70079277_TN_02

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SUBJECT:	Optioneering technical note		
PROJECT:	70079277 Colaton Raleigh FRM	**AUTHOR:**	Tom Ashby
CHECKED:	Dave Turner	**APPROVED:**	Rachel Ledger

INTRODUCTION

WSP have been commissioned by Devon County Council (DCC) to undertake a study into flooding at Colaton Raleigh, to review the level of risk and identify potential options for reducing this risk.

This technical note provides an overview of the options which have been identified following review and analysis of the available information, site walkovers and discussions with stakeholders including DCC, the Environment Agency (EA) and Colaton Raleigh Parish Council (CRPC).

Figure 1 shows the main sub-catchments which drain to the River Otter through Colaton Raleigh.

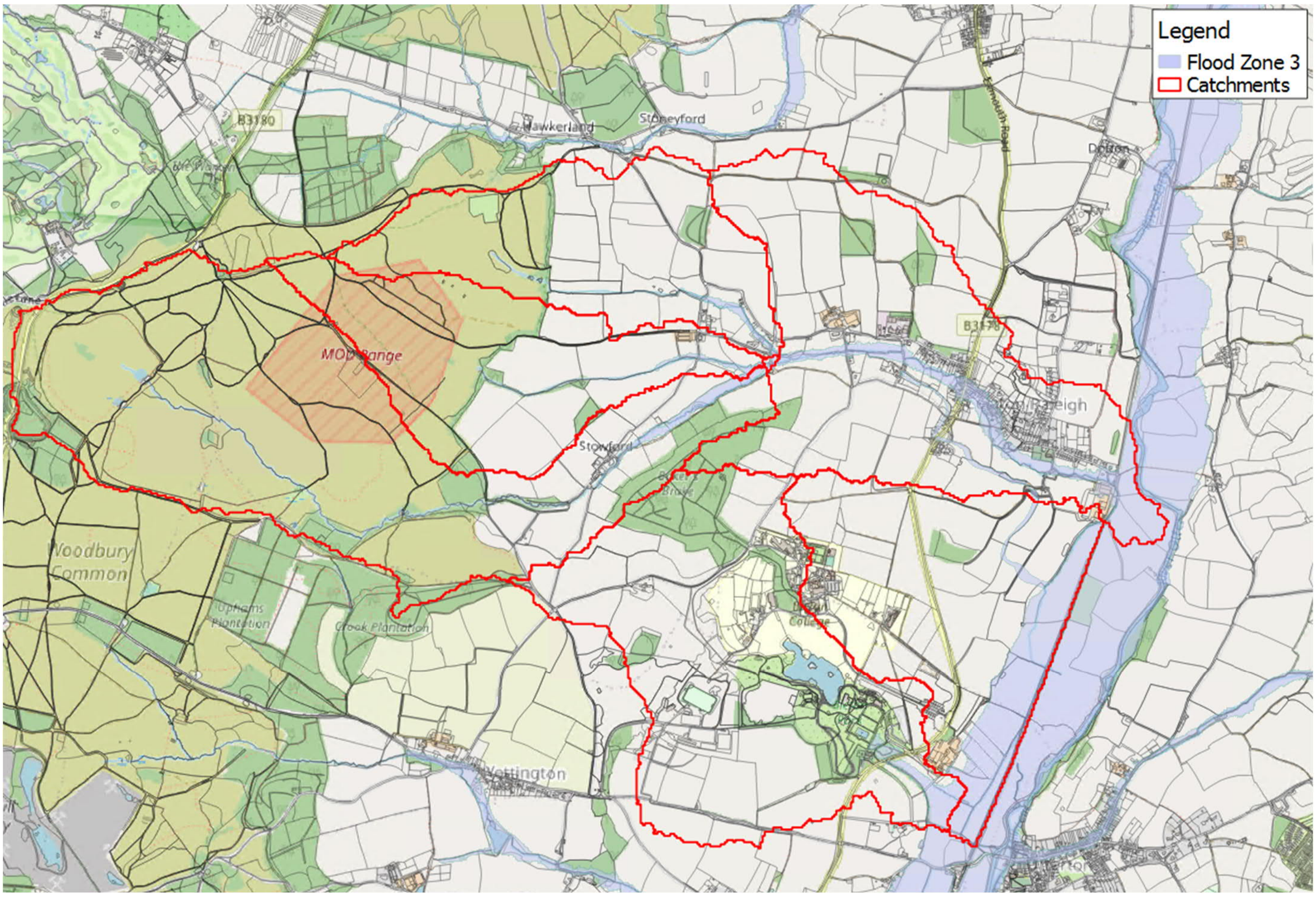

Figure 1 - Catchment plan

History of flooding

Colaton Raleigh has been subject to flooding on a number of occasions in the past, with the most recent and significant event occurring in November 2012 when much of Devon experienced significant flooding.

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Also flooding reportedly occurred in 1960, 1968, 1972, 1983, 1989, 1997[1] as well as July and November 2012.

Details of the majority of these events are sparse with limited photographic evidence.

The EA have provided some reconnaissance information from the 10th July 1968 event which featured extensive flooding on the River Otter. An outline of flooding for Colaton Raleigh in that event was also available. This is made up of knowledge of the flood event and an indicative outline. Notes suggest that the causes of flooding were similar to later events, such as inadequate capacity in key culverts. This reports only relatively few properties were affected by flooding, despite the scale of the event.

The events in November 2012 resulted in the most significant reports of flooding, with flows exceeding the capacity of the culvert at Exmouth Road, causing flooding of the road and adjacent properties. Water in the road was reportedly unable to re-enter the watercourse downstream due to the bridge parapet and earth embankment on the downstream side of the road. This retained water reached a level at which it would flow down Church Road, leading to flooding of properties along this route. The flood waters then re-joined the main watercourse downstream at Place Court. Railway Cottage was also subject to flooding due to restricted drainage of surface water into the watercourse and into the downstream River Otter floodplain.

Properties north of the channel and west of Exmouth Road experienced flooding from water backing up at Exmouth Road and water exceeding channel capacity upstream.

To try to prevent flooding, the local community installed a number of temporary interventions e.g. blocking airbricks, digging trenches or placing sand bags. This was successful at preventing flooding at several properties.

Figure 2 shows the properties which have been recorded as having experienced flooding (or would have experienced flooding if not for local intervention) in the event in November 2012. These comprise approx. 12 residential properties, the shop adjacent to Exmouth Road and a number of barns and outbuildings.

As can be seen from the figure, the affected properties are spread throughout the village. The modes and sources of flooding, while connected, are different and do not lend themselves to a single option for mitigation.

No reports of significant or widespread flooding to properties were available since November 2012.

[1] Based on photographs and reconnaissance information received from EA Product 4 request

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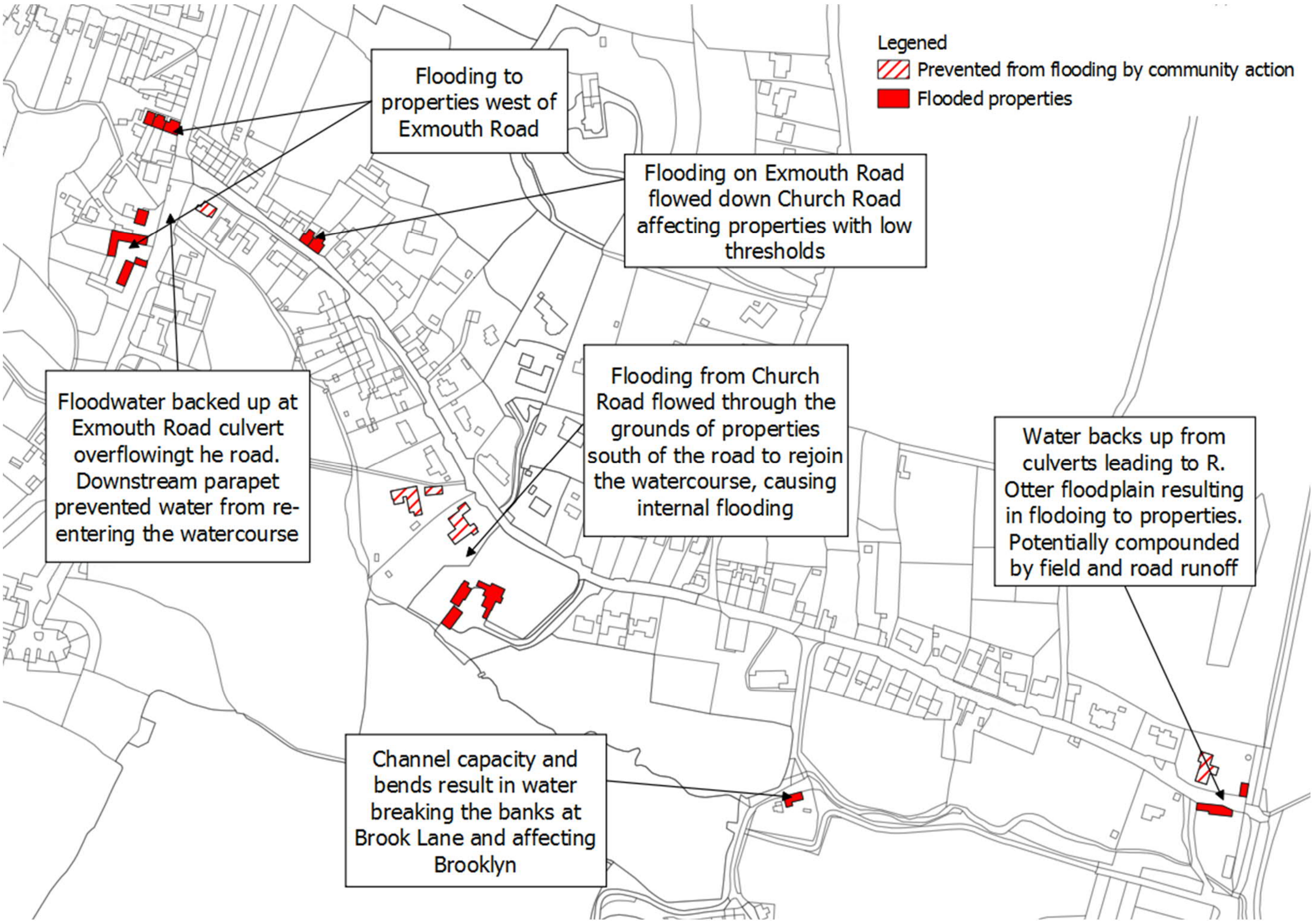

Figure 2 - Properties recorded as flooded in 2012

DATA COLLECTION AND ANALYSIS

Data review

The following data sources were available for review for Colaton Raleigh:

- Previous work carried out by DCC – catchment plans with notes on flooding and opportunities and constraints for mitigation, including culvert capacity assessments;
- EA reports of flooding – existing flood maps and historic flooding records where available;
- *Report regarding the 2012 Flood Events at Colaton Raleigh,* local community flood reconnaissance document produced in January 2013;

- Gauge data from the local (low flows) EA gauge at Pophams; and
- Topography including topographic survey specified for this study, EA LIDAR and contour maps.

These data sources, along with site observations and discussions with stakeholders, have been used as the basis for this assessment.

EA Flood Maps

Figure 3 shows an extract from the Environment Agency's Flood Zone 3 map (1 in 100yr Return Period or 1% Annual Exceedance Probability event).

The extent shown in the FZ3 map covers considerably more properties than have been recorded as previously flooding, and while accurate in some areas is considered to be potentially overestimating flood risk in other areas based on observations of ground, channel and floodplain capacity.

This may partly be due to the hydrology used for the Flood Zone maps. In the absence of locally detailed hydraulic modelling, the Devon Hydrology Strategy flows may have been used which are thought to be overly conservative in some parts of Devon. These flows are discussed in the hydrology section later in this note.

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Figure 3 - EA Flood Zone 3 extents

Site walkover

Site walkovers have been carried out on two separate occasions. The first visit was on 5th May 2021 with DCC and David Smith from CRPC .

This visit involved a thorough and detailed walkover of the site, including key flooding locations and features, and the identification of the location of the old leat system which connected one of the upper catchments to Bicton lake in the past.

The second visit was on 17th June 2021 with DCC and the EA. This included a review of previous observations and a focus on the upper catchment with regard to the constraints and opportunities for interventions.

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Observations from the site visit identified that many of the small drainage ditches along Church Road could benefit from maintenance to assist with draining surface water and runoff. Culverts adjacent to Otter Farm and Railway Cottage were observed to be blocked to some degree, in one case appearing to be completely blocked.

Topographic survey

A small-scale topographic survey was commissioned from Mendip Land Surveys to inform the assessments; collecting data at key locations to assist in modelling, calculations and option development.

This included a number of channel and structure cross sections and areas of general topographic survey as shown in Figure 4.

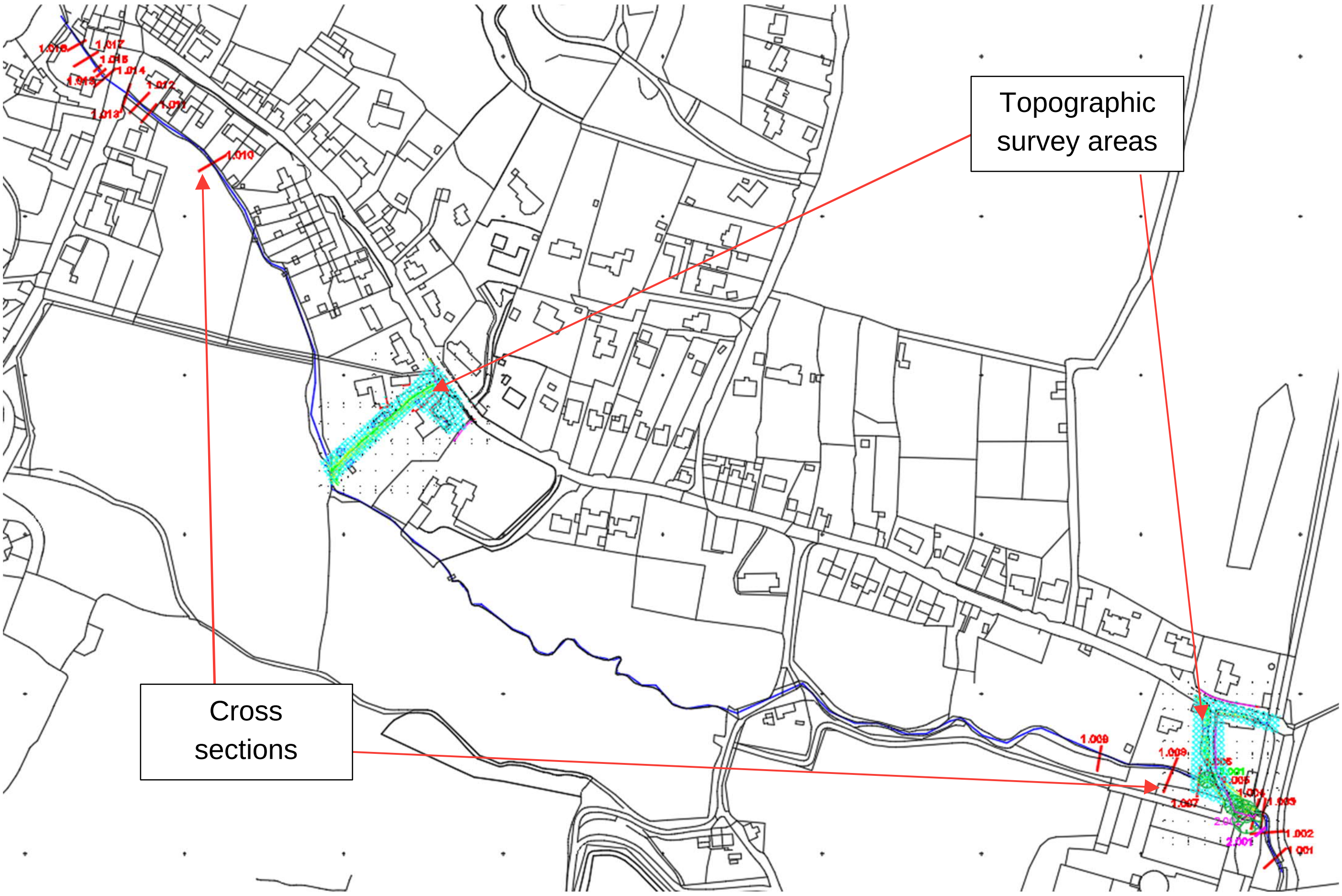

Figure 4 - Topographic survey

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Modelling and calculations

A number of analyses have been carried out to inform the identification of potential mitigation options, based on the data available.

CATCHMENT ANALYSIS

LIDAR data has been used for a full catchment analysis and the identification of flow routes based on the topography. This allows an understanding of which parts of the local area drain to where and informs the selection and investigation of hydrology methods and potential mitigation options.

HYDROLOGY

A hydrological assessment was undertaken for the Colaton Brook, with flows estimated where the Colaton Brook is culverted under the farm track to the south of Church Road (by Otter Farm) in Colaton Raleigh. Flow estimates were also derived for the sub-catchment upstream of the Exmouth Road (B3178) culvert by means of area-weighting. Smaller sub-catchment flows for tributaries upstream were estimated for the purposes of assessing the feasibility of upstream flood storage.

The flow estimates were derived using the standard FEH methods (ReFH2 and FEH Statistical), with catchment descriptors purchased from the FEH Webservice (308500,87000). The calculation record is appended to this document.

The catchment to the culvert by Otter Farm was found to have an area of 7.04km^2 and the sub-catchment to the Exmouth Road culvert has an area of 6.14km^2. The catchment of the Colaton Brook is highly permeable and is overlain by freely draining slightly acid loamy soils in the downstream portion of the catchment and by freely draining very acid sandy and loamy soils in the upper reaches of the catchment. Due to the highly permeable nature of the catchment, the FEH Statistical Method was preferred to the ReFH2 method, as the FEH Statistical Method incorporates permeable adjustments.

Local gauged data on the Colaton Brook from the Popham's Farm gauge was incorporated into the FEH Statistical Method estimates of QMED. Using the local gauged data, the estimate of QMED was calculated to be 1.76m^3/s, which is 24% higher than the estimate of QMED using donors from nearby NRFA catchments (which was 1.42m^3/s). The Popham's Farm gauge on the Colaton Brook is reported to experience bypassing at high flow events, so it is possible that the flow estimates under-represent the true flows. However, the flow estimates using the Popham's Farm gauge are conservative compared to using those based on the nearby NRFA donors and the Popham's Farm gauge was the best available local data for the Colaton Brook.

HYDRAULIC MODELLING

Small-scale culvert capacity modelling has been carried out using the cross sections from the topographic survey within the 1D hydraulic modelling package, Flood Modeller Pro. The aim of this was to determine the capacity of the culvert in relation to the inflows calculated from the hydrology. In theory this would assist in identifying what return period events would exceed the culvert capacity and potentially result in flooding.

While the capacity of the culvert has been identified, due to issues with the hydrology (described below), this cannot easily be related to a return period event with confidence. The modelling has identified that the culvert capacity (identified as approximately 6m^3/s, although this may be an overestimate due to additional entrance losses caused by the overhanging structure upstream) is sufficient to pass the majority of flood event flows, but all extreme flows.

The derived flow estimates were tested in the hydraulic model, and it was found that the flows using the Popham's Farm gauged data were closer to replicating the historic flooding that had occurred in Colaton Raleigh, compared to the flows based on the NRFA donors. However, even the more conservative flows based on the Popham's farm data did not quite replicate the observed water levels from the historic flood events. From the model outputs, the culvert can pass all events except the 1 in 1000yr RP event without flooding the road, based on the calculated flows. This may suggest that antecedent conditions had a significant impact during the historic flood events. Improving the gauging and rating at Popham's Farm on the Colaton Brook would help to increase the accuracy of and the confidence in the flow estimates.

Flows from the 2012 Devon Hydrology Strategy (DHS) were also obtained from the Environment Agency through a Product 4 request. Comparison of these flows with those from the detailed hydrology assessment described here shows that the DHS peak flow values are considerably higher. Confidence in the flows is described as 'Medium' and experience has shown that the DHS flows are often considered to be over-estimates for some of these small, rural, permeable catchments. In this case using those flows would significantly overestimate frequency of flooding with the culvert capacity being exceeded in a 1 in 25yr RP event.

UPSTREAM STORAGE

Online storage analysis has been carried out using a number of calculation and simulation methods. The aim was to identify the storage volumes that would be required to minimise the risk of flooding based on potential locations identified from the catchment analysis and site observations. This has used the inflows calculated from the hydrology with topographic data to compare required storage volumes against incoming flood volumes based on an allowance for the outflow from a storage area.

These analyses have demonstrated that the areas identified where storage potential was observed would not provide sufficient volume to store the necessary floodwater to result in a reduction of risk at Colaton Raleigh without the construction of significant earthworks which are not likely to be supported by the number of properties at risk

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Key points from anecdotal flood history

As previously stated, recorded flood history for Colaton Raleigh is sparse, with detailed information only really available in the report prepared by the community following the 2012 event, and the limited EA records of other flood events.

In addition to the report on the 2012 flooding produced by the community, letters from residents to DCC have also presented some anecdotal information in the aftermath of the flooding which occurred. The letters concerned are as follows:

- Letter from D Smith, Colaton Raleigh Flood Action Group to Richard Rainbow, March 2013
- Letter from Brian Turnbull to Martin Hutchings, January 2013

Based on these accounts, and as previously described, it is apparent that once water levels had risen above the upstream bridge parapet level and flooded across Exmouth Road it was prevented from re-entering the watercourse by the downstream parapet wall and earth bunds. This resulted in water backing up to a considerable depth (reportedly over 0.5 metres in some locations) resulting in flooding to the properties on the west side of Exmouth Road as well as flowing down Church Road. This ultimately flooded the gardens of several properties (notably Hill View and Hayes) and caused internal flooding to the main building and two other buildings of Place Court.

No 1 and 2 Baileys, Church Road (listed properties) were also affected by flooding, due to low thresholds and road camber, as flood waters flowed down Church Road.

Following the flood event, works have been carried out to the obstructions at the downstream side of Exmouth Road, creating drainage holes through the parapet wall and removing the adjacent earth embankments. These interventions are likely to have had a significant benefit on the risk of flooding here and these features should not be reinstated.

OPTIONEERING

The optioneering process has been driven by current understanding of the flood risk, changes which have occurred since the last flood, and the opportunities and constraints which have been identified during the data review, walkovers, and consultations.

A long list of options has been produced which includes a wide range of options from upstream storage, culvert replacement to small scale drainage maintenance improvements. This is shown in Table 1.

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Table 1 - Long list of options

ID	Option	Description	Comments
Enhanced maintenance			
1	Dredging and culvert maintenance	Removal of material which may be reducing capacity of main channel and blocking or partially blocking culverts	Beneficial for free flowing drainage into and through the village - includes improving flow under the railway into the River Otter floodplain.
2	Drainage ditch clearing and maintenance	Clearance of material from drainage ditches alongside highways	As above, but for highways drainage - this will assist in removing water earlier in an event delaying the onset of flooding and reducing duration.
3	Reduce blockage risks	Investigate and take action against informal structures across watercourse which can result in flood or blockage risks. Influence US land management practices	Maintenance and dredging will assist with reducing blockage risks. The management of informal structures placed over the watercourse by residents should be considered to reduce the risk. Upstream land management practices should also be monitored.
4	Enforce stakeholder maintenance responsibilities e.g. Clinton Devon, Devon Highways	Related to drainage clearance	Related to improvements to surface water drainage - there are a number of drainage ditches running along Church Road which are believed to be the responsibility of Clinton Devon and Devon Highways. Maintenance of these should be upkept.
Exmouth Road works			
5	Increase capacity at Exmouth Road culvert	Replacement of culvert beneath the road with a larger capacity structure	This is a key pinch point where water can exit the channel and pose a risk of flooding to the greatest number of properties. Some of the issues may have been improved following 2012 event, with improvements to downstream parapet walls i.e., creating drainage holes and removal of earth embankment. Potential to increase risk downstream would need to be considered carefully.
6	Flood relief culvert/channel at Exmouth Road	Additional higher-level drainage at Exmouth Road to carry exceedance flows across the road	May be constrained by services and highway cover requirements etc.
7	Improved headwall at Exmouth Road culvert	Create new headwall structure and improve conveyance into culvert	Improving the flow into the culvert could potentially improve conveyance and reduce blockage risk, reducing flood risk. Would need to investigate the impact on downstream flood risk.
8	Culvert/channel bed lining	Improve conveyance through culvert with a smoother lining	Reduce roughness in culvert could improve conveyance and reduce blockage risk. Would need to investigate the impact on downstream flood risk.
9	Regrade culvert/channel bed	Improve conveyance through culvert by maintaining bed slope	Increase in capacity could improve conveyance and reduce blockage risk in culvert and channel. May not be feasible. Would need to investigate the impact on downstream flood risk.
10	Improvements to surface water drainage	Create additional highway drainage	As above, improvements to drainage should be considered to facilitate draining water away quickly. Likely to be low capacity to reduce flood risk.

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ID	Option	Description	Comments
11	Regrade Exmouth Road to channel flows back into watercourse	Amendment of road levels or installation of traffic calming/flow training (e.g. traffic islands) to ensure flows re-enter watercourse downstream of the road.	Unlikely to be viable due to the nature of the road but some regrading could be done to direct flows across the road into the channel rather than backing up and flowing to Church Lane. However additional drainage to capture exceedance flows could be considered to facilitate quick drainage into the watercourse as far as is possible. The road camber and general gradient tends towards Church Road, and hence some improvements to drainage and grade could be carried out here to ensure that the main flow route is from upstream of the culvert to downstream back into the watercourse.
12	Interceptor drains in roads to collect and divert surface water	Install precast concrete channels with grill covers to intercept flows	Across Church Road or Exmouth Road. Could capture exceedance flows before they can cause flooding and redirect back to channel
13	Raised kerbs	Install raised kerbs to guide exceedance flows	Raising kerb heights in select locations can assist in countering road camber and gradients which channel flow into undesirable areas. This could assist with formalising exceedance flow routes.
Church Road works			
14	Regrading and improvement of flood channel at properties on Church Road	Improvement and reinstatement of route from Church Road back to watercourse. This could include regrading the ground levels and/or introducing drainage ditches or channels such as interceptor drains.	Improving the ability for waters flowing down Church Road to re-enter the channel. There is an existing ditch in this area which could be formalised, and the road and drive of the relevant property regraded to divert flows
Railway Cottage works			
15	Regrading and improvement of drainage at Railway Cottage	Amend ground levels and install drainage to reduce water ponding	Facilitate better drainage around Railway Cottage, and reduce the risk of flooding
16	Perimeter wall at Railway Cottage	Construct a low level perimeter wall around Railway Cottage to divert flows around the building	Railway cottage is impacted by exceedance flows from drainage, surface water and backing up from the main channel. A perimeter wall could be employed to prevent water from ponding against the building and reducing risk. Adverse risk to adjacent properties is not expected but should be considered.
17	Increasing culvert capacity under old railway/embankment at downstream end of watercourse	Install additional culvert from channel to R. Otter floodplain downstream of Otter Farm	An increase in capacity here could improve the drainage from the watercourse resulting in less backing up and risk to properties. It would also potentially allow for faster drainage of surface water, decreasing risk to Railway Cottage.

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ID	Option	Description	Comments
Property-specific interventions			
18	Property Flood Resilience/Resistance	Property-specific measures for preventing water entering the properties or providing resilience and easier clean up after a flood event	Individual property protection may be the most appropriate approach - in addition to any other works. This may be complicated by the listed status of a number of the properties at risk. Listed building consent is likely to be required for any permanent measures, and consultation will be required. Consideration of what measures may be used for older constructions needs to be made e.g. do they need to remain breathable, can they be made flood tight etc. Measures may need to be passive in the absence of significant flood warnings. Property specific surveys would need to be carried out to identify possible ingress points and options for PFR.
19	Demountable defences and training	External temporary defences which can be erected to control flow directions or protect properties from flooding	Differs from PFR in that it does not necessarily require permanent works to the properties. An improved version of the sandbags which had previously been used with some success to avoid flooding to properties in Colaton Flood gates across entrances to Hayes and Hill View could potentially prevent flooding to these properties and to Place Court. Direct flows back down footpath or drainage channel to re-join the watercourse. This route would need to be formalised and consideration given to bypassing of defences and whether flooding could be exacerbated at adjacent locations.
Upstream storage and works			
20	Upstream storage	Create online storage areas upstream of flooded areas to attenuate flows	Formal upstream storage has been investigated and found not to be effective on its own and could pose additional maintenance and inspection burden on DCC. However, upstream NFM measures and similar could be effective as part of a suite of measures. This is however difficult to quantify and is dependent on landowner agreement, but it could be taken forward on a no regrets basis.
21	Natural Flood Management measures in upper catchments	Leaky dams and informal storage measures in upper catchments	Small scale interventions can result in attenuation of runoff reducing peak flood flows which may be of benefit. Difficult to quantify the impacts but could be undertaken on a no regrets basis.
22	Reinstatement of old leat channel draining to Bicton Lakes	Reinstatement of control structures and clearance of leat to divert flow from upper catchment	This has been investigated and is considered to be not viable. The leat is high in one of the subcatchments with the upstream catchment accounting for approx. 30% of the total catchment to Exmouth Road. The leat is small with limited capacity and would not convey a significant proportion of flood flows. As such the leat has only very limited capacity for improving flood risk downstream. The works to reinstate and maintain the leat would be substantial compared to the benefits.
23	Improve soil aeration upstream to increase infiltration	Changes to land management practices	Westcountry Rivers trust have a soil aerator plough they can lend to farmers. Limited benefit potential but could be undertaken on a no regrets basis.

ID	Option	Description	Comments
Improved data collection and use			
24	Improved flood warning		In 2012 event records seem to indicate that residents only received a flood alert rather than flood warning - improvements to this would be of benefit, particularly if demountable defences are to be utilised.
25	Improve gauge rating for flood warning	Additional survey and analysis of the EA Pophams gauge and surroundings to improve data collection	The EA note that the gauge bypasses in a flood event so may not capture full flow/depth relationship. Improved gauging could be utilised to inform future interventions and analysis of flood events.
26	Use machine learning tools for improved flood warning	Machine learning tool using rainfall data to predict flooding	WSP have developed a tool which uses predicted rainfall data to provide advance flood warning which could be employed. This may need to be linked to improved gauging.
27	Support parish council emergency plans	Provide education and training as well as temporary defence materials etc. to local area. This includes aiding in post flood recovery	Education as to the sources of floodwaters, risks and likely mechanisms, as well as providing confidence in post-flood recovery can provide reassurance to the local area on top of other measures.

Economics

There are a number of factors which impact on the assessment of flood economics for Colaton Raleigh.

Typically, the estimation of damages and hence benefits from a flood scheme will be dependent on a reliable history of flooding and supporting data, accurate EA modelling/mapping of flood risk or detailed hydraulic modelling outputs.

In the case of Colaton Raleigh there are issues with each of these elements which impact on an assessment of flood damages.

The flood history is sparse with no records of significant flooding since the events in November 2012. In addition, works have been undertaken following those floods which may have removed or improved a significant influencing factor in the flooding, namely improvements to the downstream bridge parapet and surrounding topography.

History of flooding and anecdotal evidence suggests that the EA Flood Zone maps and the Risk of Flooding from Surface Water maps may not adequately capture the flooding which has been experienced at Colaton Raleigh and as such may not be a reliable source of evidence for assessing properties at risk. Review of the Flood Zone 3 maps against flooding in some of the key areas do show agreement with flooding experienced in the November 2012 event, but with some key areas missing. This is likely due to the level of detail in the models used to produce them. Uncertainties in hydrology and the influence of such things as catchment permeability and antecedent catchment wetness are also likely to have an influence.

Due to these catchment characteristics standard hydrological methods are potentially not capturing the flows in the watercourse adequately. In addition, the potential complexity of the system means that a hydraulic model which captured flooding as experienced would be difficult and costly to produce.

Constraints

There are number of constraints which relate to the option selection process or implementation of options identified, some specific and some more general. In summary:

- Buried services may constrain drainage improvements
- Maintaining main road access along Exmouth Road can limit works or significantly increase costs and timescales
- Uncertainty over flood history/lack of frequent flooding impacts on the ability to quantify flood risks
- Limited economic benefits due to infrequent flooding and limited numbers of properties affected
- Disparate flood issues may require different solutions
- Risk of making flooding worse downstream of interventions – improvements at Exmouth Road could exacerbate the different flooding issues downstream.

SHORT-LIST OF OPTIONS

A Multi-Criteria Assessment (MCA) has been created to review the long list of options with scores assigned based on an assessment of the following criteria, on a relative basis:

- Feasibility - Technical feasibility of the option, is it proven
- Benefit - What standard of protection can be provided
- Adaptability - How readily can the option be adapted to accommodate climate change impacts
- Health & Safety - Impacts of proposed scheme (construction and long term (excluding flood risk impacts))
- Environmental Impact - Are there potentially significant impacts (positive or negative on habitats, flora and fauna or natural processes)
- Social - Effect on residents, businesses, recreation
- Relative cost

The MCA is appended to this document.

As can be seen from Table 1, the options do not all relate to works affecting every location within Colaton Raleigh. Some options are specific to properties (e.g. Railway Cottage) or more general improvements to drainage or works which will impact multiple properties (i.e. those at Exmouth Road).

Table 2 gives a summary of the MCA outputs, ranked in order of highest score to lowest, with an indicative cost/benefit ratio based on the relative cost and benefit scores.

Table 2 - MCA summary

Option ID	Option	BCR	MCA score
18	Property Flood Resilience/Resistance	1.33	28
19	Demountable defences and training	1.33	27
27	Support parish council emergency plans	1.5	25
2	Drainage ditch clearing and maintenance	3	24
4	Enforce stakeholder maintenance responsibilities (e.g. Clinton Devon, Devon Highways)	3	24
16	Perimeter wall at Railway Cottage	1	24
17	Increasing culvert capacity under old railway/embankment at downstream end of watercourse	1	23
14	Regrading and improvement of flood channel at properties on Church Road	1	22
1	Dredging and culvert maintenance	1.5	21
7	Improved headwall at Exmouth Road culvert	1	21
21	Natural Flood Management measures in upper catchments	1	21
24	Improved flood warning	1	21
3	Reduce blockage risks	1	20
12	Interceptor drains in roads to collect and divert surface water	1	20
13	Raised kerbs	1.5	20
20	Upstream storage	0.6	20
15	Regrading and improvement of drainage at Railway Cottage	1	19
9	Regrade culvert/channel bed	1	19
25	Improve gauge rating for flood warning	0.67	19
26	Use machine learning tools for improved flood warning	0.5	18
6	Flood relief culvert/channel at Exmouth Road	1	17
8	Culvert/channel bed lining	0.67	17
10	Improvements to surface water drainage	0.67	17
11	Regrade Exmouth Road to channel flows back into watercourse	1	17
23	Improve soil aeration upstream to increase infiltration	0.5	16
5	Increase capacity at Exmouth Road culvert	1	15
22	Reinstatement of old leat channel draining to Bicton Lakes	0.25	14

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There are some common scoring elements in many of the options assessed, which can be seen in the full MCA. For example, for the majority of the options the degree of adaptability for future climate change is considered to be low.

On the basis of the scores from the MCA and based on the understanding of flood risk gained through this study, a short list of viable options has been extracted and is presented below. Some of the options from the long list have been combined where they are similar but relate to separate parts of the system:

- Property Flood Resilience/Resistance
- Demountable defences and training
- Support of parish council/community emergency plans
- Drainage ditch clearing and maintenance/enforcement of stakeholder maintenance responsibilities/ culvert clearance at downstream end of watercourse
- Increasing culvert capacity at downstream end of watercourse

Additional options which do not score so highly but may have sufficient additional benefits to justify their consideration are:

- Improved headwall at Exmouth Road culvert
- Natural Flood Management measures in upper catchments

CONCLUSIONS AND NEXT STEPS

Based on the analyses and assessments carried out as detailed in this report, a long list of options has been created and assessed against a range of criteria defined in a Multi-Criteria Assessment. This was completed with reference to site constraints and an understanding of the flood risk and was informed by the calculations and analysis carried out as part of this study.

Through this process a short list of options has been produced which are proportionate to the scale of risk at Colaton Raleigh, as well as the uncertainty over elements such as hydrology, a sparse history of flooding and whether key elements of flood risk have already been addressed through local interventions since the most recent significant flood event.

The short-listed options range from providing property-level flood resistance or resilience measures to properties which have previously been affected by flooding, clearance of drainage infrastructure (either by DCC or stakeholders/landowners) and small-scale improvements to drainage infrastructure in key locations.

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CHECKED:	Dave Turner	**APPROVED:**	Rachel Ledger

Recommended next steps

In the short-term it is recommended that the relevant landowners and asset managers are contacted to carry out drainage or culvert clearance activities where the need for them has been identified. Principally these comprise small drainage channels running along Church Road, and the larger ditches connecting these to the watercourse adjacent to Railway Cottage. Clearance of the channel and culverts at the downstream end of the catchment in the vicinity of Railway Cottage and Otter Farm is particularly recommended to prevent water backing up before draining to the River Otter floodplain. It should be noted that many of these assets are outside DCC's ownership so engagement with the asset owners and stakeholders should be carried out.

Over the longer-term, gaining agreement that these activities are carried out periodically would be of benefit.

Engagement should be made with the local community and parish council regarding the flood risk including what options have been identified as suitable, and the rationale for disregarding other options. This would include the potential for offering property flood resistance measures to those previously affected and other parties who could be considered at risk based on existing EA flood maps. A ground-truthing exercise taking account of property threshold would be required. This would also be useful in identifying if there is a desire on the part of individual homeowners/residents to implement this kind of mitigation.

To produce a business case for carrying out flood mitigation works, a high-level assessment of the economics may be possible based on existing flooding information (i.e. EA flood maps and historic flooding records). Due to the relatively low likelihood of flooding, combining the business case at Colaton Raleigh with one for one or more other settlements may be an appropriate approach in order to achieve sufficient funding. This should be carried out once the community engagement has been made and feedback received.