Appendix 9

Flood Alleviation Report 2010 (ref EB 08/06)

BOURNE BROOK CATCHMENT & FLOOD ALLEVIATION STUDY, FILLONGLEY, NORTH WARWICKSHIRE
July 2010

1 Introduction

The village of Fillongley is located towards the south east boundary of North Warwickshire Borough and 6.2 miles north west of Coventry city centre. The Bourne Brook runs from south to north through the village and is a tributary of the River Tame. For details of the catchment refer to Plan 1 in Appendix A.

The upstream catchment consists of two valleys which are approximately 95% rural. High up in the catchment there is dense woodland but agricultural farming is the most common type of land use with grazing land for live stock being the second. There are small hamlets and clusters of properties and farming units dotted around the catchment but besides a contribution from the M6 motorway there are no real significant built up urban areas.

The Bourne Brook is formed from smaller drainage ditches in two separate valleys upstream of Fillongley. The ditches form two main watercourse channels, one in each valley, and pick up runoff from the M6 motorway as well as contributions from the greenfield areas. The M6 discharges into the two watercourses at three different points, two directly into one of the two main watercourses and at a third point into drainage ditch which joins the main watercourse channel further downstream.

The two watercourses then flow directly to the Fillongley castle ruins which are 300m south of Fillongley village, flowing through the old moats of the castle before merging into one brook, the Bourne Brook on the north side of the castle. The watercourse then meanders into the village where it discharges to two 900 mm diameter brick culverts at the rear of the Manor House public house. The culvert then flows under the Coventry Road in a large s-bend shape curve and along Church Lane. The culvert issues in the rear of the gardens of the properties in Church Lane into an open channel which have been altered to suit residential requirements. The open watercourse flows though the remainder of the village where another tributary joins at Little London, before exiting the village under the Nuneaton Road Bridge and onwards into the fields downstream of Fillongley.

The watercourse then merges with the Didgley Brook and flows north west merging with several other watercourses before joining the River Tame.

The aim of this report is to greatly reduce the affects of flooding to the village of Fillongley. This will require a multi-agency response to fund aspects of the required works to be carried out in the near future.

2 Background

There is a long history of flooding in the centre of Fillongley Village from the Bourne Brook watercourse. Anecdotal evidence in the form of old photographs is available from some of the local residents and also in the local public house; The Manor House. However there is no detailed information of the dates of these events or supporting information of the duration and intensity of the accompanying rainfall.

More recently there have been two significant flooding events for which a greater amount of observational data can be obtained. These occurred on the 20th July 2007 and 13th December 2008. Evidence of the effects of flooding from these two events is contained in Appendix C.

2.1 Flooding Event - 20th July 2007

Analysis of the rainfall event from the Met Office indicates that between 50mm and 75mm of rainfall occurred. This heavy and prolonged rainfall event was caused by a slow moving area of low pressure and associated frontal system.

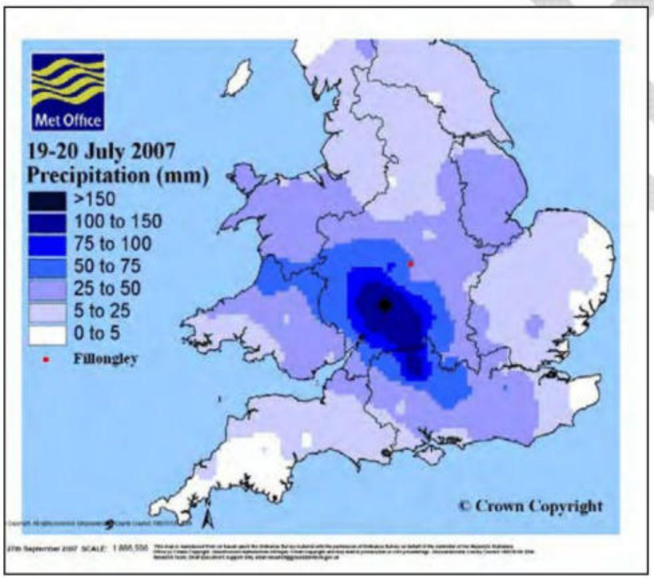


Figure 1 – Met Office Data for 20th July 2007

Whilst this level of rainfall is not entirely unusual it was coupled with extremely wet antecedent conditions. Further information from the Met Office indicates that during June and July 2007, the amount of rainfall was 200 to 250% higher than average in the North Warwickshire area. This is further confirmed by an analysis of the local Soil Moisture Deficit (SMD) during this period. This is a measure of the amount of rainfall required to be added to the soil to restore it to field capacity. An average value for July is about 75mm – 100mm which indicates that this is the quantity of rainfall which can be absorbed in the soil. However, the SMD value for July 2007 was about 1mm which indicates that the ground was already saturated when the event occurred. These are the sort of antecedent conditions normally associated with winter rainfall events and it is unusual for them to occur in the summer.

The consequence of this rainfall event was to cause high surcharge at the culvert inlet in the village. Ultimately the pressure from the static head of water forced the brick wall around the culvert inlet to fail and the centre of the village was flooded. As the water levels continued to rise flood water was routed along Church Lane and flooded a number of low lying properties. Properties which are at risk of flooding are shown on Plan 2 in Appendix A.

2.2 Flooding Event - 13th December 2008

The effects of this rainfall event were recorded by one of the residents and are contained in Appendix C. It was also possible to obtain rainfall data for this event from a local rain gauge which had been deployed by a flow survey contractor.

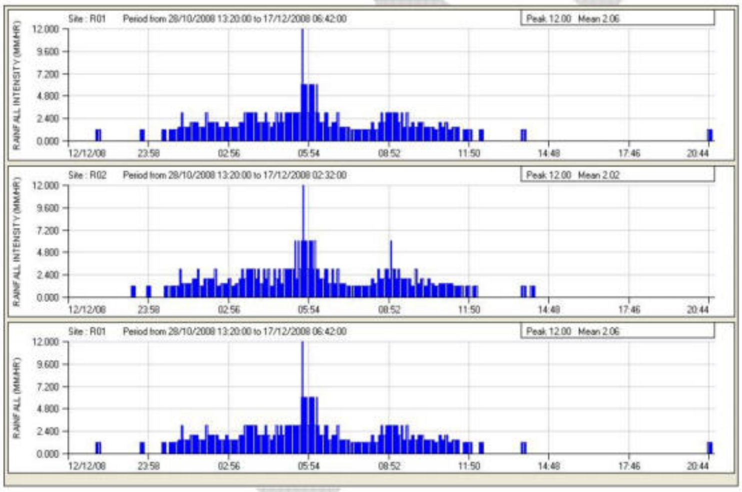


Figure 2 – Rainfall Intensities and durations for 13th December 2008.

This rain gauge indicated that 23 mm of rainfall occurred in approximately 12 hours on the 13th December. This is not particularly excessive rainfall and would equate to a return period of about 1 in 1 year (Flood Studies Report methodology). The SMD value for Warwickshire for December 2008 was again about 1 mm which compares to an average for this time of year of 10 mm. So again this indicates that the preceding conditions are critical to flooding as well as the depth and duration of rainfall.

2.3 Third Party Ownerships and Liaison

The Bourne Brook has the status of an ordinary watercourse. Whilst North Warwickshire Borough Council (NWBC) has permissive powers to carry out flood defence works, there are also a number of other parties that have responsibilities and contributions to the performance of the watercourse.

NWBC – have overall responsibility for the ordinary watercourses within the Council boundary.

Warwickshire County Council (WCC) – the highway authority responsible for the culverted section of the Bourne Brook which runs beneath the public highway and footpaths. They are also responsible for any highway drains which discharge to the Bourne Brook.

Highways Agency (HA) – responsible for the M6 motorway which discharges un-attenuated runoff to the head of the Bourne Brook.

Various riparian owners – where the Bourne Brook runs through privately owned land, the land owner has "riparian" ownership of the watercourse and is responsible for the maintenance of that section. These include Punch Taverns who own the Manor House PH and various private residences.

Severn Trent Water – are responsible for the public surface water sewers which discharge to the watercourse.

NWBC has contacted the Highways Agency (HA) with a view to include them in the problem solving process and to obtain the original drawings of the M6 drainage plans.

Severn Trent Water has been contacted to investigate the storm water and foul combined sewer system

WCC has been contacted to look at the surface water run off and as a riparian owner for a large section of culvert. An internal survey of the village culvert for its length within the public highway was commissioned by WCC any obstructions were removed at the time of the survey. A length of the culvert was also subsequently relined.

Other works which also been carried out include securing an eroded bank using a gabion retaining wall and the channel realigned to line up with the Nuneaton Road Bridge.

3 Modelling Methodology

3.1 Model Build

To provide a tool for the analysis of the Bourne Brook, a computer hydraulic model was required. Modelling was carried out using InfoWorks RS produced by Wallingford Software. As a basis for the model a topographical survey was carried out of the main watercourse channel and flood plain.

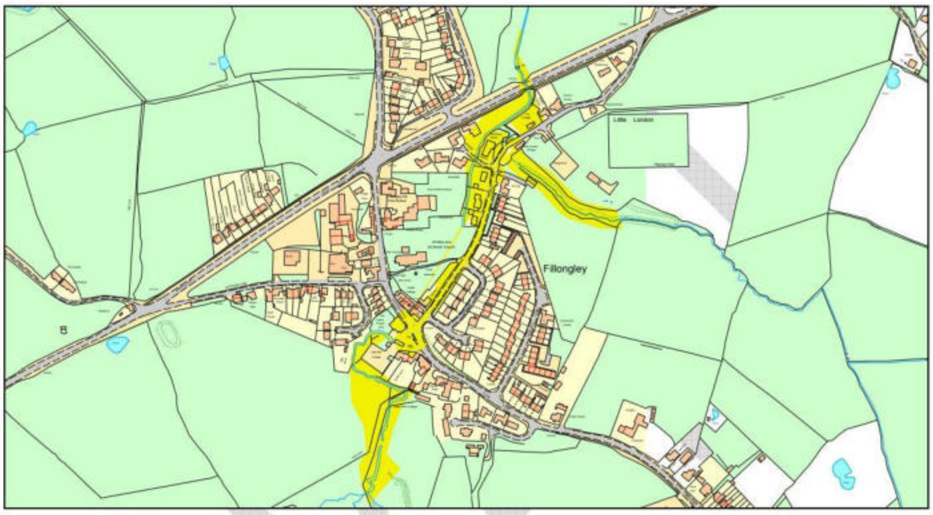


Figure 3 – Extent of Survey Work (Highlighted Yellow)

The model included a representation of the main watercourse channel from the Ancient Monument which is about 300m upstream of the village. The model includes the culverted section of the watercourse through the centre of the village. The culvert consists of a twin 900mm barrel circular pipe. The model also includes a representation of the known flooding mechanism in the centre of the village. The headwall around the culvert inlet is included as a weir which spills to a storage area in the centre of the village. The storage area can also spill to Church Lane which acts as a natural flood route. The above ground flood route along Church Lane discharges back into the main channel further downstream adjacent to the Little London tributary.

3.2 Model Hydrology

Inflows into the model have been generated using the Flood Estimation Handbook (FEH) and the revitalised Rainfall Runoff Method. The details of the calculation of flows for the 100 year event for the Bourne Brook and the Little London Tributary are contained in Appendix B.

	Catchment Inflows				
	100 Yr (m3/s)	**75 Yr (m3/s)**	**50 Yr (m3/s)**	**25 Yr (m3/s)**	**10 Yr (m3/s)**
Bourne Brook Inflows	3.3	3.1	2.8	2.4	1.9
Little London Tributary Inflows	0.9	0.9	0.8	0.7	0.5
Total Inflows	**4.2**	**4.0**	**3.6**	**3.1**	**2.4**

Table 1 – Catchment Hydrology

3.3 Model Flood Mechanisms

The pipe full capacity of the culvert through the village is 1.4 m^3/s, which is exceeded by all of the design events. The lack of capacity in the culvert is the primary cause of flooding in the catchment. The flooding mechanisms are shown on Plan 3 in Appendix A.

The flooding mechanisms included in the model are:

- Culvert capacity is exceeded and water levels rise at the culvert entrance. The top of the wall around the culvert inlet is at a level of 115.1mAOD. This has been modelled as a weir which directly to the centre of the village. In reality (and also in the model) it is unlikely that the wall will over top at this location because there are a number of other mechanisms which will relieve the system first.

- The lowest gulley in the village is outside of the Post Office and has a level of 113.3mAOD. This has been represented in the model to allow water to back-up the gulley connection and flood the road. The level of this gulley is only 0.65m above the culvert invert although it does require additional head to pressurise the system. Although this is the first location to flood there are a number of other gulley connections in the village which will also flood if the water level continues to rise. **(Flood Mechanism A)**

Flood Mechanism A

- The brickwork around the headwall is in a poor condition. Water can therefore escape through the gaps in the mortar. This has been modelled but the extent to which it occurs has been estimated. This can occur when the water level rises above the external ground level at 114.0mAOD which is 1.6m above the culvert invert. **(Flood Mechanism B).**

Flood Mechanism B Flood Mechanism C

- Further upstream from the culvert inlet in the rear garden of the Manor House PH the wall protecting the surrounding areas drops to a lower level of 114.75mAOD which is 2.3m above the culvert invert. This has been modelled as a weir which spills directly to the centre of the village. **(Flood Mechanism C).**

- It also known that the event on the 20th July 2007 caused the wall around the culvert entrance to collapse. This process has not been represented in the model. However assuming that this does not normally occur, the final flooding mechanism will be the wall being breached at a level of 115.1mAOD. **(Flood Mechanism D).**

Flood Mechanism D

3.4 Model Results

The model has been simulated using a range of design return period rainfall events (10yr, 25yr, 50yr, 75yr and 100yr). The critical duration for the catchment was found to be 14 hours in accordance with the FEH procedure.

The model shows that flooding is predicted to occur for all events which have been simulated. The lowest property threshold level is 113.4 mAOD at the Post Office. This is exceeded by the 10 year event where a water level of 113.799 mAOD is predicted. For the 100 year event a water level of 113.975 mAOD is predicted.

This is corroborated by the known flooding history. In section 2.2 it was shown that the event was in the region of a 1 year event. The observed flood levels for this event are less than the predicted flood levels for the 10 year event. To provide further confirmation of the performance of the model it is intended to simulate a 1 year design event and compare the predicted levels with the observed levels taken from photographs for the 13th December 2008.

4 Impact of the M6 Motorway

As built construction drawings of the M6 were provided to NWBC by the Highways Agency, Management Agency Contractor for Area 9 (MAC9). At the time of request Optima were the MAC 9 agent, who has since been replaced by Amey Highways. This information has enabled more concise analysis to be undertaken of the contributing area of the M6 to the catchment.

An analysis has been carried out of the contribution to the overall catchment runoff of the M6 motorway.

	Catchment Inflows				
	100 Yr (m3/s)	**75 Yr (m3/s)**	**50 Yr (m3/s)**	**25 Yr (m3/s)**	**10 Yr (m3/s)**
Total Inflows	4.2	4	3.6	3.1	2.4
Motorway Runoff Contribution	0.76	0.7	0.62	0.5	0.37
Percentage Contribution from Motorway	18%	18%	17%	16%	15%

Table 2 – Percentage runoff contribution from M6 motorway

This table shows that the contribution from the M6 motorway is significant but it is not the main source of runoff in the catchment. The model has been simulated with a 100 year event with all of the motorway contribution removed. This was not sufficient to prevent flooding from occurring but did reduce the impact.

Recommended Action: - flood routing from the M6 should be examined in more detail. A possible solution would be to ascertain if there was sufficient space within the confines of the M6 boundary to provide a swale or pond storage system to attenuate the flows.

As an alternative, negotiations should take place with the MAC 9 agent to provide a percentage of the costs towards flood alleviation works elsewhere. There is currently no legal obligation for the Highways Agency to make a contribution for motorway runoff and the right of connection to the watercourse cannot be removed.

5 Proposals to Alleviate Flooding

The information compiled in the first sections of the report has formed the basis for the various scheme options. An estimated cost of constructing the schemes has also been determined. **These costs do not allow for feasibility, design, contract preparation, or supervision costs, or any works proposed to the various organisations or private individuals involved.**

A summary of the effects of each of the options is given in the following table followed by a more detailed discussion of each of the options and the advantages and disadvantages of each.

	Flood Volume m^3								
		Option A	Option B	Option C	Option D	Option E1	Option E2	Option E3	Option E4
Event	**Existing**	**Fit Non-Return Valves to highway and private gullies**	**As Option A with 5,200m3 balancing pond upstream**	**As Option A with reconstruction of 35m of headwall**	**As Option C with 6,700m3 balancing pond upstream**	**Temporary flood barrier around Bell Cottages (36m)**	**Temporary flood barrier around Manor House Pub (47m)**	**Temporary flood barrier around Post Office (60m)**	**Temporary flood barrier around Church Lane (82m)**
10yr	457 m^3	30 m^3	30 m^3	0	0	0	0	0	0
25yr	1,936 m^3	1,292 m^3	1,052 m^3	0	0	0	0	0	0
50yr	4,584 m^3	3,777 m^3	2,497 m^3	0	0	0	0	0	0
75yr	6,767 m^3	5,911 m^3	3,553 m^3	1,334 m^3	0	0	0	0	0
100yr	8,703 m^3	7,947 m^3	4,109 m^3	3,127 m^3	0	0	0	0	0
Cost		**£63,100**	**£640,821**	**£170,000**	**£918,064**	**£14,700**	**£8,500**	**£24,500**	**£14,800**

Table 3 Comparison of the Effects of Each Option on Predicted Flood Volume (m^3)

As a comparison of where the events recorded over the last couple of years would equate to these events. The event on 20th July 2007 would be between the 25 year and 50 year event. The event on the 13th December 2008 would be less than the 10 year event.

5.1 Option A – Gulley Isolation

This option proposes to alleviate the flooding from flooding mechanism A which was identified in section 3.3. The first cause of flooding in the village occurs when water backs up through the highway gullies and floods the highway. This option involves fitting non-return valves to all of the surface water sewers and highway drains which discharge directly to the brook. This will prevent flows from backing up and flooding out of the highway gullies.

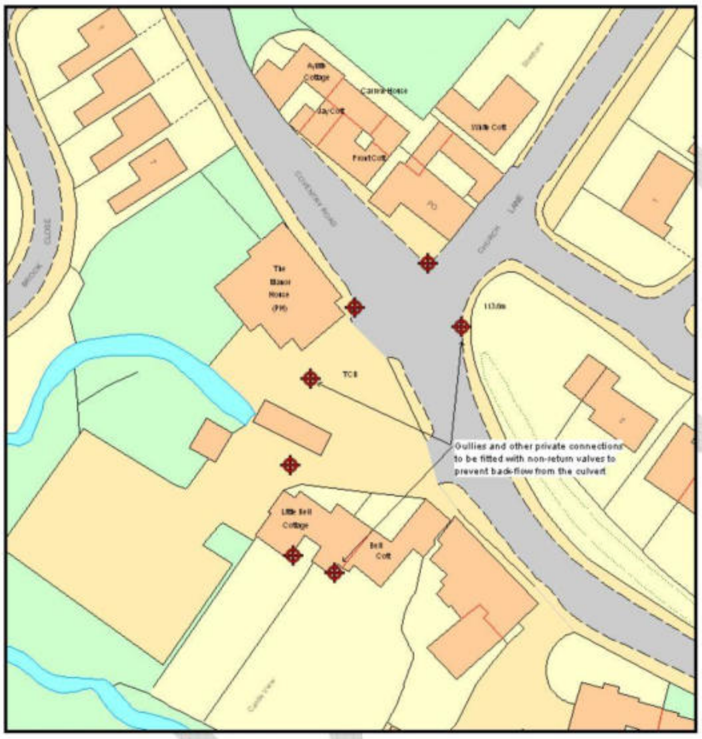


Figure 4 – Option A

As shown in Table 3 this option does not prevent flooding for any of the design events but it does reduce the volumes significantly.

5.1.1 Environmental Impact

The works are all within the existing highway and non highway areas. There will be some low level excavations within the highway but the environmental impact of these will not be significant.

5.1.2 Advantages

- Relatively low construction cost.

- Good level of protection for events of less than 50 year return period.

5.1.3 Disadvantages

- Detailed surveys will be required to discover where all the gulley connections are. The option has been based on five new manholes with non-return valves and connecting pipe work. The assumption has also been made that the location of existing utility services will allow sufficient space for these proposals. As part of the feasibility works it will be necessary to investigate utility and gulley locations to ensure that this option can be constructed. It should therefore be noted that the cost of this option may be subject to change.

- This option relies on being to identify every direct connection to the culvert. It is known that some of the properties have private surface water connections onto the watercourse. There is a risk that if any connections are missed then they will continue to flood despite all the measures taken elsewhere.

- There is a risk that the culvert pressurising will cause damage to road surface or manhole covers under surcharge conditions. It will therefore be necessary to carry out a structural assessment of the carriageway construction. This would be carried out at the feasibility stage and could potentially prevent the scheme from going ahead.

- There is a residual risk with this option that flooding will continue to take place. The non-return valves will prevent back flows from the watercourse from flooding out through the road gullies onto the highway and surrounding areas. However, when the valves close off to prevent back flows they will also prevent runoff from the highway from draining away. The volume of highway runoff will be significantly less than the back flows from the water course. This effect will therefore need to be fully quantified and considered during the feasibility stage. It may be possible to mitigate the effect by providing some localised storage on the surface water system.

- There will be some disruption to village traffic during works.

- It will be necessary to obtain third party permission (STW, highway authority or residents). There is no reason why this permission would be withheld but this could potentially affect the progress of the scheme.

5.2 Option B – Gulley Isolation with Storage (5,200m^3)

This option includes the details of Option A (gulley isolation) but also has the provision of storage in the fields upstream of Fillongley to attenuate the flows.

A storage area of approximately 5,200m3 to be excavated in the fields up stream of Fillongley and the gully connections are to be retro fitted with non-return valves to isolate them from the culvert structure in the event of a surcharge state.

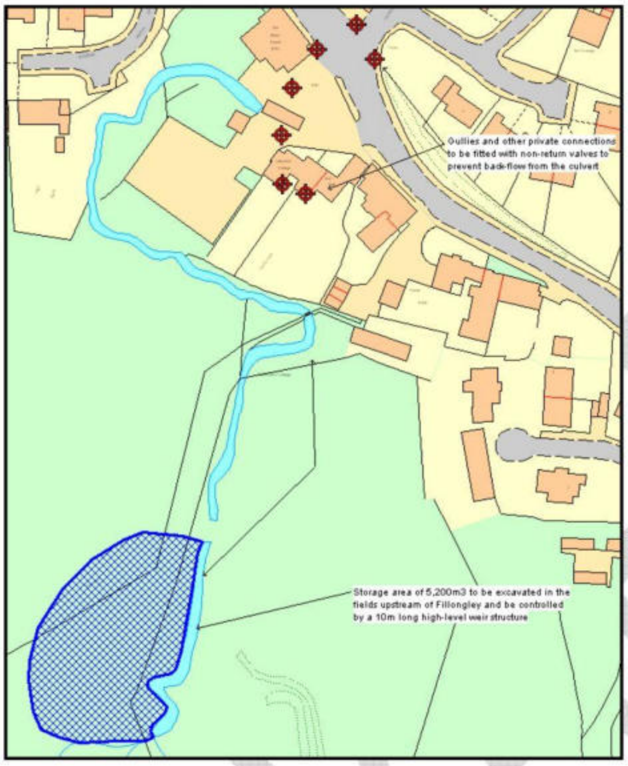


Figure 5 – Option B

5.2.1 Environmental Impact

As this option requires significant ground excavations in the vicinity of the watercourse, an Environmental Impact Assessment is likely to be required.

5.2.2 Advantages

- Significantly reduction in the flooding for all events.

5.2.3 Disadvantages

- This option has the same disadvantages as Option A as well as some others.
- Despite the cost this option does not fully mitigate the flooding for any storm event.
- There are possible land acquisition issues for the storage pond. For the purposes of this assessment the location of the storage pond has not been explored in detail. It would be beneficial to locate the storage area upstream of the ancient monument site as this will mitigate exposures to planning delays. A check on the land upstream of the ancient monument has

revealed that there is "no registered estate". This may therefore delay proceedings whilst due process is followed to establish if there is a land owner.

- Agreement with land owners will also be necessary for access during the construction phase and for maintenance. This may well delay or potentially stop the proposals being implemented.

5.3 Option C – Gulley Isolation and Headwall Reconstruction

This option contains all the elements of option A but additionally the wall surrounding the watercourse adjacent to the manor house public house is to be demolished and reconstructed, using waterproofing and retaining measures. This will effectively protect the village from flooding mechanisms A, B and C which were discussed in Section 3.3. This will increase the head on the system and increase the pressurising of the culvert.

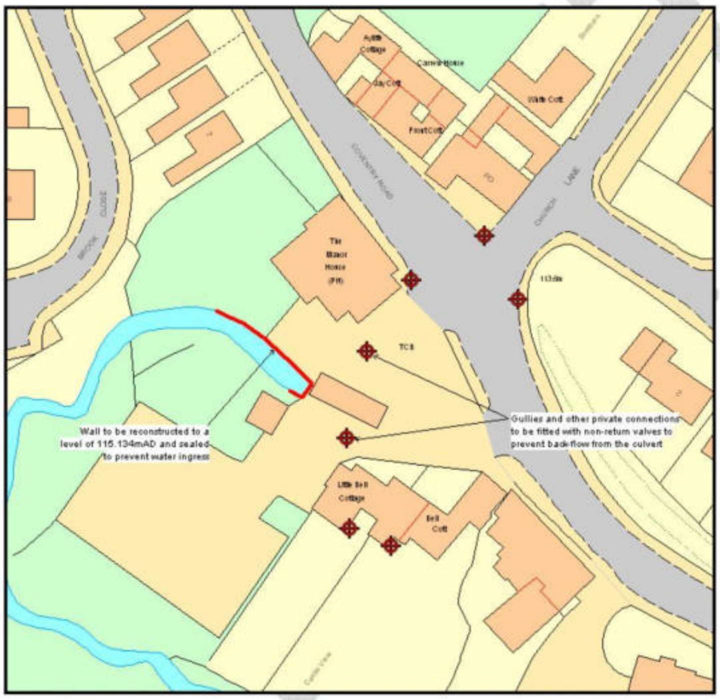


Figure 6 – Option C

5.3.1 Environmental Impact

As this option requires construction work directly over the watercourse an Environmental Impact Assessment is likely to be required.

5.3.2 Advantages

- Predicted flooding prevented for up to 50 year flood periods.

- Relatively low construction cost.

5.3.3 Disadvantages

- This option has the same disadvantages as Option A but also has some additional ones to be considered.
- Work on the wall would require third party agreement with the Brewery (Punch Taverns). There is no foreseeable reason why this would be withheld but the negotiations may delay the process.
- A foot bridge in the pub garden would need to be removed or altered to make allowance for the retaining wall.

5.4 Option D - Gulley Isolation and Headwall Reconstruction with Balancing Pond (6,700m^3)

This option includes the details of Option C (gulley isolation and wall reconstruction) but also has the provision of storage in the fields upstream of Fillongley to attenuate the flows.

This option would require a two pond system. The favoured location for the two pond system would be upstream of the castle. This would be constructed by excavating and using the excavated material to construct a small embankment. At its base would be a 1250m diameter culvert with a penstock flow control device that can be adjusted to control the depth of water in the pond. There would be the need to provide an overtopping spillway which could be constructed using reinforced grass so that should flows exceed the design storm event of 1 in 100 years the flows can flood route on at this location.

Access roads can be constructed from high ground to allow for maintenance and inspections to be carried out when required in flooding periods.

The sites are currently are not agriculturally cropped and appear to be set aside for grazing land or for natural and wild flow meadow that could transform into a holding area with improved habitat area and could become a location of special scientific interest home to many species of wildlife with a dipping platform that can be used by local schools.

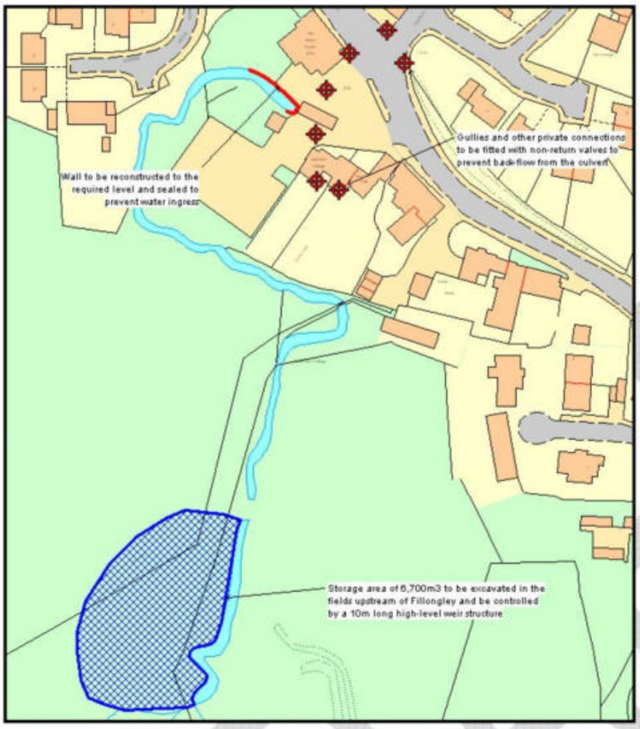


Figure 7 – Option D

5.4.1 Environmental Impact

As this option requires construction work directly over and adjacent to the watercourse an Environmental Impact Assessment is likely to be required.

5.4.2 Advantages

- The construction of the balancing pond area may offer an opportunity to encourage wild life and plants. This could be used for the local schools to visit to see a habitat area.
- Predicted flooding is prevented for events up to 100 year return periods.

5.4.3 Disadvantages

- This option has the same disadvantages as Option C but also has some additional ones to be considered.
- There are possible land acquisition issues for the storage pond. For the purposes of this assessment the location of the storage pond has not been explored in detail. It would be beneficial to locate the storage area upstream of the ancient monument site as this will mitigate exposures to planning delays. A check on the land upstream of the ancient monument has

revealed that there is “no registered estate”. This may therefore delay proceedings whilst due process is followed to establish if there is land owner.

- There would be a long term inspection and maintenance issue for the balancing ponds.
- Significant construction cost to construct flood storage area.

5.5 Option E – Temporary Flood Barriers

This option includes the provision of demountable flood barriers at four separate locations. Each of these locations could be promoted in isolation from the other, for this reason sub-options have been designated for each location. The flood barrier would have to be manually deployed when a flood is imminent. As they are dependent on manual intervention there is a risk of failure if a sudden flood occurs overnight.

There are a multitude of flood barrier products available on the market. For the purposes of this assessment the costs are based on a simple self-weighting barrier. These require the weight of the incoming flood water to provide ballast and are at the low-cost end of the market.

Figure 8 – Typical Self-Weighting Flood Barrier

Other types of products are available, including self-closing flood barriers, but the costs vary considerably. A full assessment of the different products should be undertaken and the relative advantages and disadvantages of each considered.

NWBC has secured funding from the Department of Environment, Food and Rural Affairs (Defra) for property-level flood protection measures to be implemented at the 14 properties which are at risk of flooding. This is provided so that each property can be provided with flood protection measures at the point that water enters the property. From initial discussions with Defra’s representatives it does not appear that this funding could be used to contribute to Option E solutions as these options protect groups of properties and not individual properties.

This type of solution relies on the intervention of a local flood warden or the local residents to be effectively deployed. As the response time of the watercourse to rainfall is likely to be less than an hour, it will be necessary to act quickly to ensure that the flood barriers can be deployed in time. As the water course is not a Main River it will not be part of the flood warning system operated by the Environment Agency. The only currently available warning system would be to use the Met Office severe weather warnings. However, these are indicative of weather only and not an indication that flooding is likely to occur. To provide adequate warning of an imminent flood it is recommended that a flood warning system is utilised in the village. Initial discussions with a manufacturer have identified a mechanism for doing this. It is proposed to use two wall mounted water sensors fitted to the headwall around the culvert inlet. The height of the monitors would be set so that one gave an early warning of the rising water levels and the second a final warning of impending flood. They would be linked to a modem and mobile phone sim card so that a text message could be sent to a number of pre-set mobile phone numbers. The cost of the flood warning system has still to be finalised so it has not been included in these option costs but it will be explored in more detail if this option is promoted.

5.5.1 Option E1 – Temporary Flood Barriers at Bell Cottages

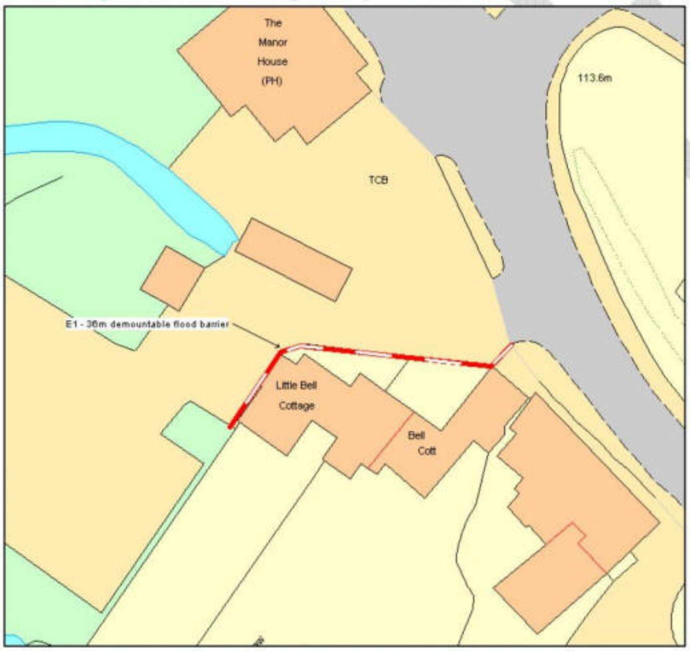


Figure 9 – Option E1

This option would effectively isolate Little Bell Cottage and Bell Cottage from the flood water. Due to the topography of the surrounding ground the properties cannot flood from the rear. When deployed this barrier would block the footpath on the south side of Coventry Road. It would therefore need to be agreed with the Highway Authority so that it can be deployed in an emergency. From discussions with the Environment Agency it is understood that permission has been granted by other Highway Authorities for such measures.

5.5.2 Option E2 – Temporary Flood Barriers at Manor House PH

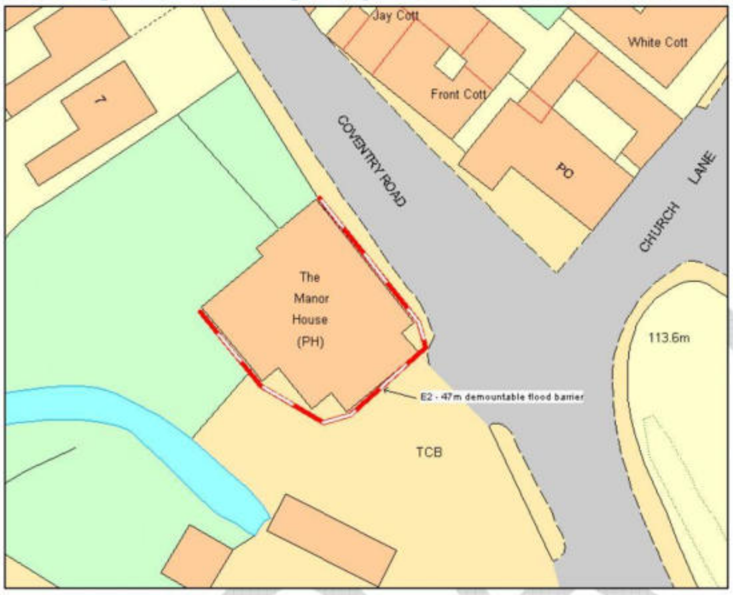


Figure 10 – Option E2

This option provides a temporary flood barrier to protect The Manor House PH in isolation from all other properties. Due to the topography of the ground The Manor House will not be subject to flooding from the north west side. The Manor House is also used as a private residence by the landlord so this barrier will not just be protecting a commercial property.

5.5.3 Option E3 – Temporary Flood Barriers at Post Office

Figure 11 – Option E3

This option provides a temporary flood barrier to protect the cluster of properties at risk of flooding around the Post Office. When deployed this barrier would block part of the footpath on the north side of Coventry Road. It would therefore need to be agreed with the Highway Authority so that it can be deployed in an emergency. From discussions with the Environment Agency it is understood that permission has been granted by other Highway Authorities for such measures.

5.5.4 Option E4 – Temporary Flood Barriers at Church Lane

Figure 12 – Option E4

This option provides a temporary flood barrier to protect the three properties at risk of flooding along Church Lane. The flood barrier would protect the properties from flood waters which have been routed along Church Lane from the centre of the village. It would not protect the properties from flood water directly from the watercourse in the rear gardens. From the analysis carried out the greater flood risk comes from the centre of the village as the culvert is the main restriction. When deployed this barrier would block part of the footpath and highway around Church Lane and Adkins Croft. It would therefore need to be agreed with the Highway Authority so that it can be deployed in an emergency. From discussions with the Environment Agency it is understood that permission has been granted by other Highway Authorities for such measures.

5.5.5 Environmental Impact

As these are temporary demountable barriers no Environmental Impact Assessment would be required.

5.5.6 Advantages

- These options are relatively inexpensive compared to other flood mitigation measures.
- The flood barriers could be used for other purposes such as traffic delineation.

- They are relatively easy to store and deploy.

5.5.7 Disadvantages

- As this system requires manual deployment there is a risk of failure if there is insufficient time to respond to an event. An integral part of this system would therefore be to fit a high level alarm at the culvert to give warning of imminent flooding.

- The flood barriers would need to be stored somewhere locally.

- They would not be easy for elderly residents to deploy. It would therefore be beneficial to encourage a community flood group to take responsibility for deployment.

- Permission would be required from the Highway Authority so that they can be deployed in an emergency (i.e without referring to the Highway Authority).

6 Maintenance Issues

6.1 The Fillongley village culvert and downstream watercourse

Trash screens should be constructed at the entrances to the culverted sections of watercourse within the village of Fillongley and on any proposed inlets to control structures within the flood storage areas upstream of the village. This is to safe guard the culverted sections from becoming blocked with debris. Although there are costs associated with the maintenance of the screens this would minimal compared to the costs involved in removing blockages from culverts as this will require specialist contractors and machinery.

The screens should be constructed from suitable materials so that vandalism has minimal effect on them and so that they are structurally sound enough to take the weight of the debris and the water loading.

The screen should be designed so that maintenance crews can use the structures in a safe manner but members of the public are prevented from accessing. Suitable safety fencing, gates and signage should be provided around the site of the screen along with tie off points for the crew. There should be a standing deck and the front face of the screen should be rack able. The screen should stop large debris entering the culvert but should still allow water to flow through the structure even when partly blocked. The structure should include a lockable access point so that the screen does not need to be removed in its entirety when maintenance staffs are checking the culvert for debris and sediment build up. Suitable access ways should be provided to the structures so that maintenance equipments can be brought to the structure by vehicle and then by hand. Access steps should also be provided to gain access to the channel bed in front of the screen. A temporary storage area for debris should be provided out of the area where the debris could be dragged back into the flow, so that material can dry off before transporting it to tip.

The proposed construction of trash screens will require a cleansing and structural inspection regime to be set up overseen by the local authority. Inspections should be carried out to monitor the build-up of debris on the screens and clearance works carried out as required. Failure to undertake inspections and clearance works will ultimately see the screens being blocked and the filling of the watercourse channel upstream before the overtopping of the structure.

The Fillongley catchment is very rural therefore it is envisaged that agricultural and natural waste will form the bulk of the debris collected on the trash screen with a small percentage of urban waste from potential fly tipping. The clearance works should be monitored and recorded on a suitable database with before and after pictures of the works carried out. Any issues arising from the debris collected should be taken up with upstream land owners and with Environmental Health should dangerous material be found.

It is advised that inspections are carried out initially on a high frequency before during and after storm events on an ad-hoc basis and once weekly on a routine basis over the first year. This is so that a history database can be set up of the recorded findings. Once the frequency of blockages is ascertained then the regime can be a tailored to suit the area. Screens that block more frequently than others can be inspected and cleared on a 4 to 8 weekly basis.

7 Conclusions and Recommendations

This report has demonstrated that there is a risk of flooding to 14 properties in Fillongley. The catchment would appear to be particularly sensitive to flooding during periods when the catchment greenfield areas are saturated prior to a rainfall event. Under such circumstances the village is susceptible to flooding for rainfall events of 1 year return period and greater.

Anecdotal evidence indicates that there is a long history of flooding in the village. The two most recent events in 2007 and 2008 have a reasonable amount of supporting information available.

A hydraulic model has been built of the catchment and watercourse to examine the efficacy of flood prevention options. Each of these options is discussed in more detail in Section 5.

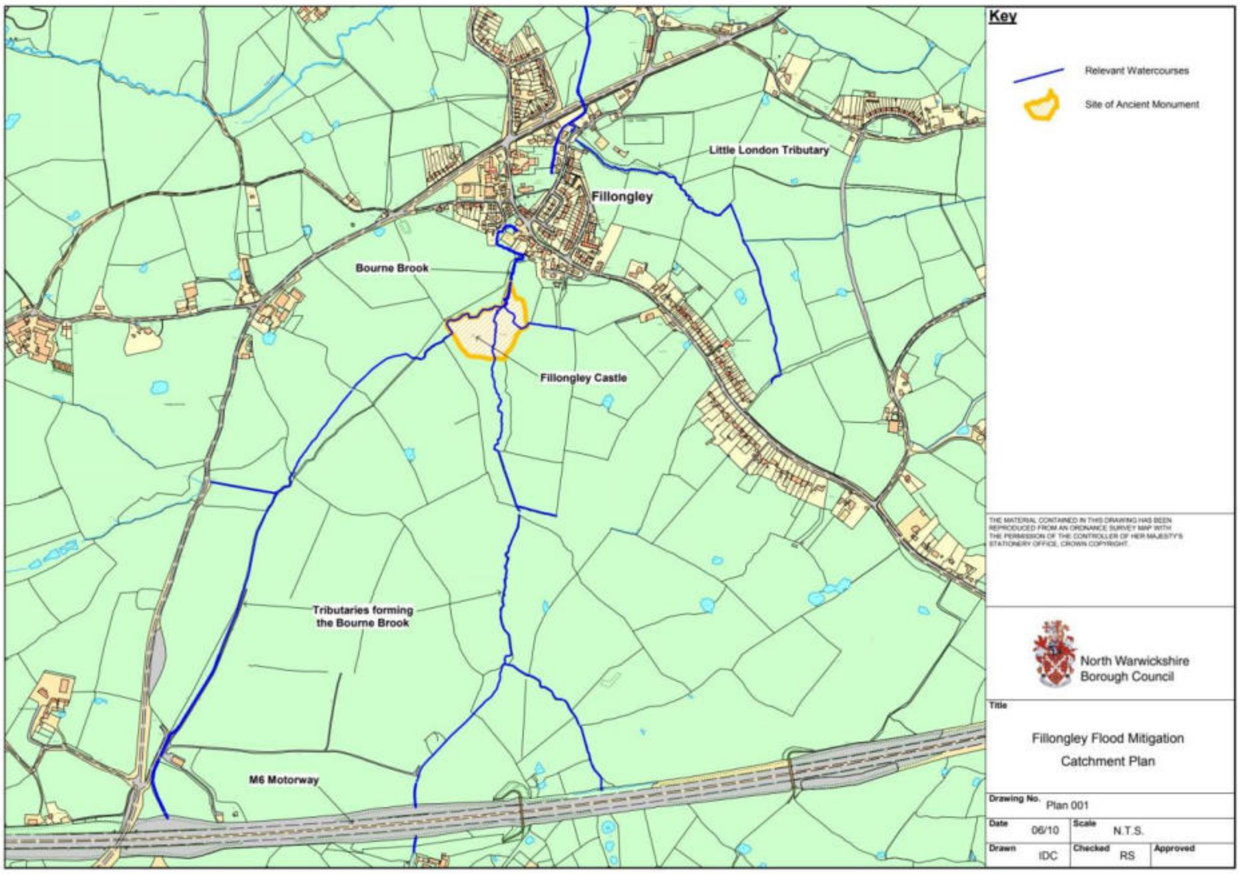
The recommended option is Option C which has a cost of **£170,000** and could be constructed in phases. The first phase would be the gulley isolation which is effectively Option A and has a cost of **£63,100**. The second phase would be to carry out the reconstruction of the headwall and has an additional cost of **£106,900**. When completed the model indicates that these measures would protect the village from flooding up to a 50 year event. There are a number of risks associated with this option which are explained in detail in Section 5.

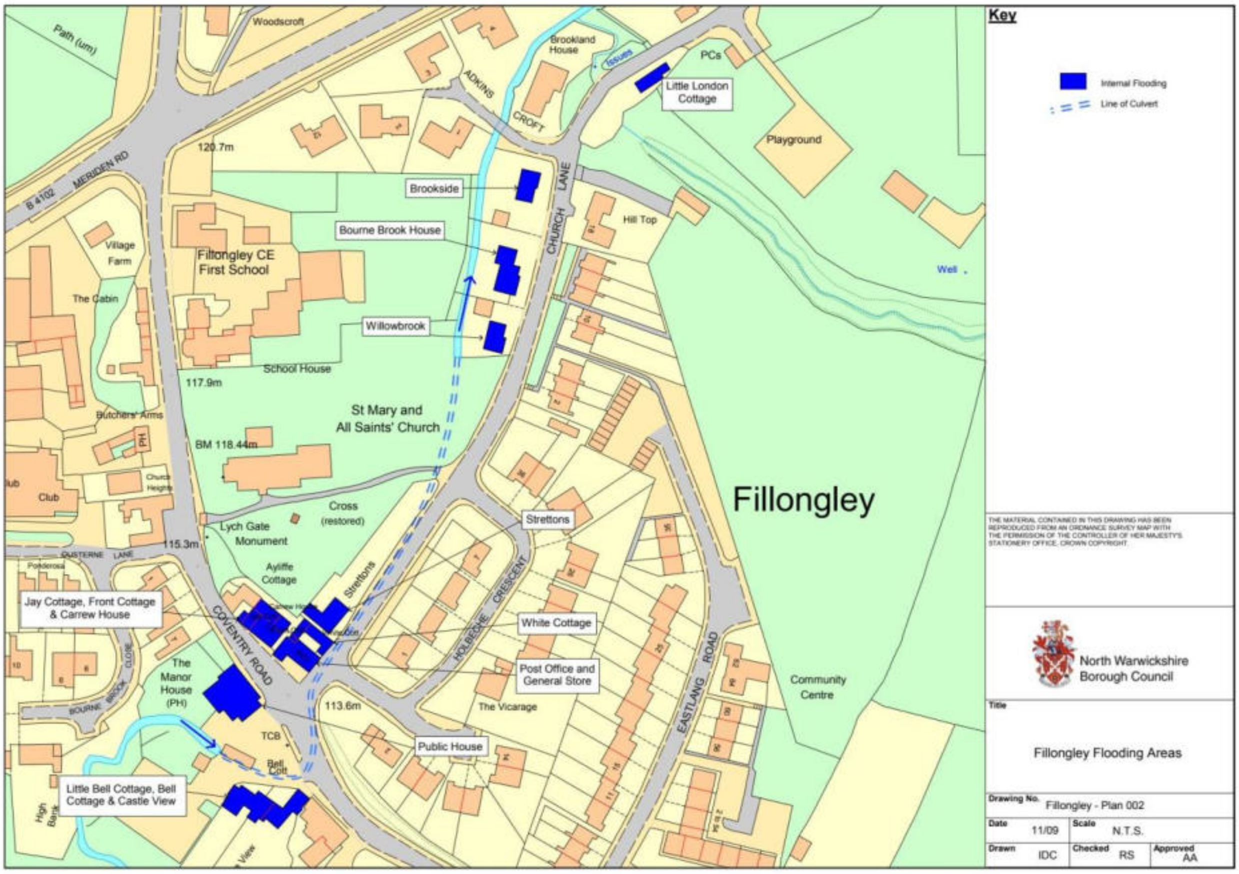
These costs do not allow for feasibility, design, contract preparation, or supervision costs, or any works proposed to the various organisations or private individuals involved.

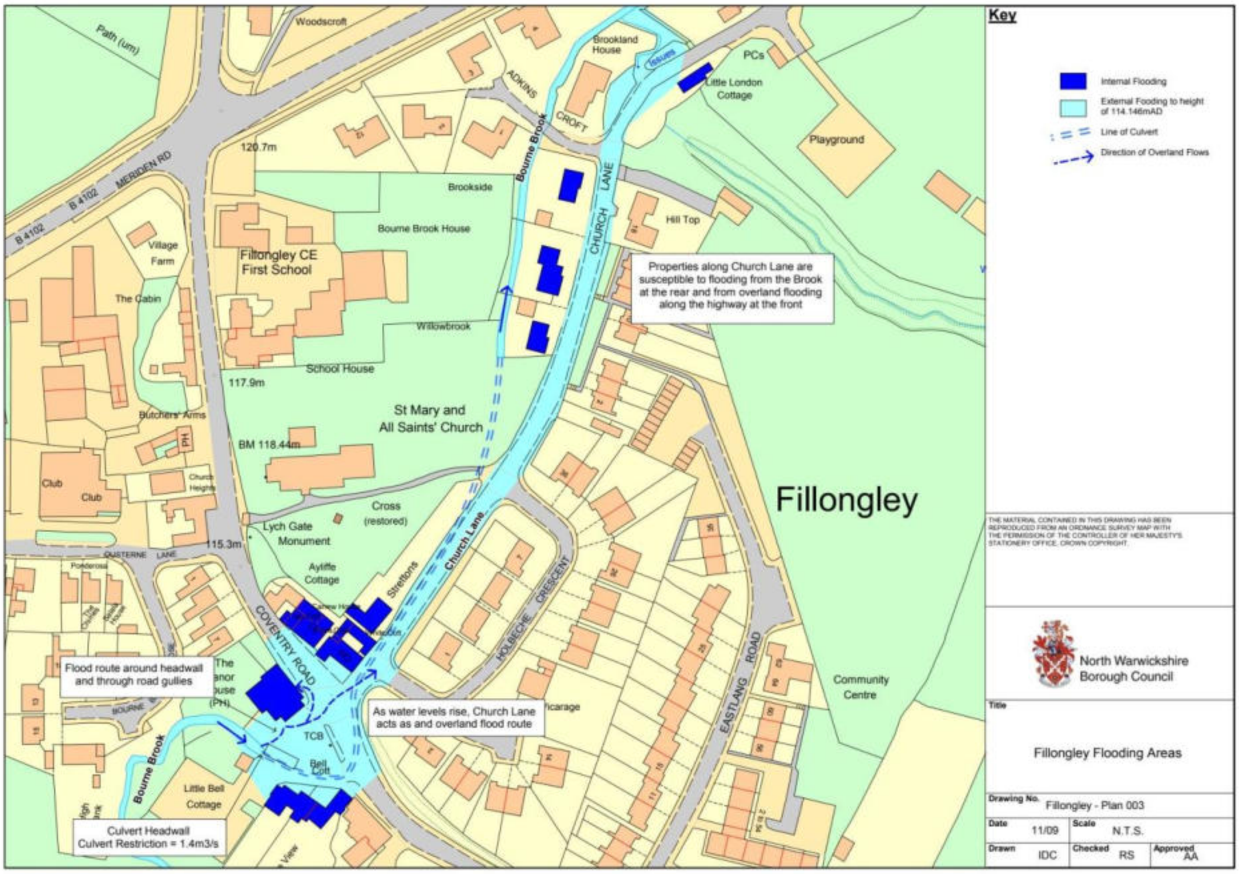
It is recommended that negotiations take place with the other stakeholders with a view to obtaining a contribution from them for the preferred option. It would seem to be reasonable that the cost of mitigating the effects of flooding are shared amongst the various agencies which contribute toward the problem. Negotiations should therefore take place with Severn Trent Water, Warwickshire County Council and the Highways Agency.

8 Appendices

Appendix A – Plans


Key
Relevant Watercourses
Site of Ancient Monument
Little London Tributary
Fillongley
Bourne Brook
Fillongley Castle
Tributaries forming the Bourne Brook
M6 Motorway
THE MATERIAL CONTAINED IN THIS DRAWING HAS BEEN REPRODUCED FROM AN ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE CONTROLLER OF HER MAJESTY'S STATIONERY OFFICE, CROWN COPYRIGHT.
North Warwickshire Borough Council
Title
Fillongley Flood Mitigation Catchment Plan
Drawing No. Plan 001
Date 06/10
Scale N.T.S.
Drawn IDC
Checked RS
Approved


Key
Internal Flooding
Line of Culvert
Woodscroft
Path (um)
Brookland House
Issues
PCs
Little London Cottage
Adkins Croft
Playground
120.7m
B 4102 Meriden Rd
Brookside
Bourne Brook House
Church Lane
Hill Top
Village Farm
Fillongley CE First School
Well
The Cabin
Willowbrook
School House
117.9m
St Mary and All Saints' Church
Butchers' Arms
PH
BM 118.44m
Club
Church Heights
Fillongley
Stretton
Cross (restored)
Lych Gate Monument
115.3m
Ousterne Lane
Ponderosa
Aylife Cottage
Strettons
Jay Cottage, Front Cottage & Carrew House
Coventry Road
Holbeche Crescent
White Cottage
Post Office and General Store
The Manor House (PH)
Bourne Brook Close
113.6m
The Vicarage
Eastlang Road
Community Centre
TCB
Bell Croft
Public House
Little Bell Cottage, Bell Cottage & Castle View
High Bank
THE MATERIAL CONTAINED IN THIS DRAWING HAS BEEN REPRODUCED FROM AN ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE CONTROLLER OF HER MAJESTY'S STATIONERY OFFICE, CROWN COPYRIGHT.
North Warwickshire Borough Council
Title
Fillongley Flooding Areas
Drawing No. Fillongley - Plan 002
Date 11/09
Scale N.T.S.
Drawn IDC
Checked RS
Approved AA


Key
Internal Flooding
External Fooding to height of 114.146mAD
Line of Culvert
Direction of Overland Flows
Properties along Church Lane are susceptible to flooding from the Brook at the rear and from overland flooding along the highway at the front
Flood route around headwall and through road gullies
As water levels rise, Church Lane acts as and overland flood route
Culvert Headwall
Culvert Restriction = 1.4m3/s
Fillongley
Fillongley CE First School
St Mary and All Saints' Church
Bourne Brook
Church Lane
Coventry Road
Holbeche Crescent
Eastlang Road
Meriden Rd
B 4102
Community Centre
Playground
North Warwickshire Borough Council
Title
Fillongley Flooding Areas
Drawing No. Fillongley - Plan 003
Date 11/09
Scale N.T.S.
Drawn IDC
Checked RS
Approved AA

Appendix B – Calculations

DRAFT

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Catchment sheet

Catchment name: Bourne Brook at junction of Little London

Catchment Descriptors (Descriptors in bold are used within model)

File name: C:\SDA Projects\Fillongley\Fillongley\FEH Data\ds Fillongley.csv

Import Catchment Descriptors

FEH CD ROM version	1	Exported on		
Easting	428150	Northing	287300	
Area	5.87			
FARL	1	RMED-1H	10.8	
PROPWET	0.3	RMED-1D	32.6	
ALTBAR	148	RMED-2D	40.7	
ASPBAR	21	**SAAR**	709	
ASPVAR	0.33	SAAR4170	704	
BFIHOST	0.577	SPRHOST	32.7	
DPLBAR	2.23	URBCONC	0.483	
DPSBAR	44.3	**URBEXT1990**	0.018	essentially rural
LDP	4.19	URBLOC	0.706	
C	-0.027	C(1km)	-0.027	
D1	0.364	D1(1km)	0.365	
D2	0.323	D2(1km)	0.326	
D3	0.254	D3(1km)	0.257	
E	0.306	E(1km)	0.308	
F	2.377	F(1km)	2.373	

Catchment Comment:

Catchment Comment list: User comments

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Rainfall sheet

Catchment name: Bourne Brook at junction of Little London

Specify design rainfall

Time Step (hr): 0.25
Duration (hr): 5.25

Return Period (yr): 100

Season: Winter (Recommended Season is Winter as URBEXT is less than 0.125)

Seasonal Correction Factor
SCF method: ReFH Design Standard — SCF: 0.69

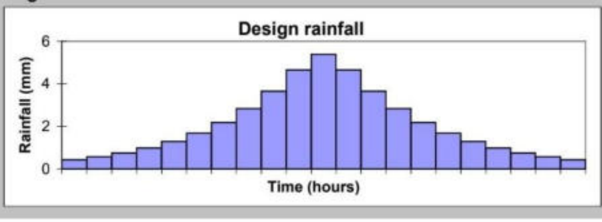
Areal Reduction Factor
ARF method: ReFH Design Standard — ARF: 0.96

Rainfall Comment:
Rainfall Comment list: User comments

Add Comment to List

Clear List

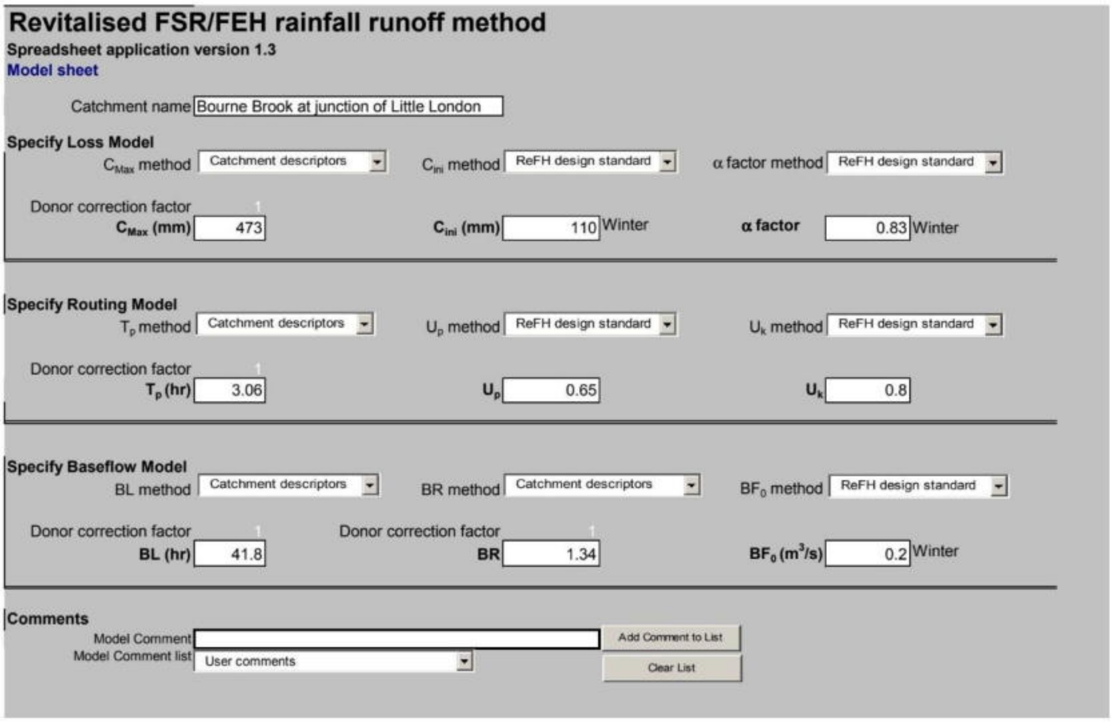
Design Rainfall Results



FEH DDF Model rainfall (mm): 65.5

Design rainfall (mm): 43.5

Peak rainfall (mm): 5.4



Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Model sheet

Catchment name: Bourne Brook at junction of Little London

Specify Loss Model

C_{Max} method: Catchment descriptors | C_{ini} method: ReFH design standard | α factor method: ReFH design standard

Donor correction factor: 1

C_{Max} (mm) 473 | **C_{ini} (mm)** 110 Winter | **α factor** 0.83 Winter

Specify Routing Model

T_p method: Catchment descriptors | U_p method: ReFH design standard | U_k method: ReFH design standard

Donor correction factor: 1

T_p (hr) 3.06 | **U_p** 0.65 | **U_k** 0.8

Specify Baseflow Model

BL method: Catchment descriptors | BR method: Catchment descriptors | BF_0 method: ReFH design standard

Donor correction factor: 1 | Donor correction factor: 1

BL (hr) 41.8 | **BR** 1.34 | **BF_0 (m^3/s)** 0.2 Winter

Comments

Model Comment: [ ] Add Comment to List

Model Comment list: User comments | Clear List

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Results sheet

Catchment name: Bourne Brook at junction of Little London

Easting 428150
Northing 287300

Model Parameters

Design rainfall parameters		Loss model parameters		Routing model parameters		Baseflow model parameters		Catchment descriptors	
Return period (yr)	100	C_{max} (mm)	473	T_p (hr)	3.06	BL (hr)	41.8	URBEXT	0.018
Duration (hr)	5.25	C_{ini} (mm)	110	U_p	0.65	BR	1.34		
Timestep (hr)	0.25	α factor	0.83	U_k	0.8	BF_0 (m^3/s)	0.2		
Season	Winter								

Run Model

Generate Audit Report

Summary

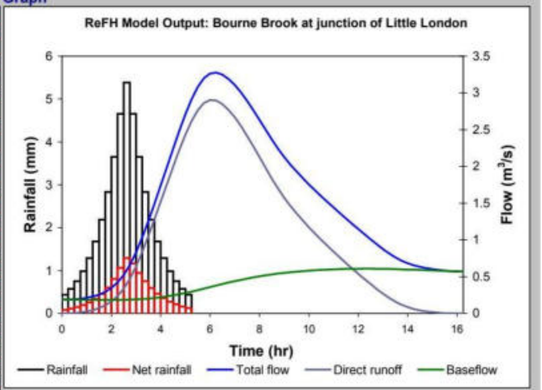
FEH DDF rainfall (mm)	65.5	Peak rainfall (mm)	5.4
Design rainfall (mm)	43.5	Peak flow (m^3/s)	3.3

Progress: Complete

Data

Series	Design Rainfall	Net rainfall	Direct runoff	Baseflow	Total flow
Units	mm	mm	m3/s	m3/s	m3/s
0.00	0.4	0.1	0.0	0.2	0.2
0.25	0.6	0.1	0.0	0.2	0.2
0.50	0.8	0.1	0.0	0.2	0.2
0.75	1.0	0.2	0.0	0.2	0.2
1.00	1.3	0.3	0.0	0.2	0.2
1.25	1.7	0.3	0.0	0.2	0.2
1.50	2.2	0.5	0.1	0.2	0.3
1.75	2.8	0.6	0.1	0.2	0.3
2.00	3.7	0.8	0.2	0.2	0.3
2.25	4.7	1.1	0.2	0.2	0.4
2.50	5.4	1.3	0.3	0.2	0.5
2.75	4.7	1.2	0.5	0.2	0.7
3.00	3.7	0.9	0.6	0.2	0.8
3.25	2.8	0.8	0.8	0.2	1.0
3.50	2.2	0.6	1.1	0.2	1.3
3.75	1.7	0.5	1.3	0.2	1.5
4.00	1.3	0.4	1.5	0.2	1.7
4.25	1.0	0.3	1.8	0.2	2.0
4.50	0.8	0.2	2.0	0.2	2.2
4.75	0.6	0.2	2.2	0.3	2.5
5.00	0.4	0.1	2.4	0.3	2.7
5.25	0.0	0.0	2.6	0.3	2.9
5.50	0.0	0.0	2.8	0.3	3.1
5.75	0.0	0.0	2.9	0.3	3.2
6.00	0.0	0.0	2.9	0.4	3.3
6.25	0.0	0.0	2.9	0.4	3.3
6.50	0.0	0.0	2.8	0.4	3.2
6.75	0.0	0.0	2.8	0.4	3.2
7.00	0.0	0.0	2.7	0.4	3.1
7.25	0.0	0.0	2.5	0.5	3.0
7.50	0.0	0.0	2.4	0.5	2.9
7.75	0.0	0.0	2.3	0.5	2.8
8.00	0.0	0.0	2.1	0.5	2.6
8.25	0.0	0.0	2.0	0.5	2.5
8.50	0.0	0.0	1.8	0.5	2.4
8.75	0.0	0.0	1.7	0.5	2.2
9.00	0.0	0.0	1.6	0.6	2.1
9.25	0.0	0.0	1.5	0.6	2.0
9.50	0.0	0.0	1.4	0.6	1.9
9.75	0.0	0.0	1.3	0.6	1.8
10.00	0.0	0.0	1.2	0.6	1.8
10.25	0.0	0.0	1.1	0.6	1.7
10.50	0.0	0.0	1.0	0.6	1.6
10.75	0.0	0.0	0.9	0.6	1.5
11.00	0.0	0.0	0.8	0.6	1.4
11.25	0.0	0.0	0.8	0.6	1.4
11.50	0.0	0.0	0.7	0.6	1.3
11.75	0.0	0.0	0.6	0.6	1.2
12.00	0.0	0.0	0.5	0.6	1.1
12.25	0.0	0.0	0.5	0.6	1.1
12.50	0.0	0.0	0.4	0.6	1.0
12.75	0.0	0.0	0.3	0.6	0.9
13.00	0.0	0.0	0.3	0.6	0.9
13.25	0.0	0.0	0.2	0.6	0.8
13.50	0.0	0.0	0.2	0.6	0.8
13.75	0.0	0.0	0.1	0.6	0.7
14.00	0.0	0.0	0.1	0.6	0.7
14.25	0.0	0.0	0.1	0.6	0.7
14.50	0.0	0.0	0.0	0.6	0.6
14.75	0.0	0.0	0.0	0.6	0.6
15.00	0.0	0.0	0.0	0.6	0.6
15.25	0.0	0.0	0.0	0.6	0.6
15.50	0.0	0.0	0.0	0.6	0.6
15.75	0.0	0.0	0.0	0.6	0.6
16.00	0.0	0.0	0.0	0.6	0.6
16.25	0.0	0.0	0.0	0.6	0.6
Totals	43.5	10.4	10.4	4.4	14.8

Graph



Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Catchment sheet

Catchment name: Little london Tributary

Catchment Descriptors (Descriptors in bold are used within model)

File name: C:\SDA Projects\Fillongley\Fillongley\FEH Data\Little London.csv

Import Catchment Descriptors

FEH CD ROM version	1	Exported on	
Easting	428200	Northing	287300
Area	0.76		
FARL	1	RMED-1H	10.7
PROPWET	0.3	RMED-1D	32.6
ALTBAR	137	RMED-2D	40.6
ASPBAR	300	**SAAR**	704
ASPVAR	0.62	SAAR4170	704
BFIHOST	0.419	SPRHOST	40.1
DPLBAR	0.89	URBCONC	0.7
DPSBAR	41.2	**URBEXT1990**	0.02 essentially rural
LDP	1.53	URBLOC	0.706
C	-0.027	C(1km)	-0.027
D1	0.362	D1(1km)	0.365
D2	0.328	D2(1km)	0.326
D3	0.253	D3(1km)	0.257
E	0.306	E(1km)	0.308
F	2.384	F(1km)	2.373

Catchment Comment

Catchment Comment list: User comments

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Rainfall sheet

Catchment name: Little london Tributary

Specify design rainfall

Time Step (hr)	0.25
Duration (hr)	4.75
Return Period (yr)	100
Season	Winter

(Recommended Season is Winter as URBEXT is less than 0.125)

Seasonal Correction Factor

SCF method: ReFH Design Standard — SCF 0.68

Areal Reduction Factor

ARF method: ReFH Design Standard — ARF 0.98

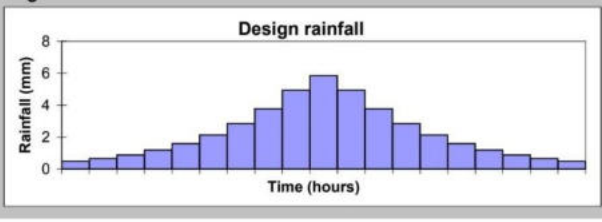
Rainfall Comment

Rainfall Comment list: User comments

Add Comment to List

Clear List

Design Rainfall Results



FEH DDF Model rainfall (mm)	64.2
Design rainfall (mm)	42.8
Peak rainfall (mm)	5.8

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Model sheet

Catchment name: Little london Tributary

Specify Loss Model

C_{Max} method	Catchment descriptors	C_{ini} method	ReFH design standard	α factor method	ReFH design standard
Donor correction factor	1				
C_{Max} (mm)	349	**C_{ini} (mm)**	128 Winter	**α factor**	0.83 Winter

Specify Routing Model

T_p method	Catchment descriptors	U_p method	ReFH design standard	U_k method	ReFH design standard
Donor correction factor	1				
T_p (hr)	1.79	**U_p**	0.65	**U_k**	0.8

Specify Baseflow Model

BL method	Catchment descriptors	BR method	Catchment descriptors	BF_0 method	ReFH design standard
Donor correction factor	1	Donor correction factor	1		
BL (hr)	29.4	**BR**	0.95	**BF_0 (m^3/s)**	0 Winter

Comments

Model Comment: [blank]   Add Comment to List

Model Comment list: User comments   Clear List

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application version 1.3

Results sheet

Catchment name: Little london Tributary

Easting 428200
Northing 287300

Model Parameters

Design rainfall parameters		Loss model parameters		Routing model parameters		Baseflow model parameters		Catchment descriptors	
Return period (yr)	100	C_{max} (mm)	349	T_p (hr)	1.79	BL (hr)	29.4	URBEXT	0.02
Duration (hr)	4.75	C_{ini} (mm)	128	U_p	0.65	BR	0.95		
Timestep (hr)	0.25	α factor	0.83	U_k	0.8	BF_0 (m^3/s)	0		
Season	Winter								

Run Model

Generate Audit Report

Summary

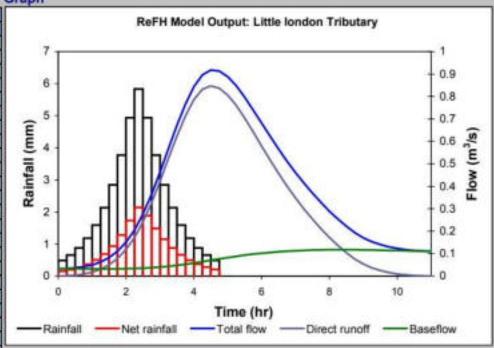
FEH DDF rainfall (mm)	64.2	Peak rainfall (mm)	5.8
Design rainfall (mm)	42.8	Peak flow (m^3/s)	0.9

Progress: Complete

Data

Series	Design Rainfall	Net rainfall	Direct runoff	Baseflow	Total flow
Units	mm	mm	m3/s	m3/s	m3/s
0.00	0.5	0.1	0.0	0.0	0.0
0.25	0.7	0.2	0.0	0.0	0.0
0.50	0.9	0.3	0.0	0.0	0.0
0.75	1.2	0.4	0.0	0.0	0.0
1.00	1.6	0.5	0.0	0.0	0.0
1.25	2.1	0.7	0.0	0.0	0.1
1.50	2.8	0.9	0.1	0.0	0.1
1.75	3.8	1.3	0.1	0.0	0.1
2.00	4.9	1.7	0.1	0.0	0.2
2.25	5.8	2.1	0.2	0.0	0.2
2.50	4.9	1.9	0.2	0.0	0.3
2.75	3.8	1.5	0.3	0.0	0.4
3.00	2.8	1.1	0.4	0.0	0.5
3.25	2.1	0.9	0.5	0.0	0.6
3.50	1.6	0.7	0.6	0.0	0.7
3.75	1.2	0.5	0.7	0.1	0.8
4.00	0.9	0.4	0.8	0.1	0.8
4.25	0.7	0.3	0.8	0.1	0.9
4.50	0.5	0.2	0.8	0.1	0.9
4.75	0.0	0.0	0.8	0.1	0.9
5.00	0.0	0.0	0.8	0.1	0.9
5.25	0.0	0.0	0.8	0.1	0.8
5.50	0.0	0.0	0.7	0.1	0.8
5.75	0.0	0.0	0.6	0.1	0.7
6.00	0.0	0.0	0.6	0.1	0.7
6.25	0.0	0.0	0.5	0.1	0.6
6.50	0.0	0.0	0.5	0.1	0.6
6.75	0.0	0.0	0.4	0.1	0.5
7.00	0.0	0.0	0.3	0.1	0.5
7.25	0.0	0.0	0.3	0.1	0.4
7.50	0.0	0.0	0.3	0.1	0.4
7.75	0.0	0.0	0.2	0.1	0.3
8.00	0.0	0.0	0.2	0.1	0.3
8.25	0.0	0.0	0.1	0.1	0.3
8.50	0.0	0.0	0.1	0.1	0.2
8.75	0.0	0.0	0.1	0.1	0.2
9.00	0.0	0.0	0.1	0.1	0.2
9.25	0.0	0.0	0.0	0.1	0.2
9.50	0.0	0.0	0.0	0.1	0.1
9.75	0.0	0.0	0.0	0.1	0.1
10.00	0.0	0.0	0.0	0.1	0.1
10.25	0.0	0.0	0.0	0.1	0.1
10.50	0.0	0.0	0.0	0.1	0.1
10.75	0.0	0.0	0.0	0.1	0.1
11.00	0.0	0.0	0.0	0.1	0.1
Totals	42.8	15.7	15.7	4.3	19.9

Graph



Appendix C – Photographs and Flooding History

Photographs of flooding – 20th July 2007


BECO


THE


CAR PARK


Flooding 13th December 2008
Note of issues with photographs
All Photographs taken between 12.00 and 13.00 on Saturday the 13th December. After 13.00 hours the flood waters subsided.

Location 1 Post Office, Manor House Pub and Culvert.

The culvert could not cope with the water, which fell overnight and during the morning of 13th December. The Culvert was submerged and the water held back by the pub head wall. The landlord eventually parked his van against the wall to prevent it collapsing

Water flowed around the wall through the car park to submerge the centre of the village. The police closed the road. The fire brigade pumped out the water to further down church lane to bypass the culvert.

Location 2 Little London Gulley on Church Lane
The gulley opposite Little London, which was reported as blocked did not function water ran down from Little London to the gulley at the entrance to Atkins Croft. It could not cope and there was local flooding preventing pedestrian access to the Croft.
Gulley being bypassed by water at Little London. Difference in Levels shows that there is still capacity on Brook if gulley was working

Location 3
Junction of Atkins Croft and Church Lane

Location 4 Nuneaton Road
Nuneaton Road flooded over the top of the Culvert as gulleys were blocked or could not cope. Police allowed vehicles through with care.

Culvert below on Nuneaton Road still has capacity, but not much.

Location 5 The Brook at Nuneaton Road end
Photographs show the new footpath is over topped and that it will tale capacity when flood events occur. This event was not as bad as July 2007.

Location 6 Major Trees blocking flow of Brook

Location 7 Water meadow beyond Nuneaton Road
Blockage by old timber structure meant water flow disturbed.

Issues to be arising from this flood.

- Head Wall at public house needs to be strengthened
- The new culvert under the road at the Manor did not have enough capacity.
- Gulleys in Church Lane, which were reported in correspondence to the county council as blocked, had not been cleaned causing local flooding at Atkins Croft.
- Gulleys in Nuneaton Road above the culvert did not cope and were blocked. This has been reported at every meeting
- Sand bags ran out. Aqua Sacs which had been promised at the last meeting were not delivered. The cottage behind the post office, which was supposed to have them did not. This requires immediate action.

Appendix D – Option Costs

Option A - Cost Breakdown

Should gully be located directly on culvert then grout up gully - Assume 2

2/600/39	Backfilling of disused gullies, 450 mm diameter with in-situ 4N foamed concrete	no.	2	178.04	356.08

	Cut back intrucding connections within the culvert flush with cuvert wall & make good			est.	£2,950.00
	To trace the location of drainage system's with the Manor pub car park & church land Including CCTV van and Jet Vac on site for 3 days.			est.	£3,825.00
				Total	£7,131.08

Traffic Safety and Management

1/100/08	3 way Traffic safety and management inc associated Chapter 8 signing	item		
	Site set up		£450	
	Maintain per day estimated 2weeks on site	14	£120	£1,680
	Remove from site on completion		£250	

Post Office Area

total £2,380

Breakout existing Gullys - Remove to tip
Grout up existing connections to culverts
Place new gullys and back fill
Construct new manhole with 150mm Forge non return Valve
Excavate new drainage pipes and connect to existing gullys & culvert & manhole
Back fill with Granular Material
Relay kebs with backing and bed
Reinstate full highway construction

2/200/21	Take up or down and remove to Contractor's tip off site precast concrete kerbing including bed and backing	m	4	£34.46	£137.84
2/200/32	Take up or down and remove to Contractor's tip off site gulley grating and frame	no.	4	£63.18	£252.72
2/600/38	Backfilling of disused sewer or drain 150 mm internal diameter with 1 metre or less of cover to formation	no.	1	£114.86	£114.86
2/600/11	Extra over excavation for excavation in hard material **(For New manhole & drainage)**	m^3	0.18	£45.95	£8.27
2/600/21	Disposal of unacceptable material class U1 **(For New manhole & drainage)**	m^3	0.18	£57.43	£10.34
2/500/173	Precast concrete manhole Type 11b with Class A cover and frame depth to invert exceeding 1 metre but not exceeding 2 metres	no.	1	£1,378.38	£1,378.38
2/500/183	Precast concrete trapped gulley (450 x 900 mm) with GA1-450 grating and frame	no.	4	£459.46	£1,837.84
2/500/19	150 mm internal diameter drain specified design group Z1 in trench depth to invert not exceeding 2.0 metres, average depth to invert 1.35 metres	m	10	£103.38	£1,033.80
2/500/20	Adjustment on last item for variation greater than 150 mm above or below the average depth of 1.35 metres per 25 mm of variation in excess of 150 mm	**Rate only required**		£0.46	£0.00
2/500/139	Connection of 150 mm diameter pipe to existing 450 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding 4 metres	no.	9	£183.78	£1,654.02
	Non return valve - **(Supply & Fit)**	no.	1	£817.40	£817.40
2/500/143	Connection of 150 mm diameter pipe to existing 900 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding	no.	1	£229.73	£229.73

	4 metres				
2/1100/01	Precast concrete kerbs Type HB2 laid straight or curved exceeding 12 m radius	m	4	£28.72	£114.88
2/1100/24	Additional in-situ concrete mix ST4 for precast concrete kerbs	m³	0.36	£103.38	£37.22
2/700/09	Reinstate paved area with 55/10 stone asphalt Surface Course, 40 mm thick	m²	4.5	£10.11	£45.50
2/700/08	Reinstate paved area with 20 mm aggregate Dense Macadam Binder Course, 60 mm thick	m²	4.5	£12.35	£55.58
2/700/10	Reinstate paved area with 28 mm aggregate Dense Macadam Base, 125 mm thick	m²	4.5	£25.85	£116.33
2/700/01	Granular Type 1 sub-base in carriageway, hard shoulder, hard strip and all other trafficked areas	m³	4.5	£51.69	£232.61
				Total	£8,077.30

Little Bell Cottage Area

Breakout existing Gullys - Remove to tip
Grout up existing connections to culverts
Place new gullys and back fill
Construct new manhole with 150mm Forge non return Valve
Excavate new drainage pipes and connect to existing gullys & culvert & manhole
Back fill with Granular Material
Relay kebs with backing and bed
Reinstate full highway construction

2/200/21	Take up or down and remove to Contractor's tip off site precast concrete kerbing including bed and backing	m	4	£34.46	£137.84
2/200/32	Take up or down and remove to Contractor's tip off site gulley grating and frame	no.	4	£63.18	£252.72
2/600/38	Backfilling of disused sewer or drain 150 mm internal diameter with 1 metre or less of cover to formation	no.	1	£114.86	£114.86
2/600/11	Extra over excavation for excavation in hard material **(For New manhole & drainage)**	m³	0.54	£45.95	£24.81
2/600/21	Disposal of unacceptable material class U1 **(For New manhole & drainage)**	m³	0.54	£57.43	£31.01
2/500/173	Precast concrete manhole Type 11b with Class A cover and frame depth to invert exceeding 1 metre but not exceeding 2 metres	no.	1	£1,378.38	£1,378.38
2/500/183	Precast concrete trapped gulley (450 x 900 mm) with GA1-450 grating and frame	no.	4	£459.46	£1,837.84
2/500/19	150 mm internal diameter drain specified design group Z1 in trench depth to invert not exceeding 2.0 metres, average depth to invert 1.35 metres	m	30	£103.38	£3,101.40
2/500/20	Adjustment on last item for variation greater than 150 mm above or below the average depth of 1.35 metres per 25 mm of variation in excess of 150 mm	Rate only required		£0.46	£0.00
2/500/139	Connection of 150 mm diameter pipe to existing 450 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding 4 metres	no.	8	£183.78	£1,470.24
	Non return valve - (Supply & Fit)	no.	1	£817.40	£817.40
2/500/143	Connection of 150 mm diameter pipe to existing 900 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding 4 metres	no.	1	£229.73	£229.73

2/700/09	Reinstate paved area with 55/10 stone asphalt Surface Course, 40 mm thick	m²	13.5	£10.11	£136.49
2/700/08	Reinstate paved area with 20 mm aggregate Dense Macadam Binder Course, 60 mm thick	m²	13.5	£12.35	£166.73
2/700/10	Reinstate paved area with 28 mm aggregate Dense Macadam Base, 125 mm thick	m²	13.5	£25.85	£348.98
2/700/01	Granular Type 1 sub-base in carriageway, hard shoulder, hard strip and all other trafficked areas	m³	13.5	£51.69	£697.82
				total	£10,746.24

Manor House Area

Breakout existing Gullys - Remove to tip
Grout up existing connections to culverts
Place new gullys and back fill
Construct new manhole with 150mm Forge non return Valve
Excavate new drainage pipes and connect to existing gullys & culvert & manhole
Back fill with Granular Material
Relay kebs with backing and bed
Reinstate full highway construction

2/200/21	Take up or down and remove to Contractor's tip off site precast concrete kerbing including bed and backing	m	4	£34.46	£137.84
2/200/32	Take up or down and remove to Contractor's tip off site gulley grating and frame	no.	4	£63.18	£252.72
2/600/38	Backfilling of disused sewer or drain 150 mm internal diameter with 1 metre or less of cover to formation	no.	1	£114.86	£114.86
2/600/11	Extra over excavation for excavation in hard material **(For New manhole & drainage)**	m³	1.26	£45.95	£57.90
2/600/21	Disposal of unacceptable material class U1 **(For New manhole & drainage)**	m³	1.26	£57.43	£72.36
2/500/173	Precast concrete manhole Type 11b with Class A cover and frame depth to invert exceeding 1 metre but not exceeding 2 metres	no.	1	£1,378.38	£1,378.38
2/500/183	Precast concrete trapped gulley (450 x 900 mm) with GA1-450 grating and frame	no.	4	£459.46	£1,837.84
2/500/19	150 mm internal diameter drain specified design group Z1 in trench depth to invert not exceeding 2.0 metres, average depth to invert 1.35 metres	m	70	£103.38	£7,236.60
2/500/20	Adjustment on last item for variation greater than 150 mm above or below the average depth of 1.35 metres per 25 mm of variation in excess of 150 mm	Rate only required		£0.46	£0.00
2/500/139	Connection of 150 mm diameter pipe to existing 450 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding 4 metres	no.	8	£183.78	£1,470.24
	Non return valve - (Supply & Fit)	no.	1	£817.40	£817.40
2/500/143	Connection of 150 mm diameter pipe to existing 900 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding 4 metres	no.	1	£229.73	£229.73
2/700/09	Reinstate paved area with 55/10 stone asphalt Surface Course, 40 mm thick	m²	31.5	£10.11	£318.47
2/700/08	Reinstate paved area with 20 mm aggregate Dense Macadam Binder Course, 60 mm thick	m²	31.5	£12.35	£389.03
2/700/10	Reinstate paved area with 28 mm aggregate Dense Macadam Base, 125 mm thick	m²	31.5	£25.85	£814.28

2/700/01	Granular Type 1 sub-base in carriageway, hard shoulder, hard strip and all other trafficked areas	m^3	31.5	£51.69	£1,628.24

total £16,755.87

Church Lane
Breakout existing Gullys - Remove to tip
Grout up existing connections to culverts
Place new gullys and back fill
Construct new manhole with 150mm Forge non return Valve
Excavate new drainage pipes and connect to existing gullys & culvert & manhole
Back fill with Granular Material
Relay kebs with backing and bed
Reinstate full highway construction

2/200/21	Take up or down and remove to Contractor's tip off site precast concrete kerbing including bed and backing	m	2	£34.46	£68.92
2/200/32	Take up or down and remove to Contractor's tip off site gulley grating and frame	no.	5	£63.18	£315.90
2/600/38	Backfilling of disused sewer or drain 150 mm internal diameter with 1 metre or less of cover to formation	no.	16	£114.86	£1,837.76
2/600/11	Extra over excavation for excavation in hard material **(For New manhole & drainage)**	m^3	0.774	£45.95	£35.57
2/600/21	Disposal of unacceptable material class U1 **(For New manhole & drainage)**	m^3	0.774	£57.43	£44.45
2/500/173	Precast concrete manhole Type 11b with Class A cover and frame depth to invert exceeding 1 metre but not exceeding 2 metres	no.	2	£1,378.38	£2,756.76
2/500/183	Precast concrete trapped gulley (450 x 900 mm) with GA1-450 grating and frame	no.	5	£459.46	£2,297.30
2/500/19	150 mm internal diameter drain specified design group Z1 in trench depth to invert not exceeding 2.0 metres, average depth to invert 1.35 metres	m	43	£103.38	£4,445.34
2/500/20	Adjustment on last item for variation greater than 150 mm above or below the average depth of 1.35 metres per 25 mm of variation in excess of 150 mm	Rate only required		£0.46	£0.00
2/500/139	Connection of 150 mm diameter pipe to existing 450 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding 4 metres	no.	12	£183.78	£2,205.36
	Non return valve - (Supply & Fit)	no.	2	£817.40	£1,634.80
2/500/143	Connection of 150 mm diameter pipe to existing 900 mm diameter drain or existing piped culvert depth to invert exceeding 2 metres but not exceeding 4 metres	no.	2	£229.73	£459.46
2/700/09	Reinstate paved area with 55/10 stone asphalt Surface Course, 40 mm thick	m^2	19.35	£10.11	£195.63
2/700/08	Reinstate paved area with 20 mm aggregate Dense Macadam Binder Course, 60 mm thick	m^2	19.35	£12.35	£238.97
2/700/10	Reinstate paved area with 28 mm aggregate Dense Macadam Base, 125 mm thick	m^2	19.35	£25.85	£500.20
2/700/01	Granular Type 1 sub-base in carriageway, hard shoulder, hard strip and all other trafficked areas	m^3	19.35	£51.69	£1,000.20

total £18,036.62

Grand Total £63,127.10

Option B Costs - Balancing Pond Only

Series		Amount £	p
100	Preliminaries	£0.00	
200	Site Clearance	£6,424.40	
300	Fencing, Gates and Stiles	£24,663.36	
500	Drainage and Service Ducts	£2,182.40	
600	Earthworks	£349,358.28	
700	Pavements	£74,869.33	
1200	Traffic Signs, Road Markings and Ancillaries	£1,527.70	
1700	Structural Concrete	£2,908.58	
1800	Steelwork for Structures	£5,000.00	
2400	Brickwork, Blockwork and Stonework	£0.00	
2700	Provisional Sums and Prime Cost Items	£11,216.00	
3000	Landscape and Ecology	£72,060.40	
	Sub-Total	£550,210.46	
	Add 5% for Contingencies	£27,510.52	
	TENDER TOTAL Carried to Form of Tender	£577,720.99	

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Date …………………………………

127

The prices are based on possible 5300m3 and 6700m3 flood storage areas. , it is assumed that the land is completely flat and ground conditions are ideal to construct on. We would require a full topographic survey to be taken of the proposed sites along with trail holes and core samples taken. Planning permission would be required and agreement and funding from land owners for the adoption of the land. Land owners would have to be consulted to ascertain how much material could be spread onsite as this will reduce tipping costs.

I have therefore allowed for the following:

Generally site clearance
Take up existing cattle fencing

Construct unbound access road with turning head/parking:
200mm 6G material
150mm type 1 layer
100mm type 1 to dust layer

Erection of access gates for pedestrians & vehicles to safe guard site.

Construct headwalls from concrete and surround with keyclamp fencing, construct control structure in watercourse
Excavate out 1.1m deep storage area including 0.100 topsoil, to be stored onsite and resited in storage area to vegetate.
Excavate 1m acceptable material
Form bund approx 18m3 in section by 100m in length, cover with 100mm of topsoil. All other material to go off site.
Take up 4 – 8 existing land drains to the sides of the storage area, and construct new headwall on them.

Surround flood storage area with cattle fencing
Along sections of roadway over control structure construct 3 rail wooden fencing to stop undesired access.
Erect safety rings and deep water signs

Grass seed all areas
Plant up pond and wetland

Option C - Headwall Reconstruction

Demolish & Reconstruct wall

Remove tree and exavate out stump
Take up brige for reuse
Take down existing collaping wall - Assume 35m in length
Reconstuct using reinforced concrete filled hollow concret blocks
Waterproof Concrete face with Bitium, filter drain, Filtram membram
Resite footbridge
Face concrete wall with red brick to tie in with conservation area, use stainless steel ties
Construct trash Screen

Large Tree

	Remove Tree and route mass				£600.00

Raise Footbride

	Prep footings for removal, two day Crane Hire, Prep footings & reset				£10,000.00

Garage

	Demolish existing garage & reconstruct garage 5.4m x 3.6m in size with 0.600 x 0.600 concrete footings				£10,000.00

Total £20,600.00

Headwall

2/200/01	General Site Clearance	ha	0.023	########	£261.89
2/200/29	Take up or down and remove to Contractor's tip off site brickwall, 230 mm thick	m²	60	£57.43	£3,445.80
2/600/10	Extra over excavation for excavation in hard material in cuttings and other excavation	m³	2	£45.95	£91.90
2/600/07	Excavation of unacceptable material Class U1	m³	175	£22.97	£4,019.75
2/600/33	Excavation of soft spots and other voids below cuttings or under embankments	m³	4	£57.43	£229.72
2/600/34	Filling of soft spots and other voids below cuttings or under embankments with granular type 1	m³	4	£57.43	£229.72
2/600/21	Disposal of unacceptable material class U1	m³	181	£57.43	£10,394.83
2/1700/11	High yield steel for reinforcement nominal 16 mm and under of 12 metres length or less	tonne	2.1	£1,435.81	£3,015.20
2/1700/03	In situ concrete RC30	m³	32.55	£201.01	£6,542.88
2/1700/06	Formwork Class F1 vertical more than 300 mm wide	m²	271.5	£45.95	£12,475.43
2/2000/02	Waterproofing with two coats of bitumen sprayed or brushed to surfaces more than 300 mm wide or less at any inclination	m²	151	£28.72	£4,336.72
2/2400/03	Brickwork in Engineering Class B bricks in cement mortar designation type (i) one and a half brick thick in any bond in wall	m²	126	£137.84	£17,367.84
	Stainless steel ties spaced 5 per square m	no.	525	£3.90	£2,047.50
2/500/125	150 mm single diameter filter drain specified design group Type H1 in trench	m	35	£45.95	£1,608.25

	depth to invert not exceeding 2 metres, average depth to invert 1.0 metre				
	Filtram	m^2	129	£5.00	£645.00
2/600/23	Imported acceptable material Class 6F2 in embankments and other areas of fill	m^3	119	£51.69	£6,151.11
2/700/01	Granular Type 1 sub-base in carriageway, hard shoulder, hard strip and all other trafficked areas 200mm thick	m^3	19.32	£51.69	£998.65
2/700/11	Reinstate paved area (footway) with 20 mm aggregate Dense Macadam Binder Course, 50 mm thick	m^2	84	£11.49	£965.16
2/700/12	Reinstate paved area (footway) with 45/6 stone asphalt Surface Course, 25 mm thick	m^2	84	8.27	694.68
2/400/07	Kee Klamp Type 90º galvanised 50 mm diameter tube handrails, 1 m high inclusive of posts and fittings, or similar approved	m	35	£57.43	£2,010.05
2/1200/01	"Danger Deep Water" yellow signage 400mm x 600mm PVC on backing boards mounted on 4 m long 75 mm diamter plastic coated tubular steel posts	no.	2	£252.70	£505.40
2/1200/02	Life rings - 600 mm "Glasdon" lifebouy	no.	1	£258.45	£258.45

	Trash Screen				£8,000.00

total	#########

Option D - Balancing Pond Only

Series		Amount £	p
100	Preliminaries	£0.00	
200	Site Clearance	£3,802.02	
300	Fencing, Gates and Stiles	£36,181.68	
500	Drainage and Service Ducts	£0.00	
600	Earthworks	£488,189.72	
700	Pavements	£74,869.33	
1200	Traffic Signs, Road Markings and Ancillaries	£1,527.70	
1700	Structural Concrete	£2,908.58	
1800	Steelwork for Structures	£5,000.00	
2400	Brickwork, Blockwork and Stonework	£0.00	
2700	Provisional Sums and Prime Cost Items	£11,216.00	
3000	Landscape and Ecology	£88,747.16	
	Sub-Total	£712,442.20	
	Add 5% for Contingencies	£35,622.11	
	TENDER TOTAL Carried to Form of Tender	£748,064.31	

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Date …………………………………

127

The prices are based on possible 5300m3 and 6700m3 flood storage areas. , it is assumed that the land is completely flat and ground conditions are ideal to construct on. We would require a full topographic survey to be taken of the proposed sites along with trail holes and core samples taken. Planning permission would be required and agreement and funding from land owners for the adoption of the land. Land owners would have to be consulted to ascertain how much material could be spread onsite as this will reduce tipping costs.

I have therefore allowed for the following:

Generally site clearance
Take up existing cattle fencing

Construct unbound access road with turning head/parking:
200mm 6G material
150mm type 1 layer
100mm type 1 to dust layer

Erection of access gates for pedestrians & vehicles to safe guard site.

Construct headwalls from concrete and surround with keyclamp fencing, construct control structure in watercourse
Excavate out 1.1m deep storage area including 0.100 topsoil, to be stored onsite and resited in storage area to vegetate.
Excavate 1m acceptable material
Form bund approx 18m3 in section by 100m in length, cover with 100mm of topsoil. All other material to go off site.
Take up 4 – 8 existing land drains to the sides of the storage area, and construct new headwall on them.

Surround flood storage area with cattle fencing
Along sections of roadway over control structure construct 3 rail wooden fencing to stop undesired access.
Erect safety rings and deep water signs

Grass seed all areas
Plant up pond and wetland

Option E - Cost Estimate

Option	Length of Barrier	Height of Barrier	Cost £/m	Cost £	Uplift for Price Inflation (20%) £
E1	36	0.9m	340	12240	14688
E2	47	0.5m	150	7050	8460
E3	60	0.9m	340	20400	24480
E4	82	0.5m	150	12300	14760

Costs are based on fluvial solutions "Floodstop" barrier. Data obtained in January 2010.

Appendix E – Maintenance Costs

Maintenance Costs

Screen Clearance estimated Costs

Prices Based on approx meterage of debris cleared per visit		Estimated to be cleared 1x a every month		Adhoc clearances		annually	Over 5 years
Little London Triburity Screen	£11.99	12	£143.91	8	£95.94	£239.85	£1,199.25
Manor House Public House Screen	£22.14	12	£265.68	8	£177.12	£442.80	£2,214.00
Flood storage area 1 screen	£27.68	12	£332.10	8	£221.40	£553.50	£2,767.50
Flood storage area 2 screen	£27.68	12	£332.10	8	£221.40	£553.50	£2,767.50
	Total		£1,073.79		£715.86	£1,789.65	£8,948.25

Estimated costs to visit operate, cleans, and grease Forge valve's

		Approx number of valves:-	Cost per valve	1x visit annually	2x visits annually	over 5 years based on 2x visit annually
Surface water drainage to watercourse culvert		5	£65.00	£325.00	£650.00	£3,250.00
Properties to Severn trent foul System		14	£65.00	£910.00	£1,820.00	£9,100.00
	Total	19		£1,235.00	£2,470.00	£12,350.00

CCTV Survey & Culvert cleansing

Based on 1 x survey & culvert cleans every 5 years

CCTV Van per day	est. time onsite in days	
£600	1	£600
Jet Vac & Gully Suck		
£675	2	£1,350