From: **Simon Jones, Director of Highways, Transportation & Waste**

To: **Cabinet**

Date: **12 October 2020**

Subject: **Mitigating Surface Water Flood Risk on the Highway**

Summary:
During the Cabinet meeting on Monday 22 June 2020 a further report was requested to discuss the available options surrounding highways flood mitigation.

This report outlines the work undertaken, both analytical and operational, on how the county could improve resilience against surface water flooding. Empirical data analysis and Geographic Information Systems have been used to identify and prioritise areas of interest using our own data as well as published information.

The report also provides details of operational trials into smarter gully maintenance via the 'Live Labs' project.

This work will form part of an update to Kent County Council's Local Flood Risk Management Strategy which remains on target for 2023.

Recommendations:
Cabinet is asked to:

a. Note and comment on the developing work in preparing for and addressing highways flooding.

b. Endorse the approach taken to identify and proactively develop a programme of works focusing on identified areas of potential surface water flood risk on our strategic and locally important highway network.

1. Background

1.1 We are experiencing intense rainfall events on an increasingly frequent basis, with recent rainstorms generating a volume and intensity of rain well beyond the design capability of highway drainage systems. As well as winter rainfall, summer 'flash flooding' is becoming an increasingly significant risk for the highway authority. For example, on 15th August 2020 over 40mm of rain fell in the Sittingbourne area in just 45 minutes. To put this into some perspective, the average amount of rainfall for the entire month of August for the region is 56.3mm.

1.2 The burden on our highway drainage systems can also be exacerbated by many other factors including:

- The age and condition of highway drainage systems. Some systems can be more than 100 years old and / or be operating beyond their original design life.
- Asset management strategy and available budget has focused on high need/risk and safety critical assets. This approach has yet to reduce the asset management backlog.
- Capacity issues of drainage systems not under the control of the Highway Authority, such as public sewers or private ditches and watercourses into which they connect.
- Structural damage to drainage systems by third parties or site environs (such as root damage from adjacent trees and hedges) that may go unnoticed until significant rainfall occurs.
- Poor maintenance of associated drainage features in land adjacent to the highway which then flows onto the highway (including ditches and culverts, as well as urban drainage).
- 'Urban Creep' effects such as additional run-off onto highways from the paving of front gardens.
- Increases in the peak intensity of rainfall brought about by climate change as evidenced by flash flooding occurring at least annually within the county

1.3 Our highway drainage systems were designed to drain water from the highway surface only and generally were not intended to be flood defences. However, they still play a key role in managing local flood risk.

1.4 They were historically designed to cope with what is known as a '1 in 5 year' event. An example of such a storm is one which produces approximately 20mm of rainfall in a one-hour period. Whilst such a storm is significant, many occurrences have been noted in recent years that exceed that design standard. In the last 5 years we have seen several events exceeding this threshold including those affecting Tunbridge Wells in 2015 and 2017, Swale in 2018 and 2020, West Kingsdown, Vigo and Snodland in 2019 and Deal in 2020

1.5 In these events, run-off does not just originate from the highway, but often uses the highway as a conduit to escape to lower ground. This can be as 'overland flows' following the topography or 'exceedance flows' where a drainage system is unable to cope. Highway flooding or property damage can occur which may be remote from the original source of the flood water. Some photographs in Appendix A illustrate these issues.

1.6 This often gives the impression that the run-off originated solely from the highway and should have been dealt with by the drainage system in that

location. Hence, the Highway Authority is often seen as the cause of property flooding where often it is not the source of the problem.

2. Intelligence and Investment

2.1 As well as being the Highway Authority, KCC is the Lead Local Flood Authority for Kent and has produced a range of Surface Water Management Plans (SWMPs) intended to increase the understanding of local flood risks and provide a high level action plan to identify measures to mitigate local flooding risks. The majority were produced during 2012 and 2015 so predate some notable surface water flooding events of recent years.

2.2 The current one and two-year programme of works for capital drainage improvements for the 'Well Managed Highways' approach (financial years 2019/20 and 2020/21) was based upon a Geographic Information System (GIS) analysis of customer enquiries involving highway flooding and/or properties damaged by flood.

2.3 In the last two years, schemes have also been jointly funded or delivered by the Highway Drainage Asset Management Team and the Flood and Water Management Team which pilot the use of Blue-Green Infrastructure. Further details of these are included in the Appendix B to this report.

2.4 Blue-Green infrastructure refers to natural and semi-natural measures to help mitigate certain location specific problems in a sustainable manner. Examples of green infrastructure are hedgerows, copses, bushes, orchards, woodlands, natural grasslands and ecological parks. Blue landscape elements are linked to water. They can be pools, ponds and pond systems, wadis, artificial buffer basins or water courses. Together they form the green-blue infrastructure and in this context, it provides a sustainable and natural approach to reducing flood risk.

3. Improving Revenue Funded Asset Maintenance

3.1 Keeping our existing drainage assets operational and effective will help to reduce the risk of flooding occurring. It is vital to ensure that maintenance and drainage improvements are focused at priority locations and that operational maintenance and enhancements are undertaken when and where it is needed.

3.2 The Highway Drainage Asset Management team has been exploring ways to improve the maintenance the drainage network. As part of the 'Live Labs' project, information about how the drainage system is constructed and performs is being collected. This information will allow intelligence of how various drainage assets fail and the speed of failure to be collected. Armed with this knowledge new intervention regimes can be developed so that only those gullies, pipes and the like that need intervention are addressed.

3.3 Work to introduce productivity improvements has started. Research has shown that similar county councils are able to clear 99 gullies per day. Our current average remains at 65. Lean management assessment should expose potential opportunities to improve productivity and address this 52% operational difference.

3.4 Through the Live Labs project, we have engaged a company called Kaarbontech to assist in developing an intelligence led drainage regime. Maidstone has been chosen as the trial District and currently we are:

a) Collecting a detailed inventory of drainage assets.
b) Checking historic information from other council systems.
c) Defining and prioritising zones of interest.
d) Risk profiling maintenance based on prioritised/condition assets.
e) Assessing if and how live data (via handheld devices) can play a part in future maintenance.
f) Undertaking ongoing data collection.
g) Looking at how to asset map the drainage network and highlight how it operates (and fails)

3.5 To date, 21,639 gullies across 1,097km of highway in Maidstone have been validated with further surveys carried out to validate the data on silt levels and depth of gully pots.

3.6 It has been established that half of the assets contain less than 20% silt. Only 4% contain more than 70% silt. This clearly indicates that significant changes (reductions) to the planned routine maintenance can be safely undertaken. It has also highlighted those locations that need more frequent maintenance.

3.7 As part of the ongoing Live Lab works, several smart gully sensors from different manufacturers have been installed across the County to record data which will also be factored into future proactive cleansing.

3.8 Following the trial, the sensors which are most reliable and cost effective would be proposed for installation, as funding becomes available. Examples of these sensors are included in Appendix C to this report.

4. Developing Our Future Capital Investment Programme

4.1 In order to properly inform future planning, we have developed mapping of the locations where the risk of surface water flooding is high and/or where climate change impacts may affect the risk of flooding. This will allow a more proactive asset management approach to be taken rather than focusing solely on customer enquiries.

4.2 A GIS analysis has been undertaken to identify and score roads across the County based upon a series of flood risk metrics.

4.3 Using GIS to present the data ensures multiple factors are taken into consideration when assessing a road, including details about the road (for

example whether is part of the strategic network or a numbered road) and the risk of flooding (for example the area that is flooded in a ‘flood cell’, the area of the road that flooded in the cell, the number of properties etc).

4.4 This method allows us to identify roads where there is an external source of flooding, that is where the road is part of a larger flood, and where the road is a significant source of the flooding, that is where the flood originates or substantially originates on the road. This allows us to identify areas where highway drainage can make a significant contribution to flood risk management.

4.5 An example of a ‘flood cell’ at Swanscombe is shown below to illustrate the area of road which may contribute to a flooding issue based upon a ‘1 in 30 year’ event. The coloured markers represent reports of flooding issues and jobs attended from the work allocation and management system (WAMS):

4.6 The analysis provides a high-level overview of the risk and the area where surface water run-off may contribute, but each ‘flood cell’ location will require a more detailed review in the future. By studying this data we can inform our three to 5-year capital works programme and focus our efforts on root cause rather than symptom.

4.7 Some of these sites may require investment in the drainage systems in order to prevent flooding from the highway. Enhancing drainage in this way is consistent with modern highway drainage design standards, which set out a requirement for no flooding to extend beyond the highway boundary in a 1 in 100-year event, plus an allowance for climate change[1]. This assessment specifically excludes areas where the flooding is not from the highway, so it is consistent with highway funding requirements. The standard of service in these locations may change based upon site specific constraints, though this is still in accordance with best practice for highway design and asset management.

4.8 It is important to note that not every site identified will require drainage improvement works to reduce the risk of flooding. There may be instances where minor repairs or an enhanced maintenance regime will be enough. In other circumstances there may not be a solution that is viable or within KCC's control to deliver and in these situations, we will attempt to resolve with the various stakeholders/organisations.

4.9 Opportunities for mitigation could include, but are not limited to, the following:

- Enhanced maintenance regimes where the existing drainage system is in sound operational order but is liable to blockage from leaves or silt. These areas could potentially be linked into future trials and collaboration with other organisations.
- Replacement of existing assets where operational or structural issues are found where existing reports of flooding are minimal.
- Use of modern techniques to extend the life of existing drainage assets, such as trenchless and no-dig cast in place pipe and culvert lining and stabilisation.
- Retrofit of Sustainable Drainage (SuDS) features and Blue-Green Infrastructure such as permeable paving, rain gardens, open attenuation for exceedance flows etc.
- Replacement or supplementing of existing assets with new or upsized assets (for example larger or additional soakaways) where greater resilience is required.
- Attenuation of surface water to accommodate additional run-off volume with a controlled discharge back into the network so as not to increase flood risk elsewhere.
- Separation of surface water from existing sewers and redirection to an alternative outfall (where viable) to ease sewer capacity issues.

4.10 Any future improvement must be cost-beneficial (i.e. is the costs of delivering them must be outweighed by the benefits they provide) and any improvements made are unlikely to completely eliminate the risk of surface

[1] Design Manual for Roads and Bridges, CG 501 Design of highway drainage systems, https://www.standardsforhighways.co.uk/dmrb/search/ada3a978-b687-4115-9fcf-3648623aaff2

water flooding - all measures can be overwhelmed by a rainfall event of sufficient extremity.

4.11 There is also a need to work closely with the various water and utility organisations to develop co-operative programmes to align our operational needs to their ongoing asset modernisation and water management obligations.

4.12 In those cases we would propose to include geographic areas of interest within the next update of KCC's Local Flood Risk Management Strategy where collaborative working between risk management authorities (such as the sewerage undertakers, Environment Agency etc.) is required over a longer time period.

5. Next Steps

5.1 In April 2020 the government announced that it will double its investment in flood and coastal defences in England to £5.2 billion over the next six years. This gives an opportunity to seek external funding for some drainage schemes where they can be demonstrated to offer a good cost benefit ratio and/or be match funded by KCC.

5.2 We will continue to research and develop methods to improve knowledge, performance and productivity in order to be best placed for any future funding opportunities and so build future resilience against surface water flooding.

6. Recommendations:

Cabinet is asked to:

a. Note and comment on the developing work in preparing for and addressing highways flooding.

b. Endorse the approach taken to identify and proactively develop a programme of works focusing on identified areas of potential surface water flood risk on our strategic and locally important highway network.

Contact Details

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Appendix A – Examples of ‘Overland Flow’, ‘Exceedance Flow’ and ‘Exceedance’ of Drainage Capacity

‘Overland Flows’ from fields near the A20 London Road, West Kingdown and the subsequent overwhelming of highway drains on the highway. This flooded the strategic route and nearby properties in Ash Tree Close in June 2019.

‘Exceedance Flows’ exiting manhole covers from overwhelmed sewers contributing to flooding at Albert Road, Deal in August 2020.

‘Exceedance’ of drainage capacity at A2 Canterbury Road, Sittingbourne where a large existing drainage system is present within an area of borough council owned green space. This flooding occurred in May 2019. A similar flood also occurred in August 2020 following a severe thunderstorm:

‘Exceedance’ of drainage capacity at Lower Road, Teynham also in May 2019. A similar but less extensive flood also once again occurred in June 2020 following localised heavy rainfall.

Appendix B – Example Blue-Green Infrastructure Projects

BLUE-GREEN CITIES IN THE SPOTLIGHT: KENT

An introduction to Blue-Green Infrastructure pilot projects in the county of Kent, England

By Kent County Council and Bax & Company

In Kent, Blue-Green Infrastructure (BGI) connects urban hydrological functions with urban nature, landscape design and planning. Put simply, it's about combining green spaces and good water management.

BGI reduces flood risk by using a more natural approach to water management within the urban environment. This is typically done by utilising existing green assets and infrastructure e.g. parks, rather than building grey infrastructure e.g. new piped drainage. Not only can the utilisation of green assets reduce flood risk, but it can also create multifunctional spaces. Blue-Green Infrastructure typically provides more amenity value to local residents and increases the resilience of urban spaces to climate change, while improving the liveability for the wider community. In particular, small 'orphaned' (underutilised) urban green spaces, such as Pocket Parks and Village Greens, present a unique opportunity to manage floodwater, improve the ecological value and enhance the amenity of the local areas.

In Kent, the increased frequency of intense rainfall events, often associated with summer thunderstorms, has led to more frequent flooding of residential and commercial properties across the county. The existing urban environment and infrastructure don't have the capacity to deal with unprecedented climatic events, which presents challenges for reducing flood risk.

Heavy rainfall events are anticipated to increase in severity and frequency. Climate change is expected to reduce the liveability of our urban environments for communities across Kent. Kent County Council is one of six European partners of the three-year BEGIN (Blue Green Infrastructure through Social Innovation) Interreg North Sea Region project **(northsearegion.eu/begin).**

BEGIN has funded two pilots projects in Kent. One in **Sittingbourne** and another in **Margate**.

The objectives of these pilots are to:

1. Trial the delivery of BGI projects in Kent
2. Engage Kent residents within the BGI design process using social innovation techniques
3. Identify the social, environmental and economic benefits that can be achieved for the local communities.

Co-designing with communities

BELL ROAD, SITTINGBOURNE

At Bell Road, 12 residential properties were frequently flooded during heavy rainfall events, due to the highway drainage system becoming overwhelmed. A large urban green space adjacent to Bell Road provided the opportunity to divert water away from the highway into an attenuation soakaway. The soakaway has a capacity of 300,000 litres with the surface water stored within the system draining to the chalk below.

GEORGE PARK, MARGATE

At George Park a scheme has been designed to divert surface water from the surrounding roads into the park. Previously excess surface water within this area would have discharged into the combined sewer causing flooding due to the capacity constraints. As a result of the BGI pilot project the water will now enter the park through swales and will then be is discharged into ponds in the park. Over time the water will slowly and naturally filter into the chalk below.

These two pilot projects in Kent have delivered significant landscaping improvements for the local community. For example, the creation of wildflower meadows, swales and ponds, as well as the planting of new trees within the existing Council green spaces.

The projects have provided KCC with their first-ever opportunity to work with local communities in co-designing BGI spaces. This has been done by working in partnership with the local community through the support of the *Places Team*, *Kent Wildlife Trust, Isle of Thanet Trees and Woodland Initiative* and *Swale in Bloom*.

The two pilot projects have demonstrated that:

1. Blue-Green Infrastructure provides a viable solution to managing urban flood risk, whilst utilising the existing green infrastructure within our urban environments and across Kent county.
2. Working with the community to co-design BGI creates spaces which communities can have greater ownership of and contribute to the long-term maintenance.
3. Previously, public green spaces had only provided one single function. Retrofitting BGI within Local Authority existing assets and spaces can deliver a multifunctional place and space with multiple social, environmental, and economic benefits for both KCC and communities across Kent.

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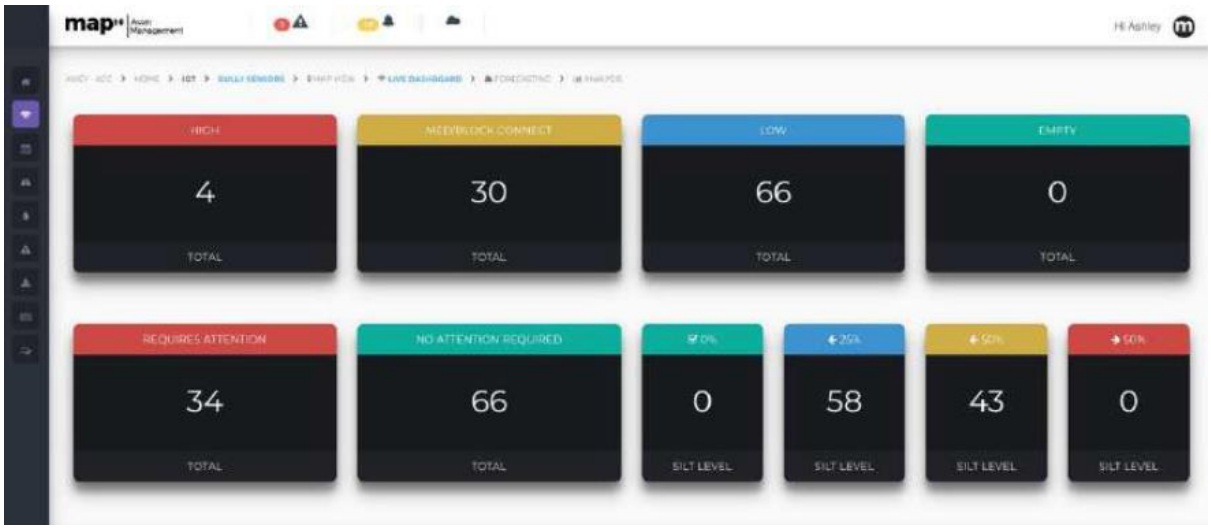
Kent's story relates BGI to communities by demonstrating the value to them.
For further information read the **BEGIN Policy Brief** at: baxcompany.com/begin-policy-brief/

Appendix C – Examples of Smart Gully Sensors and Monitoring Software

Example of ‘DMS Live Grid’ in which a sensor is embedded into a gully grid:

Example of ‘Internet of Things Sensors’ installed below existing gully grids:

Example of the live dashboard showing us clearly the live status of every sensor, how many needed attentions and what the current silt levels were within those gullies:



Example map view providing a real time insight into gully sensor status during a heavy rainfall event in Maidstone, showing where a risk of flooding was being detected: