Subject	Loxwood Flood Risk Management Scheme – Preliminary Advice Note 2	**Originator**	L. Brodie 08/09/2017
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From	C. Jenkins	**Approved by**	N. Bean 08/09/2017
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Technical Note

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Introduction

This Preliminary Advice Note 2 (PAN2) provides Mott MacDonald's advice to the Environment Agency on the viability of the Loxwood Flood Alleviation Scheme (FAS) project, and whether the project should progress. This note sets out the current economics and recommendations of the project. This PAN2 follows up from the advice provided to the EA in the PAN1 which was issued on 15th June 2017.

A high-level economics assessment has been carried out using data available to improve on the assessment undertaken for the SOC, to determine the number of properties at flood risk in Loxwood, and the potential funding available for a scheme.

Background Information

Loxwood is a rural village which generally floods most winters due to a silted, under capacity and manipulated watercourse. Surface water from surrounding hillsides entering the highway drainage systems can exacerbate the problem. The Scope received from the EA states that it is understood that flooding problems also occur due to Southern Water's combined sewer system. During the kick off meeting it was identified that Loxwood is within Southern Water's 'Drainage Area Plan' which will involve reviewing flood risk from their assets. There is also a highways drainage improvement works planned on the B2133.

According to the Strategic Outline Business Case (SOC), the number of properties at risk from flooding is estimated to be between 10 no. and 30 no. There has been no previous significant study of the fluvial system

through the village, however, Loxwood Parish Council have commissioned an independent flood risk consultancy, Water Environment, to investigate potential reduction measures. Details of this work can be found in PAN1 (June 2017) and minutes from the meeting with Water Environment (Nov 2016).

Review of the Strategic Outline Case

Based on available fluvial and surface water flood mapping, the SOC predicts the following number of properties at flood risk in Loxwood:

Table 1: Summary of Properties at Risk

Flooding Mechanism	Estimated Number of Properties at Risk		
	<3.33% AEP	<1% AEP	>1% AEP
	High Risk	Moderate Risk	Low Risk
Fluvial	6	10	16
Surface Water	18	30	43
Combined	21	33	46

Loxwood Flood Risk Management Scheme, Strategic Outline Business Case (SOC), Feb 2016

These values were based on NaFRA and surface water flood mapping data, as no hydraulic model was available. The SOC indicates that available benefits are approximately £881k.

Mott MacDonald Assessment Summary

Mott MacDonald carried out a high-level economics assessment to check and improve upon the values set out in the SOC.

Analysis of the EA's NaFRA and surface water flood mapping shows that they closely matched the flow routes seen during heavy rainfall due to the topography of the site. For this reason, MM used the EA's surface water flood maps and associated depths as a proxy to represent both surface water and fluvial flooding. A summary of the number of properties at risk from the surface water flood maps are detailed in Table 2.

Table 2 Number of residential properties at risk of flooding as used for OM2s

Flooding Mechanism	Estimated Number of Residential Properties at Risk		
	3.33% AEP	1% AEP	>1% AEP
	High Risk	Moderate Risk	Low Risk
Surface Water (MM)	0	6	17
Potential increase in numbers from fluvial flood zones 2 & 3.	unknown	+1	+3

Source: EA surface water flood maps; EA flood zones 2 & 3

As well as the residential properties at risk, there are 7 commercial properties and infrastructure at risk of flooding; 1 asset in a 3.3%AEP event, 4 in a 1.1%AEP event and 7 in a 0.1%AEP event.

Work undertaken by Mott MacDonald has indicated that the number of properties at flood risk is less significant than identified in the SOC. This is likely due to the use of GIS information to acquire the flood depth bandings and by including a doorstep level of 150mm. Properties at flood risk to a depth of between 0 and 0.15m were therefore not considered at flood risk.

A damage assessment of the surface water flood risk was undertaken following FCERM-AG guidance and the MCM manual. The methodology is described in detail in the following sections. Do-Nothing damages are estimated to be £301K. Benefits are calculated as flood damages avoided, due to having no 'Do Something' damages the benefits in this assessment are assumed to be 80% of the Do-Nothing damages. Using this assumption, the baseline benefits have been estimated as £240k. Cost estimates were acquired through consultation with Mackley. Total high-level scheme costs including appraisal, design and a 60% optimism bias has been estimated as £1,487k. This results in a Benefit Cost Ratio below unity (0.16). Table 4 summarises results of the benefit cost analysis, including sensitivities of the results. Qualifying benefits arising from overall scheme is £40k as shown in the Partnership Calculator attached.

Recommendations

Due to the low BCR (<1), the small amount of properties under OM2s, and a low value for the qualifying benefits of £40k, it is recommended not to progress the Loxwood Flood Alleviation Scheme to Outline Business Case.

Mott MacDonald Assessment

Estimated option costs

Consultation with Mackley was undertaken to acquire high level cost estimates for a potential scheme as identified by Water Environment to be the most effective out of the options modelled at reducing flood risk. Dimensions of the option were not made available from Water Environment, and so estimations were made using engineering judgement and mapping data.

The following estimates were obtained:

- Widening a 1km long channel from 1.5m to 3m wide at a depth of 0.5m.
  - Ø Estimated at £128/m. Total= £128,000
  - Ø Assumptions: estimate includes disposal off site.
- Replacement of 3 culverts under highways with 3X2m box culvers at 10m length.
  - Ø Estimates at £120,000 per culvert. Total= £360,000
  - Ø Assumptions: includes disposal off site, headwalls, tarmac road reinstatement and road closure.

Construction Total= **£488,000**

Scheme costs are summarised in Table 3. Costs do not include survey costs, modelling costs or maintenance costs into the future.

Table 3 Summary of scheme costs

Descriptions	Cost (£)
Widening Channel	128,000

3 culverts	360,000
Total construction costs	**488,000**
Additional costs (% of construction costs)	
Indirect (33%)	161,040
Risk (5%)	24,400
Overhead (6.95%)	33,916
Profit (3%)	14,640
Other Costs EA (20%)	97,600
Design (12.5%)	61,000
Appraisal (10%)	48,800
Total	**929,396**

Source : Construction activities Mackley Appraisal cost Mott MacDonald

Optimsim Bias

Within the economic analysis a 60% optimism bias risk allowance was added to the costs to account for potential risks that may arise during the detailed design and construction phases. This risk allowance is based on guidance within the FCERM-AG (2010) and the HM Treasury Green Book (2011).

Including optimism bias costs are estimated at **£1,487k.**

Damages assessment

MM has undertaken a damage assessment using the EA surface water flood mapping. Annual Average Damages (AADs) have been calculated for the flooding of commercial and residential properties for 3 different return period events (0.1%, 1.0% and 3.3% AEP). To determine the AADs, the National Receptor Database (NRD) (Address Point database provided by the EA, (2014)) was used to calculate the number of properties within the flood extents. The AADs have been calculated following the FCRM-AG (EA, 2010) and MCM (Penning-Rowsell *et al.* 2017) guidance. Data tables from the MCM (Penning-Rowsell *et al.* 2016) have been used to determine flood damage values. Key assumptions include:

- A 0.15m doorstep level was used and therefore properties with flood depth of 0.00-0.15m were determined not to be at risk of flooding.
- The AAD values for the properties have been capped at the value of the property.
- To calculate the AAD and estimate a capping value, residential properties were categorised by detached, semi-detached, flat or bungalow. The types were determined using the classification identified within the NRD data and by checking against Google Streetview.
- Residential property values were estimated from zoopla.co.uk (accessed on 25th August 2017).
- Commercial property values were estimated using the rateable value that was used to estimate the commercial property values.
- Following guidelines (Environment Agency, 2008), properties considered to be caravans or mobile homes were capped at a value estimated to relocate them (£5,000).
- Damages include vehicle damages as £3,600 per residential property that flood >0.3m.
- Health damages at £232 per flooded property.
- The MCM's rural (non-city) uplift of 10.7% was applied to all flood damages to account for the cost of emergency services responding to flooding incidents.

Discounting

Damages are expressed in terms of their Present Value (PV). The PV of the future pound is assumed to fall away through time. To include this in the economic assessment the discount factor provided in the HM Treasury Green Book (2011) is applied. HM Treasury Green Book recommends that for benefit cost analyses (BCA) that accrue for more than 30 years the following discount rates should be used; 3.5% (0 to 30 years), 3% (30 to 75 years) and 2.5% (75 to 100 years).

The PV Do-Nothing Damages have been estimated as £300,912.

Benefit cost analysis

Using the damages assessment and option cost a benefit cost analysis was undertaken in order to determine the viability of the scheme. Due to the high-level nature of the approach, sensitivity analysis was undertaken. The results are detailed in Table 4.

Table 4 Summary of the benefit cost analysis and sensitivities

Description		
Baseline	Benefits (taken as 80% of Do Nothing Damages)	£240,730
	Cost	£1,487,034
	BCR	0.16
Sensitivity 1	Benefits (assumes 95% of Do Nothing Damages)	£285,866
	Cost (same as baseline)	£1,487,034
	BCR	0.19
Sensitivity 2	Benefits (same as baseline)	£240,730
	Cost (construction costs only)	£488,000
	BCR	0.49

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References

Environment Agency, 2008. Economic evaluation of damages for Flood Risk Management projects

Environment Agency, March 2010, Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG).

Penning-Rowsell, E., Priest, S., Parker, D., Morris, J., Tunstall, S., Viavattene, C., Chatterton, J., and Owen, D, 2017. 'Flood and Coastal Erosion Management: Handbook for Economic Appraisal.'