From:	**Simon Jones, Director of Highways, Transportation & Waste**
To:	1) Cabinet – 12 October 2020
Date:	2) Kent Flood Risk Management Committee – 23 November 2020 (For Information)
Subject:	**Mitigating Surface Water Flood Risk on the Highway**

Summary:
During the Cabinet meeting on Monday 22 June 2020 it was resolved that a further report be brought to a future meeting to discuss a wide range of options for flood mitigation plans and proposals. This follows on from numerous severe weather events, including those in the winter of 2019/2020, which had a significant impact upon the residents and communities of Kent with the highway service responding to an exceptional level of enquiries and requests for emergency support.

The report outlines how the authority has made an initial assessment of areas of the county that would benefit from investigations into measures for increased resilience against surface water flooding. Geographic Information Systems have been used to identify and prioritise areas of interest using our own data as well as published information. This will help to inform our three to five-year capital forward works programme for the Highway Drainage Asset Management team by undertaking proactive investigations into our assets in these areas. The report also provides details of our trials into smarter gully maintenance via the 'Live Labs' project. These proposals may also aid a future update to Kent County Council's Local Flood Risk Management Strategy.

Recommendations:
Cabinet is asked to:

a. Note the increasingly persistent impact of flooding on our roads and Kent County Council's current approach to the development and implementation of the capital works programme focusing on existing identified issues.

b. Agree that a further report outlining the results of the 'Live Labs' project and Kaarbontech trial for improved gully maintenance be brought to a future meeting of this Cabinet.

c. 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.

d.	Note the potential risks for future funding of works post 2021 and that potential changes in policy and/or service levels would be required in order to do more to use our own drainage systems in a greater flood defence role.

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 that of the above design capability of highway drainage systems. As well as winter rainfall, summer 'flash flooding' is becoming an increasingly significant risk to 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.
- Operational issues arising from budget limitations for ongoing routine maintenance.
- 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 root damage from adjacent trees and hedges) that may go unnoticed until significant rainfall occurs.
- Poor maintenance of 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.

1.3 Our highway drainage systems are 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 usually 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.

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 the appendix 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 often receives criticism or blame for flooding that may have been outside of their reasonable control.

2. Current Capital 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 2013 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 This allowed an initial focus on areas with existing reported issues rather than place reliance on the SWMP action plans. These are considered out of date and do not cover the entire county.

2.4 In the last two years, schemes have also been jointly funded or delivered by 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 to this report.

3. Improving Revenue Funded Asset Maintenance

3.1 It is also key to manage our existing assets appropriately to reduce the risk of flooding occurring. In addition, it is important to protect our investment in areas where capital funded repairs and drainage improvements are carried out. This is likely to require additional future revenue funding and smarter use of existing funding.

3.2 The Highway Drainage Asset Management team has been exploring better drainage management via the 'Live Labs' project in order to seek a more encompassing software platform, dedicated to the complexities of drainage, that has the functionality to support our maintenance activities while

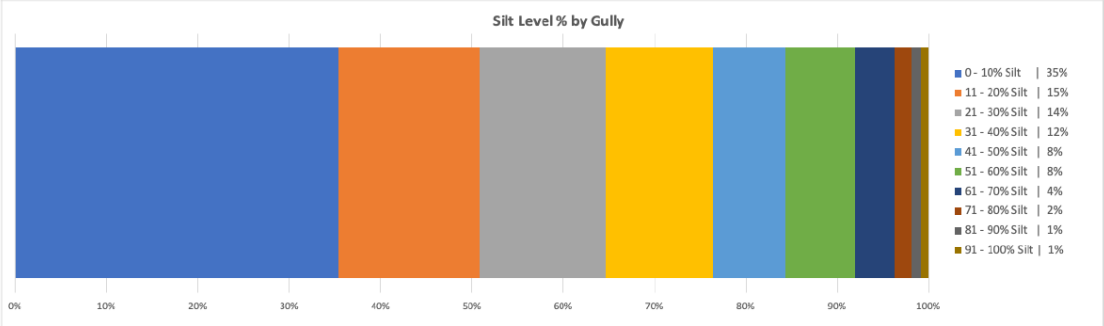
communicating as much data as required to the Pitney Bowes Confirm system (WAMS) already in operation within the authority.

3.3 In addition to the improved customer service experience, our research highlighted several areas where the financial opportunity for better management of the drainage network is significant. In comparison to similar county councils, our average cyclical/scheduled crew productivity is 65 gullies per day, vs their 99 which represents a 52% opportunity for improvement.

3.4 Kaarbontech were identified as the appropriate platform for KCC and their trial includes several stages and options as part of an approach to drainage management differently in Kent. The chosen trial area is the District of Maidstone and the broad goals of the project include:

a) Collecting an inventory of drainage assets.
b) Attributing historic information from other council systems to assets.
c) Defining and prioritising zones of interest.
d) Risk profiling maintenance based on prioritised assets.
e) Assessing if and how handhelds devices can play a part in future maintenance.
f) Allowing ongoing data collection to feed into the risk profiling automatically.
g) If the trial is successful invest in the asset management software platform to map all our drainage assets to include the final outfalls, this will reduce cost as future investigations will not be required as we have the asset plotted, including all CCTV surveys.

3.5 21,639 assets across 1,097km of highway in Maidstone have been validated and surveys carried out to validate the data on silt levels and depth of gully pots. A chart of silt level % by gully has been presented:



3.6 The charts note that half of the assets contain less than 20% capacity of silt. Only 4% contain greater than 71% silt capacity. This clearly indicates that significant parts of the drainage network could be reduced in cleansing frequency but there may be a need to target the smaller proportion that requires 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. Following the trial, the sensors which are most effective in performance and costs will be installed across the County as future funding becomes available. Examples of these are included in the appendix to this report.

4. Developing Our Future Capital Investment Programme

4.1 We proposed to develop a map of the locations where the risk of surface water flooding is high and/or where climate change impacts may affect the risk of flooding in future. This will allow a more proactive asset management approach to be taken rather than focusing solely on customer enquiries.

4.2 A GIS analysis was undertaken to identify and scores a number of ‘flood cells’ across the County based upon a series of metrics. Using GIS to present the data ensures multiple factors are taken into consideration when assessing a site. When looking at 1 in 100-year events the map shows surrounding areas which are contributing to the main flooding site and allows a broader view of the issue.

4.3 An example of a ‘flood cell’ at Swanscombe is shown below to illustrate the area which may contribute to a flooding issue. The coloured markers represent reports of flooding issues and jobs attended from WAMS:

4.4 The table below describes the metrics and risk weighting / scores in more detail:

Metrics and Scores	**Comments**
Proportion of the flood which is on the Highway	The area of the 'flood cell' which is affecting the public highway
Proportion of the flood within is affecting buildings	The area of the 'flood cell' which is affecting buildings adjacent to the public highway
Flood Depth Score	The modelled depth of flooding taken from the EA surface water map to determine the risk to the highway from the flooding – deeper water will give risk to a higher safety risk and higher likelihood of adjacent property damage
Road Category Score	A weighting is applied to reflect the type of route – The Resilient Highway Network receives a weighting of 100%, A Roads 90% and B Roads 80%. This is to give weight to the strategic and locally important highway network.
Residential Score	The number of properties affected multiplied by the proportion of flooding (where the

	highway is more than 20% of the total 'flood cell'. This score is then doubled.
Non-Residential Score	As above but this is not doubled so that additional weight is given to residential property flooding.
Climate Change Score	A combination of the metrics to look at the difference in flood extent between the modelled 1 in 30-year flood and 1 in 100-year flood. Note in some instances the highway becomes a less proportion of the flood as sources of surface water outside of the highway become the overriding factor
Enquiry Score	Whilst the assessment does include existing reports of flooding, this has been given limited weight so as not to adversely affect the identification of flood risk areas which may be either go unreported, or that are not a risk now but may become a risk in the future.
Total Score	The total score is made up of the Climate Change Score, Enquiry Score, and other Metrics to give an overall risk rating.

4.5 The analysis provides a high-level overview of the risk and the area where surface water run-off may contribute to that risk, but each 'flood cell' location will require a more detailed review in the future. By undertaking this, we can inform our three to 5-year capital works programme where these more proactive inspections reveal issues.

4.6 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 are sufficient. In other circumstances there may not be a solution that is viable or within KCC's control to deliver.

4.7 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 following in the 'Live Labs' project.
- A like-for-like 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.

4.8 It should also be noted that future improvements 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 water flooding - all measures can be overwhelmed by a rainfall event of sufficient extremity.

4.9 There is also an obvious 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.

4.10 In those cases we would propose to include 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. Funding for Capital Works and Maintenance

5.1 At present the Highway Drainage Asset Management Team benefits from an increased capital budget of £15m spread over a 3-year period from financial year 2019/20 until 2021/22. This is likely to be sufficient to deliver the current highway works year one and two capital programme but clearly there are significant uncertainties on future funding allocations currently.

5.2 It should be noted that performing works to our own highway drainage systems such that they perform more a of flood defence role is considered to be a change in policy as it is beyond the current level of service we provide and likely to be beyond our statutory duties as a Highway Authority.

5.3 Is however important to note that the roles of highway drainage and those of the Lead Local Flood Authority need to interlink so we act as one council. However, this will involve either jointly funded and seeking further funding beyond that which we have for usual highway maintenance and capital improvement activities if we wish to increase use our use of highway drainage systems to serve a flood defence role.

5.2 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 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. Changes to the previous scheme have introduced a

new risk category which will enable schemes that prevent surface water flooding to qualify for more funding.

5.4 It is important that KCC continues to seek investment in its highway drainage infrastructure to support the delivery of improvements as even with external funding, match funding is usually required to enable delivery and potentially significant investment is required to support the investigation and design of drainage schemes before any bids can be made.

5.5 As noted, it is of great importance to ensure future maintenance needs of our highway drainage systems are met so that our investment can be protected into the future, together with smarter maintenance of our existing assets. This will greatly assist with future resilience against surface water flooding.

6.

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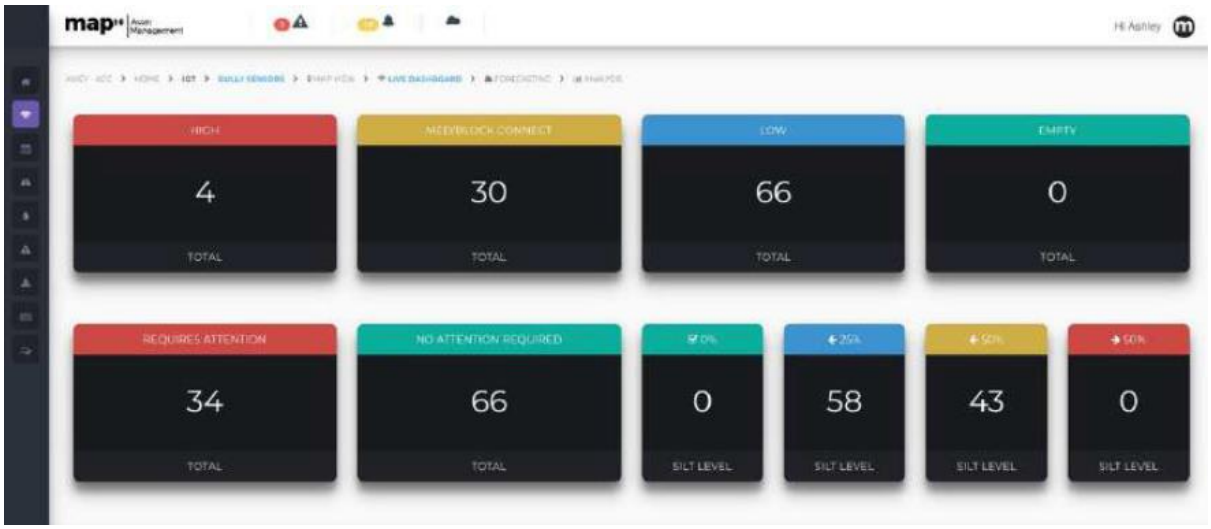
Kent's story relates BGI to communities by demonstrating the value to them.
For further information read the **BEGIN Policy Brief** at: baxcompany.com/begin-policy-brief/

Appendix – 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: