Layer Brook Sediment Investigation

Abberton Reservoir has experienced a rapid reduction in the abundance of submerged plant life in the areas close to where Layer Brook flows in. Investigations have so far failed to explain the loss of plant life but have identified an increased build-up of sediment entering from Layer Brook.

This project aims to bring greater certainty to the sources of sediment in the reservoir. Abberton Reservoir is not only an important public water supply within Essex, it is also an important wildlife site and has been designated as a Site of Special Scientific Interest (SSSI) for overwintering birds.

The suspicion is that sedimentation in the reservoir is reducing the areas available for aquatic plants to grow. If true then this could have an impact on the birds that use this site, as a lack of plant life will reduce the food availability for the wildfowl that make it such an important SSSI.

Essex and Suffolk Rivers Trust has been working with Essex & Suffolk Water and the Environment Agency to determine the best ways to investigate the sources of sediment and this report explains what has been and done and what has been found to date.

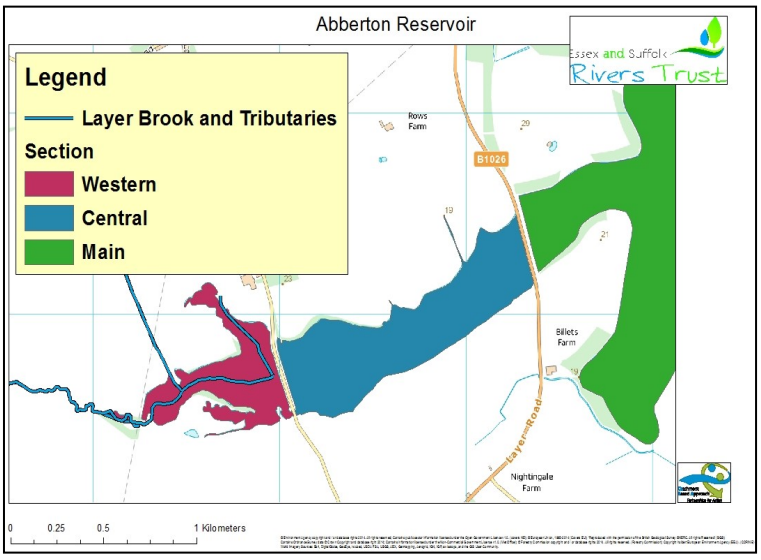
The information for all research detailed here was collected between March 2017 and February 2018. The data was gathered by carrying out crayfish surveys, Bathymetric surveys and installing turbidity meters within the brook. A technique called sediment fingerprinting was also carried out by an MSc student from University of East Anglia.

Bathymetric Survey

* *Summary of the Survey*

Between the 20th and 24th March 2017, a small boat was used to access what is referred to as the western and central sections of Abberton Reservoir (see map). Sensors and specialist equipment was used to measure the base of the reservoir to determine the thickness of sediment within these areas.

The information collected will enable Essex & Suffolk Water to determine how sediment levels, within the reservoir, change overtime.



* *Results*

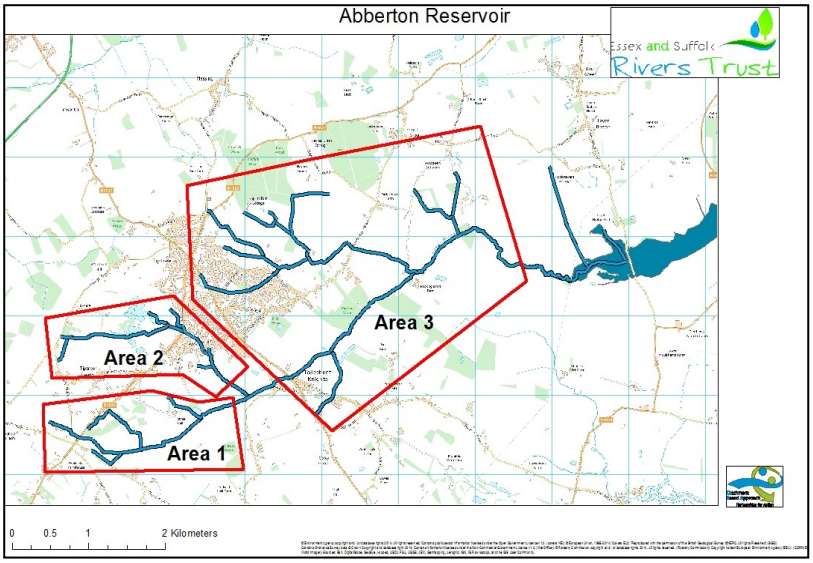
The Western section had an average depth of **0.16m** of sediment which accounts for **15%** of the total volume of this area of the reservoir. The deepest level of sediment found was **0.72m**, in an area where the **18m** water depth is on average.

The central section had an average depth of **0.29m** of sediment which accounts for **9%** of the total volume of this area if the reservoir. The deepest level of sediment found was **0.61m**, in an area where the water depth is **18m** on average.

Sediment Fingerprinting

* *Summary of the Technique*

This technique involved taking 10 soil samples from various points along the banks of Layer Brook and analysing these to find differences and similarities between them. This analysis determined that there were 3 distinct areas within Layer Brook that displayed similar soil characteristics (the detail of these characteristics can be found in the results section).

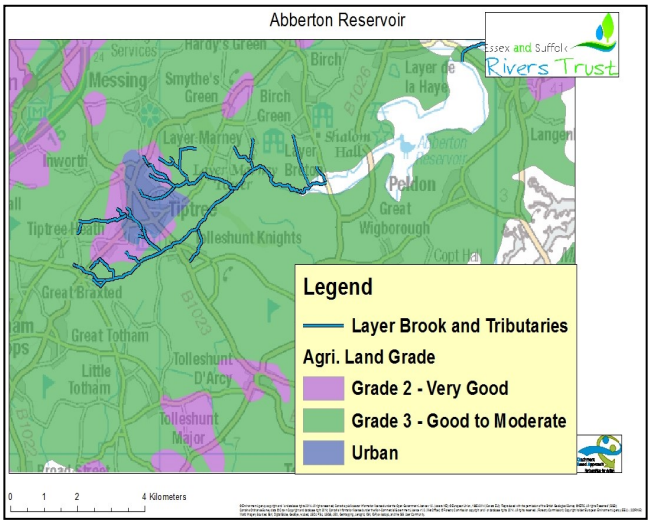


Next; sediment samples were taken from the bed of the western and central sections of Abberton Reservoir. These samples were then analysed and compared to the soil samples collected from Layer Brook to determine what areas the sediment came from (soil is referred to as sediment once it enters the water environment).

Samples from the brook and the reservoir were collected between May and July 2017.

* *Results*

The 3 areas identified based on similar characteristics were grouped due to the following:



Area 1 was characterised by a higher concentration of silicon and sodium than other areas.

Area 2 was characterised by a higher concentration of phosphorous than other areas.

Area 3 was characterised by a higher concentrations of calcium, magnesium, aluminium, iron, potassium, titanium, and cerium than other areas. The report also stated that the Layer Brook catchment is made up 80% of grade 2 and 3 agricultural land. Once the characteristics of the soil in each area was determined these were compared to the samples collected from Abberton Reservoir. The concentration of soil from the three areas are as follows;

Western section

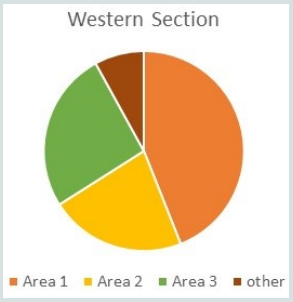
Area 1	= 44%
Area 2	= 22%
Area 3	= 26%
Other/could not be linked to other areas	= 8%

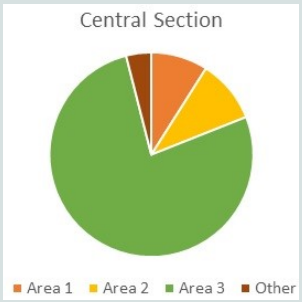
Central Section

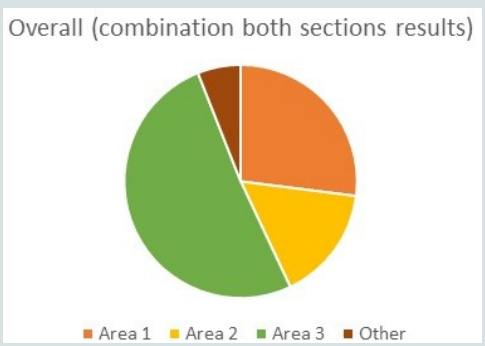
Area 1	= 9%
Area 2	= 10%
Area 3	= 77%
Other/could not be linked to other areas	= 4%

Overall (combination of western and central section results)

Area 1	= 27%
Area 2	= 16%
Area 3	= 51%
Other/could not be linked to other areas	= 6%







The results suggest that overall area 3 has contributed more sediment into the reservoir overall, as well as the central section, than the other 2 areas. However, there were higher levels of sediment from area 1 in the western section.

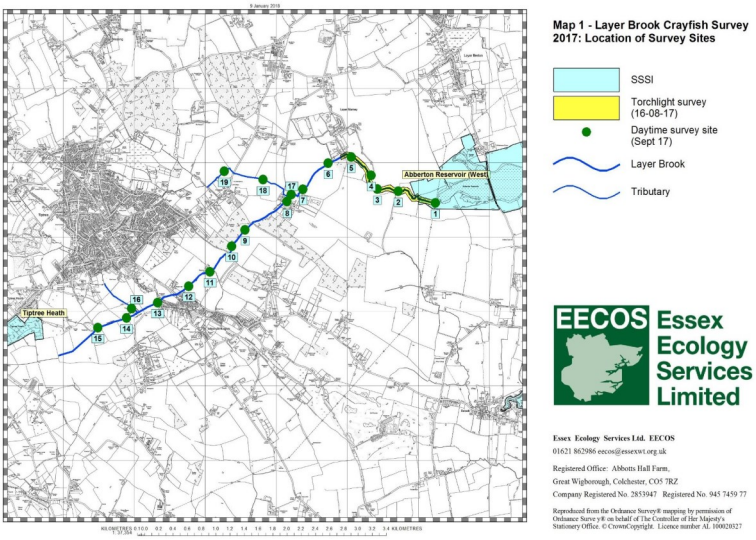
This study would seem to indicate that around 50% of recent sediment has come from area 3, while just over a quarter of the sediment came from area 1

Crayfish Surveys

* *Summary of the Technique*

The aim was to determine the species of crayfish present in the brook and estimate population size. This could help to determine the impact that this species is having on the sediment levels in the brook.

Surveys were carried out between 16th August and 25th September 2017. Suitable points were selected every 400 metres along the brook and 10 minutes was spent searching for crayfish in vegetation and under large stones in the channel. All individuals found were measured to determine size and species.



The green points on the map show the survey locations.

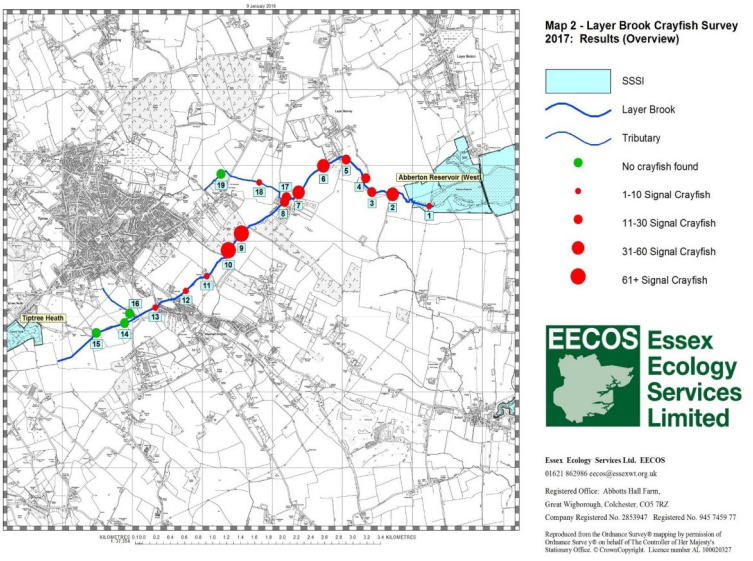
Apparatus was installed in the river where it flows into the reservoir to collect samples of water every 3 hours. These were then analysed to determine the amount of sediment in each sample and the results used to identify if sediment levels increased during the night when crayfish are most active. Large individuals excavate relatively deep holes into the banks to shelter, releasing soil from the banks into the water. When there are large populations that are creating many holes in the banks, this also makes the banks unstable and prone to erosion, which increases the levels of soil getting released into the water.

* *Results*

A total of 19 areas were surveyed; 15 along the main brook and 4 along tributaries to the brook.

Only the invasive American Signal Crayfish were found during the surveys. A total of 348 crayfish were found ranging from 8-55mm in length so both juveniles and adults were found.

74% of those caught were under 15mm (258 individuals) and only 6% (21 individuals) were mature adults capable of reproduction.



Red points show where crayfish were found, the size of the point indicates the number found. Green shows where no crayfish were found.

At each area where crayfish were found there was also signs of bankside burrowing. This ranged from occasional scattered holes to over 15 burrows per metre of bank. The burrowing is the main contribution that crayfish make to sediment in watercourses. Some stretches were found to be free of crayfish and this is probably due to unsuitable habitat. In upstream stretches of the main channel and tributaries it would most likely be due to reduced flow. In the area close to the reservoir the high levels of sediment would create lower oxygen conditions not ideal for most aquatic species.

The high number of juveniles indicates that the Signal Crayfish population is healthy and recruiting, with successful breeding numbers of adults. There are records of this species going back to 2000 in the brook so this indicates that they are well established and have been for many years.

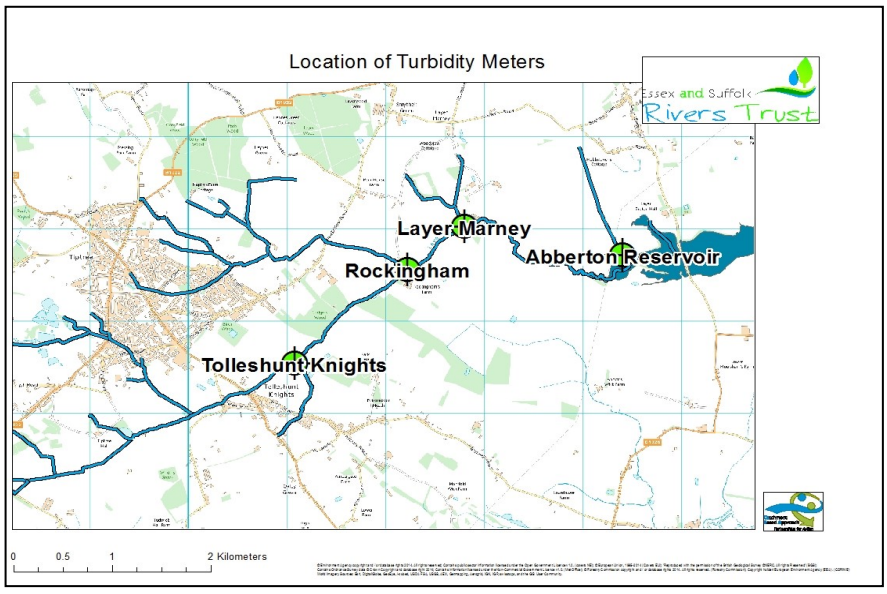
* *Results continued...*

It is difficult to estimate population size but the ecologist who carried out the surveys gave his opinion that it is an average population for this species. He has many years experience of studying and surveying crayfish. The presence of aquatic plants and a range of aquatic invertebrates and small fish in the brook, indicate that this species appears not to be having a detrimental effect on ecology.

The samples collected from the brook did not show peaks of sediment during the night when crayfish are typically active. This suggests that the population is not causing an increase in sediment dispersal.

Turbidity Monitoring

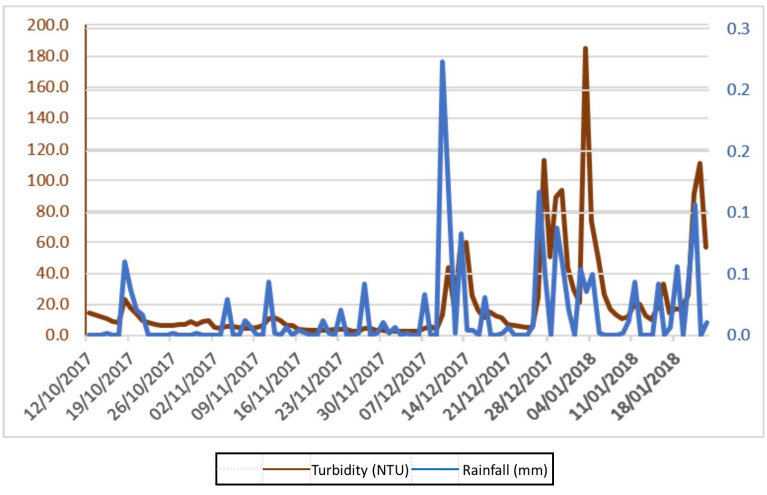
* *Summary of the Technique*



Turbidity meters were installed into Layer Brook at 4 locations. These were set to record turbidity levels every 30 mins and were in Layer Brook between 8th September 2017 till 18th January 2018. There was some problems with the equipment so we did not get data for all sites during this time period so the data available varies at each site.

The turbidity data was compared to rainfall data for Layer Brook to see if there were peaks in turbidity levels during or just after rainfall events. The aim was to determine if this showed if certain areas showed increased levels of turbidity.

* *Results*



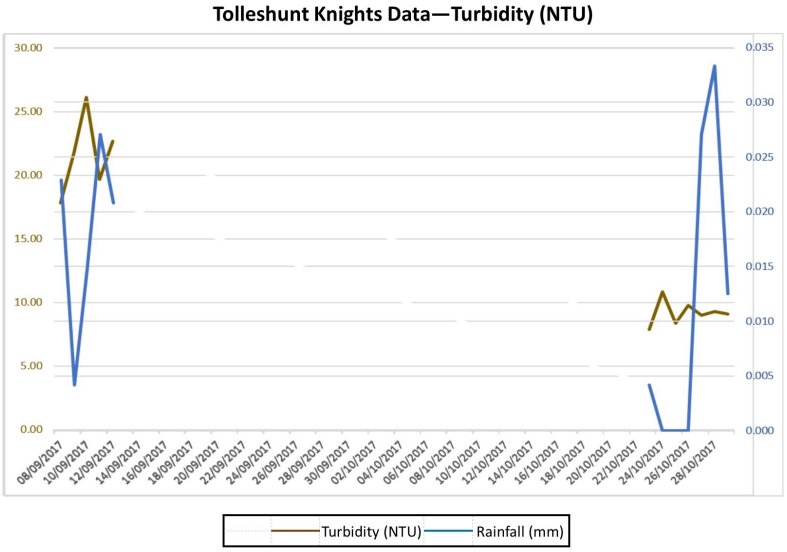
The data from Rockingham was the best data collected as there was no equipment problems at this location so there was continued recording for the whole period.

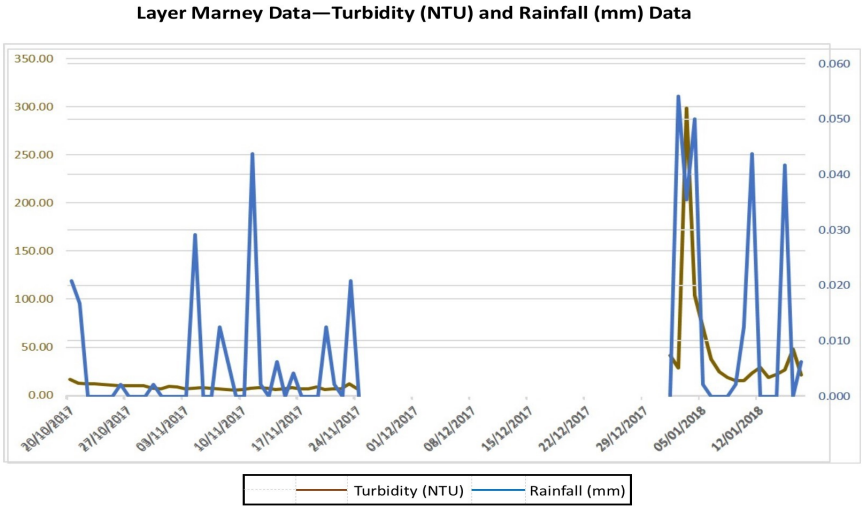
The data shows that there are peaks of turbidity levels through the period of December and January and that these coincide with rainfall events. The peak in early January was particularly high measuring around 185 NTU, which was significantly higher than other sites along Layer Brook. The peak could indicate that soil was being washed from the land and into the brook at this time.

* *Results continued...*

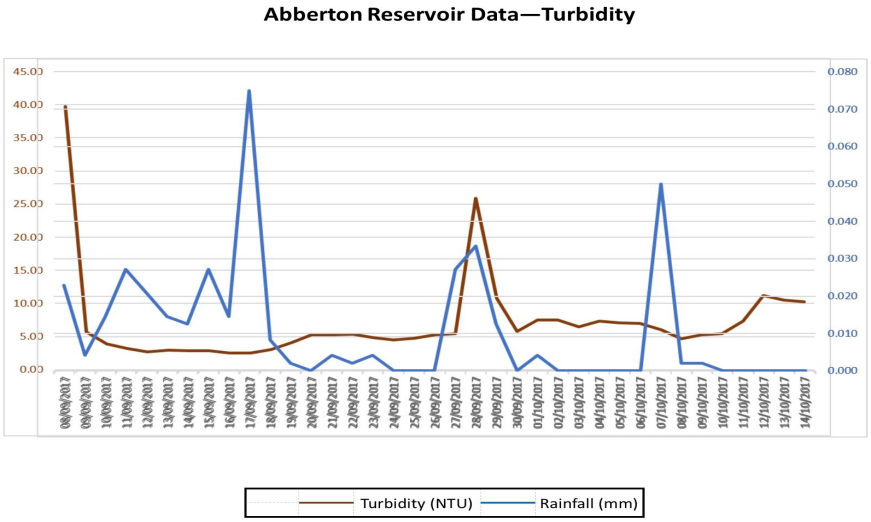
The data from Tolleshunt Knight is very limited at the equipment stop recording after the 18th October and due to problems with batteries there is no data from14th September till the 22nd October.

It is very difficult to draw conclusions with such little data but the turbidity levels that were recorded at this point are low.





The data from Layer Marney has a gap between the 14th November 2017 and 3rd January 2018. This was due to problems with replacing batteries during this time. The data available shows one peak of turbidity in January that coincide with the rainfall event. This peak is the highest recorded amongst all the meters installed at around 310 NTU.



The data from Abberton Reservoir has no breaks but only covers the period 4th September till 14th October 2017. Again this was due to the equipment not recording after this date. The data shows only one peak around the 28th October (although as the data recording begins on 8th September but it is hard to determine the details as some of the data is missing) but there are 2 other peaks of rainfall that does not show a peak in turbidity. The reason for this is not know but could suggest that some activity or change in land use around this time in October resulted in levels of soil entering the brook to be greater then at other times during the recording period.

Although a peak is shown at the time the levels are very low at only around 26 NTU.

Conclusions and Recommendations

The surveys and analysis detailed here have not identified the exact area/source(s) where the soil is being lost into the brook.

Sediment fingerprinting indicated that area 3 was the main contributor to Abberton Reservoir, however this area is a large area of the catchment.

The turbidity data could be interpreted to indicate that the areas around Layer Marney and Rockingham Farm show the highest peaks of turbidity, however the meters in these areas gathered the most data and, perhaps more significantly, over the period of January 2018 when we had more rainfall than October—December 2018. Therefore the higher levels of turbidity in these two locations could be contributed to the time of year they were recorded. If the other meters were active during January, they may have shown similar peaks turbidity at all areas.

The results from the crayfish surveys show the presence of a large Signal Crayfish population. These will be having an impact on the sediment entering the brook as they will be burrowing into the banks and depositing soil into the brook, however the levels of sediment are high and cannot be attributed to the crayfish alone. When surveying the brook close to the reservoir, the depth of sediment was almost a metre.

There is no known method to control invasive crayfish once they have reached such large numbers. The popular idea to be caught and remove them from the river, however research has found that this will most likely make the situation worse. The reason for this is that removal of a large number of the adults (the easiest to find and remove) will result in an increase in the survival rate of smaller individuals, of which there is many as they produce an abundance of offspring. The reason for this is that this species predate on each other so larger individuals will eat many of smaller ones, reducing numbers overall. Once the larger individuals are removed there will be an increase in the size of the populations, increased their impact on the ecology of the brook.

When considering trapping crayfish, or installing any type of trap into a water course, there are legal requirements and possible risks to wildlife such as Otters and Water voles. If you would like advice please contact us or the Environment Agency.

We have concluded from the data gathered that the sediment needs to be considered at the catchment level so we would like to work in as many areas as possible throughout the Layer Brook catchment where soil is being lost from the land. This could include areas of land that regularly flood causing soil to runoff into the brook, or ditches that contain significant amounts of soil, or the creation of sediment ponds (where suitable land is available) to intercept land runoff before it enters the brook. We would also like to identify areas where bank erosion could be having an impact and discuss what we could do there.

If anyone has an area that they think could be a source of sediment, please get in touch and we can provide advice on how to minimise this. If you have a project idea that you think would reduce soil loss, or reduce sediment in the brook, then again, please get in touch. We'd be very happy to arrange site visits, provide advice, and fund some works to address any identified problems.

Top Clockwise: buffer strip; between field and river, interceptor pond; land runoff drains into the pond, remains long enough for sediment to drop out then flows into the water course, bund; under constructed within a ditch, this slows the flow and allowing sediment to drop out.

Bottom left-right: swale; vegetated ditch were runoff can collect and slowly filter through the ground into the ground water, Silt trap; a shallow pool connected to a ditch that stores land drainage. Both above features slow the water so that sediment is able to drop out and remain on the land.

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