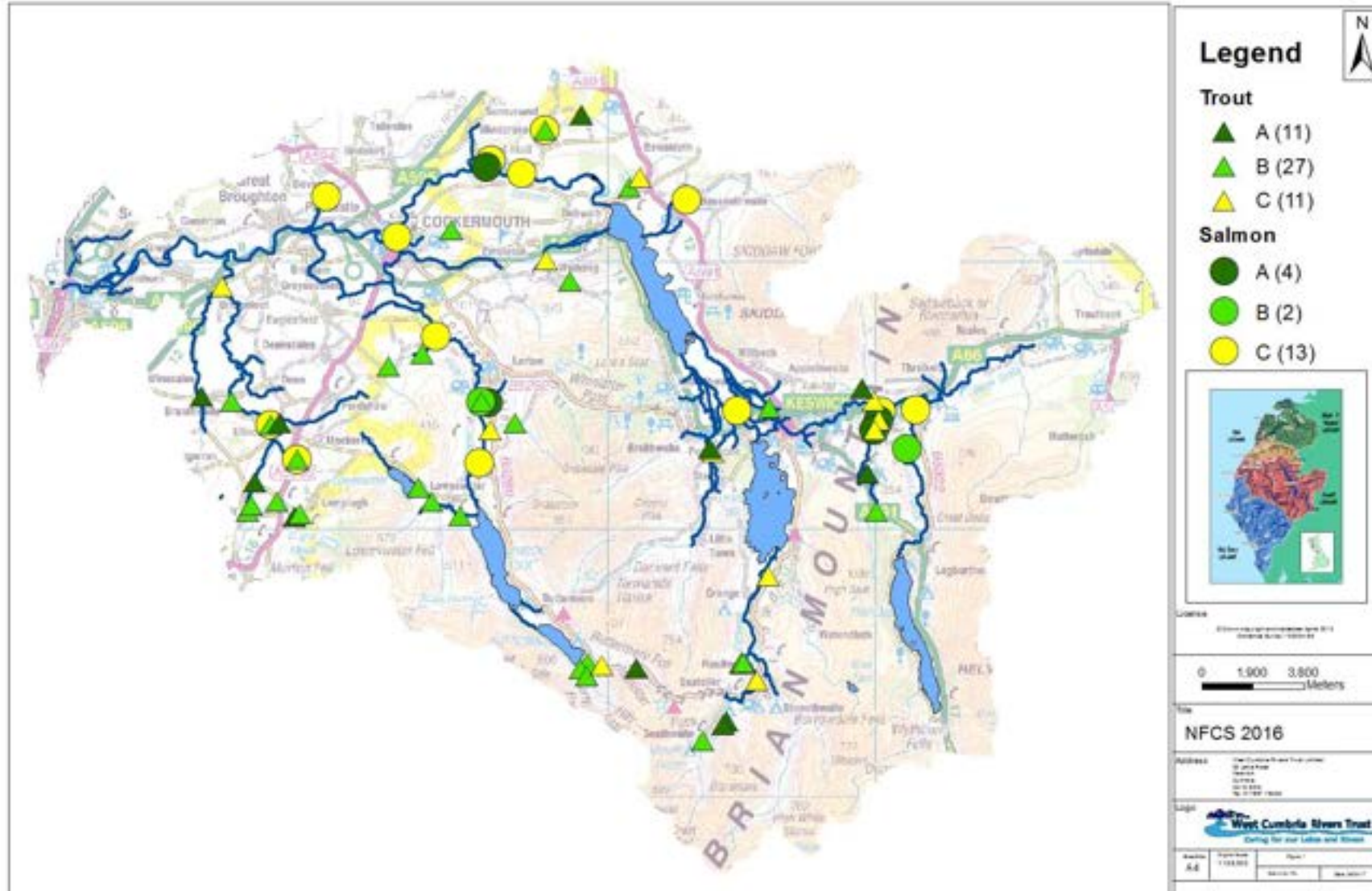
Figure 5. 2016 results showing all the scores in the river Derwent which are within the lowest 40% compared to the rest of England and Wales
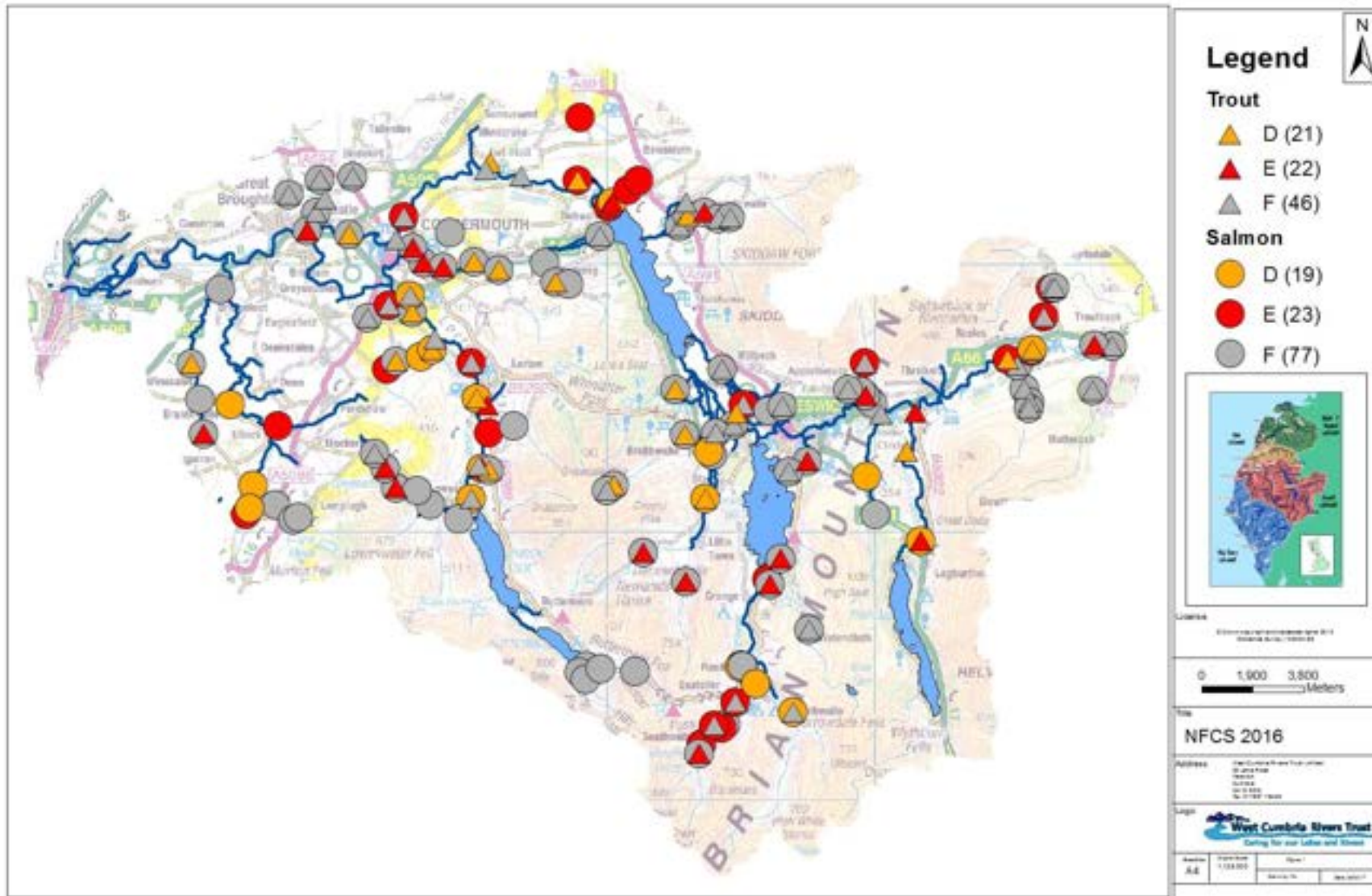
Figure 6. NFCS 2016 Marron Catchment

Figure 7. NFCS 2016 Cockermouth Tributaries

Figure 8. NFCS 2016 Lorton Valley
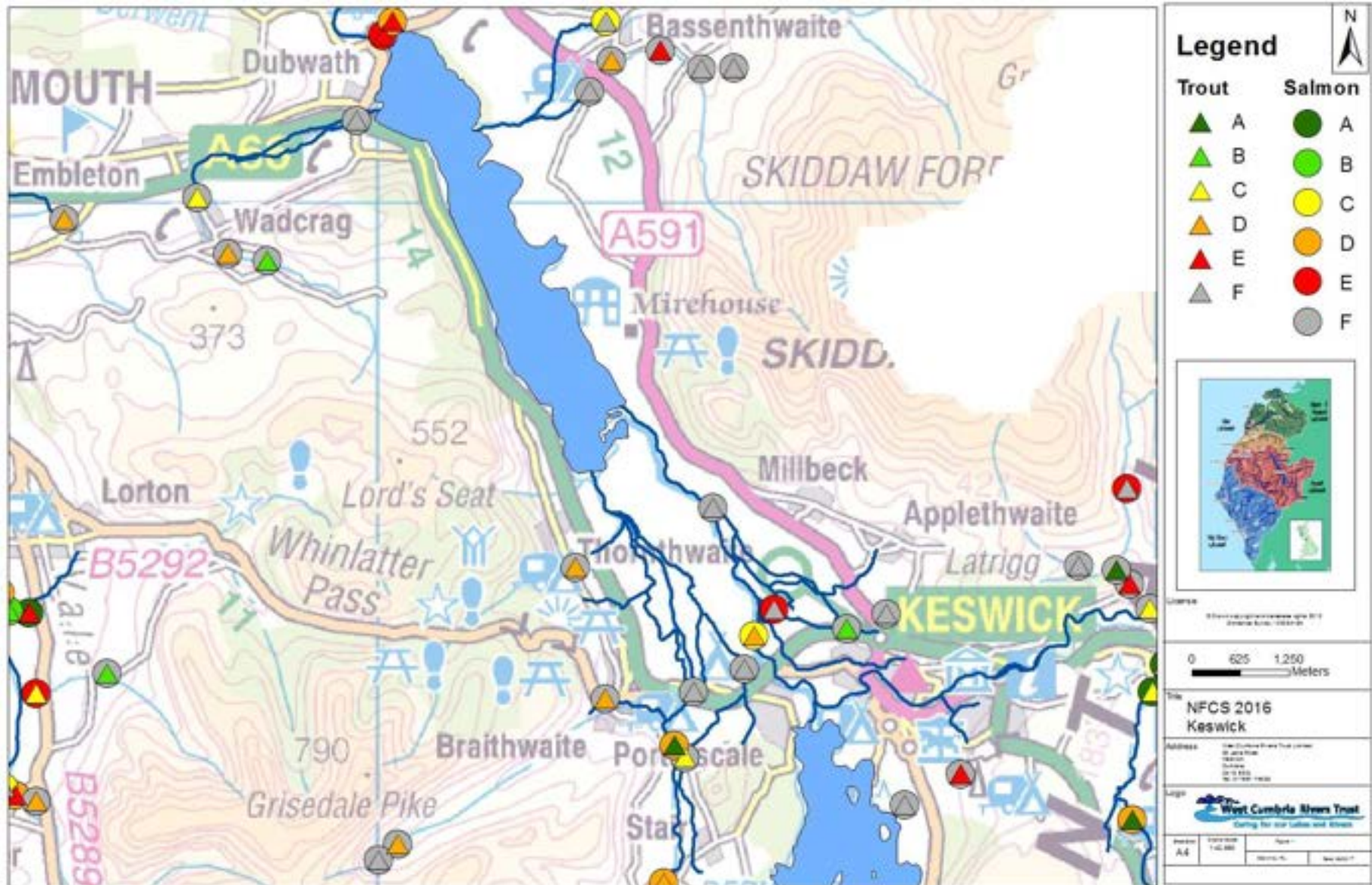
Figure 9. NFCS 2016 Keswick area

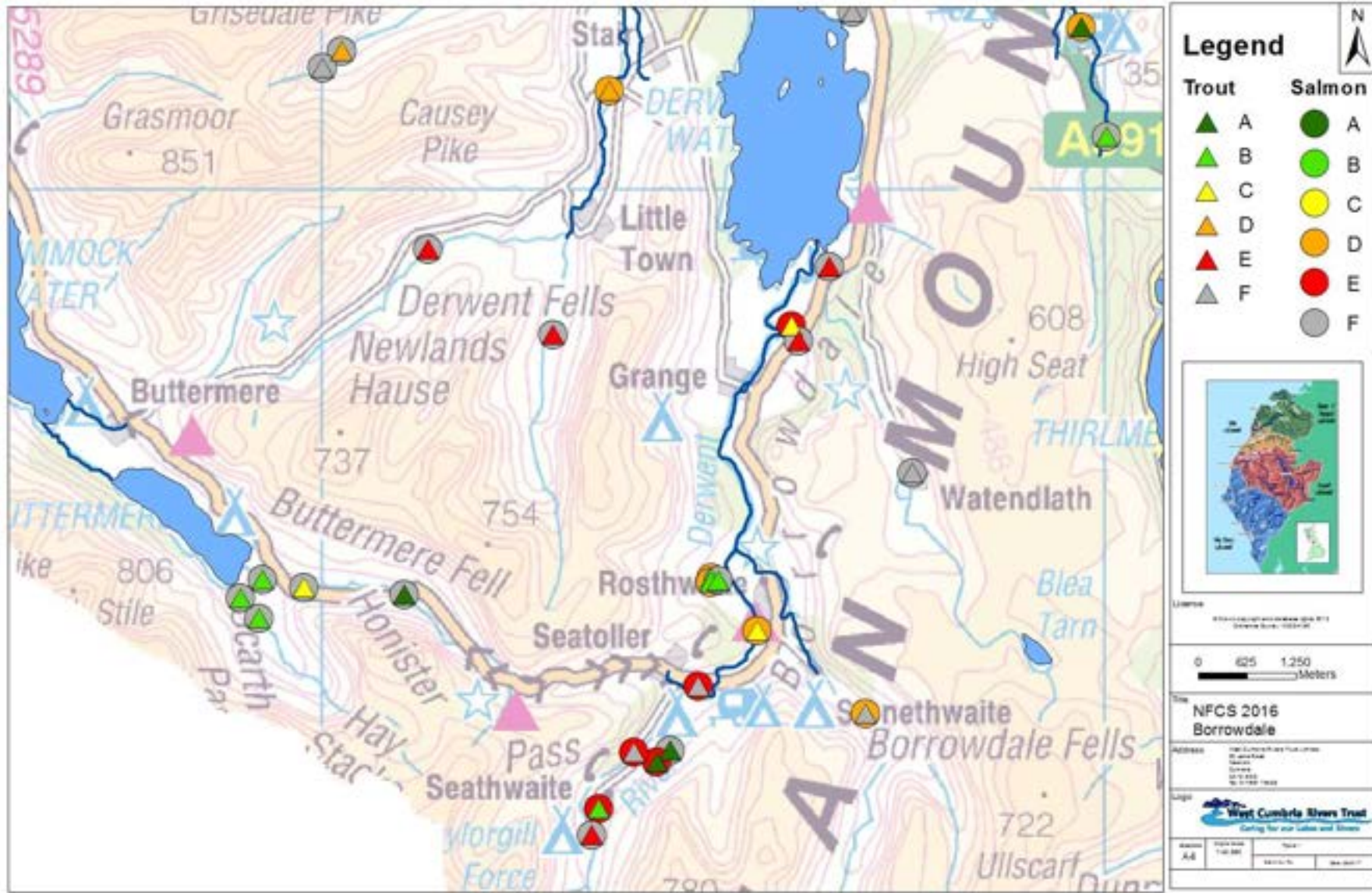*Figure 10.* NFCS 2016 Borrowdale area

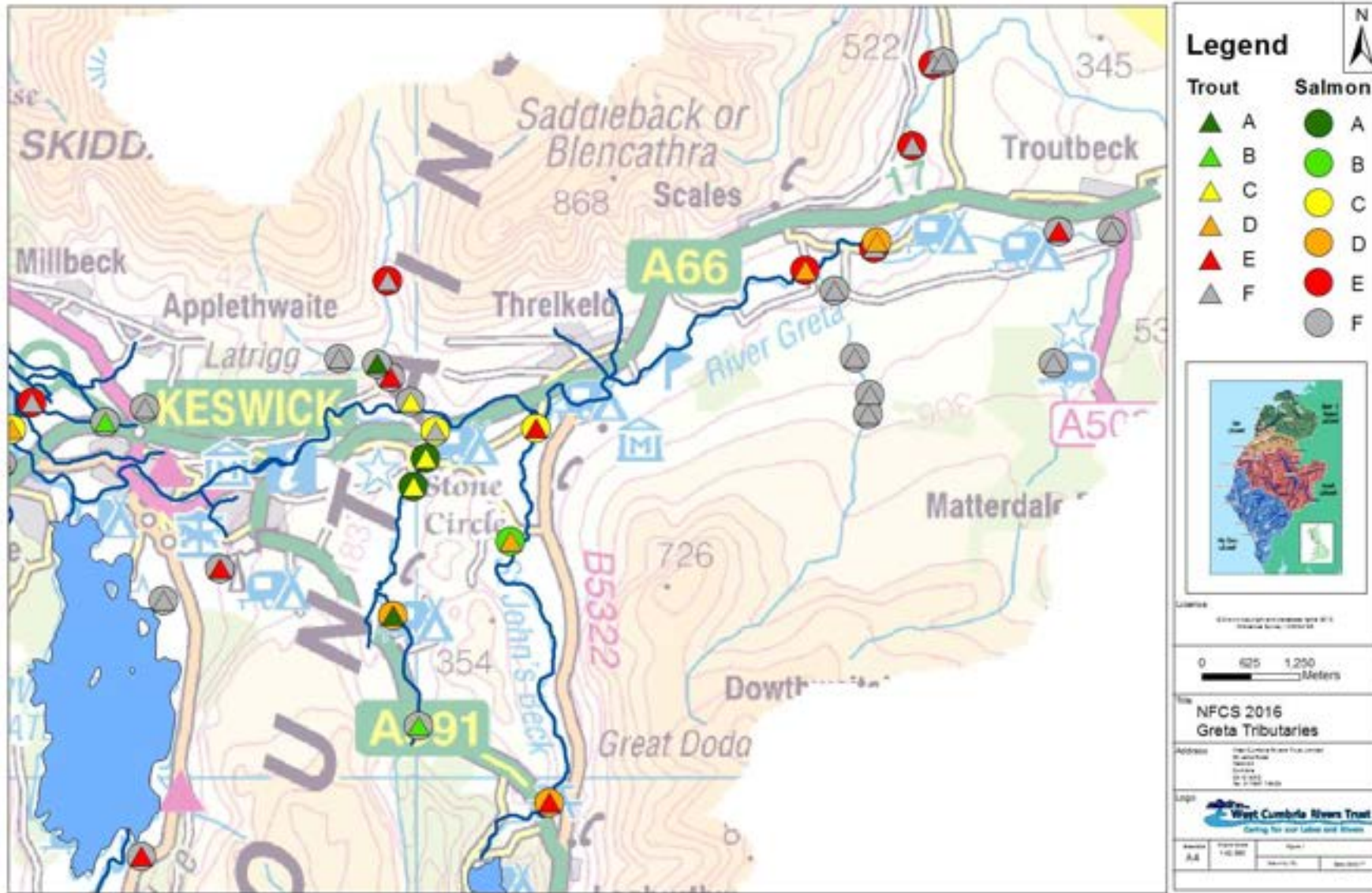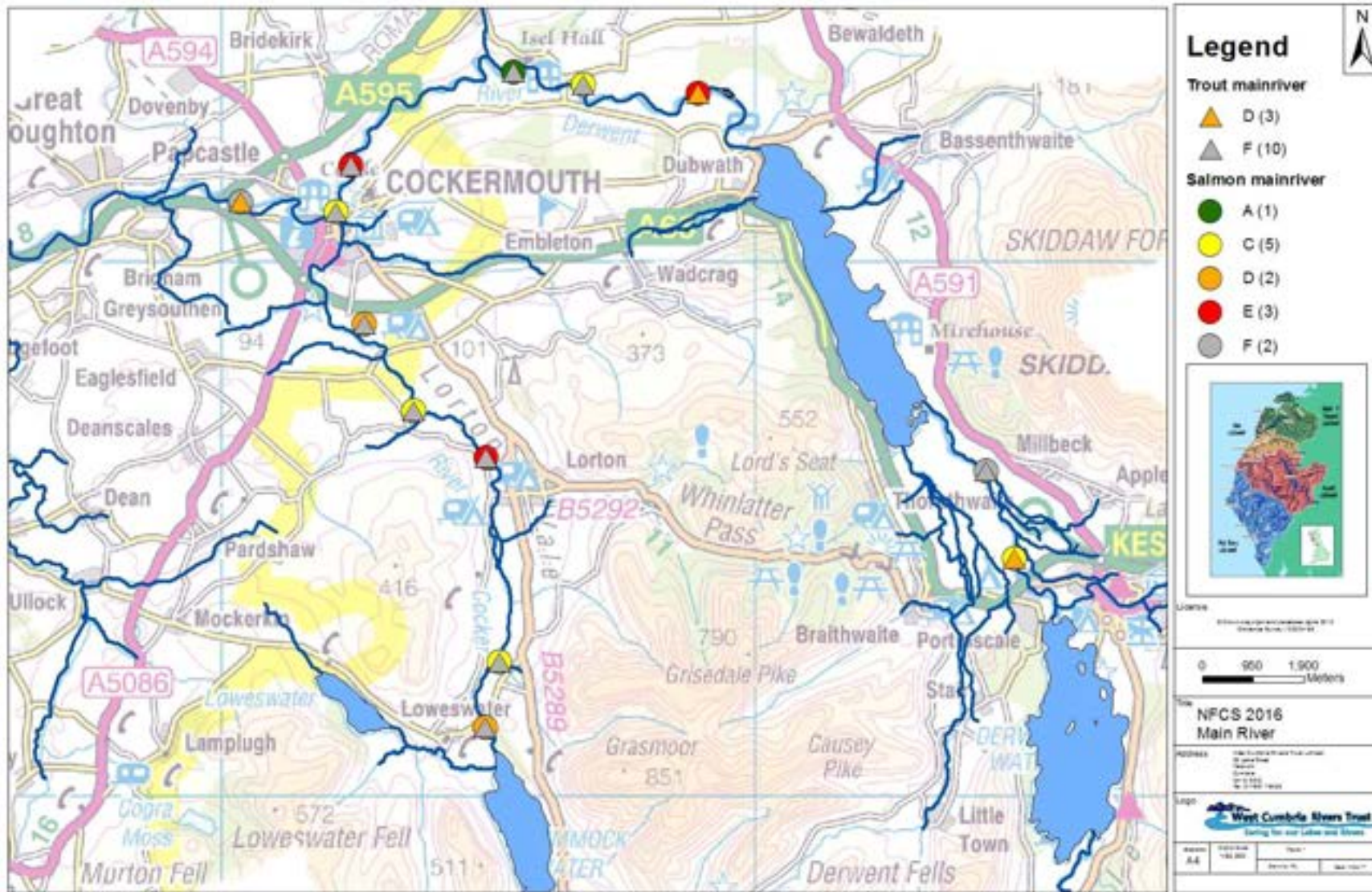Figure 11. NFCS 2016 Greta tributaries

Figure 12. NFCS 2016 EA sites on Helvellyn Gill

Figure 13. NFCS 2016 Main River Sites

3.4   Habitat characterisation

3.4.1   The survey sites were scored using a weighted scoring system, with higher scores meaning better habitat for fish. For example the highest scoring sites had large riparian width, dappled shade, and no stock access, gravel provision with minimal silt, no barriers, no invasive species, and large wooded debris provision.

3.4.2   These scores where then split into three categories which were defined as requiring the following levels of work to provide the best habitat for fish;

- **Maintain** - limited small scale work required such as insertion of large woody debris or tree maintenance (for example, Figure 14)

- **Repair** - modest work such as fencing off buffer strips, provision of new gravels, willow spiling and tree planting (for example, Figure 15),

- **Restore** - major restoration works such as re-routing the channel required (for example, Figure 16).

3.5   Site Habitat Scores

3.5.1   Out of the 138 sites 52 were classed as Maintain, 65 as Repair, and 21 as Restore, (Figure 17) however this only represents the small area observed directly at the survey sites (approximately 10-20 metres in size).

Figure 14. An example of a survey site classified as Maintain, with dappled shade, gravel provision, minimal silt and a fenced riparian strip.

Figure 15. An example of a survey site classified as Repair, which currently has erosion problems caused by livestock access, but could easily be repaired with fencing and willow spiling or tree planting.

Figure 16. An example of a survey site classified as Restore, which has a major siltation problem, invasive species such as Himalayan Balsam present, no shade from trees and minimal riparian fencing for livestock.

3.6   Tributary Habitat Scores

3.6.1   The overall tributary habitat scores which incorporated the individual site scores and in house knowledge of each tributary are shown in Figure 18. Out of the 45 tributaries surveyed 9 were classed as Maintain (21%), 32 as Repair (71%), and 4 as Restore (8%). The main rivers were more complicated to categorise, however overall it was considered that the main River Derwent should be classified as Repair. The main River Cocker was split into Maintain at the source, Restore in the middle and Repair further downstream. The notes which helped to decide the tributary habitat score are shown in appendix 1.

Figure 17. Site habitat score 2016.

Figure 18. Tributary habitat scores 2016.

3.7 Invasive non-native species (INNS)

3.7.1 As part of the habitat surveys the presence of INNS on each river bank was one of the criteria checked. There were two sightings of Japanese Knotweed, which were treated within a few weeks of the survey and the rest were all the presence of Himalayan Balsam. Figure 19 shows the distribution of INNS within the River Derwent Catchment. 47 out of 138 sites had INNS present on the left river banks and 48 sites had INNS present on the right river bank. Most of the INNS seen were located in the lower catchment.

3.8 Substrate

3.8.1 Another criterion in the habitat survey was the percentage of the river substrate made up of boulders, cobbles, gravel, sand and silt. Figure 20 shows the survey sites as the proportion of gravel and silt present in the substrate Gravel is the substrate required for successful salmonid spawning. 95 out of the 138 sites had more than 30% of the substrate made up of gravel, however 10 sites had less than 10% of the substrate made up of gravel. Silt usually prevents successful salmonid reproduction and Figure 20 also shows that 69 out of the 138 sites had no silt present, whilst 13 sites had more than 20% of the total substrate made up of silt.
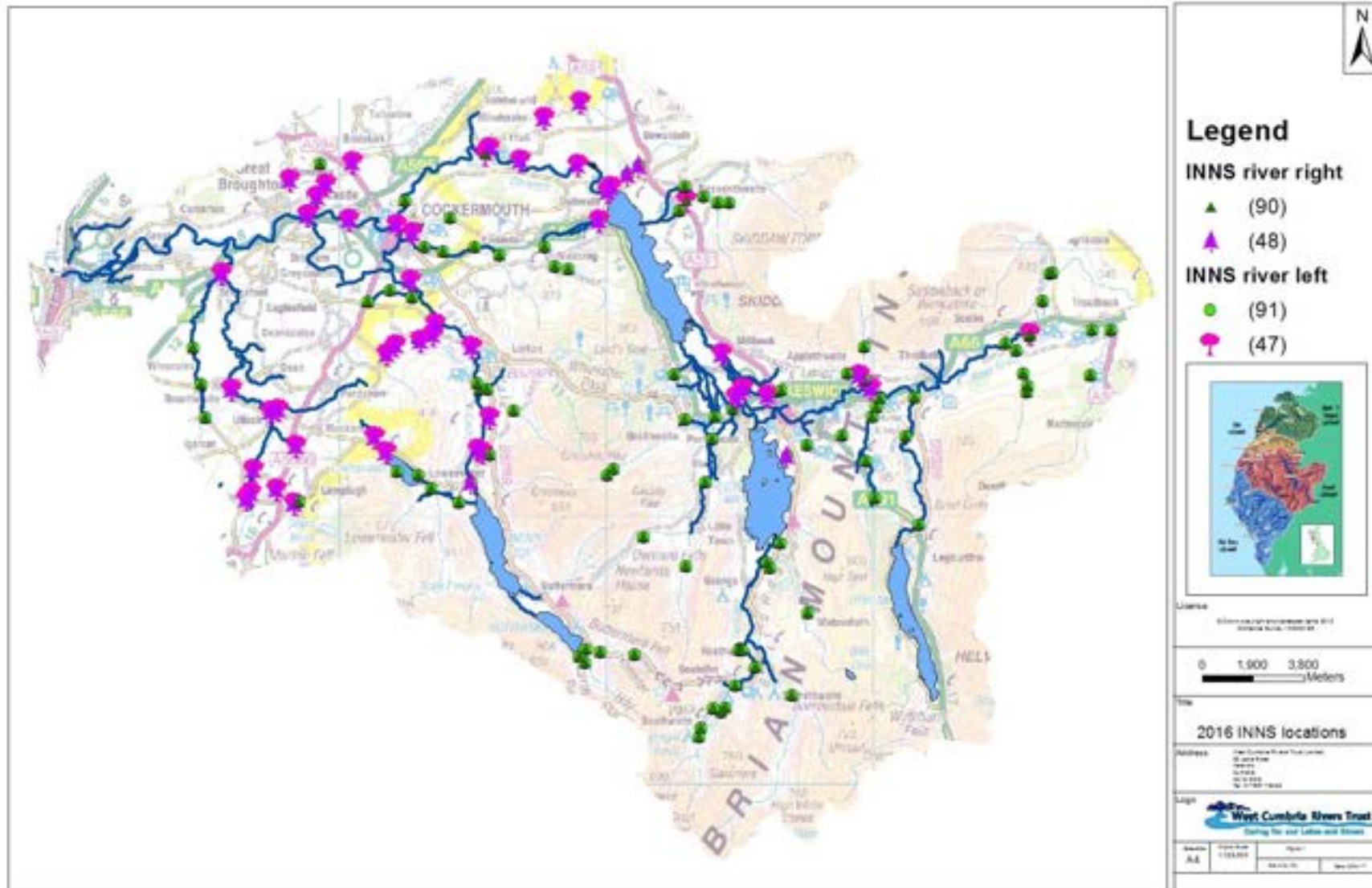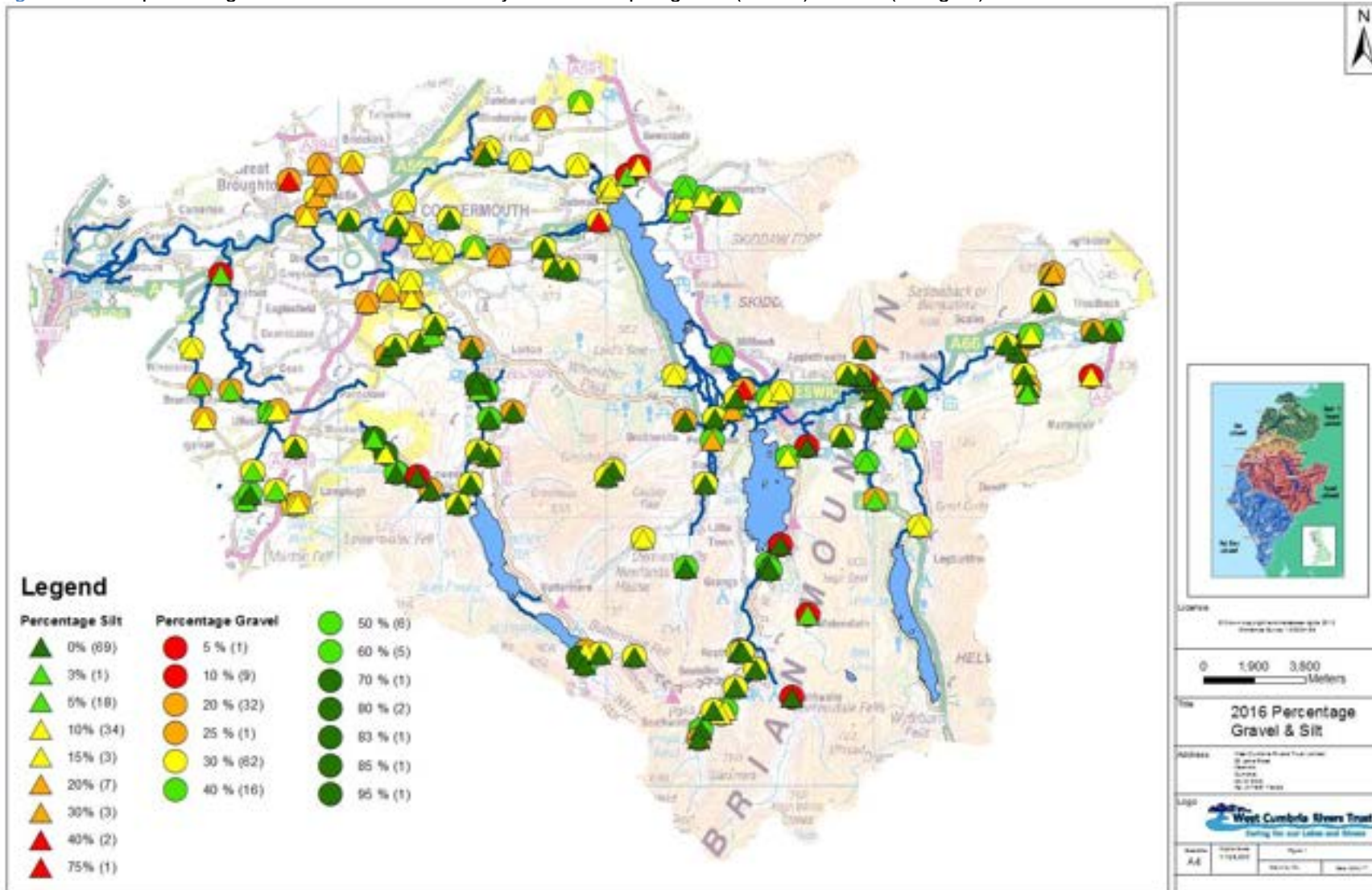
Figure 19. Presence of INNS at survey sites

Figure 20. The percentage of substrate at each survey site made up of gravel (circles) and silt (triangles)

4   Summary

4.1   Findings from 2016 salmonid numbers

4.1.1   Whilst the overall fish numbers were lower in 2016 than the 2015 surveys, most likely as a result of the severe floods in December 2015, a remarkable number of salmonid fry have survived.

4.1.2   A lot of the sites with low fry numbers in the 2016 surveys, still had parr present, which suggests that the floods in 2015 had greatest effect on redds whilst some fish were able to find shelter from the flood waters.

4.1.3   This is the second year of surveying juvenile salmonids in the River Derwent catchment so whilst the results cannot yet be used to detect trends, a database is being built using the results.

4.1.4   Following the calibration of WCRT surveys with those of the EA, the results produced from the River Derwent can be compared to those in the rest of England and Wales which have also used the NFCS. In proceeding years this will enable general trends in salmonid populations to be understood from a country wide perspective rather than just comparisons within the catchment.

4.1.5   The few main river sites surveyed have generally shown relatively high fry numbers, and have shown that this method is possible, although it is not necessarily representative of the entire main river as the site selection had the constraints of access and deep water.

4.1.6   Whilst these surveys are primarily to determine juvenile salmonid populations it is important not to ignore other fish species present in the surveys. Other species can be good indicators of potential problems in the river system which salmonids are more sensitive to. For example some sites which had low or no salmonids present had large numbers of Stoneloach, this species is out competed by salmonids but feeds on similar food and requires gravel for spawning in a similar manner to salmonids, however it is more resilient to siltation than Salmon and Trout and so indicates that by reducing silt in these areas salmonids would benefit.

4.2   Findings from 2016 habitat surveys

4.2.1   With more sites surveyed in 2016 a greater database of habitat conditions has been built. This database will then be used to inform areas where habitat work would provide the greatest benefit for fish populations. Also considered in the tributary habitat scorings was the feasibility of doing the required habitat work, so that any potentially improvements undertaken have the best chance of being successful.

4.2.2   It was noted that sites with greater fish densities reflect the sections of river with good habitat and with room for flood waters to spread out across the flood plain and therefore reduce redd washout. In areas where the river has been modified, with built embankments, to flow down an over straight channel, the effects of fast flood flows appears to have reduced the survival of juvenile salmonids.

4.2.3   In order to test the effectiveness of previous habitat work, and any undertaken as a result of these surveys, it is essential that any habitat work completed is recorded. To be most useful this data would include the exact location with a grid reference, GPS tagged photographs, a description of the work and when it was completed. This would enable the choosing of future survey sites to incorporate known habitat work and to build up a database of the most effective techniques employed and the timescales required for habitat work to be effective. Other sites without habitat improvements would still have to be surveyed in order to provide a contrast to those where work has been completed.

5 Acknowledgements

5.1.1　There are many organisations and individuals who have contributed to make this project, not only work but to become a success. Without all those mentioned below, this project would not be possible and WCRT is extremely grateful to all those who helped in a variety of different ways including;

- Approximately 100 landowners and tenants who gave permission to access the river from their land, encouraged us to do so and showed great interest in the results.

- Financial contributions from the Rivers Corridor Group, the Derwent Owners Association, Keswick Anglers, Cockermouth Anglers, and the EA.

- Advice from other Rivers Trusts, especially Ribble Rivers Trust, the EA and Scotland's Rural College.

- A lot of very willing and able volunteers who gave up a total of 430 hours of their time to catch fish!

6 References

Scottish Fisheries Co-ordination Centre, 2007. Electrofishing Team Leader Training Manual. Fisheries Management SVQ Level 3. Manage Electrofishing Operations. Inverness College.

Appendix 1 Notes about habitat condition for each tributary in the River Derwent system.

Tributary	Range of habitat scores	Site habitat categories	Tributary habitat category	Comments / notes
Broughton Beck	45 - 95	3 x Maintain 3 x Repair	Repair	Lots of stoneloach, invertebrates, algae and silt. Some sewage fungus. Lot of flood repair work ongoing.
Blumer Beck	39 - 74	2 x Maintain 1 x Restore	Repair	Potential for a lot more fencing projects, some gravel movement. Areas of newly planted trees.
Coal Beck	48 - 69	2 x Maintain 2 x Repair	Repair	A lot of Himalayan Balsam. Channelised in sections and suffered from floods. Litter on river banks, silt in lower reaches.
Dash Beck	55	1 x Repair	Repair	Some fencing potential.
Chapel Beck	55 - 81	1 x Maintain 2 x Repair	Repair	Some fencing done to a high standard but more to do. Very fast flowing, especially where channelised. Minimal invertebrates seen.
Mill Beck (Chapel Beck)	70 -141	2 x Maintain	Maintain	Lots of invertebrates, lots of LWD, some movement in floods.
Lair Beck	38 - 98	2 x Maintain 1 x Restore	Repair	Potential barrier and pollution problems but where fenced has good habitat with LWD.
Glenderaterra	43 - 74	1 x Maintain 2 x Repair	Maintain	Severe flood damage, bridge washed away, landslip, resulting in dredging. Salmon with a damaged gill.
Whit Beck - Glenderaterra	34 - 61	1 x Repair 1 x Restore	Maintain	Severe flood damage, lots of invertebrates, potential fencing project in one area.
Glenderamackin	41 - 65	1 x Maintain 3 x Repair	Maintain	Some flood damage, potential for fencing where banks slumped or where there is livestock poaching.
Barrow Beck	85	Repair	Maintain	Lot of algae.
Troutbeck	40 - 92	2 x Maintain 2 x Repair 1 x Restore	Repair	Potential pollution issues, lot of areas of good habitat.
Mosedale	46 - 81	2 x Maintain 2 x Repair	Maintain	Lot of flood damage with gravels washed away and bank repairs already failing. Some fencing but livestock in the buffer strip.
St Johns	36 - 81	1 x Maintain 1 x Repair 1 x Restore	Repair	Potential for more fencing, habitat creation and dappled shade creation.

Tributary	Range of habitat scores	Site habitat categories	Tributary habitat category	Comments / notes
Naddle Beck	34 -86	1 x Maintain 3 x Repair 1 x Restore	Repair	Flood damage, mainly good habitat, potential for some habitat work and crossings. Some stretches of gravel but with weed in places.
Brockle Beck	60 - 61	2 x Repair	Repair	Some big parr, new river course by lake with a lot of stoneloach already present.
Watendlath	44 - 60	2 x Repair	Repair	Lot of algae, straightened channel in places.
Comb Gill	47 - 95	1 x Maintain 1 x Repair	Repair	No fencing in places, over straightened in places.
Stonethwaite	50	Repair	Repair	Flood damage, very wide channel, potential for dappled shade.
Upper Derwent	47 -67	1 x Maintain 3 x Repair	Maintain	Flood damage, affected by drought, need for dappled shade and fencing in places.
Black Syke	74 - 90	3 x Maintain	Maintain	Good habitat, mostly fenced although some grazing in buffer strips. Large parr found.
Tonge Gill	40 - 64	1 x Repair 2 x Restore	Restore	Some large constraining embankments with flood damage below, affected by drought, very hot and open in need of dappled shade and fencing
Pow Beck	54 - 61	2 x Repair	Repair	Some livestock poaching but good shade and LWD in places, would benefit from fencing.
Newlands Beck	37 - 86	3 x Maintain 2 x Restore	3 x Repair 2 x Restore	Some fencing and habitat work required in upper reaches, very large embankments and straightened channels in lower reaches, affected by mine waste.
Coledale Beck	35 - 43	1 x Repair 2 x Restore	Repair	Affected by mine waste, in need of habitat especially shade.
Chapel/Comb Beck	56	Repair	Restore	Weak embankments, heavily grazed.
Wythop beck	42 - 91	2 x Maintain 2 x Repair	Repair	Where fenced has good habitat, good gravel except in lowest reaches. A lot of Himalayan Balsam and silt in lower reaches.
Bitter Beck	50 - 91	1 x Maintain 1 x Repair	Repair	Some litter nearer town, access to main river via culverts. Some potential for fencing.
Tom Rudd	51 - 78	1 x Maintain 3 x Repair	Repair	Potential pollution problems, some cattle poaching, where fenced is good habitat.
Whit Beck	76 - 87	3 x Maintain	Maintain	Two years post restoration.
Hope Beck	60 - 72	1 x Maintain 1 x Repair	Repair	A lot of flood damage, where fenced is good habitat.

Tributary	Range of habitat scores	Site habitat categories	Tributary habitat category	Comments / notes
Liza Beck	32 - 82	1 x Maintain 1 x Restore	Repair	A lot of flood damage, where fenced is good habitat.
Gatesgarthdale Beck	36 - 62	1 x Repair 2 x Restore	Repair	Potential for a lot of habitat creation with shade. Good gravel provision and heterogeneous substrate.
Warnscales Beck	57 -62	2 x Repair	Repair	Very straight and uniform, but breaking out of channel now it is maintained as wet meadow land.
Loweswater	45 - 83	3 x Maintain 2 x Repair	3 x Maintain 2 x Repair	Historically dredged but slowly improving, barrier on road culvert. Where fenced is good habitat.
Park Beck	80	Maintain	Maintain	Good substrate, dappled shade and some LWD.
Sandy Beck	62 - 106	1 x Maintain 3 x Repair	Repair	Some flood damage, a lot of Himalayan Balsam. Where not fenced there are a lot of cattle poaching problems.
Paddle Beck	44 - 52	3 x Repair	Repair	Potential pollution problems, very little fencing. A lot of algae, weed and silt in places.
River Marron	33 - 67	1 x Maintain 1 x Repair 2 x Restore	Repair	Some pollution dealt with by EA. Himalayan Balsam and Japanese Knotweed. Good habitat where fenced and a lot of good substrate. Poaching and silt where no fencing.
Black Beck	63	Repair	Repair	Good habitat and substrate where fenced.
Snary Beck	77	Maintain	Repair	Barrier under road bridges, some litter.
Wood Beck	33 - 67	1 x Maintain 2 x Repair 1 x Restore	Restore	Major pollution issue dealt with by EA. Barrier to fish passage from main river. Some steep eroding unfenced banks and a lot of gabions starting to fall into river.
Lostrigg Beck	31 - 62	2 x Repair 2 x Restore	Repair	Good mixed substrate throughout beck but a lot of silt on top. Potential pollution and silt problems throughout beck. Barrier to fish passage near top of catchment. Not much fencing resulting in a lot of livestock poaching.
River Cocker	51 - 76	3 x Maintain 2 x Repair	1 x Maintain 1 x Repair 3 x Restore	Very channelised with embankments in most places. A lot of gravel with minimal silt. Some poor fencing in places.
River Derwent	30 - 80	3 x Maintain 3 x Repair 2 x Restore	Repair	A lot of flood damage especially to banks. Good habitat where fenced and trees but very poor in areas without.