Margate Surface Water Management Plan – Stage 2

Evidence Base & Action Plan

Kent County Council

December 2014

Plan Design Enable

Notice

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Acknowledgements

Atkins would like to thank and acknowledge the following for providing information and assistance in the production of this Surface Water Management Plan:

- Max Tant (Kent County Council),
- Mike Tomlinson (Southern Water),
- Mike Humber (Thanet District Council),
- Jo Wadey (Thanet District Council),
- Alison Hill (Thanet District Council), and
- Samantha Howe (Environment Agency).

Document history

Job number: 5123965			**Document ref: Stage 2 Report**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	DRAFT FOR COMMENT	C.Sugden	A.Cambridge	K.Ravnkilde	A.Schofield	July 2014
Rev 2.0	FINAL	C.Sugden	A.Cambridge	K.Ravnkilde	A.Schofield	August 2014
Rev 3.0	FINAL Rev A	C.Sugden	A.Cambridge	K.Ravnkilde	A.Schofield	December 2014

Client signoff

Client	Kent County Council
Project	Margate Surface Water Management Plan – Stage 2
Document title	Evidence Base & Action Plan
Job no.	5123965
Copy no.	1
Document reference	5123965/070/073

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Glossary

Term / Abbreviation	Definition
AMP	Asset Management Plan
Annual Chance	The chance of a particular flood occurring in any one year. This is directly linked to the probability of a flood. For example, a flood with an annual chance of 1 in 100 (a 1 in 100 chance of occurring in any one year), has an Annual Exceedance Probability (AEP) of 1% and a return period of 1 in 100 years.
Defra	Department for Environment, Food, & Rural Affairs
DTM	Digital Terrain Model – a digital representation of topography.
EA	Environment Agency
FEH	Flood Estimation Handbook
FRM	Flood Risk Management
IDB	Internal Drainage Board
KCC	Kent County Council
LiDAR	Light Detection and Ranging – a remote sensing method used to examine the surface of the Earth and it's topography. It provides elevation data.
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
SHLAA	Strategic Housing Land Availability Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
SW	Southern Water
TDC	Thanet District Council
WFD	Water Framework Directive
WRAP	Winter Rainfall Acceptance Potential

1. Introduction

1.1. What is a Surface Water Management Plan?

A Surface Water Management Plan (SWMP) is a study to understand the flood risks that arise from local flooding, which is defined by the Flood and Water Management Act 2010 as flooding from risk from surface runoff, groundwater, and ordinary watercourses. The studies provide a co-ordinated framework for water management which can be used to enhance existing strategies (e.g. SFRAs), alleviate flood risk, assist with new development planning, forward plan SuDS provision, provide a framework for managing water quality, and ensure compliance with the EU Floods Directive and the Water Framework Directive (WFD).

SWMPs are led by a partnership of flood risk management authorities who have responsibilities for aspects of local flooding, including the County Council, Local Authority, Sewerage Undertaker and other relevant authorities.

The purpose of a SWMP is to identify what the local flood risk issues are, what options there may be to prevent them or the damage they cause, and who should take these options forward. This is presented in an Action Plan that the partners agree to.

Kent County Council (KCC) often takes a two stage approach to SWMPs. Initially, a Stage 1 SWMP is undertaken which collects all the available flood risk and flood history data in the catchment. Where this process identifies a flood prone area a Stage 2 SWMP can be required to make a more detailed assessment of flood risk and focus the resulting action plan of flood mitigation measures.

1.2. Previous Work

The Thanet Stage 1 SWMP (JBA 2013), which collated and mapped information about the history of flooding in Thanet, identified Margate as an area where further investigation was warranted. The Thanet Stage 1 SWMP identified a number of management actions, assigned areas of responsibility and defined timescales for the agreed actions to be implemented, which included:

- Coordination of targeted maintenance regimes between the key partners (particularly gullies);
- Coordination of communications in respect to maintenance regimes and the benefits of rainwater harvesting;
- Investment in hydraulic improvements (including de-silting, root removal, and minor collapse repair) for reducing the risk of property flooding;
- Ensuring that new developments do not increase the risk of surcharge within the sewer network and incorporate the use of SuDS in preference to other techniques;
- Developing measures to permit roads to be used for exceedance flow routing, for effective land drainage management, and for the collection of fats, oils, and grease; and
- Preparing a detailed SWMP for Margate and Ramsgate.

The Stage 1 SWMP identified the following specific actions for Margate:

- Investigate and identify potential flood alleviation solutions for Dane Road, Kings Road, Nash Road, St Peters Road, and Northdown Road; and
- Define who is responsible for the Tivoli Brook.

The Thanet Stage 1 SWMP has been published online and is available here.

1.3. This Commission

Following the completion of the Thanet Stage 1 SWMP (JBA, 2013) Kent County Council (KCC) commissioned Atkins in 2013 to prepare a Stage 2 Surface Water Management Plan (SWMP) for Margate, Kent. The Stage 2 SWMP was to:

- provide KCC and its partners with a comprehensive understanding of the local flood risk mechanisms in Margate;
- develop an outline of potential solutions to any significant risks identified; and
- develop a robust action plan for further work to manage the risks identified.

The project brief is provided in Appendix A and the study boundary for the project is shown in Figure 1-1 below (red line).

Figure 1-1 Study Area for Stage 2 SWMP

1.4. Report Structure

This report is structured to mirror the recommended framework provided in the SWMP technical guidance (DEFRA, 2010), and is as follows:

- Chapter 2 Preparation
- Chapter 3 Risk Assessment
- Chapter 4 Options
- Chapter 5 Implementation and Review

2. Preparation

2.1. The Need for a SWMP in Margate

Margate is an old town that is characterised by its attractive beach, deprivation, a demographic that can be considered to be transient (Thanet District Council, 2006), and is a town targeting an ambitious regeneration strategy to abate the steady decline in tourism. Margate's drainage system is predominately combined in that storm and foul flows are combined in the one sewer – modern drainage systems are typically designed to have one sewer for storm flows and one sewer for foul flows. When storm events exceed the capacity of the sewers, open channels that the sewers typically discharge into, and/or the capacity of the soil, flooding can result. For older drainage systems that are predominately combined, this floodwater is a mix of storm and foul flows containing pollutants from the sewers and contaminants from the land surface e.g. oils from roads and nutrients used for farming the land.

Historically, the issues of flooding in urban areas like Margate have been managed by simply increasing the capacity of the sewers, using "release valves" known as Combined Sewer Overflows (CSOs) that essentially allow contaminated water to discharge to open channels and/or the coastline, and upgrading associated infrastructure (e.g. bridges). This 19th century approach to managing flooding have often been effective in resolving issues or needs in the short term or needs (e.g. flood alleviation schemes or development), but not in managing the issues/needs in the longer term as the approach to drainage fundamentally remains.

Faced with the challenges of climate change and an ambitious regeneration strategy there is a risk that Margate's drainage system and existing issues could become overwhelmed with additional flows from changes in climate and new development. Margate therefore requires a SWMP to ensure future drainage provision for the Town is managed, is sustainable, and allows Margate to prosper through regeneration.

2.2. The Local Plan - Strategic Development Planning

Margate has ambitious regeneration aspirations. The current Local Plan's vision (Thanet District Council, 2006) is founded upon creating a "self contained" community which fosters inward investment and provides improvements in quality of life (attractive environment, quality housing, quality retail, quality education). Whilst the current Local Plan will be superseded by the new Local Plan (TDC, 2013) currently being prepared, the strategic priorities for the Thanet 2030 vision (the new Local Plan) are largely similar to those currently in place:

1. Create additional employment and training opportunities, to **strengthen and diversify the local economy** and improve local earning power and employability.
2. Facilitate the continued **regeneration of the coastal town centres**, developing their individual and niche roles, whilst also consolidating the role and function of Westwood as Thanet's primary retail centre, ensuring retail expenditure is retained within the district.
3. Provide **homes** that are accessible to, and suited to the needs and aspirations of, a settled and balanced community.
4. Safeguard local distinctiveness and promote awareness, responsible enjoyment, **protection and enhancement of Thanet's environment**, including the coast, countryside, rich seaside heritage, historic environment, diverse townscapes and landscape, biodiversity and water environment.
5. Provide an efficient and effective transport system, delivering the **transport infrastructure** required to support existing communities and new development.

These regeneration aspirations can be supported by a SWMP for Margate, and to allow this to occur Thanet District Council have provided the Strategic Housing Land Allocations (SHLAAs) for the purposes of this commission.

2.3. Existing Flood Risk Issues

A number of strategies / assessments have been undertaken to identify and manage the existing flood risk in Margate. This has included the Preliminary Flood Risk Assessment (KCC, 2011), the Strategic Flood Risk Assessment (Thanet District Council, 2009), and most recently the Stage 1 SWMP (JBA, 2013) which identified that –

- Margate is the 10th most at risk from surface water flooding settlement in Kent (based on dwellings at risk) (KCC, 2011);
- The Old Town and the Dreamland Sites of Margate are at risk from tidal inundation (Thanet District Council, 2009);

- The Tivoli Brook, which flows through the Dreamland Site, is known to have surface water drainage issues and have a complex flood history due to interactions with the sea (Thanet District Council, 2009). The location of the Tivoli Brook is shown in Figure 2-1 below;
- The following flood events have been the most significant for Margate (JBA, 2013):
    - 1953 – Tidal inundation (circa >550 properties)
    - 1980 – Surface water (circa >150 properties)
    - 2008 – Surface water (circa 10 properties)
    - 2009 – Surface water (circa 4 properties)

Existing flood risk issues that could be alleviated with a SWMP for Margate.

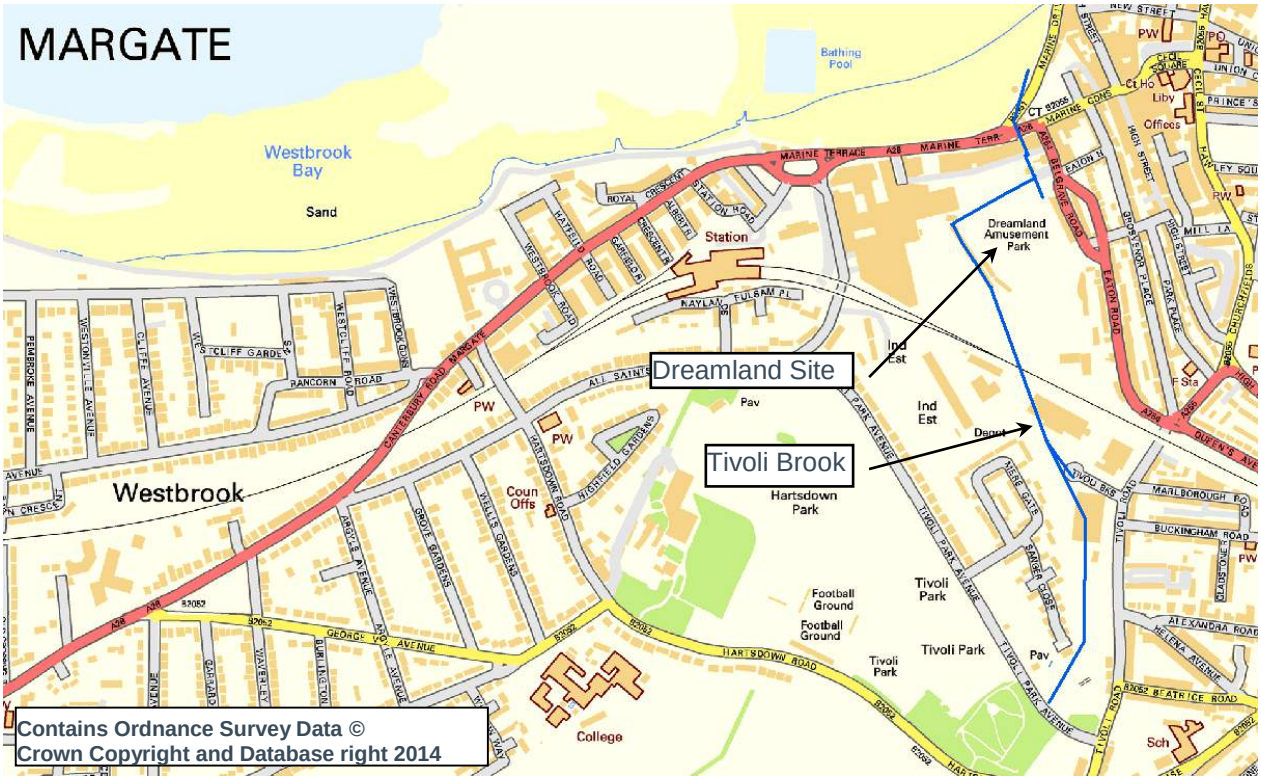

Figure 2-1 Location of Tivoli Brook

2.4. Existing Water Quality Issues

The South East River Basin Management Plan (RBMP) (EA, 2009) sets out the approach for managing pressures on the water environment for the region that covers Margate up to 2015 (and beyond with revision). This has identified that the Thanet Chalk suffer from high levels of nitrates, pesticides, and solvent contamination. Actions to monitor, safeguard and improve groundwaters are provided in the South East RBMP (EA, 2009), and include:

- Addressing rural diffuse pollution with catchment sensitive farming;
- Limiting the introduction of pollutants from road drainage, private sewage disposals, and pesticide use in urban areas; and
- Awareness raising and protecting the aquifer.

The beaches of Margate and in the immediate surrounding area are highly regarded, as reflected in that seven of the beaches have attained a “Blue Flag” status (Visit Thanet, 2014). These “Blue Flag” statuses are supported by Environment Agency sampling of bathing water cleanliness in England and Wales, which is accessible via the Bathing Water Explorer (EA, 2014). This dataset shows that the beaches of Margate and in the immediate surrounding area consistently attain annual compliance and why the “Blue Flag” statuses have been awarded, but also that there are instances of failures in water quality.

Review of the Bathing Water Explorer for the purposes of the SWMP has identified that the most recent instances of when bathing water quality failed to meet minimum standards for Intestinal Enterococci and Escherichia Coli were:

- in the summer of 2013 (13/06/2013) in the “Margate The Bay”; and
- in the summer of 2014 (21/07/2014) in the “Westbrook Bay”.

It is not known what the causes of these failures were, but it could be in response to the drainage system becoming overwhelmed and discharging into the Tivoli Brook, as the drainage system is predominately combined and these containments can be traced to human excrement in foul flow.

The water quality issues identified in the RBMP and the bathing water quality incidents recorded by the Environment Agency could be improved through a SWMP for Margate.

2.5. Existing Ecology & Habitats

The existing ecology and habitats in Margate have been determined through review of the MAGIC (MAGIC, 2014) and Kent Coastal Communities (Kent Coastal Communities, n.d.) mapping which shows the location of flora and fauna, amongst other data sets. The data sources reviewed as part of this SWMP indicate that there are a number of woodland, traditional orchards, sand BAPs, and the area supports farmland and coastal birds. The beach is designated as a:

- Special Area of Conservation (SAC);
- Site of Special Scientific Interest (SSSI); and an
- Important Bird Area.

Thanet’s Natural Environment Topic Paper (Thanet District Council, 2013) identifies that there is significant Green Infrastructure in Margate, as shown in Figure 2-2 below. These aspects will need to be protected and enhanced in pursing a regeneration strategy for Margate.

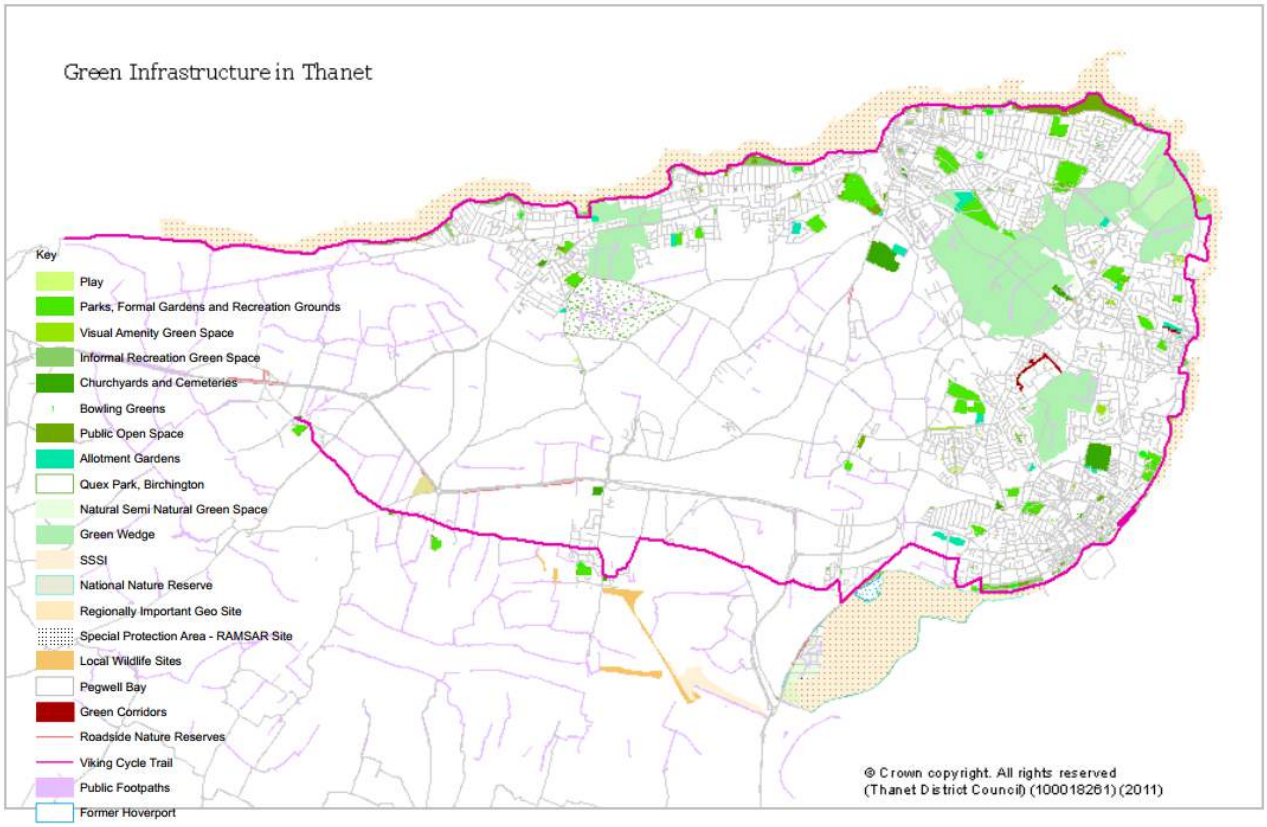

Figure 2-2 Green Infrastructure in Thanet (Thanet District Council, 2013)

2.6. The SWMP Partnership

During the Stage 1 SWMP (JBA, 2013) a partnership was established between the respective authorities responsible for water management, including:

- Kent County Council,
- Environment Agency,
- Thanet District Council;
- Southern Water; and
- River Stour (Kent) Internal Drainage Board (IDB).

In undertaking a Stage 2 SWMP for Margate the partners agreed that all of the authorities except the IDB would remain involved, as the IDB do not have responsibilities for water management within Margate.

It was agreed that other stakeholders, such as local councillors and other departments within the partner organisations, would be given the opportunity to attend partnership workshops as per the Communications & Engagement Plan (CEP) that was prepared for the project.

2.7. Communications and Engagement Plan (CEP)

To ensure that this Stage 2 SWMP was able to readily incorporate local knowledge, gain trust, and stakeholder acceptance of the SWMP, a Communications and Engagement Plan (CEP) was prepared in conjunction with the partnership. The CEP (Appendix B) essentially sought to engage with internal stakeholders through the use of partnership workshops and briefing notes until a sufficient evidence base could be used to engage with external stakeholders. The workshops undertaken during this project included:

1. Start-up Workshop 19/07/2013
2. Inception Workshop 27/09/2013
3. Options Workshop 15/11/2013
4. Engagement Workshop 07/02/2014

2.8. SWMP Objectives

During the start-up and inception workshops issues and aspirations for managing the water environment in Margate were discussed by key partners. It was highlighted that the following were issues in Margate that either needed to be considered as part of this SWMP or through other works:

- Define Tivoli Brook ownership;
- Provide a better understanding and joined up overview of Highway drainage;
- Reduce persistent, local level flooding, and water quality incidents in problem areas;
- Understand the cumulative effect of increases in impermeable areas such as paved over gardens;
- Protect and reduce the impact on bathing water quality and groundwater source protection zones,
- Provide a better understanding of the spatial nature of surface water flooding in Margate and root causes, so that future development can be planned sustainably and appropriately;
- Engage other members of the Flood Risk Management community to offer a better service and improve communication between parties, and
- Provide a better understanding of the capacity of the combined sewer network and look to provide an opportunity to disconnect / take out surface water from the combined sewer network through the use of SuDS.

The objectives of this Stage 2 SWMP were pre-defined in the commissioning of this project and are listed in 1.3.

3. Risk Assessment

3.1. Approach

The risk assessment was undertaken in two phases. The first, an intermediate assessment, was carried out to take forward the outputs from the Stage 1 SWMP (JBA, 2013) and identify the most vulnerable and persistent problem areas in Margate. The second, a detailed assessment, was undertaken to prepare strategic surface water flood risk maps, prepare predicted economic damages, identify potential solutions, and develop an action plan to take forward the outline options.

3.2. Intermediate Assessment

3.2.1. General

To take forward the Stage 1 SWMP (JBA, 2013) Kent County Council commissioned Atkins to expand the flood history included in the Stage 1 SWMP and determine what the root cause catchment conditions for the respective events were (e.g. was it caused by the catchment being saturated). The flood history was expanded to cover other factors, such as bathing water incidents and urban growth, for the purposes of the root cause analysis, as it was recognised during the preparatory phase that Margate's setting warranted the inclusion of these aspects. The flood history therefore became a "water management chronology" and the root analysis allowed linkages between flooding, water quality, urban growth, and historical schemes to be understood. Both are summarised under the respective headings below.

3.2.2. Water Management Chronology

To develop a comprehensive understanding of the local flood risk mechanisms, as well as identifying the most vulnerable and persistent problem areas in Margate for informing where the detailed assessment should be focused (refer to section 3.3), the flood history prepared during the Stage 1 SWMP was enhanced to develop a water management chronology for Margate. The water management chronology was developed by:

- Including additional flood records (e.g. Kent Fire and Rescue);
- Pairing the flood records with information on rainfall, tidal level, and antecedent catchment conditions, so that the aspects that contributed to the flood event could be understood (e.g. high intensity rainfall or due to tidal locking);
- Incorporating incidents of when bathing water quality has failed to meet minimum standards (EA, 2014), records of flood alleviation schemes, and times of urban growth (census data), so that linkages between water quality and the construction of infrastructure could be made and understood. A bathing water quality incident in this context is when routine sampling of the water quality identifies that the quality exceeds established thresholds for good quality[1].

The water management chronology is provided in Appendix C and is presented in graphical form in Figure 3-1 below. This illustrates that occurrences of floods and bathing water quality incidents have increased with time and as populations have grown, underlining the importance of Margate pursuing a considered and informed regeneration strategy in respect to the water environment.

[1] Note: Water quality standards are being refined and updated as part of the Water Framework Directive (WFD). The majority of the water quality incidents included in the water management chronology are when sampling failed to meet minimum standards for Intestinal Enterococci and Escherichia Coli.

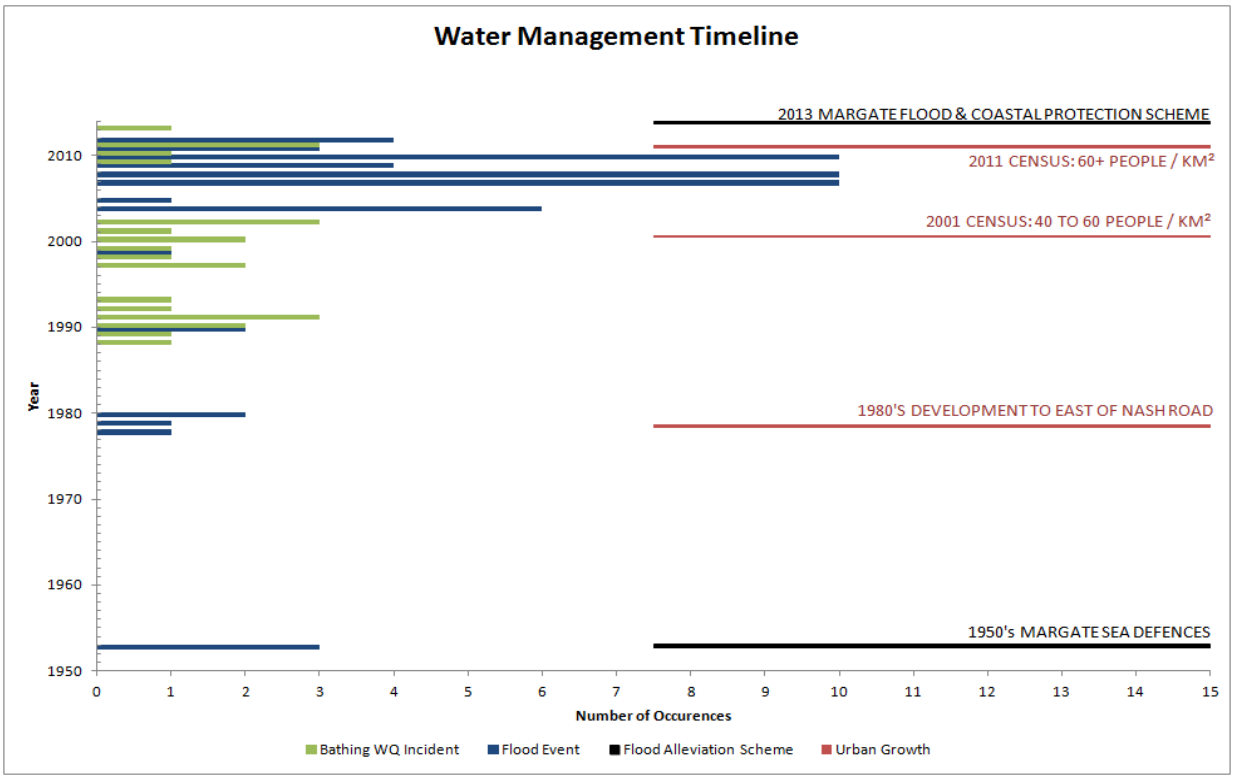

Figure 3-1 Water Management Timeline

3.2.3. Root Cause Analysis

To identify the key conditions that have led to the respective flood and bathing water quality incidents in Margate, a root cause analysis was undertaken using the information included in the water management chronology on rainfall, tidal level, and antecedent catchment conditions. This was undertaken by using the data to describe conditions in respect to:

- The season of rainfall – divided into summer and winter water years, so as to distinguish between flashy rainfall, which is typical in the summer, and sustained winter rainfall, which is typical in the winter.
- The antecedent catchment soil conditions – were again divided into summer and winter conditions, so that catchment wetness could be compared to when in the season the rainfall fell (e.g. a flashy summer rainfall event that fell on a catchment that could be considered to be wet or even saturated). This was undertaken using the standard design event storm thresholds for the Margate catchment soils and the antecedent catchment conditions calculated for the respective events/incidents.

The classification of rainfall and antecedent catchment soil conditions into summer and winter types were then used to determine the common conditions that have resulted in either a flood event or a bathing water quality incident – i.e. the root cause conditions. Tidal conditions, which were determined using the thresholds at which outfalls for when the drainage system would become tidally affected or locked, were initially used along with the rainfall and catchment classifications to determine root causes. However, this approach was discounted because of uncertainties associated with the asset data used for the detailed modelling (refer to Section 3.3.4). This issue could be re-visited in any future work to assess whether interactions with the sea (e.g. tide) are a critical condition for flood and bathing water quality incidents, given that aspects of the drainage system are known to be affected by sea conditions (e.g. Tivoli Brook – refer to section 2.3).

The root cause analysis work identified that over 60% of both the flood and bathing water quality incidents have occurred in the summer (summer rainfall) when the catchment has been saturated (winter antecedent condition). Whilst this is limited by both the events that have been identified for the chronology and the data record length with which it has been paired with, targeting this design condition could allow:

- designs to more robustly prepared, as it is targeting the key condition; and
- both water quality and flood issues to be alleviated / managed concurrently if adopted as the design condition.

Further work is required to refine the data used in the root cause analysis (in particular the temporal resolution of data), as well as enhance it with more records before it can be definitively concluded that this should be the design standard for the catchment. Until this is undertaken, it is recommended that the "summer design storm profile with a winter antecedent catchment condition" be used as a sensitivity test for designing infrastructure.

3.2.4. Conclusions from the Intermediate Assessment

From the intermediate assessment it can be concluded that:

- Historical urban growth has brought more flood risk and more occurrences of when bathing water quality has failed to meet minimum standards (refer to the water management chronology Section 3.2.2); and
- Historically Margate has been at risk from flooding and bathing water quality incidents in the summer when the catchment has been saturated (refer to the root cause analysis Section 3.2.3).

The strong linkages between urban growth, flooding, and water quality incidents are in part because the drainage system for the town is predominately combined because when the system is overwhelmed it will either lead to flooding, or point (e.g. Combined Sewer Outfalls) and diffuse (highway runoff) discharges to the sea.

To uphold the aspirations of the Local Plan, which is seeking to strengthen the economy, regenerate the coastal town, provide homes, and protect and enhance Thanet's environment, a step change in drainage provision is required. A step change that removes storm runoff from the combined system by infiltration techniques, so the combined can accommodate foul only flows and thereby reduce the risks of flooding and water quality incidents along the coastline. A step change that can be delivered through an informed and effective SWMP.

3.3. Detailed Assessment

3.3.1. General

The detailed assessment was undertaken to prepare strategic surface water flood risk maps, prepare predicted economic damages, identify potential solutions, and develop an action plan to take forward the outline options. Recognising that the beach played an important role in the character of Margate and some areas of the drainage system could be affected by tidal conditions, this phase of the SWMP also saw the establishment of a recreational value of the beaches and tidally sensitive areas being defined.

The basis for undertaking the detailed assessment is summarised below, and the economic damages and potential options are summarised in Chapter 4.

3.3.2. Recreational Value of the Beach

It was recognised during the undertaking of the project that the beach frontage played a significant role in Margate's past and future vision. It was deemed appropriate to establish the recreational enjoyment value of the beaches in Margate in the event that they were to become closed due to unsatisfactory water quality conditions.

The work is summarised in Appendix E, but it essentially determined that a closure of the beach could result in a recreational economic loss of £5,236k (over 100 years). This does not consider the total recreational value of the beaches year round, nor the socio-economic value of the tourism and trade, which would be considerably higher. This highlights that investment brought in through development should be delivered in a sustainable manner with due regard to the water and environment, and it is recommended that a valuations of the beach be determined to support this.

3.3.3. Tidally Sensitive Areas

It was recognised at the inception of the project that areas of drainage could be affected by interactions with the coast. Areas of Margate that are sensitive to tides have been demarcated such that development can be mindful of these affects when designing infrastructure. For this purpose, all drainage infrastructure below the annual tidal level of 3.26m AOD (refer to Table D-3) have been used to identify "tidally sensitive areas" and are presented in Appendix F. It is important to stress that this should not be used to blight development, but rather ensure that designs for development or alleviation schemes consider the affects of tidal locking.

3.3.4. Identifying Areas for Detailed Assessment

To identify areas for detailed assessment the water management chronology was used in combination with TDC's Strategic Housing Land Allocations (SHLAAs) to identify Key Flood Risk Areas for prioritising areas of focus in Margate. Both the water management chronology and the SHLAA were used, so that both existing issues and potential issues (due to development exacerbating issues) could be considered during the detailed assessment. The intention was to not identify a specific house, but rather a broad area that the detailed assessment would refine and allow potential options to be assessed.

The three areas that were identified for more detailed assessment are shown in Figure 3-2 below (labelled as the main road that the area covers). Here

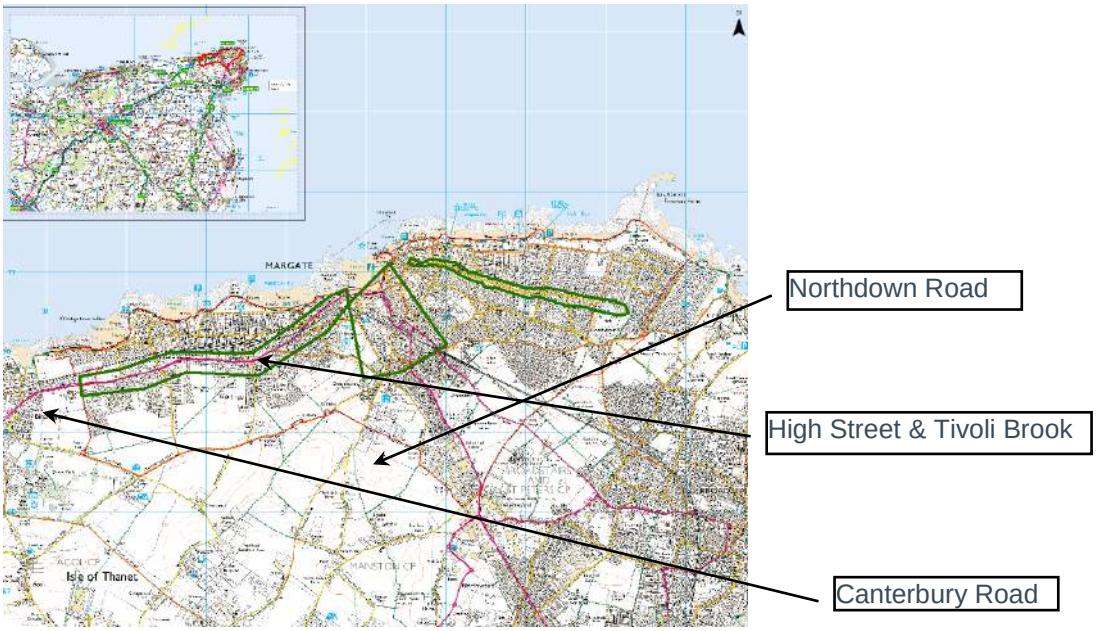

Figure 3-2 Key Flood Risk Areas

3.3.5. Integrated Urban Drainage Modelling

To define local flood risk within Margate, assess potential options, and to assist in preparing an action plan for managing surface water in Margate, a fully Integrated Urban Drainage (IUD) hydrodynamic model was developed. The IUD model was developed using InfoWorks ICM, and represents the sewers, culverted watercourses (Tivoli Brook was coarsely represented), the above ground surface, and interactions with the coast.

The IUD model was verified to two flood events (28/05/2008 and 05/10/2009), validated against typical design parameters, and agreed by the project partners to be appropriate for the purposes of the project (Inception Meeting on 27/09/2013). The development of the model is summarised in Appendix D, detailing the key assumptions, uncertainties, and limitations in its use.

Further work to take forward the IUD model, as part of the SWMP, and more broadly managing flood and water quality issues in Margate, will be required. Improvements include:

- Calibration – to flow survey
- Re-verification – to flood events identified in the water management chronology and using flood event surveys to glean more refined information for assessing the models performance
- Refinement – inclusion of local details, such as walls and kerbs, the use of radar-rainfall / time series rainfall, and surveys / additional drainage details e.g. the representation of the Tivoli Brook.

3.3.6. Strategic Surface Water Flood Risk Maps

The IUD model was used to prepare surface water flood risk maps for the 1 in 30 and 1 in 100 year design rainfall events. More frequent return period storms have not been used to prepare flood risk maps due to a lack of calibration, uncertainties associated with the IUD model, and an understanding that it would only be worthwhile preparing the full range of maps once the IUD model has been further refined.

The surface water flood risk maps show areas of Margate that are predicted to be at flood risk during a 1 in 30 and 1 in 100 year design rainfall event as a result of:

- either the rainfall exceeding the capacity of watercourse and the underground/man-made drainage systems;
- run-off from land; or
- flows not able to discharge to the sea due to high sea levels (e.g. high tide).

The surface water flood risk maps will be used by the key partner organisations in the following ways:

- identifying opportunities for flood risk alleviation;
- the preparation of the Local Plan and associated strategic plans (already provided to TDC); and
- providing an overall holistic and partnered approach to managing the complexities of surface water flood risk.

A sample of the strategic surface water flood map for an area of Margate and what it shows is provided in Figure 3-3 below.

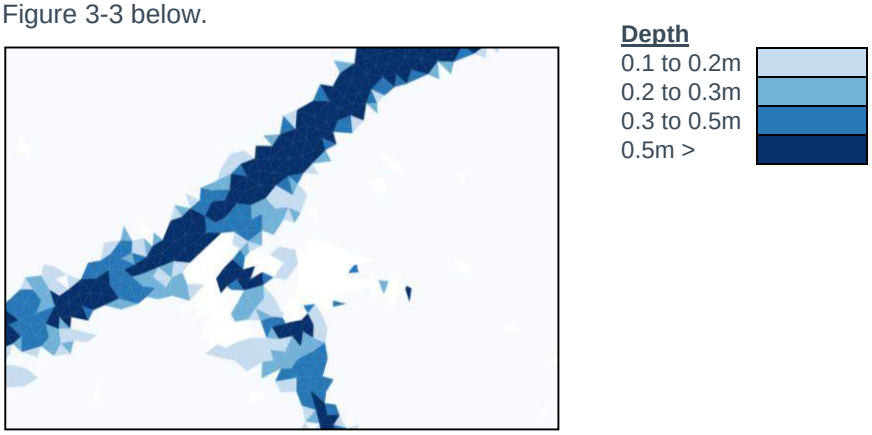

Figure 3-3 Strategic Surface Water Flood Risk Maps

3.3.7. Opportunities for Surface Water Management

Opportunities for improving surface water management in Margate were identified for the three key areas (identified using the SHLAA, and flood and water quality issues) using the strategic surface water maps and a source-pathway-receptor approach. The opportunity areas were discussed at an Options Workshop on 15/11/2013 where it was agreed that this is where options appraisal should be focused.

The thirteen opportunity areas are shown in Figure 3-4 below.

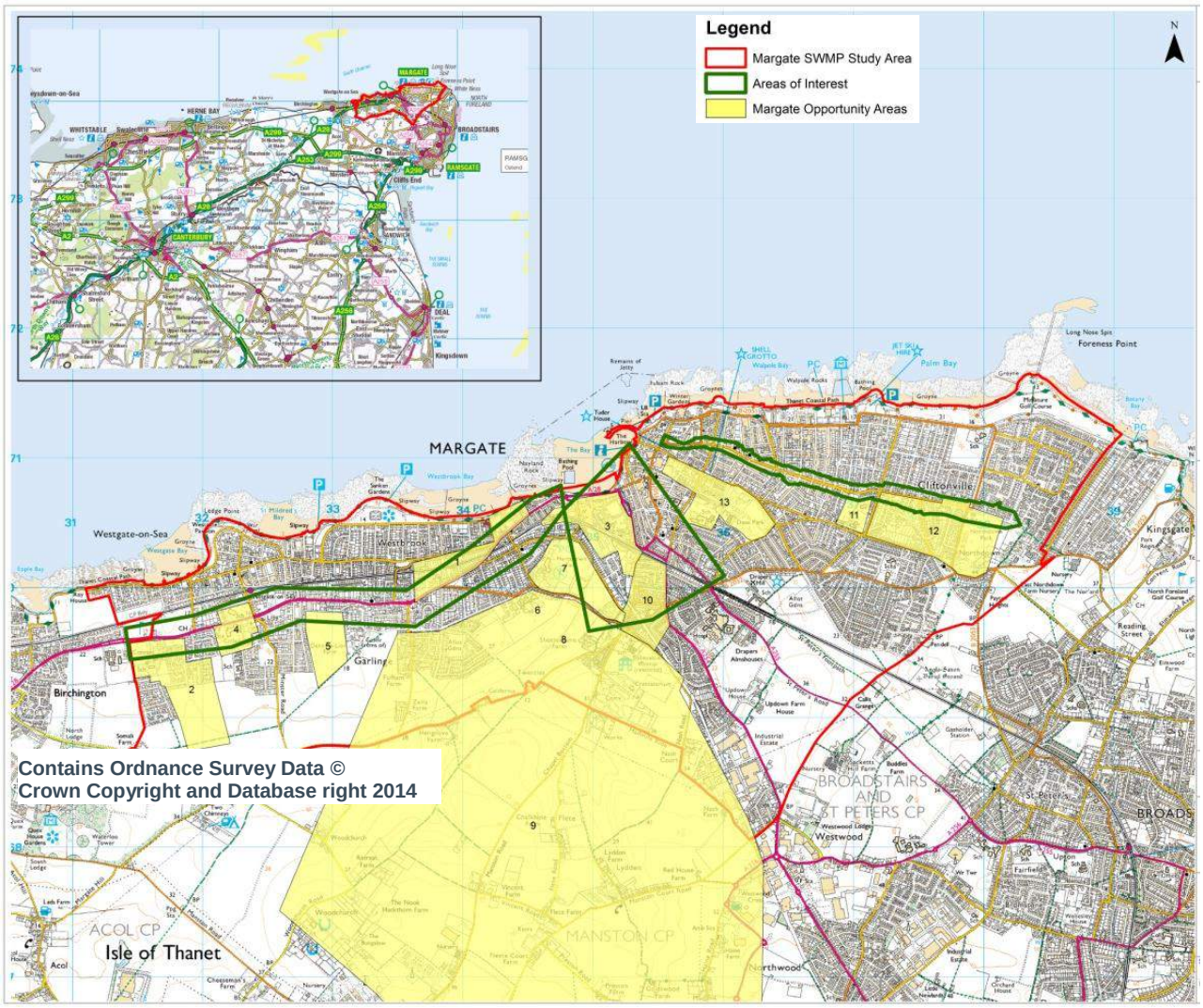

Figure 3-4 Opportunity Areas for Surface Water Management

4. Options

4.1. Approach

The scope for this project was not to look at options in detail, but rather provide an outline of potential solutions. It is important to highlight that the options provided in this SWMP are conceptual and will require further refinement. The conceptual options were developed at an Options Workshop (15/11/2013) where a set of preferred interventions were applied to the respective thirteen opportunity areas. The preferred interventions were developed by the partnership at the Options Workshop to ensure any options assessed would be acceptable if, or when, taken forward by an authority within the partnership.

The preferred interventions were developed on the basis that Margate is targeting an ambitious regeneration strategy. This presents opportunities for implementing improvements to surface water management, where the drainage system is combined and attenuating / removing storm flows from the system is the most sustainable approach to drainage. The three preferred interventions were

1. **Planning Activities** – incorporation of options in the regeneration of Margate (using SHLAA);
2. **Surface Water Removal** – disconnecting storm inflows into the combined network with a preference for the use of SuDS;
3. **Attenuation & Retention** – storage of flood flows in above ground storage e.g. a swale.

4.2. Assessment of Conceptual Options

The options identified for the respective opportunity areas were simulated in the InfoWorks ICM model to conceptually assess their performance and benefit. The benefit of the conceptual options were then summarised in a "story board" format (Appendix G) showing how they could be taken forward and the following information which would support this process:

- historic flooding incidents;
- high level constraints;
- receptors;
- predicted existing flood risk for the 1 in 30 and 1 in 100 year rainfall events;
- the key flood mechanisms;
- the number of properties at risk and average annual damages;
- the long list of options considered;
- the preferred conceptual option;
- the cost benefit ratio of the preferred conceptual option;
- key stakeholders for the preferred conceptual option;
- actions (including deadline / timeline, review date, and date agreed);
- lead and responsible partner.

Flood damages were determined using a Weighted-Annual-Average-Damages (WAAD), which is a high level economic appraisal approach and suitable for the purposes of this commission (refer to Appendix E). Capital construction costs were determined using published unit rates[2][3] brought to net present value, and an uplift of 1.8 to account for risk (45%), design work required (20%), and preliminaries (15%). The damage and cost were then used to determine cost benefit ratios and are presented in the storyboards (Appendix G).

The "Summary Table" in Appendix G shows that cost benefit ratios are low for the thirteen opportunity areas identified (currently a factor of 8 achieves funding and the highest is 1.4) and either alternative funding measures or further refinement of the work undertaken in this commission will be required to determine whether funding from Grant in Aid can be sourced. For example, optimising the requirements of the design options, refining capital costs, and, if an option can be designed to mitigate against the risk of further water quality events, incorporating these benefits. Work undertaken as part of this commission (Appendix E) has established that £773k (over 100 years) could be added to Outcome Measure 1 in the Partnership funding score if such an option could be developed. This could substantially change cost benefit ratios and the ability to obtain Grant in Aid and further work is recommended.

[2] Stovin, V.R. & Swan, A.D. (2007) Retrofit SuDS - Cost estimates and decision-support tools
[3] EA (2010) Flood Risk Management Estimating Guide – Update 2010

4.3. Internal Consultation on Options

The conceptual options and Stage 2 SWMP outputs more generally, were discussed with internal partner departments, councillors, and the partnership members at an Engagement Workshop on 07/02/2014. The engagement workshop confirmed that:

- the thirteen opportunity areas are the priority areas for Margate;
- the conceptual options being considered at the thirteen opportunity areas are appropriate;
- there would be benefit in linking the regeneration strategy with the SWMP – agreeing that the strategic surface water flood maps should be shared with TDC's planners;
- the ownership issues surrounding the Tivoli Brook would need to be resolved in subsequent meetings; and
- the proposed Action Plans for the SWMP were appropriate and should be pursued / implemented.

5. Implementation and Review

5.1. Introduction

During the workshops held with the partnership it was agreed that the SWMP would be implemented using two Action Plans. One Action Plan would be the overarching strategy for Margate ("Generic Action Plan") and the second would include a series of Action Plans for the respective opportunity areas ("Opportunity Area Specific Action Plans").

The "Generic Action Plan" sets out how surface water would be managed sustainably in the long term, and the "Opportunity Area Specific Action Plans" would allow "quick wins" to be implemented e.g. as part of regeneration activities or with further refinement of the options.

5.2. Generic Action Plan

Key success criteria were discussed at a series of workshops to ensure the Generic Action Plan would be adopted by the respective authorities in the partnership. The key partners identified and agreed that the Generic Action Plan must be:

- Practical;
- Feasible;
- Implementable (now and in the future);
- Not blight development in Margate and promote sustainable development;
- Provide a robust evidence base for surface water management decisions;
- Require minimal resourcing and promote effective cross-organisation working;
- Be time limited; and
- Act as a catalyst for improvement, future planning, and regeneration of Margate.

The Generic Action Plan is provided in Table 5-1 below.

The Generic Action Plan will be kept "live" and up to date, so that when actions are completed they are removed, and when additional actions are required, they are included. The Generic Action Plan will be formally reviewed every five years and inline with water company Asset Management Planning (AMP), given that this has a bearing on the ability of partners to cross fund opportunities. The next times the Generic Action Plan will be reviewed are:

- 2015;
- 2019 (in preparing for AMP7).

5.3. Opportunity Area Specific Action Plans

Action Plans for the respective thirteen opportunity areas are provided in Table 5-2 (below) with further detail provided in Appendix G. These actions shall be taken forward by the respective lead partners and reviewed / updated inline with the timelines provided. If opportunities are deemed to be unviable they will remain as potential opportunities for the SWMP, but only if funding is made available.

The next times the opportunity area specific Action Plans shall be reviewed are:

- 2015
- 2019 (in preparing for AMP7).

Table 5-1 Generic Action Plan

Action		Responsible		Benefits	Timeline
		Lead	**Support**		
Planning	Prepare planning policy to prevent and reduce surface water runoff from entering the combined system using SuDS techniques.	TDC - planning	KCC & SW	Reduction in flood and water quality risk. Provides headroom for additional foul loads (as part of population growth) in the combined system thereby reducing pressure on Southern Water's sewer network. Supports the enhancement of "green corridors" and thus the social and aesthetic qualities of Margate.	For inclusion in next draft of the Local Plan.
	Ensure tidal locking does not affect new / refurbished drainage from the indicative delineated area. Tidally sensitive drainage areas are provided in Appendix C.	SW	KCC & TDC - *planning*	Reduction in flood and water quality risk. Considered drainage designs prepared for new / refurbished developments.	For inclusion in the Infrastructure Delivery Plan which will support the Local Plan and policy for inclusion in the next draft of the Local Plan.
	Prepare specific guidance on positively draining coastal frontage development to the sea and determine economic valuations for the beaches.	KCC TDC - planning	SW	Reduction in flood and water quality risk. Provides headroom for additional foul loads (as part of population growth) in the combined system thereby reducing pressure on Southern Water's sewer network. Supports that investment brought in through development should be delivered in a sustainable manner with due regard to the water and environment.	For inclusion in the Infrastructure Delivery Plan which will support the Local Plan and policy for inclusion in the next draft of the Local Plan.
	Positively drain development to the Tivoli Brook ensuring it is not overloaded and is adequately maintained.	KCC TDC - planning	EA & SW	Reduction in flood and water quality risk. Provides a focused and consistent approach to draining the Tivoli Brook and encourages appropriate drainage for new developments.	As the opportunity arises
Management / Maintenance	Improve hydrometric network and/or adopt radar-rainfall outputs, as data becomes available	EA	SW & KCC	Improved confidence in SWMP opportunities pursued and the overall management of flood and water quality risks in Margate.	As the opportunity arises
	Maintain and improve the water management chronology with further records and refined data, in particular the temporal resolution of data. Until undertaken, the "summer design storm profile with a winter antecedent catchment condition" shall be used as a sensitivity test for designing infrastructure.	KCC	SW & TDC	To allow targeted design storm conditions to be established for the SWMP and infrastructure.	Ongoing
	Southern Water and Kent County Council to co-ordinate maintenance on drainage systems – review and maintain maintenance schedules on new / refurbished drainage.	SW	KCC	Reduction in the risk of flood and water quality issues being caused by blockage and such like.	Ongoing
	Partners are to adopt the InfoWorks ICM model for all future flood and water quality management in Margate enhancing where and when required e.g. surveys, model calibration to short term flows survey, historical verification, and use of radar-rainfall / time series inputs.	KCC	SW, EA, TDC	Robust and co-ordinated approach to managing surface water (flood and water quality risk). Cost efficiencies for all partners.	As the opportunity arises
	Tivoli Brook – explore issues surrounding the ownership, state of repair, water quality and flood risk, as enough is not currently known about the culverted watercourse.	TDC	SW & KCC	Clear and defined areas of responsibility for the Tivoli Brook should reduce flood and water quality issues and encourage safe and sustainable development.	2015
	Consider the thirteen opportunity areas identified in a greater level of detail refining damage estimates, capital construction costs, and concurrently developing an option for improving the management of water quality, as this could enable Grant in Aid funding to be sought. The three preferred interventions shall be adopted in preference for all infrastructure design (refer to section 4.1).	KCC	SW & TDC	To enable sustainable and cost effective alleviation solutions to be implemented.	Ongoing
Engagement	Prepare an engagement plan to promote the SWMP with wider stakeholders, improve awareness of drainage in Margate and potential options to resolve them, as well as ensure opportunities are incorporated into the regeneration strategy.	KCC TDC - planning	SW, EA,	Should support the implementation of schemes by encouraging collaborative working. Provides an evidence base of the decision making processes.	As the opportunity arises

Table 5-2 Opportunity Area Action Plans

Opportunity Area Reference	Key Flood Risk Area	Preferred Intervention	Actions		Lead & Responsible Partner	Date Agreed	Deadline / Timeline	Review Date
			As Agreed by Partner Organisations					
			1	2				
Area 1	Canterbury Road	Planning Activities	Improve evidence base through model improvements and detailed review into historical flooding.	Establish development principles in the Local Plan / Core Strategy.	TDC	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 2	Canterbury Road	Attenuation & Retention - Surface Water Removal		Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land management techniques.	KCC	07/02/2014	2015	2015
Area 3	High Street & Tivoli Brook	Planning Activities		Establish development principles in the Local Plan / Core Strategy.	TDC	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 4	Canterbury Road	Attenuation & Retention - Surface Water Removal		Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land management techniques.	KCC	07/02/2014	2015	2015
Area 5	Canterbury Road	Attenuation		Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land management techniques.	KCC	07/02/2014	2015	2015
Area 6	Canterbury Road	Surface Water Removal		KCC to contact school / academy to explore opportunities for SUDS retrofit.	KCC	07/02/2014	2015	2015
Area 7	Canterbury Road	Attenuation & Retention - Surface Water Removal		Incorporate opportunity into the regeneration of the Margate Football Club.	TDC	07/02/2014	2015	2015
Area 8	Canterbury Road	Attenuation		Investigate the feasibility and benefits of upstream storage and land management techniques to Margate.	EA	07/02/2014	2015	2015
Area 9	High Street & Tivoli Brook	Planning Activities		Establish development principles in the Local Plan / Core Strategy.	TDC	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 10	High Street & Tivoli Brook	Planning Activities		Establish development principles in the Local Plan / Core Strategy.	TDC	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 11	Northdown Road	Planning Activities		Establish development principles in the Local Plan / Core Strategy.	TDC	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 12	Northdown Road	Attenuation, Retention - Surface Water Removal, & sewer upgrades		Investigate the feasibility of re-directing overland flows for storage in Northdown Park alongside Southern Water's scheme.	SW	07/02/2014	2015	2015
Area 13	High Street & Tivoli Brook	Attenuation & Retention - Surface Water Removal		Investigate the feasibility of optimising flood storage in Dane Park.	KCC	07/02/2014	2015	2015

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Appendices

Appendix A. Project Brief

A.1. Background/Project Description

As Lead Local Flood Authority Kent County Council has undertaken a number of Stage 1 Surface Water Management Plans (SWMPs) across Kent to identify areas that require more in depth local flood risk management investigations. These Stage 1 SWMPs have focussed on available data and flood history, they have not included any modelling or public engagement.

The Stage 1 SWMP for Thanet district has found that the town of Margate has a significant local flood risk, with a flood history of overloaded drains and flooding from an ordinary watercourse. Margate is also at risk of tidal flooding. Whilst there are new defences to defend the town from this source of flooding, there is a combined risk from the tide locking of outfalls.

The town of Margate lies on the north Kent Coast on the Thanet peninsula. The coast is an important feature in the history, economy and image of Margate and plays an important role in its flood history. Margate town centre is on low level land, lying next to the harbour. The land rises to the south and east, making the town centre particularly prone to flooding.

KCC would like to appoint a suitably qualified consultant to undertake a Surface Water Management Plan in Margate with the purpose of producing a 2D hydrodynamic model of the sewers, roads, ground surface and other local water infrastructure that affects the drainage of the town.

The purpose of this project is to provide KCC and its partners with a comprehensive understanding of the local flood risk mechanisms in Margate, an outline of potential solutions to any significant risk identified and a robust action plan for further work to manage the risks identified.

A.2. Outline Service Requirement / Specification

The Margate SWMP will have the following objectives:

1. The establishment of a local partnership as a steering group;
2. The collation and mapping of a comprehensive flood history for all relevant local flood risk sources, which may include collecting data from the residents of Margate;
3. The preparation of source pathway receptor models for all the risks and sources that are identified;
4. The preparation of a hydrodynamic flood model in an appropriate modelling package, which should include:
    - All appropriate local water infrastructure, eg surface water sewers, combined sewers, ordinary watercourses ,the sea and any other controls
    - Collation of any relevant monitoring data, including sewer flow data, rain gauge data
    - Calibration of the modelling with any monitoring data and recorded events
5. Sensitivity analysis of the model's performance;
6. The predicted flooding, including depth, velocity and hazard, to the town from the 1 in 2, 10, 30, 75, 100 and 100 +CC events for the three storm durations to be determined;
7. Determine the areas at risk of flooding, as identified by the model and historic flooding data, including allocated sites;
8. Identification of the causes of flooding and/or constraints to drainage;
9. Using the model outputs to estimate the economic impact of flooding to the town and to assess mitigation options for the flood risks identified;
10. A clear plan for further work that may be necessary to manage or better understand the risks identified, including the owner of the actions, the timeframe for undertaking them and indicative costs; and
11. Public engagement on the findings of the SWMP and the proposed action plan.

All actions and further work proposed by the SWMP should be agreed by the project steering group and the proposed owner of the action prior to the end of the project.

A.3. Study Area

The study area should be appropriate to assess the risks from local flood sources to the town of Margate. Where the sources of risk originate outside of the town they should be included in the study (for example, runoff from nearby hills, or a wider sewer network).

A plan of Margate is shown on the attached figure. The exact extent of the study area should be discussed with the project steering group at an early stage to ensure that any important plans or future changes can be incorporated into the study area.

A.4. The deliverables

1. A fully integrated surface and sewer model of the town in an appropriate modelling package (eg InfoWorks ICM). All files and data necessary to run the model and produce all the outputs used in the project including any licences for the data;
2. A report detailing the flood risks and flood mechanisms to the town including maps of the flooding from each of the model scenarios;
3. An action plan for managing the risk identified including the owner of the actions, the timeframe for undertaking them and indicative costs;
4. An appendix to the final report that provides a comprehensive modelling report that details how the model was constructed, all assumptions made, all testing, calibration and verification undertaken and maps of all the modelled scenarios;
5. A minimum of three project steering group meetings; and
6. A public consultation event to gather information/opinion on local flood risk in Margate and present on the findings of the SWMP.

Appendix B. Communications & Engagement Plan

B.1. Introduction

Surface water cannot be managed by a single authority, organisation, or partner. All the key organisations involved in the management of surface water need, and must, work together and execute a plan that allows surface water to be managed sustainably.

To ensure this Stage 2 SWMP was able to readily incorporate local knowledge, gain trust, and stakeholder acceptance of the SWMP, a Communications and Engagement Plan (CEP) was prepared in conjunction with the partnership.

B.2. Approach and Objectives

The CEP prepared during this project was developed on the basis that the partnership needed to first of all understand more about the risks and issues in Margate before wider scale engagement could take place. It was agreed by the partnership that engagement would primarily revolve around the key partnership members, but internal stakeholders of the partnership would be engaged through the use of briefing notes and an Engagement Workshop (07/02/2014).

The objectives of the CEP were to communicate:

- Internally and externally, so as to allow knowledge to be shared and used in improving the way flood risk is managed;
- As appropriate, listening to stakeholder and community views to ensure long-term relationships are built;
- Effectively, so that people are educated, became well informed, encouraged, participated, and took ownership of the outcomes of the project;
- So that expectations were managed in respect to solutions and delivery of solutions
- Following good practice guidance and consultation legislation e.g. 2011 Localism Bill

Objectives that were delivered using the “Engage, Deliberate, Decide” (EDD) process of decision making.

B.3. Engagement Outputs

The three briefing notes that were prepared and distributed to partner organisations for wider distribution and keeping internal departments informed of project progress are provided under Section B.4 below.

The culmination of the engagement undertaken during the project was the Engagement Workshop which was held in TDC offices on 07/02/2014. The Engagement Workshop was attended by the internal partner departments, councillors, the partnership members, and Atkins where the project outputs were presented and discussed in a breakout workshop format. Views and opinions were minuted and recorded for the following participatory sessions that are provided in Section B.5 below –

- Session Three – Proposed Actions
- Session Four – Measuring Success
- Session Five – Next Steps

The engagement workshop confirmed that:

- The thirteen opportunity areas where the priority areas for Margate;
- the conceptual options being considered at the thirteen opportunity areas are appropriate;
- there would be benefit in linking the regeneration strategy with the SWMP – agreeing that the strategic surface water flood maps should be shared with TDC’s planners; and
- the proposed action plans for the SWMP were appropriate and should be pursued / implemented.

B.4. Briefing Notes

B.4.1. Briefing Note 1

Summary

Kent County Council is preparing a detailed Surface Water Management Plan (SWMP) for Margate with their partners/stakeholders. The project will provide a detailed understanding of surface water flood risk issues, assess flood alleviation measures, and prepare an action plan to ensure this type of flood risk is managed in a co-ordinated manner in Margate.

Background

Following the Thanet Stage 1 SWMP, which collated and mapped information about the history of flooding, Margate was identified as an area in Kent where further investigation would assist in understanding its complex flood history. The Thanet Stage 1 SWMP identified a number of management actions, assigned responsibility, and defined timescales for the agreed actions to be implemented. Kent County Council has published the Stage 1 SWMP online here.

What is a SWMP?

A SWMP is a plan that seeks to manage surface water flood risk and improve water quality at a local level now and into the future. In this context 'surface water' includes heavy rainfall exceeding the capacity of watercourses and the underground/man-made drainage systems, runoff from land, and the interactions with the coast. This holistic approach provides the necessary framework to ensure surface water flood risk and water quality is managed in a coordinated manner.

What are the Issues in Margate?

The area that will be studied in detail in preparing the SWMP is shown in Figure 1. This area has been flooded a number of times by tidal inundation (1953) and by watercourses / underground drainage systems becoming overwhelmed during heavy rainfall (1980, 2008, and 2009).

What is the Purpose of the SWMP?

The purpose of the SWMP is to:

Develop a computer model of the watercourses, underground and man-made drainage systems, terrain, and coastal interactions in Margate.

Use the computer model to understand and assess flood risk now and into the future (e.g. as a result of climate change and urbanisation).

Assess flood alleviation measures and identify fundable options that are cost beneficial.

Prepare a practical action plan to ensure flood risk is managed in a co-ordinated manner by all of the partners and stakeholders going forward.

What stage is the SWMP at?

Starting from July 2013, the SWMP will be prepared over a period of 5 months and by December 2013. The project is in its initial stages in which the computer model is being developed.

Who is involved in the SWMP

The Stage 2 SWMP will involve a partnership of all the relevant flood management authorities working in Margate. This includes Kent County Council, the Environment Agency, Thanet District Council and Southern Water. Other stakeholders, such as local councillors and other departments within the partner organisations, will be kept informed of progress using briefing notes, of which this is the first. Depending on the level of risk and the type of solutions under consideration, further engagement with stakeholders and local communities may be necessary.

Contact us

If you would like any further information you can contact a member of the project team (provided below). Further information about SWMPs is available here.

Name	Organisation	Role	Contact Details
Max Tant	Kent County Council	Flood Risk Manager, project sponsor. Contact for general information regarding the purpose of the project and flood risk management in Kent.	01622 221691 Max.tant@kent.gov.uk

Note: contact with other partner organisations can be provided upon request.

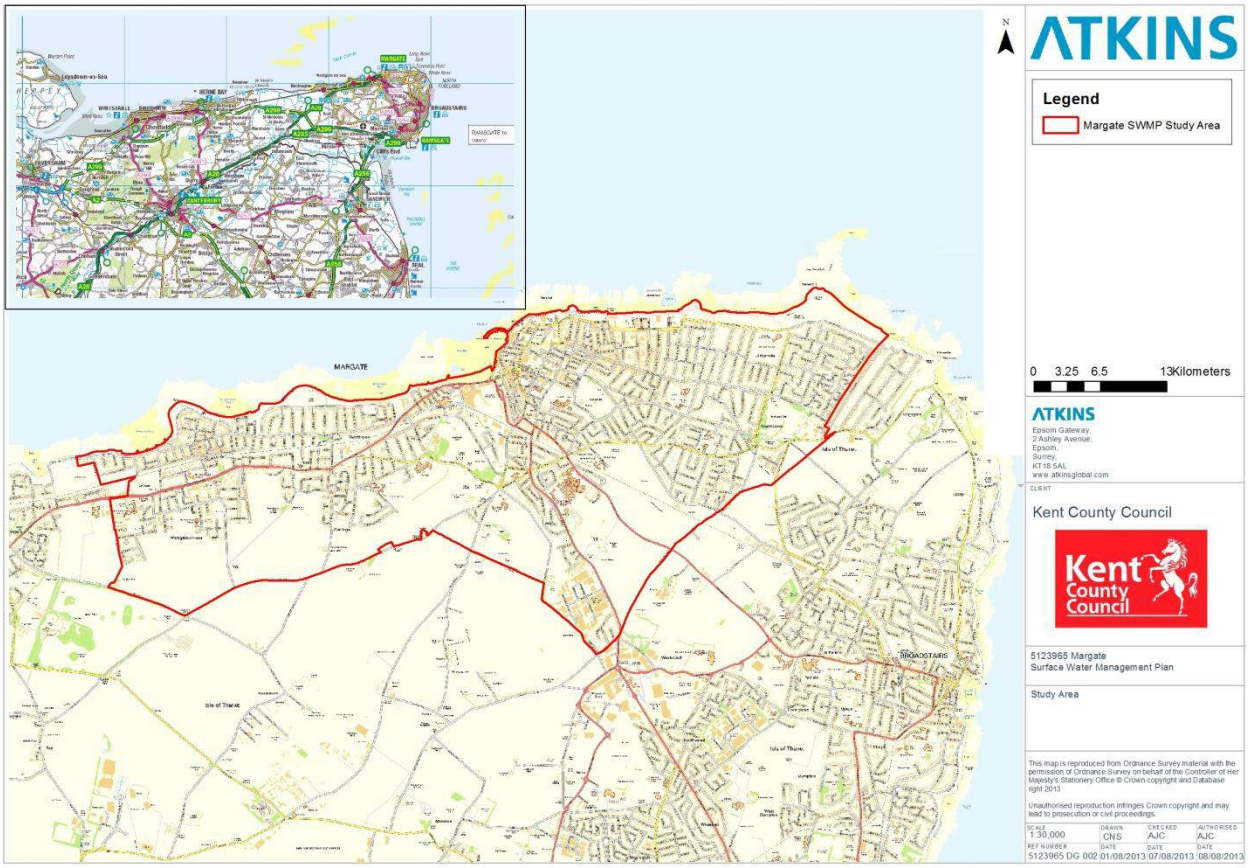


Figure 1 – Study Area

B.4.2. Briefing Note 2

Summary

Kent County Council is preparing a detailed Surface Water Management Plan (SWMP) for Margate with their partners/stakeholders. The project is providing a detailed understanding of surface water flood risk issues, assessing flood alleviation measures, and preparing an action plan to ensure this type of flood risk is managed in a co-ordinated manner in Margate.

Background

Following the Thanet Stage 1 SWMP, which collated and mapped information about the history of flooding, Margate was identified as an area in Kent where further investigation would assist in understanding its complex flood history. The Thanet Stage 1 SWMP identified a number of management actions, assigned responsibility, and defined timescales for the agreed actions to be implemented. Kent County Council has published the Stage 1 SWMP online here.

This is the second Briefing Note for the Margate SWMP. The first Briefing Note was distributed to all key partners and can be obtained from Max Tant of Kent County Council (contact details provided below).

What is a SWMP?

A SWMP is a plan that seeks to manage surface water flood risk and improve water quality at a local level now and into the future. In this context 'surface water' includes heavy rainfall exceeding the capacity of watercourses and the underground/man-made drainage systems, runoff from land, and the interactions with the coast. This holistic approach provides the necessary framework to ensure surface water flood risk and water quality is managed in a coordinated manner.

What are the Issues in Margate?

The area that has been studied in detail in preparing the SWMP is shown in Figure 1 below. This area has been flooded a number of times by tidal inundation (1953) and by watercourses / underground drainage systems becoming overwhelmed during heavy rainfall (1980, 2008, and 2009).

Following a high level risk and needs assessment the following three key risk areas have been identified:

- Canterbury Road (Area 1)
- High Street/Tivoli Brook (Area 2)
- Northdown Road (Area 3)

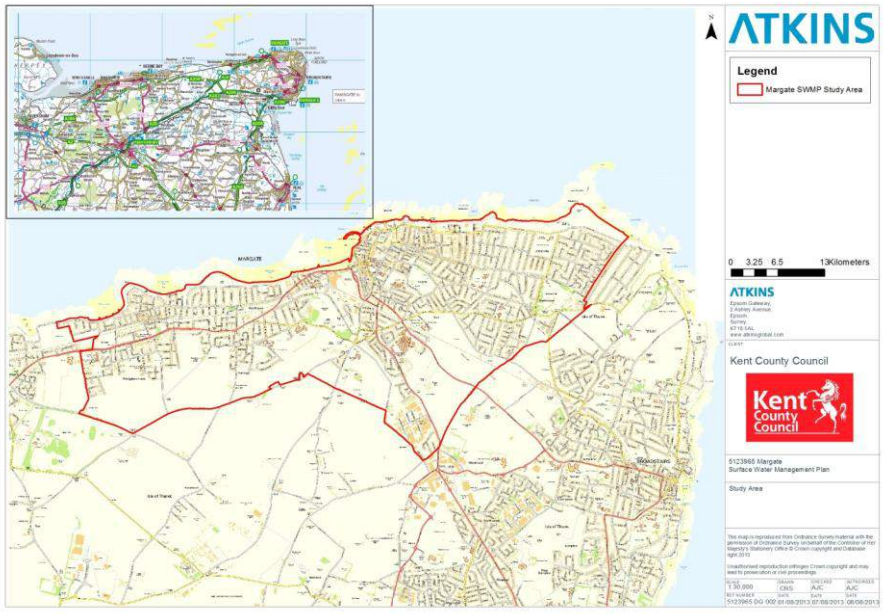


Figure 1 – Study Area

What stage is the project at?

Having gathered as much information as possible about flooding in the study area, a computer model has been developed of the watercourses, underground/man-made drainage systems, terrain and coastal interactions in Margate. This model has been used to identify 13 areas where there are potential surface water management opportunities (Figure 2 below) in terms of practicality and cost. The final list will be included in the Action Plan, so that a co-ordinated approach is taken by the partners and stakeholders going forward.

The project concludes in December 2013.

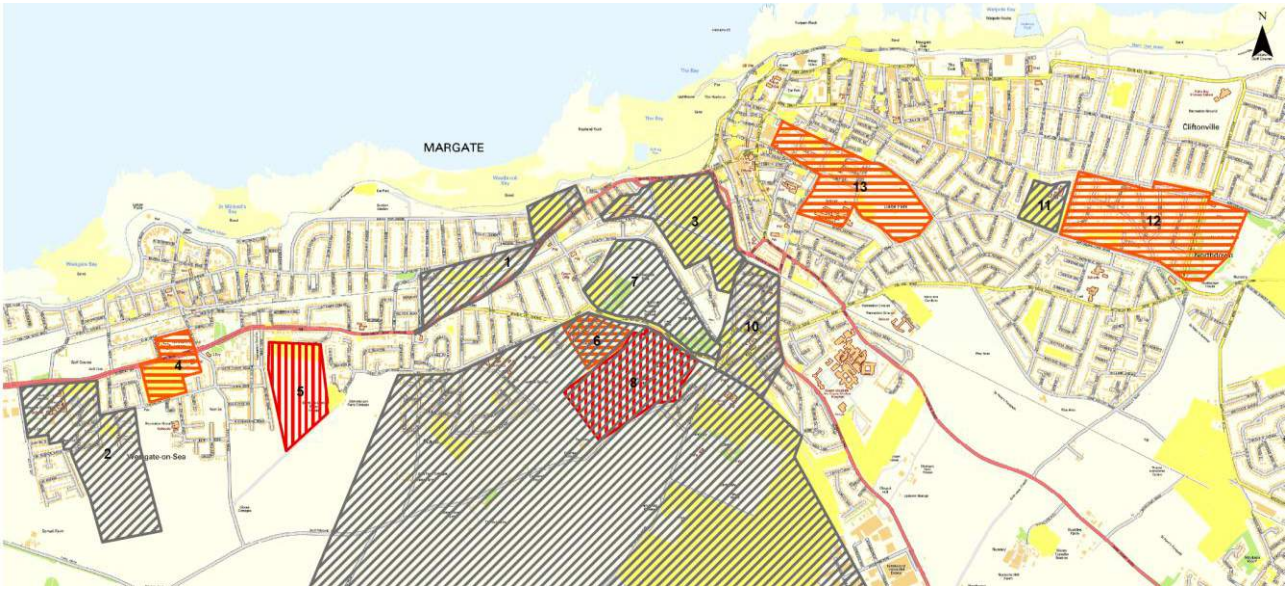


Figure 2 – Surface Water Management Opportunities

What types of actions might be taken?

Final preferred options have not yet been arrived at, but the following generic options are being considered:

- Ways of removing surface water from the drainage system
- Storing water above ground so it does not flood properties
- Building risk into planning and development opportunities in Margate

Who is involved in the SWMP

The Stage 2 SWMP involves a partnership of all the relevant flood management authorities working in Margate. This includes Kent County Council, the Environment Agency, Thanet District Council and Southern Water. Other stakeholders, such as local councillors and other departments within the partner organisations, will be kept informed of progress using briefing notes, of which this is the second.

How can I find out more and have my say?

There is a considerable amount of information on the Kent CC website. For general information, you can contact Max Tant (details below). Depending on the outcome of the preferred options process, we may be contacting local stakeholders who may be affected in some way. Those involved will be contacted directly.

Contact us

If you would like any further information you can contact a member of the project team (provided below). Further information about SWMPs is available here.

Name	Organisation	Role	Contact Details
Max Tant	Kent County Council	Flood Risk Manager, project sponsor. Contact for general information regarding the purpose of the project and flood risk management in Kent.	01622 221691 Max.tant@kent.gov.uk

Note: contact with other partner organisations can be provided upon request.

B.4.3. Briefing Note 3

Summary

Kent County Council is preparing a detailed Surface Water Management Plan (SWMP) for Margate with their partners/stakeholders. The project is providing a detailed understanding of surface water flood risk issues, assessing flood alleviation measures, and preparing an action plan to ensure this type of flood risk is managed in a co-ordinated manner in Margate.

Background

Following the Thanet Stage 1 SWMP, which collated and mapped information about the history of flooding, Margate was identified as an area in Kent where further investigation would assist in understanding its complex flood history. The Thanet Stage 1 SWMP identified a number of management actions, assigned responsibility, and defined timescales for the agreed actions to be implemented. Kent County Council has published the Stage 1 SWMP online here.

This is the third Briefing Note for the Margate SWMP. The previous Briefing Notes were distributed to all key partners and can be obtained from Max Tant of Kent County Council (contact details provided below).

What is a SWMP?

A SWMP is a plan that seeks to manage surface water flood risk and improve water quality at a local level now and into the future. In this context 'surface water' includes heavy rainfall exceeding the capacity of watercourses and the underground/man-made drainage systems, runoff from land, and the interactions with the coast. This holistic approach provides the necessary framework to ensure surface water flood risk and water quality is managed in a coordinated manner.

What are the Issues in Margate?

The area that has been studied in detail in preparing the SWMP is shown in Figure 1 below. This area has been flooded a number of times by tidal inundation (1953) and by watercourses / underground drainage systems becoming overwhelmed during heavy rainfall (1980, 2008, and 2009).

Following a high level risk and needs assessment the following three key risk areas have been identified:

- Canterbury Road (Area 1)
- High Street/Tivoli Brook (Area 2)
- Northdown Road (Area 3)

What stage is the project at?

Having gathered as much information as possible about flooding in the study area, a computer model has been developed of the watercourses, underground/man-made drainage systems, terrain and coastal interactions in Margate. This computer model has been used to identify thirteen areas where there are potential surface water management opportunities (Figure 1 below) in terms of practicality and cost, and has also assisted in the preparation of an Action Plan for both these opportunity areas and Margate more generally.

The project, its progress, and the drafting of the Action Plan have been discussed at an internal partner / stakeholder engagement event and is currently under final review. To assist with this, and to also allow opportunities to be fast tracked where possible, the surface water flood maps and the opportunity areas identified have been provided to Thanet District Council and loaded into a GIS (Geographical Information Systems) viewer. This viewer allows the partnership to see the flood risk areas and where opportunities are currently being explored. Access to the GIS viewer should be sought from Max Tant (Kent CC). A guide to what the maps show is provided at the end of the document.

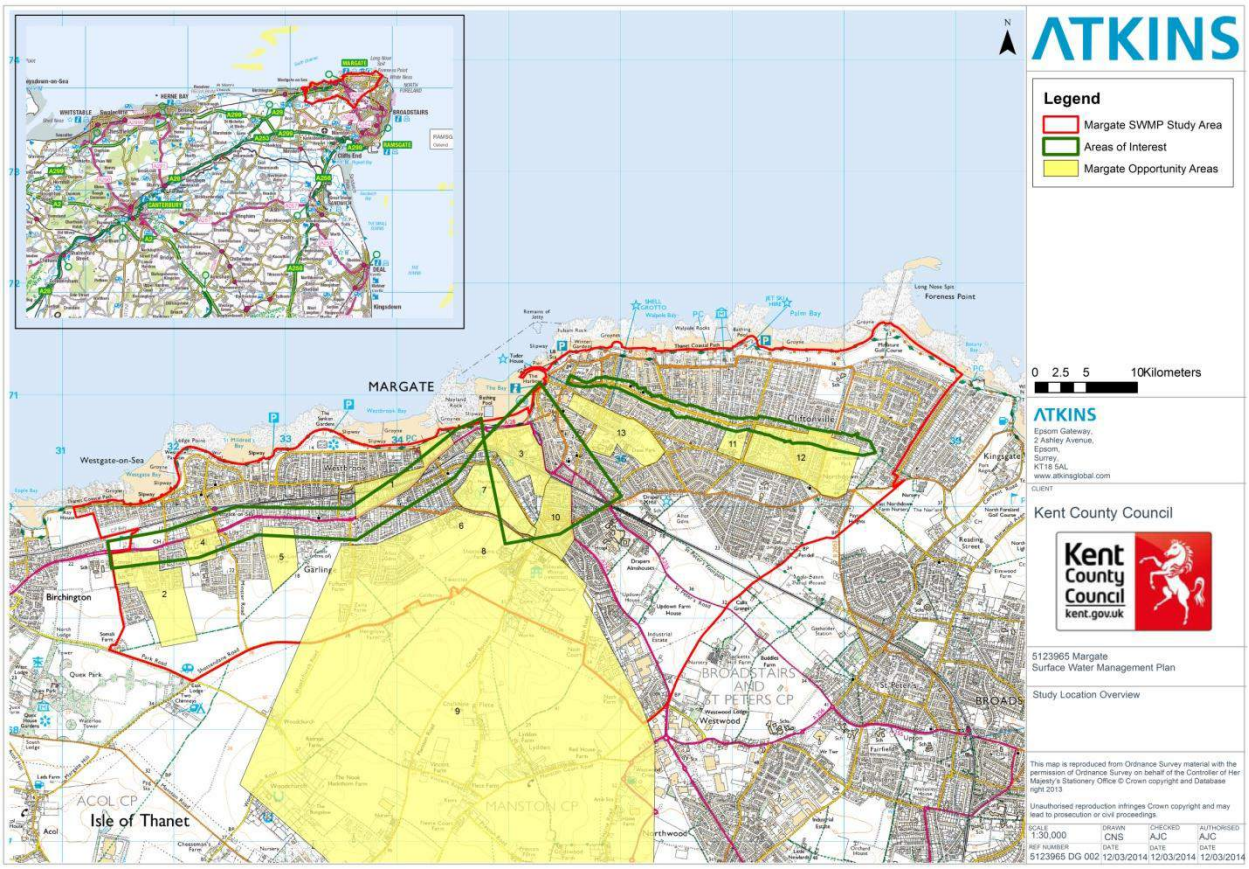


Figure 1 – Surface Water Management Opportunities

What types of actions might be taken?

Final preferred options have not yet been arrived at, but the following generic options are being considered:

- Ways of removing surface water from the drainage system
- Storing water above ground, so it does not flood properties
- Building risk into the planning process and development opportunities in Margate

Who is involved in the SWMP?

The Stage 2 SWMP involves a partnership of all the relevant flood management authorities working in Margate. This includes Kent County Council, the Environment Agency, Thanet District Council, and Southern Water. Other stakeholders, such as local councillors and other departments within the partner organisations, will be kept informed of progress using briefing notes, of which this is the third.

How can I find out more and have my say?

There is a considerable amount of information on the Kent CC website, but for general information you can contact Max Tant (details below).

Contact us

If you would like any further information you can contact a member of the project team (provided below). Further information about SWMPs is available here.

Name	Organisation	Role	Contact Details
Max Tant	Kent County Council	Flood Risk Manager and project sponsor.	01622 221691 Max.tant@kent.gov.uk

Guide to Surface Water Flood Risk Maps

Surface water flood risk maps generated by the computer model developed for Margate have been provided along with the thirteen opportunity areas identified to Thanet District Council for inclusion in a GIS viewer. The surface water flood maps show areas of Margate that are at flood risk during a 1 in 30 and 1 in 100 year rainfall event when either the rainfall exceeds the capacity of watercourses and the underground/man-made drainage systems, runs off from land, or is not able to discharge to the sea due to high sea levels (e.g. high tide).
The computer model that has been developed to prepare the surface water flood maps will be updated and further refined over the coming year. As a result of this, access to the surface water flood maps is restricted and should be sought from Max Tant (Kent CC). A sample of the surface water flood map for an area of Margate is shown in Figure 5 below.

The surface water flood maps are to be used by the respective partners in:

- identifying opportunities that can be fast tracked,
- the preparation of the Local Plan, and
- providing an overall holistic and partnered approach to managing the complexities of surface water flood risk.

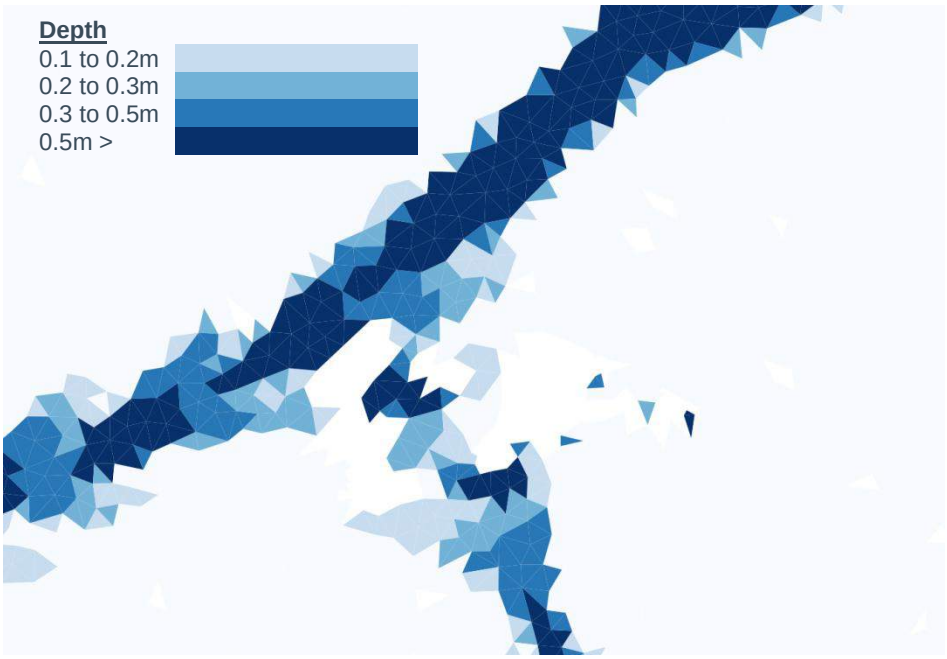


Figure 5 – Flood Mapping Example

B.5. Engagement Workshop Sessions

B.5.1. Session Three – Proposed Actions

Intervention	Proposed Actions / Opportunities	Who needs to be involved?	Comments (potential problems/challenges)
Planning Areas 1,3,9,10,11	• Reduce runoff rather than requiring no increase • Discharge directly to sea from surface water sources e.g. roofs • Encourage recycling of greywater rather than accepting runoff into combined system • Investigate and continue to fix misconnections as part of planning agreement • Utilise brownfield developments to provide underground storage features in which water can be attenuated and also reused. • Deculverting of the Tivoli Brook through Dreamland. • Regeneration of the Football Grounds with a Hotel - may be lost opportunity. • Tivoli Park - Heritage Area • Hartsdown Road - Highways scheme planned due to flooding issues • Large areas of car parking could utilise permeable paving. • All Saints Avenue Industrial Area • Critical development areas - identify (such as large housing developments to the west of Margate- along opportunity areas 2, 4, and 5) and ask to enhance their contributions to SUDS but with financial assistance? • Tesco's- opportunity for detailed drainage design	• Statutory Consultees of the Local Plan- need responses in favour of SWMP planning principles. • TDC Planning Team.	• Planning will not carry out without encouragement from Statutory Consultees of the Local Plan. • Derby Square achieved regeneration funding from Heritage Lottery funds. TSC Planning has a forward list of sites they would like to be considered for regeneration funding- tie in SWMP planning interventions? • Pressures to build housing, right time for influencing planning principles. • Utilise Destination Management Plan to push forward schemes where the beaches are involved.
Attenuation Areas 5 and 8	• Paul Verrall- TDC Parks and Coast Manager had sent through an email to JR prior to the meeting which had suggested the use of Tivoli Park as storage.	• TDC Planning Team (for policy enforcement), • Developers, • Landowners, • TDC Parks	• Area 8- impact on WQ if attenuation increases the concentration of pollutants downstream? • Landowner constraints.
Attenuation and Surface Water Removal Areas 2, 4, 6, 7, 12, 13	• Surface water removal is considered to be a good idea by the groups. Particularly keen on pairing with Dane Park as additional optimised storage. Paul Verrall- TDC Parks and Coast Manager had sent through an email to JR prior to the meeting which had suggested the use of Dane Park as storage. • Tie in Area 7 with the regeneration of Margate Football Club regeneration. • Area 6 – Suggestion that this opportunity could be taken forward with the assistance of Bronwyn as she deals with Schools in the area. • In area 12- the surface water removal could be funded in part through the Kent Wildlife Trust as there is an interest in the area along Northdown (suggestion by Paul Verrall).	• Although TDC Parks may not have the funding to support these schemes, they could provide support, advice, maintenance etc.	Suggestion to link Areas 2,4 and 5 into one opportunity area and tie in with the planning process (high density urban/residential area to be developed-preferred area to be developed over the next 15 years) in addition to investigating upland catchment management techniques (EA have suggested previously that they could assist as already part of duties).

Additional comments Raised during discussions:

- Problem Areas: All Saints Avenue - flooded 3 times recently. Issues around the Tesco's and the flats opposite, despite drainage being cleared recently.
- Historical problems of blockage and flooding have been attributed to the 'Margate Interceptors' which is the junction between the private drain and the public sewer. Also known as a Buchan drain/trap which has caused blockage problems in Eaton Road as one example.
- A sensitive approach is needed when engaging with council housing.
- Tennis Courts used to have a cess pit which connected into Tivoli. Unsure of current situation. Could use Bathing Water Framework to create an opportunity for a partner project to look into the Tivoli.
- High Street- Wayfaring project (Cllr IJ) could be used to green the High Street and deliver multiple benefits of surface water removal from the combined system.
- The Local Plan is out for consultation. Within the next 3-4 months, highlight to TDC Planning what opportunities to include in the Local Plan. Can also include during and after consultation.
- Margate Caves - could act as a Constraint.
- Consider Attenuation in combination with water quality impact of schemes.

B.5.2. Session Four – Measuring Success

What would be a success and why?	Priority? (High, Medium, Low)	Who would lead?	Delivery timescales? (short, medium, long term)
Influencing the local plan (as a result of the SWMP) to improve and encourage sustainable development in Margate.		TDC Planning and Statutory Consultees to Local Plan.	Short term
Do not blight development in Margate and improve the town's reputation		TDC Planning and TDC PR and Communications	Long-term
Cooperation and genuine commitment to deliver the action plan.		All	
Maintain award winning beaches and improve water quality status/incidents.		TDC Parks and Coastal Team	
Improve public awareness of the issues and collaborative planning and solutions that are currently ongoing to ameliorate them.		TDC PR and Communications	
Measurable improvement in flood risk and water quality (e.g. through less complaints/incidents recorded).			
Achievement of objectives as set out in this study.			
Achieve funding and spend wisely for maximum benefit.			
Ensure no opportunities are missed through the study's input to the Local Plan and through consultation and the actions of TDC Planning.		TDC Planning Team	Short term (within 6 months)

B.5.3. Session Five – Next Steps

What role does 'the public' have to play	When should they be involved?	What is the best way of doing this?	Anything else?
Be informed and create community advocates for TDC.	During local plan consultation.	Questionnaires and information giving.	
Sharing local knowledge	After Stakeholder engagement event.	Through the Councillors.	
Translating the benefit of flood alleviation works into a worthwhile value for them compared to the loss of schools for instance.			
Capture of flood incident and water quality information.		Sharing of the information once collected between TDC, KCC and Southern Water	
Improve awareness of multi-agency work in the public.			

Appendix C. Intermediate Assessment

C.1. Water Management Chronology

Event / Flood Alleviation Scheme	Date	Season	Water Year	Location Affected / Benefitted	Flood Source	Mechanism	Mechanism Details	Properies Affected	Weather Conditions
Flood Event			1953	Minnis Road, Birchington	Tidal	wave overtopping and breach in defences		>100	
Flood Event	Jan-53	Winter	1953	Margate	Tidal	wave overtopping and breach in defences	An abnormally high spring tide combined with gale-force winds on the night of Saturday 31 January 1953 and again on Sunday 1 February. High tides, strong winds and low air pressure combined to raise sea levels in the North Sea and send a storm surge with up to 20ft (6m) waves south along the coast. The surge height reached 2.74 m at Southend in Essex, 2.97 m at King's Lynn in Norfolk and 3.36 m in the Netherlands.	>550	
Flood Event	Jan-53	Winter	1953	Minnis Road, Birchington	Surface Water	regular flooding during heavy rainfall events		no records of properties being affected	
Flood Alleviation Scheme	1950's		1955	Margate Sea Defences	Tidal				
Flood Event	Jan-78	Winter	1978	Thanet Coast	Tidal (?)			destroyed jetty	
Flood Event	Feb-79	Winter	1979	Thanet Coast	Tidal (?)				
Flood Event	1980		1980	Belmount Road, Westgate on Sea	Surface Water			>150	
Flood Event	1980		1980	Nash Road- Area of St Andrews Close Rowe Close- now developed	Surface Water		periodic flooding from field runoff from Nash Road prior to development		
Urban Growth			1980	1980'S DEVELOPMENT TO EAST OF NASH ROAD (St Andrews Close and Rowe Close)					
Bathing WQ Incident	27/07/1988	Summer	1988	Margate Fulsam Rock					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Average Lower Catchment No Tide Data
Bathing WQ Incident	02/05/1989	Summer	1989	St Mildred's Bay, Westgate					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Average Lower Catchment No Tide Data
Flood Event	1990		1990	Canterbury Road, Westgate	Surface Water			no records of properties being affected	
Bathing WQ Incident	19/06/1990	Summer	1990	Margate Fulsam Rock					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	28/08/1990	Summer	1990	St Mildred's Bay, Westgate					Summer Storm Wet Urban Catchment, Average Upper Catchment, Average Lower Catchment No Tide Data
Flood Event	1990's		1990	Dreamland Site	Sewer	surcharge of existing surface water pipe			
Bathing WQ Incident	23/07/1991	Summer	1991	Margate, The Bay					Summer Storm Wet Urban Catchment, Average Upper Catchment, Average Lower Catchment No Tide Data
Bathing WQ Incident	13/08/1991	Summer	1991	Margate Fulsam Rock					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	17/09/1991	Summer	1991	Margate The Bay					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	26/08/1992	Summer	1992	Margate The Bay					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	11/08/1993	Summer	1993	Margate The Bay					Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment No Tide Data
Bathing WQ Incident	11/06/1997	Summer	1997	West Bay, Westgate					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	30/07/1997	Summer	1997	Walpole Bay, Margate					Summer Storm Wet Urban Catchment, Average Upper Catchment, Average Lower Catchment No Tide Data
Bathing WQ Incident	12/08/1998	Summer	1998	Botany Bay, Broadstairs					Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment No Tide Data
Flood Event	1999		1999	Glencoe Road	Sewer	Hydraulic overload of foul system		4 incidents of flooding within curtilage	
Bathing WQ Incident	12/05/1999	Summer	1999	St Mildred's Bay, Westgate					Summer Storm Wet Urban Catchment, Average Upper Catchment, Average Lower Catchment No Tide Data
Bathing WQ Incident	05/07/2000	Summer	2000	West Bay, Westgate					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	02/08/2000	Summer	2000	Westbrook Bay, Margate					Summer Storm Wet Urban Catchment, Average Upper Catchment, Average Lower Catchment No Tide Data
Urban Growth	2001		2001	Census- 40/60 people per km2					
Bathing WQ Incident	05/06/2001	Summer	2001	Margate The Bay					Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment No Tide Data
Bathing WQ Incident	04/09/2001	Summer	2002	Margate The Bay					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	18/09/2001	Summer	2002	Margate The Bay					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment No Tide Data
Bathing WQ Incident	05/06/2002	Summer	2002	Margate The Bay					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	17/07/2004	Summer	2004	Ethelbert Road	Unknown	Unknown			Summer Storm Wet Urban Catchment, Average Upper Catchment, Average Lower Catchment Tidal Locking
Flood event	21/08/2004	Summer	2004	ETHELBERT CRESCENT	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	21/08/2004	Summer	2004	KING STREET	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	21/08/2004	Summer	2004	ETHELBERT ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	21/08/2004	Summer	2004	SWEYN ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	21/08/2004	Summer	2004	BROAD STREET	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	03/06/2005	Summer	2005	NASH ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	2007		2007	Canterbury Road, Birchington	Sewer	Hydraulic overload of foul system		1- flooding within curtilage	
Flood event	19/04/2007	Summer	2007	STATION ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	GROSVENOR PLACE	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	MARINE TERRACE	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	BEACH ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	CHARLOTTE PLACE	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	MARLBOROUGH ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	SUFFOLK AVENUE	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	GROSVENOR PLACE	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	19/06/2007	Summer	2007	MARLBOROUGH ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	2008		2008	High Street, Margate	Sewer and Blocked Gully	blocked gullies and seweage backed up due to heavy rainfall		2 (1 from sewer and 1 from blocked gully)	
Flood Event	2008		2008	Northdown Road	Sewer	Hydraulic overload of foul system		6 incidents of flooding, 2 properties internally flooded	
Flood Event	2008		2008	Northdown Road	Surface Water	overflowing rain water gully		no records of properties being affected	
Flood Event	2008		2008	St Peters Road	Surface Water			no records of properties being affected	
Flood Event	2008 onwards		2008	Lower High Street, Margate, Market St Junction	Surface Water			no records of property counts but a number of properties were said to be affected	
Flood event	21/03/2008	Summer	2008	SELBORNE ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	26/05/2008	Summer	2008	THE PARADE	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	28/05/2008	Summer	2008	NORTHDOWN ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	28/05/2008	Summer	2008	PARAGON COURT FORT PARAGON	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood event	28/05/2008	Summer	2008	NASH ROAD	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	2009		2009	Dane Road, Birchington	Blocked Drain	Blockage and drain collapse	From collapse, water was described as backing up and coming out of the drain and running along Dane Road. Anecdotal evidence from residents of Dane Road reports that during periods of heavy rainfall, water backs up within drains.	2 incidents of internal flooding	
Flood Event	2009		2009	St Peters Road	Surface Water			no records of properties being affected	
Flood Event	16/09/2008	Summer	2009	Cuthbert Road	Sewer	blocked gullies	Foul water coming up through drain - not able to go down again as next 2 gullies down the line are blocked.		Summer Storm Wet Urban Catchment, Average Upper Catchment, Average Lower Catchment Tidal Locking
Bathing WQ Incident	20/07/2009	Summer	2009	Walpole Bay, Margate					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	24/07/2009	Summer	2009	77 Hastings Avenue	Blocked drain				Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	2010		2010	Dane Road, Margate	Sewer	Blockage		1 incident of internal flooding	
Flood Event	27/10/2009	Winter	2010	7 Dane Road, Margate	Blocked Drain	Blockage	Water appeared to back up, exit the drain and run into the road. Anecdotal evidence suggests that this water backs up the internal drainage of a property and floods	1 incident of internal flooding	Winter Storm Wet Urban Catchment, Wet Upper Catchment, Average Lower Catchment Tidal Locking
Flood Event	05/10/2009	Winter	2010	High Street - junction with Ramsgate Road, Victoria Road, St Peter's Road	Blocked gully	Blockage	Road gulleys adjacent to the interceptor are all blocked.		Winter Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	2010		2010	St Peters Road	Surface Water			no records of properties being affected	
Flood Event	06/11/2009	Winter	2010	7 Dane Road	Sewer				Winter Storm Wet Urban Catchment, Average Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	27/11/2009	Winter	2010	Nash Road at tivoli rd end	Surface Water				Winter Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	2010		2010	Eaton Road (outside 68)	Surface Water	Recurring problem	The drain at this location seems to be a recuring problem which seems to flood and has water at this location that is flooding out on to the road. Also he looked at this drain and there was some toilet paper float at this point.		
Flood Event	10/09/2009	Summer	2010	Market Place	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment Tidal Locking
Flood Event	21/04/2010	Summer	2010	Glencoe Road	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment Tidal Locking
Flood Event	02/05/2010	Summer	2010	St Peters Road and around Hospital	Surface Water	Road flooded due to dip in the road			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Bathing WQ Incident	24/08/2010	Summer	2010	Walpole Bay, Margate					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	14/11/2010	Winter	2011	Norfolk Road	Blocked gully	Blockage	3 gullies blocked on highway	1 incident of internal flooding- basement flat	Winter Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	23/08/2011	Summer	2011	High Street	Surface Water				Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Urban Growth	2011		2011	Census- 60+ people per km2					
Bathing WQ Incident	06/09/2010	Summer	2011	Minnis Bay, Birchington					Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment Tidal Locking
Flood Event	15/11/2010	Winter	2011	High Street	Surface Water	Unknown			Winter Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Maintenance	Feb-11	Winter	2011	Norfolk Road	Blocked gully	Blockage			
Bathing WQ Incident	26/08/2011	Summer	2011	Walpole Bay, Margate					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Bathing WQ Incident	29/08/2011	Summer	2011	Walpole Bay, Margate					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Event	30/05/2012	Summer	2012	Hatfield Road	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment Tidal Locking
Flood Event	30/05/2012	Summer	2012	Sea View Terrace	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment Tidal Locking
Flood Event	30/05/2012	Summer	2012	Beach Rise	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Average Upper Catchment, Dry Lower Catchment Tidal Locking
Flood Event	31/05/2012	Summer	2012	Northdown Road	Surface Water	Unknown			Summer Storm Wet Urban Catchment, Wet Upper Catchment, Wet Lower Catchment Tidal Locking
Flood Alleviation Scheme	2011/12		2013	Margate Flood & Coastal Protection Scheme	Tidal				
Bathing WQ Incident	13/06/2013	Summer	2013	Margate The Bay					Summer Storm Wet Urban Catchment, Wet Upper Catchment, Average Lower Catchment No Tide Data
Flood Event	no dates- 2 incidents recorded			Northdown Park Road- near junction_with_millmead_road	Surface Water	no description			
Flood Event	no dates			Northdown Road (outside les riggs sports shop near #168)	Surface Water / Sewer				
Flood Event	no dates			Millmead Road- junction with Northdown Park Road	Surface Water				
Maintenance	no date			High Street- junction_with_Ramsgate_Road,_Victoria_Road,_St_Peter's_Road	Blocked gully	Blockage			
Flood Event	no dates			Belgrave Road	other				
Flood Event	no dates			Nash Road	Surface Water				
Flood Event	to present			Hartsdown Road	Surface Water		CNS-Tivoli Brook???		

C.2. Root Cause Analysis

Root Cause					Flood Incident Count	Flood Event Count	Bathing WQ Incident
Summer Storm	Wet Urban Catchment,	Wet Upper Catchment,	Average Lower Catchment	No Tide Data	0	0	3
Summer Storm	Wet Urban Catchment,	Wet Upper Catchment,	Wet Lower Catchment	No Tide Data	0	0	8
Summer Storm	Wet Urban Catchment,	Average Upper Catchment,	Average Lower Catchment	No Tide Data	0	0	5
Summer Storm	Wet Urban Catchment,	Average Upper Catchment,	Dry Lower Catchment	No Tide Data	0	0	3
Summer Storm	**Wet Urban Catchment,**	**Wet Upper Catchment,**	**Wet Lower Catchment**	**Tidal Locking**	23	10	5
Summer Storm	Wet Urban Catchment,	Average Upper Catchment,	Average Lower Catchment	Tidal Locking	2	2	0
Summer Storm	Wet Urban Catchment,	Average Upper Catchment,	Dry Lower Catchment	Tidal Locking	6	4	1
Winter Storm	Wet Urban Catchment,	Wet Upper Catchment,	Average Lower Catchment	Tidal Locking	1	1	0
Winter Storm	Wet Urban Catchment,	Wet Upper Catchment,	Wet Lower Catchment	Tidal Locking	4	4	0
Winter Storm	Wet Urban Catchment,	Average Upper Catchment,	Wet Lower Catchment	Tidal Locking	1	1	0
Total					37	22	25

Winter Season Storm Wet Catchment Conditions		
16%	27%	0%
Winter Season Storm Dry Catchment Conditions		
0%	0%	0%
Summer Season Storm Dry Catchment Conditions		
22%	27%	36%
Summer Season Storm Wet Catchment Conditions		
62%	**45%**	**64%**

Appendix D. Integrated Urban Drainage Model Build

D.1. Introduction

To define local flood risk within Margate, assess potential options, and to assist in preparing an action plan for managing surface water in Margate, a fully Integrated Urban Drainage (IUD) hydrodynamic model was developed. This appendix summarises its development, assumptions, uncertainties, and limitations of its use.

D.2. Study Catchment

Topography

Margate is situated in Kent and along Thanet's coastline. The catchment has a relatively steep headwater and with levels falling from around 50m AOD to sea level along the coast front of the town.

Soil & Geology

The soils for the catchment can be considered to relatively permeable with "WRAP" (Winter Rainfall Acceptance Potential) class 1 covering the upper catchment and class 2 covering the lower catchment (NERC, 1975). The underlying geology of the catchment is predominately Chalk (BGS, 2013).

Rainfall

FEH (Flood Estimation Handbook) catchment characteristics (v3.0) for the catchment indicate that the soils can be considered to be relatively wet (PROPWET = 0.24) with average annual rainfall typically being low in respect to the rest of the UK (SAAR = 587). Rainfall across the catchment should, however, be expected to variable due to the relief of the catchment causing storm systems to condense and collapse when interacting with the coast.

Landuse

The upper catchment is rural and is mainly agricultural land, and the lower catchment is predominately urban with coastal communities spreading inland and up the catchment. The majority of the catchment is drained by the Tivoli Brook, which is a culverted watercourse in Margate (refer to Figure 2-1). The central urban areas of Margate are dense, which probably in part led to the Culverting of the Tivoli Brook, with development densities becoming less towards the periphery of the town.

Population and Trade Flows

Margate has a population of around 50,000 (KCC, 2012 - November), which can be considered to be transient and still fairly variable during the summer months even though tourism has been decline for some time.

The central areas of Margate have a few industrial units with the majority of industrial / commercial spaces located in Westwood, which is to the south of Margate.

Tidal Range

The tidal range is typically 1 to 3 metres (refer to Figure D-1 below).

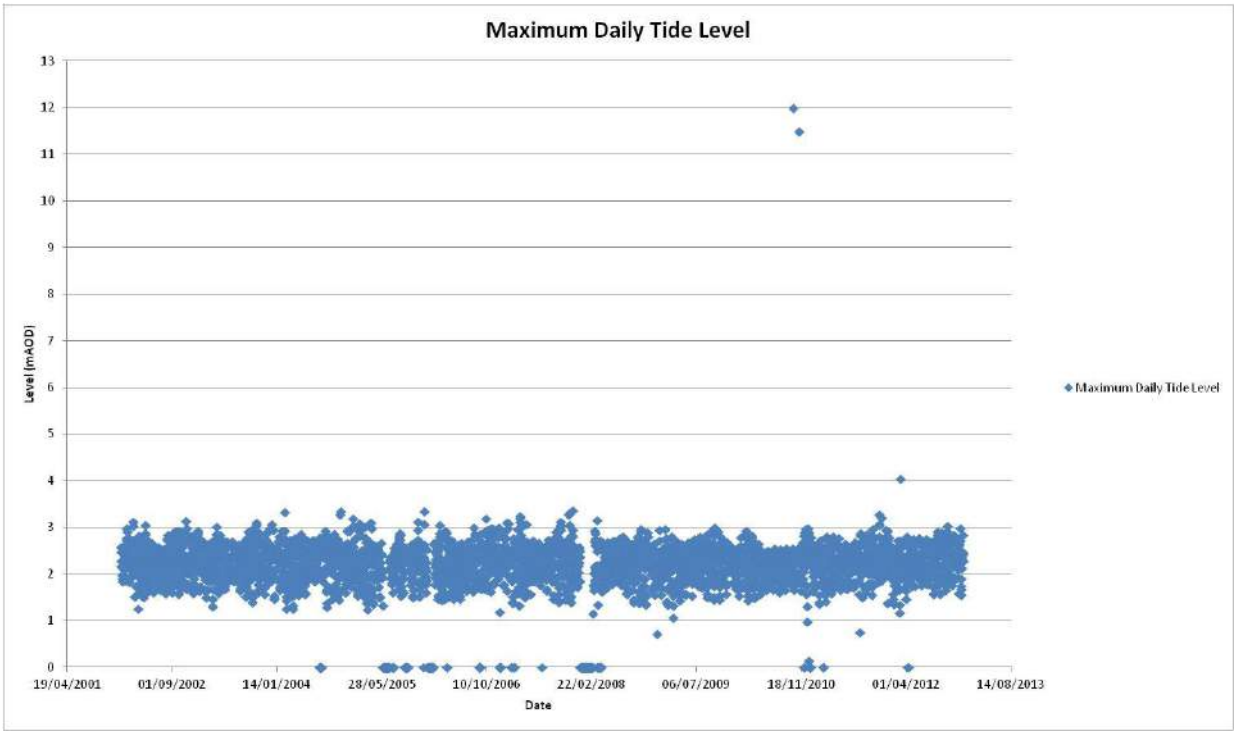


Figure D-1 Tidal Range for Herne Bay – 2001 to 2012 (CCO, 2014)

D.3. Hydrometric Data

There is limited gauging, both flow and rainfall, in the study area. The nearest permanent rainfall intensity gauge is located in Broadstairs with a number of daily rainfall gauges to the south of the study catchment (refer to Figure D-2 below). There are no permanent flow gauges in the study catchment.

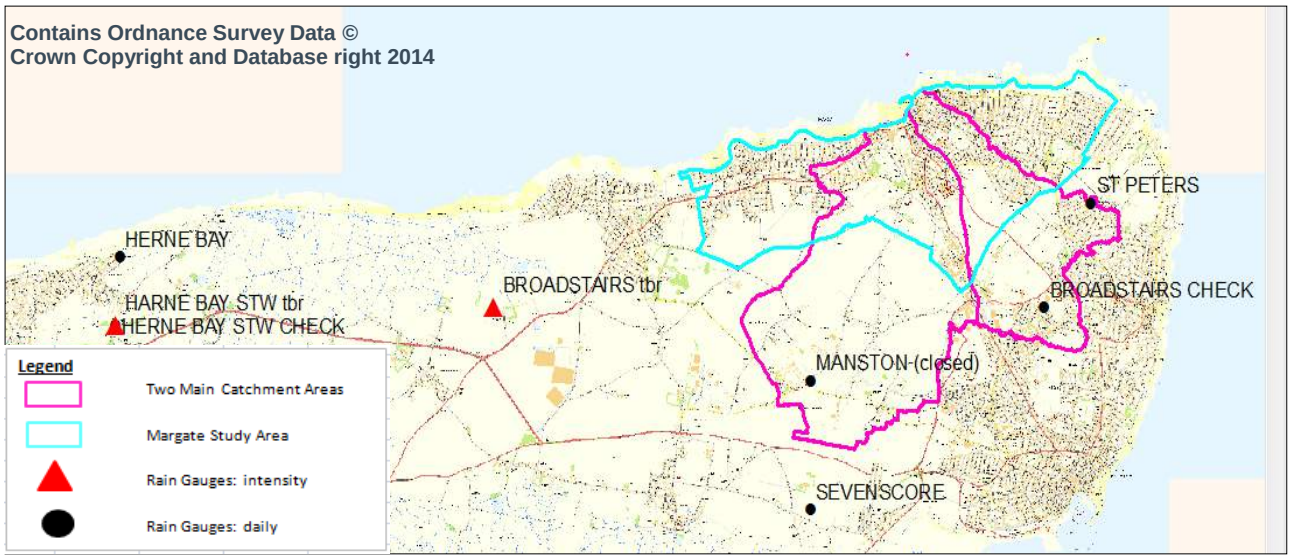


Figure D-2 Available Rain Gauge Data (source: Environment Agency)

D.4. Model Build

D.4.1. Approach

InfoWorks ICM (v4.0) was adopted for the purposes of this study and developing an Integrated Urban Drainage (IUD) hydrodynamic model, as it has the capability to represent flows in open and closed conduits, across terrain surfaces, interactions with the coast, as well as rainfall-runoff processes for both rural and urban landuse surface types. InfoWorks ICM was specifically developed to improve the understanding between systems within urban areas.

The approach to the model build was simple. Use traditional subcatchment, node, and link modelling for the defined urban areas, and use advanced 2D rainfall-runoff techniques for the rural areas where less assumptions in respect to generation of flow and subsequent routing are required.

D.4.2. Extent & Detail

The extent and key components of the InfoWorks ICM model is shown in Figure D-3 below.

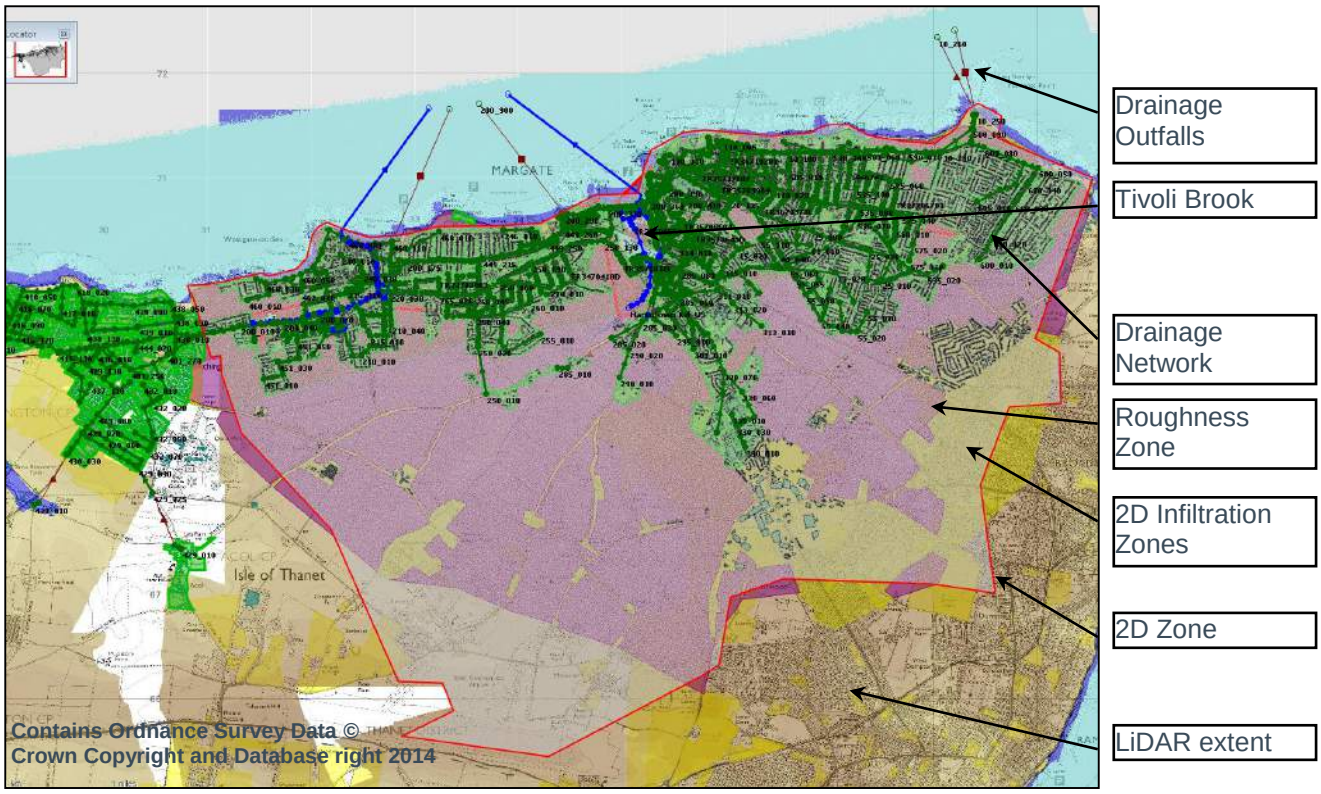


Figure D-3 Model Extent

The detail of the model varies across the modelling domain with the majority of "detail" reserved to the three Key Flood Risk Areas that were identified for undertaking the detailed assessment (refer to section 3.3.4). The model is represented more coarsely outside of these three key areas and largely only represents the main trunk sewers, which were included in the Drainage Area Planning model (InfoWorks CS) provided by Southern Water.

The model, as is outlined under the respective sections below, generates runoff from the 2D surface through the use of a Horton loss model included within InfoWorks ICM (refer to InfoWorks help) and is then equivalent to a "4b-enhanced drainage model", as set out in the SWMP technical guidance (DEFRA, 2010). However, it is important to highlight that whilst the model can be considered to be "advanced", it requires further refinement and work before it can be used reliably, as the InfoWorks ICM model has not been calibrated.

D.4.3. Survey & Data Used

The IUD model developed for the project was developed by re-using existing models and making use of available data. This included:

- A macro InfoWorks CS model of the combined drainage system (Model called “WEHB”) – Southern Water
- “Asset Miner” (Southern Water’s asset database) data to refine the InfoWorks CS model for the three Key Flood Risk Areas (refer to section 3.3.4) and for representing the Tivoli Brook – Southern Water
- LiDAR (1m & 2m) to represent the terrain – Environment Agency
- OS MasterMap building plot layouts to represent buildings – Kent County Council

D.4.4. Underground Drainage Network

The underground drainage network in Margate was represented by importing the macro InfoWorks CS model into InfoWorks ICM and then adding in refinements for the three Key Flood Risk Areas (refer to section 3.3.4). Refinements included:

- Incorporating additional manholes and pipes (from “Asset Miner”) to better represent the drainage arrangement;
- Inferring ground levels from the LiDAR data which was used to represent the terrain surface;
- Inferring pipe details (inverts, shape, size) to complete the representation of the system;
- Inferring headlosses using InfoWorks ICM’s headloss routine.

Roughness within the pipe system is represented using a Colebrook-White coefficient. Those included within the imported InfoWorks CS model have not been changed, those which have been built into InfoWorks ICM have been set to a value of 3, so as to be conservative.

It is recommended that the representation of the underground drainage be improved in subsequent studies, as the work undertaken during this commission was limited.

D.4.4.1. River & Open Channels

There are no rivers or open channels in the Margate ICM model. The Tivoli Brook, which is a culverted watercourse, was represented using assumed dimensions to allow the dynamics between the upper catchment, sea, and underground drainage network to occur.

It is recommended that surveys BE undertaken to ensure that the Tivoli Brook is appropriately represented.

D.4.4.2. Overland Flows

Overland flows are represented using a 2D Zone (refer to Figure D-3), which effectively allows water to flow in and out of 1D nodes (e.g. manholes) and runoff to be generated when rainfall is applied to the surface. The 2D zone and the associated mesh elements that represent the terrain surface was created using “bare-earth” LiDAR data. Buildings were included as porous polygons using a porosity of 1% to be conservative in terms of flows in the 2D domain and using a threshold level of 0.15m to be realistic in terms of property levels in relation to overland flows. Although this should effectively represent the 2D zone to a sufficient level of detail for the purposes of this commission, it is recommended that kerbs be included in future to ensure that the model is sufficiently detailed (for example, when preparing designs).

The 2D zone uses a 'normal' condition boundary, such that depth and velocity are kept constant on arrival at the edge of the 2D domain, and rainfall is applied to the 2D zone to generate rural flows and its setup is summarised in section D.4.4.3.

The roughness of the catchment as a whole has been represented with a Manning’s ‘n’ value of 0.0125 to represent urban surfaces, which is overridden by ‘Roughness Zones’ of Manning’s ‘n’ values of 0.05 to represent vegetated surfaces of the catchment. The values of Manning’s n were based on catchment knowledge and the recommendations provided in "Open Channel Hydraulics" (Chow, 1959).

D.4.4.3. Rainfall-Runoff

Subcatchments were used to generate runoff from predominately urban surfaces and a 2D Horton loss model was used to generate runoff from the rural contributions. Impermeable areas in the upper catchment, such as roads and large impermeable areas, are represented using ‘2D Infiltration Zones’ that use a Fixed 100% conversion of rainfall to runoff for conservatism purposes.

A Horton infiltration surface was set up to convert rainfall to runoff using soil texture to govern the initial, continuing, and decay factors. The Horton parameters were benchmarked to the overall conversion of rainfall to runoff and SPRHOST (refer to Section D.6).

The Two Horton Infiltration surfaces are used in combination with a 2D initial conditions file, which effectively set the state of the soil for simulating summer and winter storms. For the purposes of this commission, the ReFH loss model was adopted for defining initial catchment wetness for design events (expressed as a %). The infiltration surfaces are provided in Table D-1 below

Table D-1 Infiltration Surfaces

Infiltration Type	Initial Horton	Limiting Horton	Decay Horton	Fixed Runoff Coefficient
Fixed	-	-	-	1.0
Permeable - Soil Type 1	18	6.5	2	-

Subcatchments have been defined using the drainage arrangement, property boundaries, ground data (LiDAR and contours), and assigned landuses linking the respective surfaces and routing models to areas of contributing surface. The landuses which were created as part of this project are summarised in Table D-2 below.

Table D-2 Subcatchment Land Uses

Land use	Runoff surface	Area (%)	Runoff model	Fixed Runoff Coefficient	New UK Depth (m)
Combined-Medium	Road	20	Fixed[3]	1	
	Roof	20	Fixed	1	
	Permeable	20	New UK[4]		0.2
Combined-High	Road	30	Fixed	1	
	Roof	40	Fixed	1	
	Permeable	20	New UK		0.2
Storm- Medium	Road	20	Fixed	1	
	Roof	20	Fixed	1	
	Permeable	20	New UK		0.2
Storm- High	Road	30	Fixed	1	
	Roof	40	Fixed	1	
	Permeable	20	New UK		0.2

D.4.4.4. Waste / Trade Water Generators

Waste and Trade Water from foul contributions were generated by the population, trade flow, and diurnal profiles included in the InfoWorks CS model (foul/combined subcatchments).

D.4.5. Boundary Conditions

The downstream boundary of the Margate model is the coastline. The mouth of the Tivoli Brook is represented as an outfall with an appropriate ground level to allow flow into the conduit. There are also four outfalls from the underground drainage system (1 storm and 3 combined). The interaction with the tide is represented using a level boundary, which is set to 3.26mAOD, so as to represent the annual design tide.

Design tide levels were provided by the North Kent Coastal Modelling Report (EA, North Kent Coastal Modelling Report, 2013b) for the 1 in 20 year tide, up to the 1 in 1000 year. The 1 in 1 year tide level was interpolated and represents the 'peak' tide level which is expected to occur annually, which is inline with recordings (refer to Figure D-1).

Table D-3 Design Tide

	Return Period				
Tide Levels (mAOD)	1	20	75	200	1000
Modelled Design Tide Levels	N/A	3.851	4.110	4.309	4.625
Interpolated Design Tide Levels (log)	**3.26**	3.851	4.113	4.307	4.626

[4] InfoWorks ICM Help

D.4.6. Future Growth & Climate Scenarios

Future growth and climate change scenarios were developed and tested to understand the impact on flood risk and the preferred options. For the purposes of this commission, two epochs (2030 & 2080) have been used to assess future flood risk.

D.4.6.1. Urbanisation

The Strategic Housing Land Availability Assessment (SHLAA) dataset was used to uplift subcatchment and infiltration surface impermeability within the InfoWorks ICM model. These were applied to both epochs.

D.4.6.2. Population Growth

Population forecast estimates (ONS, 2013) for 2010-2035 were analysed to determine that populations could be expected to grow by a factor of 1.12 by 2035 (or the 2030 epoch), which was later confirmed to be appropriate by Thanet District Council. The uplift was applied to the 2080s epoch, as extrapolation beyond 2035 on current populations is not available.

D.4.6.3. Urban Creep

Urban creep is the change of permeable to impermeable surfaces in urban areas. Average rates of urban creep for high density and medium density housings were identified from the 2009 CIWEM WaPUG Conference Paper (Allit, 2009). The average value of urban creep used for high density development was 0.15m^2/house/year and for medium density development it was 0.75m^2/house/year. The overall increase per subcatchment, based on these rates of change, for the two epochs are provided in Table D-4 below.

Table D-4 Urban Creep Adjustments

Land use	2030	2080
Medium density development	2%	36%
High density development	1%	2%

D.4.6.4. Climate Change

Climate change was tested for the two epochs using the EA's Climate Change Guidance (EA, 2010). The 2080 climate change scenario, which was taken forward for preferred option testing, included an uplift of 20% for rainfalls.

D.4.6.5. Impact of Future Changes

Table E-3 has produced, as part of the economics undertaken, an annual probability of a water quality event occurring, based on the previous 25 years of data. With the increase in rainfall expected as a result of climate change, the more extreme rainfall depths now will become more frequent and it is therefore expected that water quality and flood events will also become more frequent. An increase in the impermeable areas of Margate will increase the rate at which water from the surface can reach the sewerage network. Encouraging sustainable development may help in alleviating both flood risk and water quality incidents.

D.4.6.6. Future Flood Risk Proofing

When assessing the likely future impact of surface water flood risk for alleviation options only the climate change uplift was included, as inclusion of the other factors are less certain and require refinement / development. It is, however, recommended that when the InfoWorks ICM model is more refined it be used for testing development proposals.

D.5. Model Verification

Review of the water management chronology (refer to section 3.2) showed that a number of properties had suffered flooding / issues on the 28/05/2008 and the 05/10/2009. These two historical incidents were adopted for the purposes of assessing the ability of the InfoWorks model to reflect reality and thus the confidence that can be placed in the model.

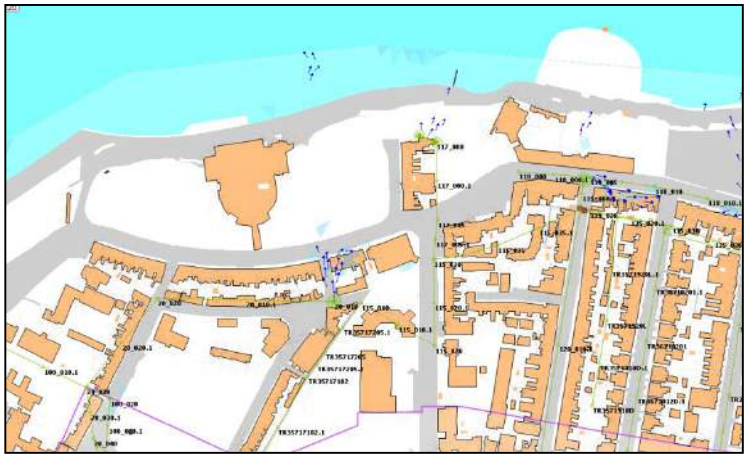
It should be noted that all verification simulations have adopted the rainfall intensity data collected at the Broadstairs gauge, which may not adequately represent rainfall that fell at the areas where the performance of the model is being assessed. It is recommended that this be re-visited with radar-rainfall data and flood event surveys to glean more refined information for assessing the model performance.

D.5.1. 28th May 2008

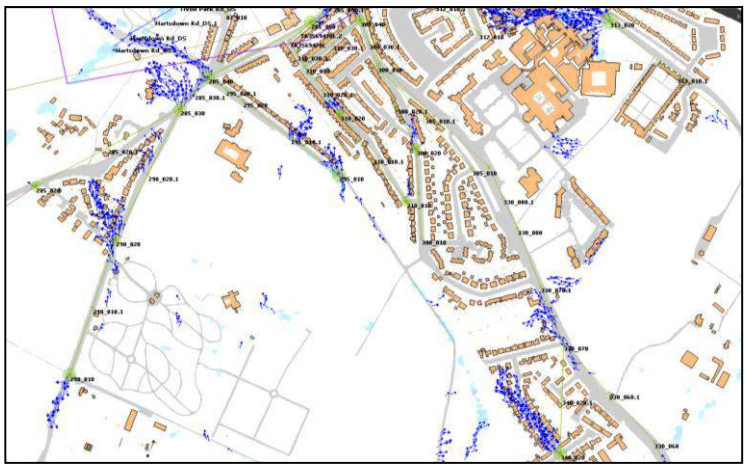
On the 28th May 2008 properties along Northdown Road, Paragon Court, and Nash Road were affected, which the InfoWorks ICM model is predicting also, albeit coarsely – see below.

Northdown Road

Paragon Court



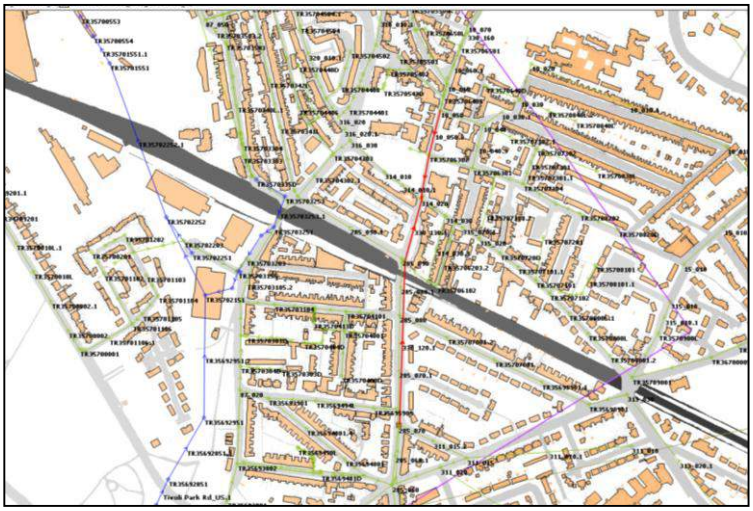
Nash Road



D.5.2. 5th October 2009

On the 5th October 2009 properties along Ramsgate Road, Victoria Road and St Peter's Road were affected, which the InfoWorks ICM model is not reproducing particularly well. This could be because the rainfall is not reflective of the event or that further model refinements are required before it can be used reliably

Ramsgate Road & Victoria Road



St Peter's Road

D.6. Model Validation

Given the relatively innovative nature of using a Horton loss model for the purposes of generating rural runoff for the InfoWorks ICM model, it was considered appropriate to validate the amount of rainfall being converted to runoff during the critical 1 in 100 year rainfall event for the catchment in respect to the standard percentage runoff characteristic (SPRHOST) of 17%. As shown in Table D-5 the model is generating 131,000m^3 of volume, or 21% is being converted. This is inline with SPRHOST and is therefore considered appropriate.

It is recommended that further work be undertaken to ensure the setup of the Horton model is appropriate.

Table D-5 Conversion of Rainfall to Runoff Using the Horton model

	Horton Model
Runoff Volume (m^3)	131,000
Total Rain Volume (m^3)	628,000
Rainfall Translated into Runoff (%)	21

D.7. Limitations & Assumptions

Representation of the any system in a model includes necessary assumptions, limitations and uncertainties, alongside aspects which could be improved with further refinement. The more significant limitations of and potential improvements to the model that was developed include:

- This model was specifically developed for preparing strategic surface water maps flood risk maps and the testing of potential flood alleviation options at the three Key Flood Risk Areas. Further refinement of the model should be carried out before the maps can be used reliably throughout the catchment or to allow the model to be used for more detailed design purposes.
- The detail in the model has focussed on three key areas. If investigation is required outside of these areas, or for another purpose, the model should be re-visited, assessed and appropriate detail included.
- The model has been verified reasonably well to two historic flood events. It has not, however, been calibrated to numerical data, for example short term flow surveys of the sewer system. This is recommended as a next step to improve the accuracy of the outputs.
- Buildings, represented as Porous Polygons, have been given an average threshold level of 0.15m. Threshold surveys should be carried out where further detail / work is undertaken, as this will have a bearing on the number of properties at risk of flooding and the economic case for Grant in Aid.
- The InfoWorks CS sewer model was purely imported and no checks have been undertaken e.g. structures, outfalls, landuse setup, population.
- Improvements include:
    - Calibration – to flow survey
    - Re-verification – to flood events identified in the water management chronology
    - Refinement – inclusion of local details, such as walls and kerbs, the use of radar-rainfall / time series rainfall, and surveys / additional drainage details.

Appendix E. Economic Appraisal

E.1. Flood Damages

E.1.1. Approach

Flood damages were calculated using the Weighted Average Annual Damages (WAAD) method. This is a high level economic appraisal which is suitable for this stage of the SWMP. The results for this economic appraisal are outlined in the attached Storyboards in Appendix F.

A range of return period rainfall events and storm durations were simulated, for both the baseline scenario (existing flood risk) and the conceptual options in the 2080s climate change scenario. The modelled results (for both scenarios) were extracted for each of the 13 opportunity areas and associated downstream areas which were affected by the modelled flooding and could therefore experience benefits from the conceptual options. The damages for each return period were then maximised by combining the flood extents from all storm durations and for each mesh triangle, picking out the maximum depth. This 'worst-case' flood outline was used to count the properties currently affected, and also with the conceptual options.

The property counts per return period, for each opportunity area, were then used to calculate the WAAD for both residential and commercial properties. The WAAD values per property were extracted from the Multi-Coloured Manual 2013 (Ref: "Flood and Coastal Erosion Risk Management. Handbook for Economic Appraisal" Flood Hazard Research Centre). The values (once discounted to the present day value) were then compared with the estimated costs for constructing each option to provide a benefit cost ratio, which is presented in the Storyboards in Appendix F.

The modelling ran the existing scenario with current day hydrology and the options with future hydrology (including increased rainfall due to climate change). In order to compare like with like, the return periods assigned to the with option model runs were adjusted to reflect current day climate conditions. Therefore the results of the economic appraisal are applicable to the current day and the effects of climate change are excluded.

Some options work in tandem to the alleviation flood risk, such as the options in opportunity areas 6 and 7, and therefore the economics for these areas have been presented together.

E.1.2. Summary of Results

The results, which can be seen for each of the opportunity areas, in the storyboards (Appendix F) show that the benefit: cost ratio for surface water flood risk alleviation schemes are low. Grant in Aid funding is expected to achieve a benefit cost ratio score of 8. It is important to consider the availability of external funding sources as these may increase the chance of achieving Grant in Aid funding.

Results in the storyboards show that some of the options have a benefit cost ratio which is less than 1, which means that the cost of the option is higher than the benefits achieved. The work undertaken as part of this commission is high level and should any of the options assessed be promoted, then the economic case will require further refinement particularly with regards to the use of depth related damage data and also a more detailed assessment of the cost of these conceptual options. For example, with opportunity area 8, the damages and therefore benefits may be higher as the downstream area affected is predominately commercial and the threshold may be below the 0.1m set in the model. Equally a more detailed assessment may reduce the option cost and therefore the benefit cost ratio may be improved.

E.2. Beach Amenity Value Economics

E.2.1. Introduction

This Surface Water Management Plan for Kent County Council at Margate considers not only flooding but also water quality. Under extreme rainfall events the sewerage system can become overloaded and storm water (combined foul and surface water) can be discharged through long sea outfalls. Weather conditions depending, this can find its way back to the beaches, and although greatly diluted, it can cause the bathing water quality to temporarily drop below the guideline and mandatory levels (EC, 2006). Normally, sampling of water quality takes two to three days for the results to be available and by then the water quality issue has passed.

This section considers the economic impacts of the temporary drops in water quality and how this would affect the value of recreation on the beach. It assumes that instantaneous water quality sampling results are available and that the beach would be immediately closed for a period of time. Of course, there are no instantaneous water quality samplers there; however, this assumption is made to enable an estimation of the loss of value to the beach. If each visitor was fully informed of a temporary water quality issue then this would affect their value of enjoyment, and possibly cause them to go to a different beach instead for that particular visit.

This section describes only the loss of the "value of enjoyment" due to loss of access to the beach. It does not include any loss of income to the town, e.g. through sale of refreshments or accommodation. If the beaches were to close regularly, or their reputation to suffer, then there would be long term implications for the whole tourist trade for the local area, however the actual loss to the UK is likely to be much smaller due to the availability of other beaches in Kent. The value of the loss of enjoyment though is a national loss (as people have chosen to go to the Margate Beaches) and consequently this value can be used in conjunction with property damages to apply for national funding.

The beach at Margate was closed for a week in 2011. This was due to a pumping station failure during intense rainfall. The water had to be released and the emergency spill released raw sewage onto the beach. The beach was immediately closed until all debris was cleared and the water quality was confirmed to be safe. This extreme event is not likely to reoccur regularly as it was a direct result of the pump failure and would not be mitigated by improved treatment facilities or sewerage systems. This one-off event is not considered further.

E.2.2. Approach

The purpose of this valuation is to incorporate the potential 'damage' of beach closure to the property flood damages calculated for the Margate SWMP. For an economic valuation to be allowable it needs to meet the requirements of the Treasury Green Book (Treasury, 2003) and the Environment Agency Flood and Coastal Erosion Management Appraisal Guidance (FCERM-AG) (EA, Flood and Coastal Erosion Risk Management appraisal guidance, 2010). Losses have to be considered in terms of loss to the nation, therefore we have not considered the value of recreation to the local economy in Margate and surrounds. If visitors cannot go to the Margate beach they are likely to either go to another beach or to another local attraction, so there is no loss in recreation expenditure to the nation. However, as the visitors to the beach have chosen to go to Margate, going somewhere else is an inconvenience so the additional travel cost to alternative site(s) has been considered.

The general approach taken was to count the number of visitors to the beaches, place a value on each visit, consider how many visits would be lost if there was a temporary drop in water quality, consider the probability of a drop in water quality and then convert this to an average annual loss for each beach. This was then discounted to a present value loss per beach, assuming that the input parameters remain constant for the next 100 years. This approach and the data used are described in more detail below.

E.2.3. Data

Visitor Counts

Two different sources of information have been used for visitor counts:

- Counts of parked cars between Margate and Westgate (supplied by Kent County Council) for 2012 and 6 months of 2013.
- Beach visitor counts from recreation studies at Walpole and Cliftonville, reported in the Multi-coloured Manual 2005.

Figure E-1 shows a plot of the 2012 data. The seasonal pattern of increased parking in the summer is clearly visible. This implies that summer tourism plays a role in this data set.

The Transport Appraisal Guidance (TAG) provides statistics about the cost of time and operating use of vehicles and is a standard reference for economic appraisals (Transport, 2013).

The TAG guidance states that there is an average of 1.85 people in a car (non-commuting). The annual count of people therefore parking here was made up from using the total count of the 2012 data, supplemented with neighbouring weeks to fill in any data gaps (53,656 cars), and multiplied by 1.85. This gives a total of 99,264 visitors. This will be an underestimate of beach users as although some people will park here and not go to the beach, however many more will arrive at the beach by alternative modes of transportation. These visitors are assumed to be equally spread between the four beaches of Westgate, St Mildred's, Westbrook, and Margate.

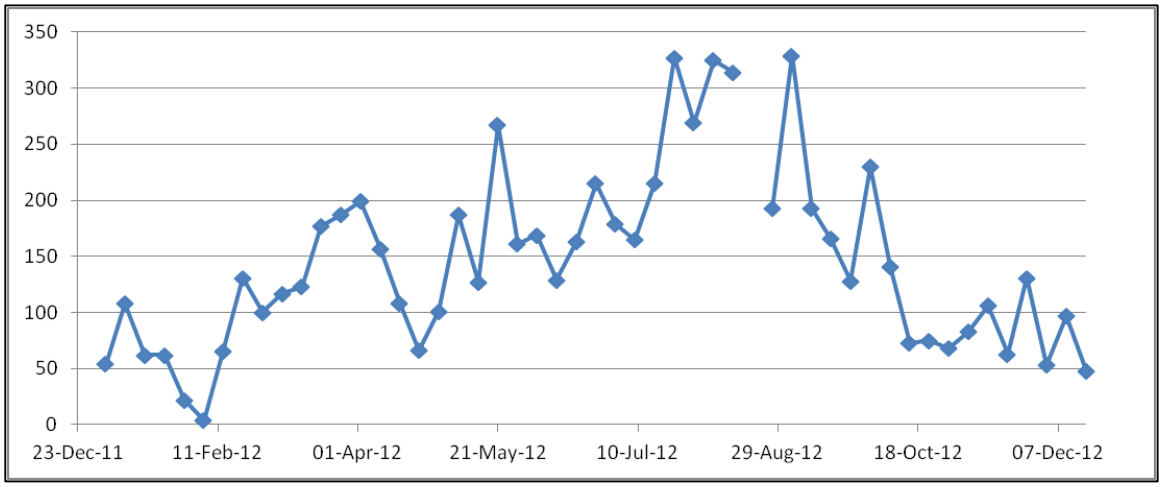


Figure E-1 Daily counts of parked cars between Margate and Westgate 2012

The Multi-coloured Manual (MCM) is a standard text used in the appraisal of flood damages. It contains details of recreation valuation for beaches to allow the valuation of improvements to beach sea defences, promenades, healthy supplies of sediment, etc. The MCM reports the results from a range of recreation studies and includes data from actual surveys at St Mildred's Bay, Westgate, and Cliftonville (Walpole Bay). The visitor counts recorded were 212,000 per year at St Mildred's Bay and an upper and lower count of 146,000 to 136,000 at Walpole Bay.

This information has been used to assign an annual visitor count to each affected beach, and this has been converted to an average summer day count (946nr for St Mildred's Bay, 607 for Walpole Bay), based on a factor increase above average derived from the car park data. The visitor counts in bold in Table E-1indicate good quality data, all the other values are based on assumptions.

Table E-1 Visitor Counts for Each Beach

Site (west to east)	Upper Range Annual Visitor count	Lower Range Annual visitor count	Upper Range: Visitors per summer day	Lower Range: Visitors per summer day
Minnis Bay, Birchington	136,000	24,816	607	111
West Bay, Westgate	136,000	24,816	607	111
St Mildred's Bay, Westgate	**212,000**	24,816	946	111
Westbrook Bay, Margate	136,000	24,816	607	111
Margate The Bay	212,000	24,816	946	111
Margate Fulsam Rock	assume included in Margate			
Walpole Bay, Margate	**146,000**	**136,000**	652	607
Botany Bay, Broadstairs	68,000	12,408	304	55
Total	1,046,000	272,487	4,669	1,216

E.2.4. Value of Enjoyment

The MCM also provides a valuation of enjoyment per visitor. This has been converted to a Quarter 4 2013 price date and included in Table E-2. The value of enjoyment for each beach has been based on these same values, conservatively choosing the lower value in each case except for Margate The Bay which is understood to be the most popular, and Botany Bay which is popular for being quieter.

Table E-2 Value of Enjoyment

Site (west to east)	£/visit Q4 2013
Minnis Bay, Birchington	£12.65
West Bay, Westgate	£12.65
St Mildred's Bay, Westgate	**£15.30**
Westbrook Bay, Margate	£12.65
Margate The Bay	£15.30
Margate Fulsam Rock	Assumed included in Margate The Bay
Walpole Bay, Margate	**£12.65**
Botany Bay, Broadstairs	£15.30

E.2.5. Probability of Beach Closure

It is assumed that each time the water quality drops below the mandatory levels that this is instantaneously known and the beach closed. It is also assumed that this closure lasts for three days.
Based on water quality records for the last 25 years, the total number of water quality failures were counted for each beach and this count used to establish an approximate annual probability of closure. This is shown in Table E-3 below.

Table E-3 Annual Probability of Beach Closure

Site (west to east)	Number of WQ Events since 1988, over 25 year period	Annual Probability of WQ event
Minnis Bay, Birchington	1	4%
West Bay, Westgate	2	8%
St Mildred's Bay, Westgate	3	12%
Westbrook Bay, Margate	1	4%
Margate The Bay	9	36%
Margate Fulsam Rock	3	12%
Walpole Bay, Margate	5	20%
Botany Bay, Broadstairs	1	4%

E.2.6. Calculation of a Present Value loss of Enjoyment

Based on the data presented above, it is possible to determine the value of loss of enjoyment for each three day beach closure (Loss per WQ event). This is used with the annual probability of closure to determine an Average Annual value of loss, and subsequently to determine a discounted Present Value loss over a 100 year period- see Table E-4.

Table E-4 Present Value Loss of Enjoyment for Each Beach £'s

Site (west to east)	Loss per WQ event, upper	Loss per WQ event, lower	Av. Annual value, upper	Av. Annual value, lower	PV loss, upper	PV loss, lower
Minnis Bay, Birchington	£23,039	£4,204	£922	£168	£27,462	£5,011
West Bay, Westgate	£23,039	£4,204	£1,843	£336	£54,924	£10,022
St Mildred's Bay, Westgate	£43,432	£5,084	£5,212	£610	£155,311	£18,180
Westbrook Bay, Margate	£23,039	£4,204	£922	£168	£27,462	£5,011
Margate The Bay	£43,432	£5,084	£15,635	£1,830	£465,933	£54,540
Margate Fulsam Rock	Assumed included in Margate the Bay					
Walpole Bay, Margate	£24,733	£23,039	£4,947	£4,608	£147,406	£137,310
Botany Bay, Broadstairs	£13,931	£2,542	£557	£102	£16,606	£3,030
Total	**£194,642**	**£48,360**			**£895,105**	**£233,105**
All beaches closed by single WQ event	**£177,194**	**£46,160**	**£177,194**	**£46,160**	**£5,280,381**	**£1,375,562**

The results have carried through the two different approaches to visitor counts - using the MCM counts as the upper end estimate, and the car counts as a lower end estimate. The car count data is considered to be

underestimated as people will come to the beach by a variety of transport methods, and the MCM data is the standard approach which is accepted by Defra and suitable for use in applications for Grant in Aid funding.
Based on the assumptions stated and the best available visitor number data, the recreational value of the beach which would be lost through poor water quality events over 100 years is most likely to be approximately £895k and certainly more than £233k.
If the public perception is that if one beach is closed due to pollution, then they may prefer to avoid all Margate beaches, then the annual probability of an event rises to 1 (25 events in 25 years) and the PV loss (upper estimate of visitor count) would be £5,280k.

E.2.7. Travel Cost Valuation

The purpose of an economic appraisal is to measure the cost to the nation. In the case of the Margate beaches, if one beach is not available then visitors will probably go to the next nearest available beach. Assuming their enjoyment is the same, the only loss then is the additional travel expenditure incurred.
As the dominant source of water quality issues is the long shore outfall under storm conditions, it is reasonable to assume that if one beach at Margate is affected then all beaches could be affected at the same time. Looking at the timing of beach WQ failures, there is no evidence to suggest that this is the case. This may be due to the sampling frequency, or simply that the dispersion of the effluent is limited and if it comes on shore, it only affects one beach at a time.
This section presents the results of a travel cost valuation for a beach closure, again over a three day period. It has been assumed that if people cannot go to a particular beach, they will instead go to Broadstairs, or Ramsgate or just stay at home. Broadstairs is the next closest beach to the Margate beaches. Ramsgate also has a beach and a marina. If it is the case that just one Margate beach is negatively affected and the other Margate beaches remain open, it is still assumed that visitors may go elsewhere as they will associate a water quality issue affecting all beaches, or they may consider it safer to travel some distance away from the polluted site for safe bathing.
Local residents are likely to just go home and incur no travel cost at all; they will still have a loss of recreational value though. However, the assumed percentage distributions take into account that not all people will want to go somewhere else, though it could be justified to value all visitors anyway as a measure of their lost enjoyment. Table E-5 shows the assumed distribution.

Table E-5 Relocation Destinations

% of visitor	Relocated to Destinations
50%	Broadstairs Beach
25%	Ramsgate Beach and marina
25%	Stay at home

The Multi-Coloured Manual contains data and information suitable for use in the valuation of travel costs. This data is based on the approach used in the Transport Appraisal Guidance by the Highways Department, however the MCM has simplified the total fuel, operating and time costs into a single speed varying cost. In this case using a value of £0.35/km. (FHRC 2010, Table E-6, £0.31 then updated to a December 2013 price date).

Table E-6 Counts and Daily Travel Costs if all Margate Beaches Closed £'s

All Beaches	Visitors /day, Upper	Visitors /day, Lower	km/return journey	Nr. of cars/day, Upper	Nr of cars/day, Lower	Travel cost / day, Upper	Travel cost / day, Lower
Broadstairs	2335	608	12	1262	329	£5,310	£1,383
Ramsgate	1167	304	15.4	631	164	£3,407	£888
Total	**3502**	**912**				**£8,717**	**£2,271**

With a total of only 75% of the visitors relocating across these two sites, this results in a upper estimate of daily travel cost of £8.7k. Table E-7 identifies the Present Value loss over 100 years, assuming the water quality event causes impact for three days, and an annual probability of closure based on the total closures for all beaches (based on actual data of 25 events over 25 years), on the basis that if the water quality is poor at one beach, then it is likely to be poor at all the Margate beaches, or at least perceived to be poor resulting in the visitors travelling to alternative locations.

Table E-7 Present Value Loss by Travel Cost Method £'s

All Beaches	Travel cost for 3 days, upper	Travel cost for 3 days, lower	Av. Annual Lost, upper	Av. Annual Loss, lower	PV loss, upper	PV loss, lower
Broadstairs	£15,930	£4,150	£15,930	£4,150	**£474,724**	**£123,668**
Ramsgate	£10,222	£2,663	£10,222	£2,663	**£304,615**	**£79,353**
Total	**£51,641**	**£13,453**	**£38,731**	**£10,089**	**£779,339**	**£203,021**

Table E-7 shows that the upper visitor count PV loss using the travel cost method is £779k over a 100 year appraisal period.

If the water quality is not affected at all sites simultaneously, beach closures are related to individual beach (as in Table E-7) and visitors to those individual beaches still leave the area to go to Broadstairs, and Ramsgate, then the PV losses are lower as the probability of beach closure is less. The results of this scenario are shown in Table E-8 below.

Table E-8 PV Loss by Travel Cost Method if Beaches are Considered Individually £'s

Site (west to east)	Upper visitors/day	Lower visitors/day	PV loss Upper	PV loss Lower
Minnis Bay, Birchington	455	83	£4,053	£740
West Bay, Westgate	455	83	£8,106	£1,479
St Mildred's Bay, Westgate	710	83	£18,954	£2,219
Westbrook Bay, Margate	455	83	£4,053	£740
Margate The Bay	710	83	£56,863	£6,656
Walpole Bay, Margate	489	455	£21,756	£20,266
Botany Bay, Broadstairs	228	42	£2,027	£370
Total	**3502**	**912**	**£115,813**	**£32,469**

Of the two different approaches to valuing the traffic losses, it is considered most appropriate to assume that if one Margate beach is affected then they all will be, or at least they will all be perceived to be affected, causing people to travel to alternative locations. Therefore the most likely current Present Value Loss using this method is £779k to £203k.

E.2.8. Climate Change

Current guidance suggests that rainfall will increase by 20% for extreme events by 2080. This means that if a 1 in 10 year rainfall event has a rain depth of 36mm, it will have increased to 43mm for the same probability event by the year 2080. Alternatively, an event now with 36mm of rain has a 1 in 10 chance of occurring in any one year, but this frequency will increase to a 1 in 3.8 chance by 2080 (refer to Table E-9).
There are wide upper and lower ranges on the estimated increase by 2080. However for the purposes of this report a simple approach has been taken and the probability of a bathing water quality event has been linked to the probability of storms with certain rainfall depth. The main consequence of this is that a rainfall event (of a certain size) will occur more frequently in the future. Whatever the drivers for the water quality issues, it is reasonable to assume that it will get worse with climate change, so the exact measurement of the increase is not as significant as making sure that some increase is included.

Table E-9 Increasing Frequencies with Climate Change

Total Rainfall depth (mm)	Return Period Year (now)	Return Period Year (2080)
21	2	1.7
36	10	3.8
49	30	13.5
63	75	36
69	100	46
84	200	104

The probability of a bathing water quality event occurring was identified in Table E-3. These probabilities have been updated to take into account the increasing likelihood of such events in the future, and the losses for both the recreation value and the increased traffic cost worked through to an annual value. As climate change gradually happens, and as this is a high level appraisal, the annual damages from now to 2080 were linearly

interpolated and then assumed to be constant post 2080, then discounted to a present value over 100 years. Table E-10 takes into effect climate change.

Table E-10 Present Value Loss for Recreation and Travel Costs

	Recreational Valuation		Travel Cost Valuation	
Site (west to east)	**PV loss, upper (£k)**	**PV loss, lower (£k)**	**PV loss, upper (£k)**	**PV loss, lower (£k)**
Minnis Bay, Birchington	£41	£8	£6	£1
West Bay, Westgate	£88	£16	£13	£2
St Mildred's Bay, Westgate	£234	£27	£29	£3
Westbrook Bay, Margate	£41	£8	£6	£1
Margate The Bay	£525	£61	£64	£8
Walpole Bay, Margate	£189	£176	£28	£26
Botany Bay, Broadstairs	£25	£5	£3	£1
Individual Total	**£1,144**	**£300**	**£149**	**£42**
All beaches closed together	**£5,307**	**£1,382**	**£783**	**£204**

The above shows that the Present Value Losses with climate change included are about 60% greater than with the same event frequency assumed previously.

E.2.9. Options

Existing situation

The analysis presented above is representative of the existing situation potential losses.

Improve to 1 in 75 Annual Chance of a Water Quality event occurring

A hypothetical option has been considered which would reduce the chance of future water quality events occurring to a 1 in 75 year event. This relatively low frequency has been based on the typical minimum target for reducing flood risk to residential property when implementing an Improvement scheme. This option was valued to see how the recreation losses would reduce if the annual probability of a bathing water quality event could be reduced to 1 in 75 for each beach. Table E-11 below shows the results for this test.

Table E-11 Recreation and Travel Cost Valuation, climate change included, 1 in 75 Option

	Recreational Valuation		Travel Cost Valuation	
Site (west to east)	**PV loss upper £k**	**PV loss lower £k**	**PV loss upper £k**	**PV loss lower £k**
Minnis Bay, Birchington	£9	£2	£1	£0
West Bay, Westgate	£9	£2	£1	£0
St Mildred's Bay, Westgate	£17	£2	£2	£0
Westbrook Bay, Margate	£9	£2	£1	£0
Margate The Bay	£17	£2	£2	£0
Walpole Bay, Margate	£10	£9	£1	£1
Botany Bay, Broadstairs	£6	£1	£1	£0
Individual Total	£77	£19	£10	£3
All beaches closed together	£70	£18	£10	£3

Table E-11 above shows that there is a considerable reduction in the losses if the probability of a water quality event is reduced to a 1 in 75 annual chance. This reduction in loss is classified as a benefit. Table E-12 below presents the present value benefits, with climate change for the 1:75 annual chance option.

Table E-12 Recreation and Travel Cost Benefits, 1 in 75 Option

	Recreational Valuation		Travel Cost Valuation	
Site (west to east)	**PV benefits Upper £k**	**PV benefits Lower £k**	**PV benefits Upper £k**	**PV benefits Lower £k**
Individual Total	£1,067	£281	£138	£39
All beaches impacted together	£5,236	£1,364	£773	£201

The benefits range between £5,236k and £39k (over 100 years) based on the different valuation methods applied.

E.3. Comparison of Valuation Methods

We have two valuation methods (recreation value and travel cost) and also an upper and lower estimate of visitor counts. As the lower visitor count is based on the counts of parked cars, this is considered to be too much of an underestimate to be reliable.

The purpose of applying the travel cost methodology is to ensure that the loss to the nation is not overestimated. The travel cost losses are considerably lower than the recreation losses due to the close proximity of alternative beaches. Therefore it is proposed that the value that should be adopted in the wider analysis of drainage improvements is the travel cost method with the upper estimate of visitor count.

In all the tables above losses are presented for individual beaches as well as for the sum of the individual beaches, with the assumption that if the water quality is poor at one beach then it is likely to be or at least considered poor at the other Margate beaches. As the sewage pipe line outfall is 3 to 4km offshore, it is reasonable to assume that if the effluent comes back to the shore then it will affect all of the beaches. Therefore, it is proposed that the Present Value benefit (100yr) of an improvement scheme is £773k – i.e. using travel cost valuation, upper visitor count and all beaches impacted.

E.4. Conclusions

- There is an existing issue with water quality at the Margate Beaches. This affects the value of the recreation at the beaches.
- The present value losses are within the range of £5,307k to £42k.
- If an option can be designed to mitigate against the risk of further water quality events, then the probability of an event would drop dramatically, and the large majority of these losses would be converted to benefits. If the probability of an event can be reduced to 1 in 75 years, then the PVb would be in the order of £773k (over 100 years).
- Other schemes may also consider the recreational value of the beach, e.g. coastal erosion schemes. These will consider the long term complete loss of the beach. As we are only considering temporary loss of a few days at a time, so any double counting is considered to be minimal.

E.5. Recommendations

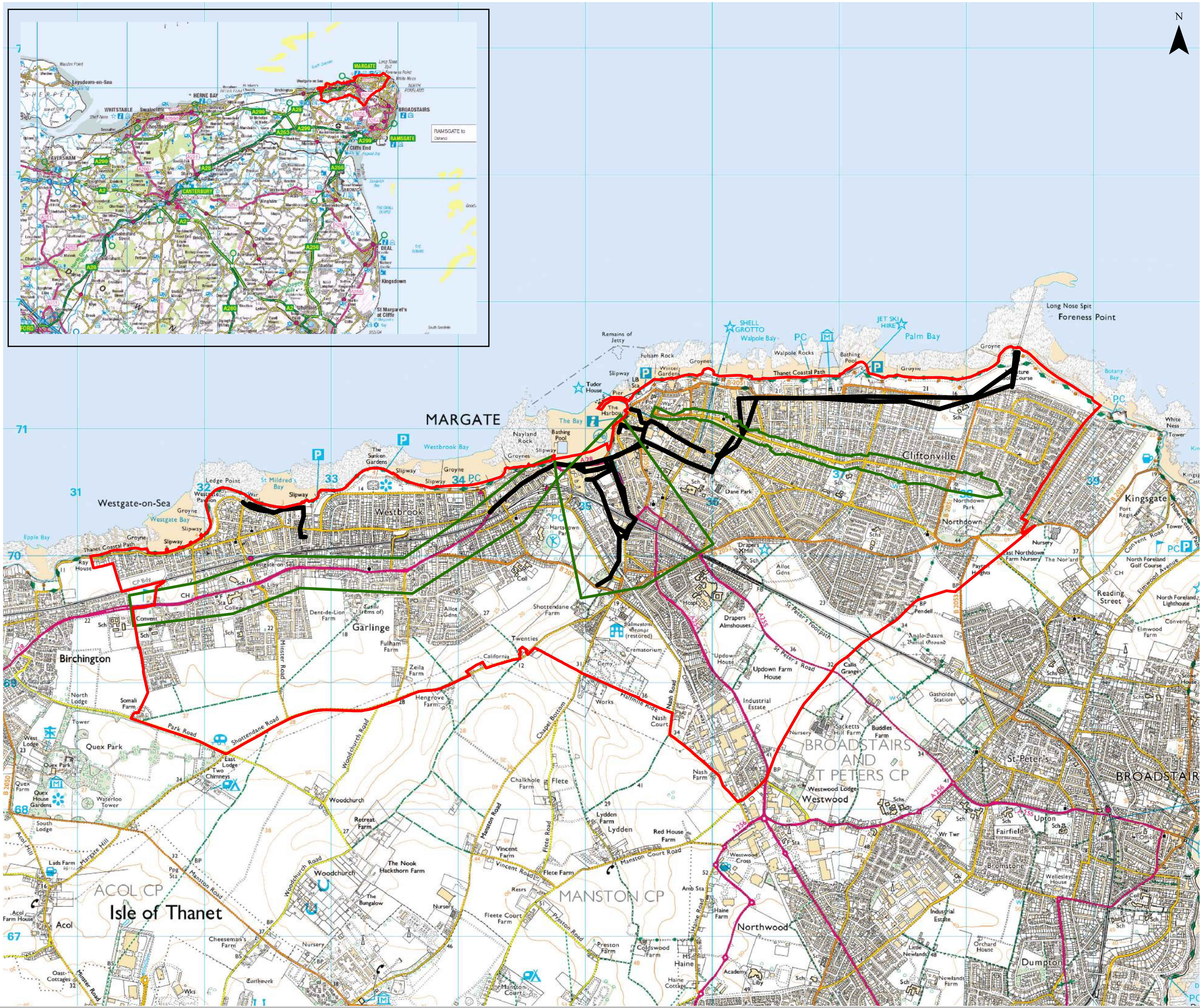
It is recommended that a Present Value benefit of £773k (over 100 years) is added to Outcome Measure 1 in the Partnership funding score for any scheme which will result in a reduction of the probability of a bathing water quality event (to a 1 in 75 annual chance). This is the value most appropriate as a measure of the loss to the nation.

The higher value of £5,236k (over 100 years) should be used in sensitivity testing of the partnership funding score and is more representative of a local recreation loss specific to the people at Margate, as opposed to a loss to the nation.

The values presented above are a measure of loss of recreational value due to water quality events. It is not a measure of the total recreational value of the beaches year round: this would be considerably higher. The value presented above also does not include the socio-economic value of the tourism and trade associated with the beaches and Margate; this could be assessed though this would require a different valuation technique. It may not be acceptable by the Environment Agency as part of Outcome Measure 1 in order to gain Grant in Aid funding.

Appendix F. SWMP Maps

F.1. Tidally Sensitive Areas



ATKINS

Legend

- Margate SWMP Study Area
- Key Flood Risk Areas
- Tidally Sensitive Areas

1,000 500 0 Meters

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5123965 Margate
Surface Water Management Plan

Tidally Sensitive Areas

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1:10,000	CNS	AJC	AJC
REF NUMBER	DATE	DATE	DATE
5123965 DG 002	14/11/2013	23/07/2014	23/07/2014

F.2. Surface Water Flood Risk Map – 1 in 30 Year Rainfall

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Legend

- Margate SWMP Study Area
- Key Flood Risk Areas

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5123965 Margate
Surface Water Management Plan

Strategic Surface Water Flood Risk Map
1 in 30 Year

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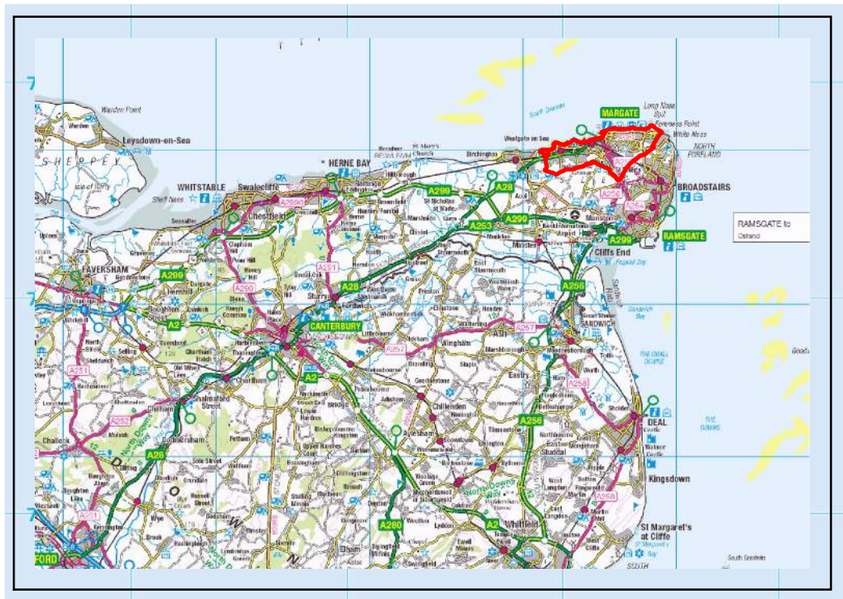
1:10,000	CNS	AJC	AJC
REF NUMBER	DATE	DATE	DATE
5123965 DG 002	14/11/2013	23/07/2014	23/07/2014

F.3. Surface Water Flood Risk Map – 1 in 100 Year Rainfall



N

Legend

- Margate SWMP Study Area
- Key Flood Risk Areas

1,000 500 0 Meters

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Surface Water Management Plan

Strategic Surface Water Flood Risk Map
1 in 100 Year

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SCALE	DRAWN	CHECKED	AUTHORISED
1:10,000	CNS	AJC	AJC
REF NUMBER	DATE	DATE	DATE
5123965 DG 002	14/11/2013	23/07/2014	23/07/2014

Appendix G. Opportunity Areas

G.1. Introduction

The outputs for the opportunity areas were summarised into a “story board” format, so that the partnership have an evidence base to take forward options as they arise. Either as part of the regeneration plan, as part of Grant in Aid applications, or as part of other funding streams.

G.2. What do the Opportunity Story Boards Show?

The “story boards show the benefit of the conceptual options” and how they could be taken forward now, or indeed the future, by providing the following information:

- historic flooding incidents;
- high level constraints;
- receptors;
- predicted existing flood risk for the 1 in 30 and 1 in 100 year rainfall events;
- the key flood mechanisms;
- the number of properties at risk and average annual damages;
- the longlist of options considered;
- the preferred conceptual option;
- the cost benefit ratio of the preferred conceptual option;
- key stakeholders for the preferred conceptual option;
- actions (including deadline / timeline, review date, and date agreed);
- lead and responsible partner.

Margate Surface Water Management Plan - Opportunity Summary Table

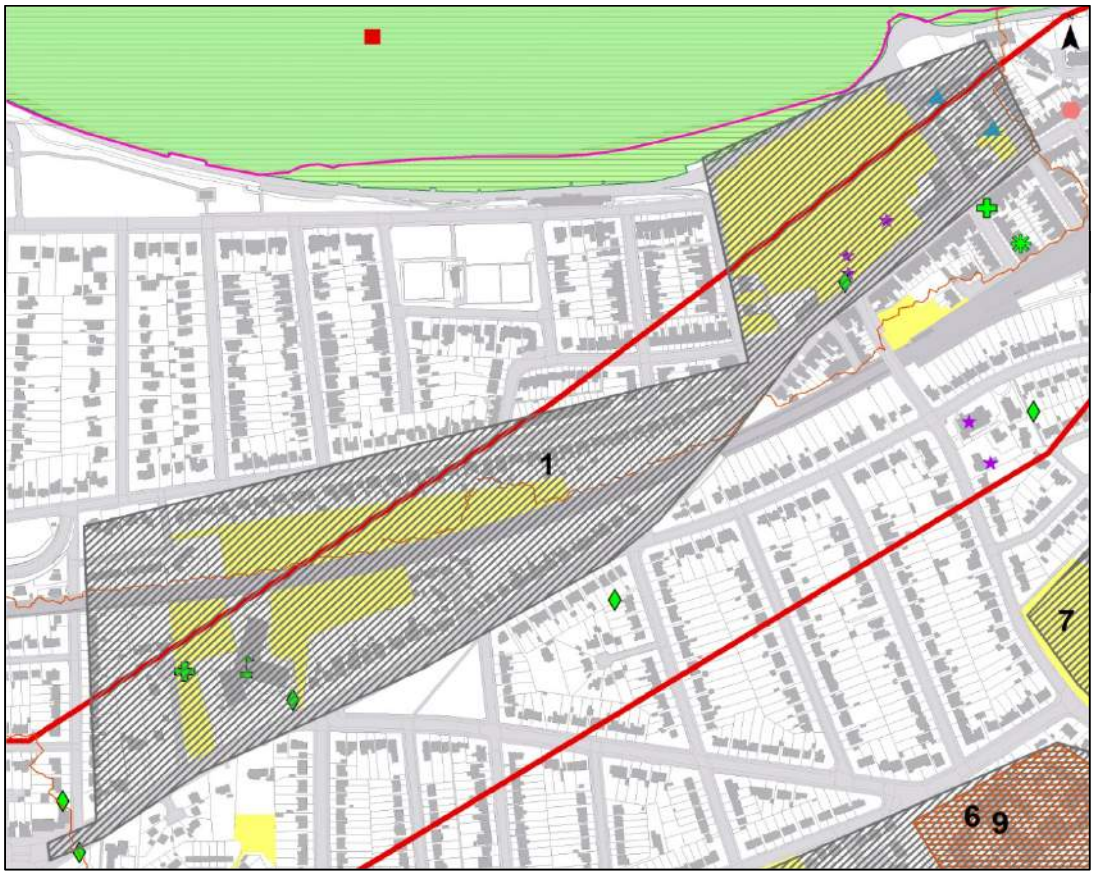
Opportunity Area Reference	Key Flood Risk Area	Preferred Intervention	Preferred Intervention Comments	Option Development (Modelling)	Indicative Capital Construction Cost	Predicted Residual Damages Present Value	Damages Avoided Present Value	Cost Benefit Ratio	Actions As Agreed by Partner Organisations 1	2	3	4	5	Lead & Responsible Partner	Key Stakeholders	Date Agreed	Deadline / Timeline	Review Date
Area 1	Canterbury Road	Planning Activities	Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.		N/A			N/A	Improve evidence base through model improvements and detailed review into historical flooding.	Establish development principles in the Local Plan / Core Strategy.				TDC	KCC Highways/Highways Agency , Schools, Developers, Network Rail, TDC Planning, Medical Facilities, Retirement Home	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 2	Canterbury Road	Attenuation & Retention - Surface Water Removal	Remove surface water from local combined sewer network and attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties	Initially the model reduced surface water contributions to the combined sewers, from impermeable areas in the subcatchments within the opportunity area boundary. This did not reduce the flood risk to the properties	£3,550,881	£81,455	£1,277,484	0.4	Improve evidence base through model improvements and detailed review into historical flooding.	Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land management techniques.				KCC	School, Residents, TDC Planning Team, English Heritage	07/02/2014	2015	2015
Area 3	High Street & Tivoli Brook	Planning Activities	Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.		N/A			N/A	Improve evidence base through model improvements and detailed review into historical flooding.	Establish development principles in the Local Plan / Core Strategy.				TDC	Local Businesses, TDC Planning Team, Industrial Park, Network Rail	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 4	Canterbury Road	Attenuation & Retention - Surface Water Removal	Remove surface water from local combined sewer network and attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties	The removal of surface water from the combined system through the removal of contributing surfaces such as roofs and roads in the subcatchment shown to the right, did not provide sufficient alleviation of flooding, particularly in the	£2,936,225	£3,904,456	£313,214	0.1	Improve evidence base through model improvements and detailed review into historical flooding.	Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land management techniques.				KCC	School, College, Residential,, TDC Planning Team, Southern Water	07/02/2014	2015	2015
Area 5	Canterbury Road	Attenuation	Attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties downstream.	Initially only the upstream storage was modelled but we realised that there was ponding which was stored in the central recreational area to the south of Canterbury road and this was additionally causing flooding and a flow path to	£1,020,935	£2,290,928	£1,424,615	1.4	Improve evidence base through model improvements and detailed review into historical flooding.	Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land management techniques.				KCC	Landowner, Utilities, Kent CC Highways, English Heritage, Residents	07/02/2014	2015	2015
Area 6	Canterbury Road	Surface Water Removal	See Area 7 for option development and preferred option.	Area 6 alone does not reduce the surface water input into the combined system sufficiently to prevent flooding from surcharged manholes downstream, therefore it was combined with attenuation/walls to prevent flooding in the larger	£2,478,755	£968,982	-£952,549	-0.4	Improve evidence base through model improvements and detailed review into historical flooding.	KCC to contact school / academy to explore opportunities for SUDS retrofit.				KCC	College, Southern Water	07/02/2014	2015	2015
Area 7	Canterbury Road	Attenuation & Retention - Surface Water Removal	Remove surface water from local combined sewer network and attenuate flows from the upper catchment by landscaping, so as to reduce the risk of flooding to	Intervention: the surface water was removed from the combined system in Area 6. This was in order to reduce the volume of surface water in the combined system which may affect downstream receptors such as the railway	£2,544,063	£1,472,540	£2,381,100	0.9	Improve evidence base through model improvements and detailed review into historical flooding.	Incorporate opportunity into the regeneration of the Margate Football Club.				TDC	College, Margate Football Club, TDC Parks and Leisure, TDC Planning Team	07/02/2014	2015	2015
Area 8	Canterbury Road	Attenuation	Attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties downstream. This should be considered during further design	The option was tested with different embankment lengths to try and capture all the flow coming from the upper catchment. THE COSTS WERE LATER ADJUSTED (through reduction in the embankment length) TO TRY	£1,454,058	£730,767	-£164,701	-0.1	Improve evidence base through model improvements and detailed review into historical flooding.	Investigate the feasibility and benefits of upstream storage and land management techniques to Margate.				EA	Cricket Club, TDC , Residents, Landowner	07/02/2014	2015	2015
Area 9	High Street & Tivoli Brook	Planning Activities	Promote surface water removal techniques in the development process (SHLAA sites) and promote adhoc surface water removal where able.		N/A			N/A	Improve evidence base through model improvements and detailed review into historical flooding.	Establish development principles in the Local Plan / Core Strategy.				TDC	Residents, Margate Football Club, TDC Parks and Leisure, TDC Planning Team	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 10	High Street & Tivoli Brook	Planning Activities	Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.		N/A			N/A	Improve evidence base through model improvements and detailed review into historical flooding.	Establish development principles in the Local Plan / Core Strategy.				TDC	Residents, Network Rail, TDC Planning Team, Southern Water	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 11	Northdown Road	Planning Activities	Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.		N/A			N/A	Improve evidence base through model improvements and detailed review into historical flooding.	Establish development principles in the Local Plan / Core Strategy.				TDC	Residents, TDC Planning,	07/02/2014	For inclusion in next draft of the Local Plan.	-
Area 12	Northdown Road	Attenuation, Retention - Surface Water Removal, & sewer upgrades	Remove surface water from local combined sewer network and attenuate flows from the upper catchment by directing flows to Dane Park,so as to reduce the	The initial surface water removal option for Area 12 was to reduce the loss from the roofs by an initial value of 5mm/hour. This did not provide a reduction in surface water sufficient to not surcharge the manholes in the model. The	£10,977,607	£3,188,353	£1,946,464	0.2	Improve evidence base through model improvements and detailed review into historical flooding.	Investigate the feasibility of re-directing overland flows for storage in Northdown Park alongside Southern Water's scheme.				SW	Residents, Southern Water, TDC Planning, Kent CC Highways	07/02/2014	2015	2015
Area 13	High Street & Tivoli Brook	Attenuation & Retention - Surface Water Removal	Remove surface water from local combined sewer network and attenuate flows from the upper catchment by landscaping, so as to reduce the risk of flooding to	The removal of surface water from the combined system through the removal of contributing surfaces such as roofs and roads in the subcatchment shown to the right, did not provide sufficient alleviation of flooding, particularly in the	£7,174,666	£6,592,614	£5,849,309	0.8	Improve evidence base through model improvements and detailed review into historical flooding.	Investigate the feasibility of optimising flood storage in Dane Park.				KCC	Local Businesses, Residents, TDC Parks and Leisure, TDC Planning Team, Southern Water	07/02/2014	2015	2015

Summary

Key Flood Risk Area	Canterbury Road
Opportunity Area Reference	Area 1
Predicted Properties at Risk (1 in 100 Year)	30
Average Annual Damages	£54,886
Preferred Intervention	Planning Activities
Indicative Capital Construction Cost	N/A
Present Value Damage Avoided	
Cost Benefit Ratio	N/A
Key Stakeholders	KCC Highways/Highways Agency , Schools, Developers, Network Rail, TDC Planning, Medical Facilities, Retirement Home
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014
Deadline / Timeline	For inclusion in next draft of the Local Plan.

Evidence Base

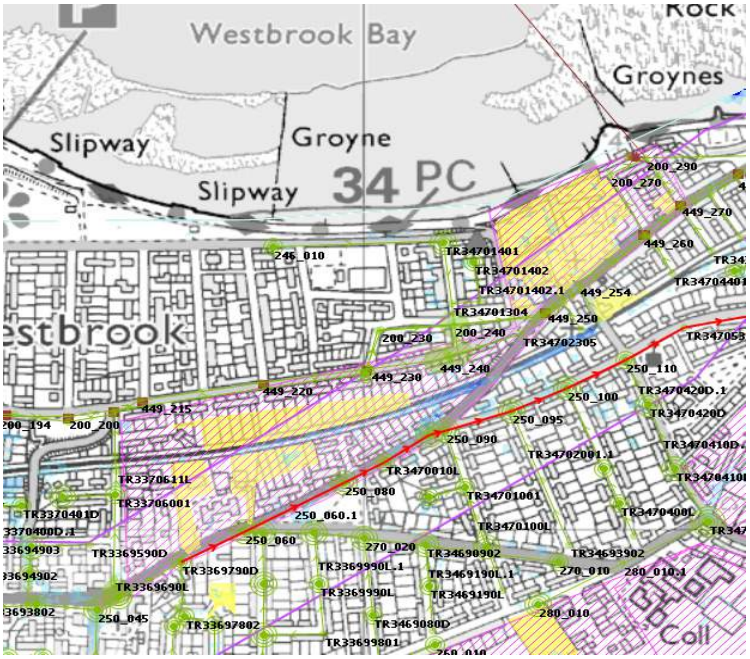
Flood History, Constraints, Receptors, and Opportunities



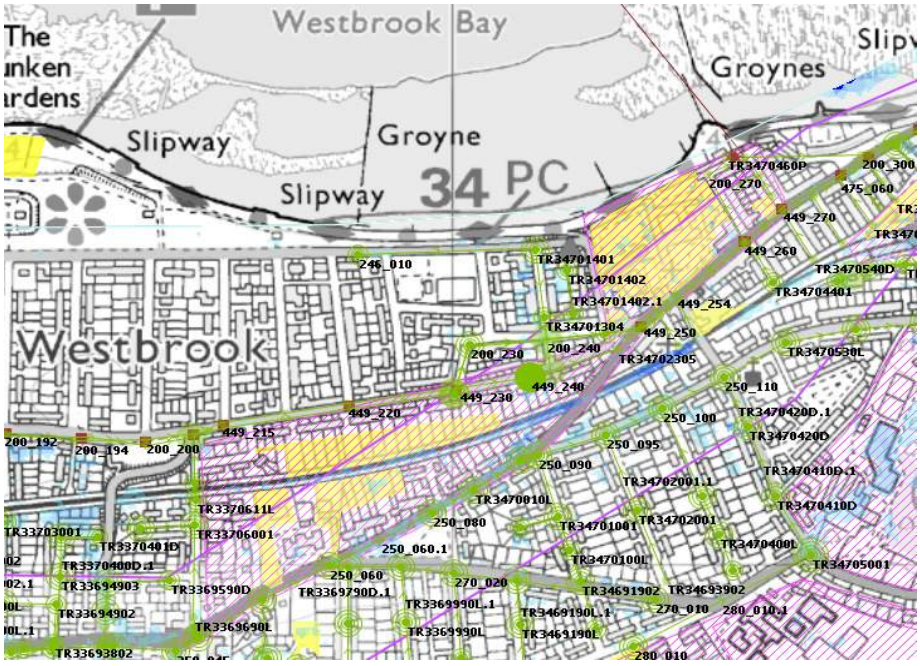
Flood History	There are two recorded flood events, recorded by the Kent Fire and Rescue Service. These are recorded as Weather related flood events.
Constraints	Receptors, Available Land, Redevelopment.
Receptors	Railway, Main Road, Residential Areas, Utilities, Listed Buildings, Healthcare / Medical Facilities, School
Opportunities	Redevelopment / development (SHLAA sites).

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	60



Rainfall Return Period	1 in 100 Year
Critical Duration	30



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
The sewer network becomes overwhelmed which causes overland flows to travel along the roads. The sewer network appears to be backing up from a known pinch point under the railway bridge on All Saints Ave.

Flood Risk Damage Estimates

Rainfall Return Period	Predicted Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	15	1	£54,886
1 in 100 Year	29	1	
1 in 100 Year + CC (2080's)	28	1	

Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	No	Urban area	No
	Agricultural processes	No	Urban area	No
	Use of Green Infrastructure	No	Urban area	No
2. Attenuation / Retention	Floodplain storage	No	Limited space	No
	Wetland creation/river restoration	No	Limited space	No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No channels	No
	Increase maintenance regime	No	No channels	No
	De-Culverting	No	No channels	No
	River engineering i.e.	No	No channels	No
	Diversion channels	No	No channels	No
	Raised Defences	No	No channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		No
	Green Roofs	Yes		No
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		Yes
	Increased maintenance regime	Yes		Yes
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
KCC Highways/Highways Agency , Schools, Developers, Network Rail, TDC Planning, Medical Facilities, Retirement Home

Preferred Intervention

Planning Activities
To be developed as part of planning
Comments
Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Establish development principles in the Local Plan / Core Strategy.
3	
4	
5	

Deadline / Timeline	For inclusion in next draft of the Local Plan.
Review Date	-
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Canterbury Road
Opportunity Area Reference	Area 2
Properties at Risk (1 in 100 Year)	30
Average Annual Damages	£45,602
Preferred Intervention	Attenuation & Retention - Surface Water Removal
Indicative Capital Construction Cost	£3,550,881
Present Value Damage Avoided	£1,277,484
Cost Benefit Ratio	0.36
Key Stakeholders	School, Residents, TDC Planning Team, English Heritage
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

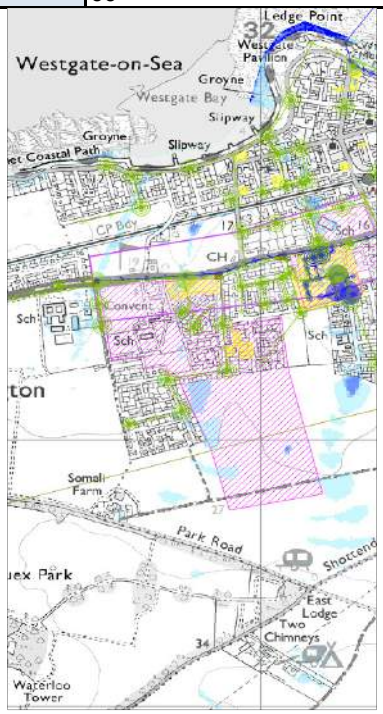
Evidence Base

Flood History, Constraints, Receptors, and Opportunities

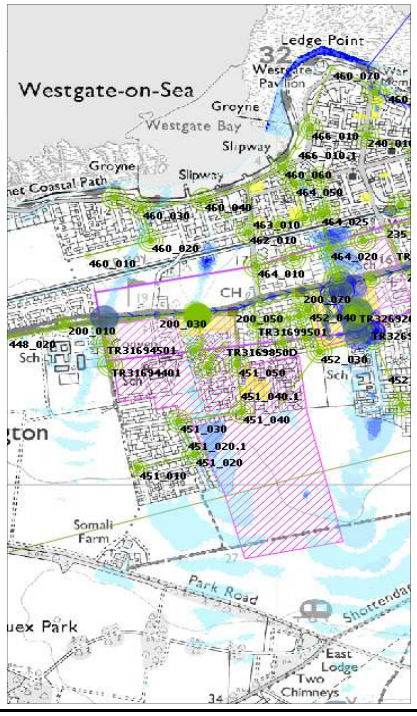
Flood History	There is one recorded flood event, recorded by the Kent Fire and Rescue Service. These are recorded as Weather related flood events.
Constraints	Receptors, Land Ownership and Management, Redevelopment.
Receptors	School, Residential Areas, Listed Building
Opportunities	Attenuation of the flows from the upper catchment and redevelopment / development (SHLAA sites).

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	60



Rainfall Return Period	1 in 100 Year
Critical Duration	120



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Initial flooding is caused by the sewer network becoming overwhelmed. Secondary mechanism/pathway occurs after ponding to the west of Chilham Avenue and Golden Close travels through the SHLAA area and overland flows from upper catchment.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	24	0	£45,602
1 in 100 Year	30	0	
1 in 100 Year + CC (2080's)	42	0	

Shortlisting of Interventions

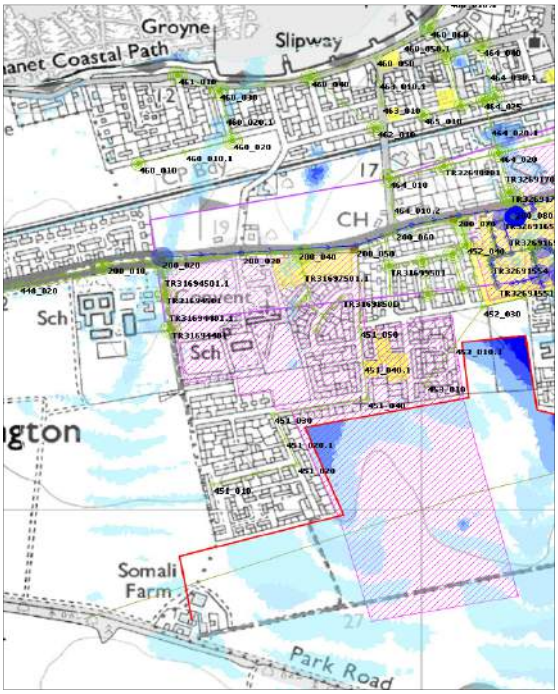
Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	Yes	Upper catchment	No
	Agricultural processes	Yes	Upper catchment	No
	Use of Green Infrastructure	Yes	Upper catchment	No
2. Attenuation / Retention	Floodplain storage	Yes		Yes
	Wetland creation/river restoration	No	No channels	No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	Yes		No
	Increase maintenance regime	Yes		No
	De-Culverting	No	No channels	No
	River engineering i.e.	No	No channels	No
	Diversion channels	No	No channels	No
	Raised Defences	Yes		No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		Yes
	Green Roofs	Yes		Yes
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		No
	Increased maintenance regime	Yes		No
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
School, Residents, TDC Planning Team, English Heritage

Preferred Intervention

Attenuation & Retention - Surface Water Removal



Comments
Remove surface water from local combined sewer network and attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties downstream.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land manage
3	
4	
5	

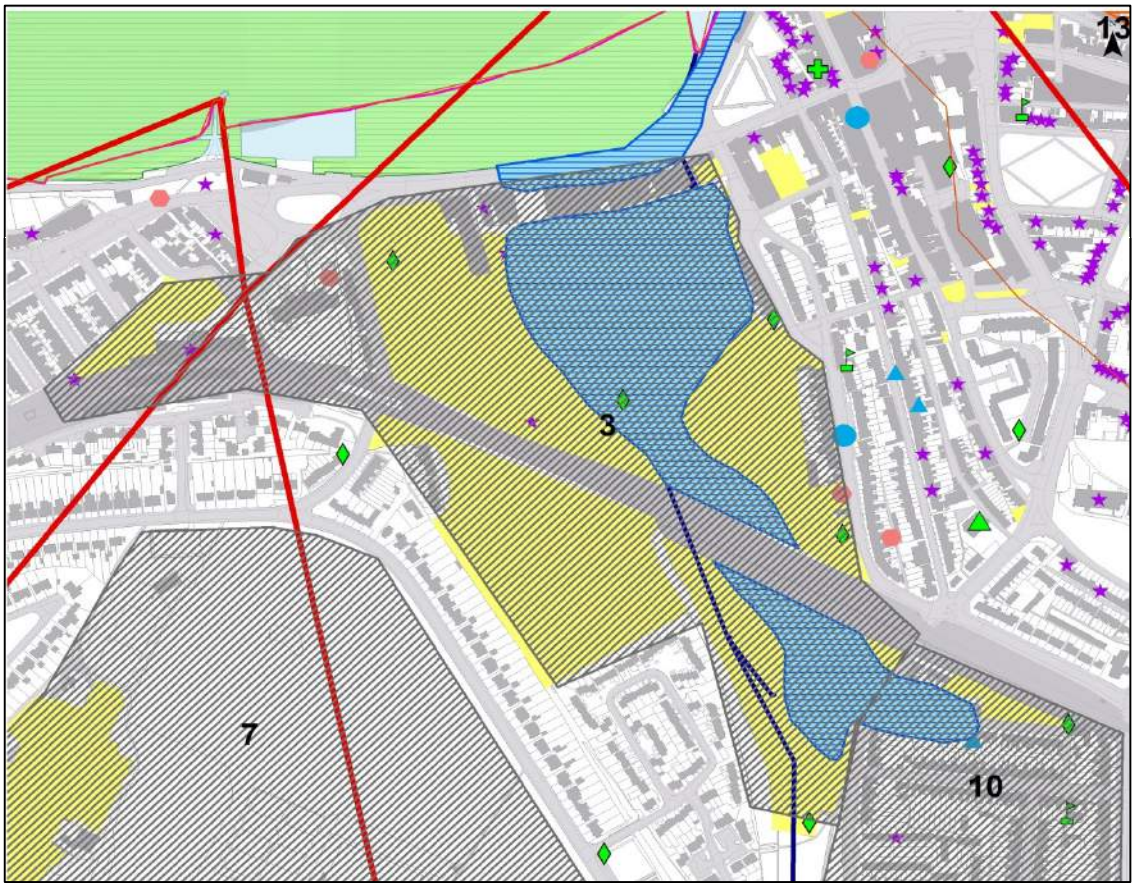
Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	High Street & Tivoli Brook
Opportunity Area Reference	Area 3
Properties at Risk (1 in 100 Year)	26
Average Annual Damages	£271,247
Preferred Intervention	Planning Activities
Indicative Capital Construction Cost	N/A
Present Value Damage Avoided	
Cost Benefit Ratio	N/A
Key Stakeholders	Local Businesses, TDC Planning Team, Industrial Park, Network Rail
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014
Deadline / Timeline	For inclusion in next draft of the Local Plan.

Evidence Base

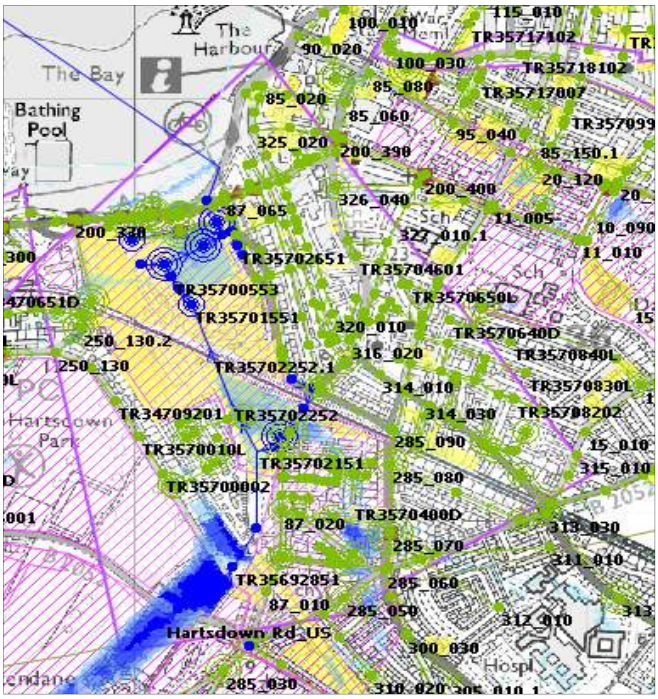
Flood History, Constraints, Receptors, and Opportunities



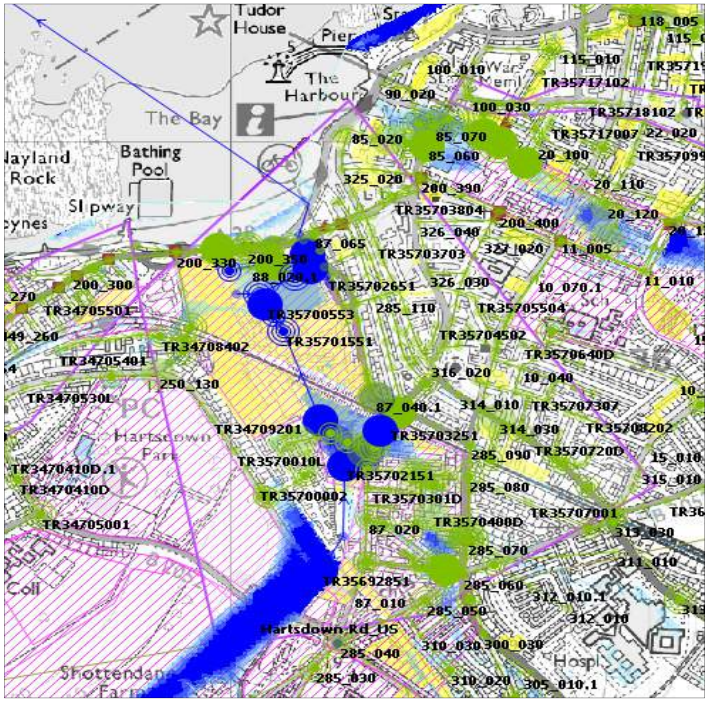
Flood History	This has historically been a flood prone area, as indicated by the blue zone (EA data) and flood incident recorded by Kent County Council above.
Constraints	Receptors, Available Land, Coastal Interactions, Redevelopment.
Receptors	Utilities, Railway, Local Businesses, Residential Areas, Listed Buildings, Main Road.
Opportunities	Redevelopment / regeneration of the Dreamland Site (SHLAA sites). Upstream storage as part of Area 8 or improved land management techniques to reduce surface water runoff.

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	360



Rainfall Return Period	1 in 100 Year
Critical Duration	600



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Overland flows from the upper catchment, sewer network becoming overwhelmed, Tivoli Brook becoming overwhelmed.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	13	13	£271,247
1 in 100 Year	14	12	
1 in 100 Year + CC (2080's)	18	15	

Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	No	Urban area	No
	Agricultural processes	No	Urban area	No
	Use of Green Infrastructure	No	Urban area	No
2. Attenuation / Retention	Floodplain storage	No	Limited space	No
	Wetland creation/river restoration	No	Limited space	No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	Yes		No
	Increase maintenance regime	Yes		No
	De-Culverting	Yes		No
	River engineering i.e.	Yes		No
	Diversion channels	Yes		No
	Raised Defences	Yes		No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		No
	Green Roofs	Yes		No
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		Yes
	Increased maintenance regime	Yes		Yes
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		Yes
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		Yes
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		Yes
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Local Businesses, TDC Planning Team, Industrial Park, Network Rail

Preferred Intervention

Planning Activities
To be developed as part of planning
Comments
Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Establish development principles in the Local Plan / Core Strategy.
3	
4	
5	

Deadline / Timeline	For inclusion in next draft of the Local Plan.
Review Date	-
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Canterbury Road
Opportunity Area Reference	Area 4
Properties at Risk (1 in 100 Year)	52
Average Annual Damages	£141,533
Preferred Intervention	Attenuation & Retention - Surface Water Removal
Indicative Capital Construction Cost	£2,936,225
Present Value Damage Avoided	£313,214
Cost Benefit Ratio	0.11
Key Stakeholders	School, College, Residential,, TDC Planning Team, Southern Water
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

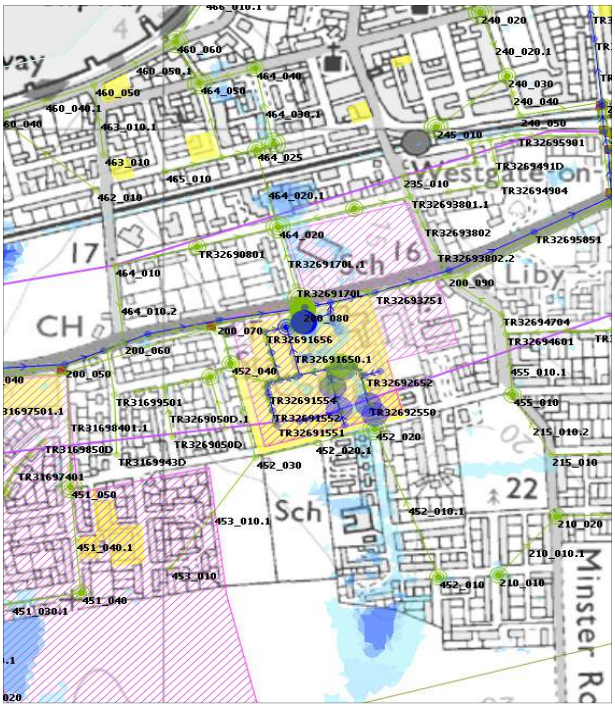
Evidence Base

Flood History, Constraints, Receptors, and Opportunities

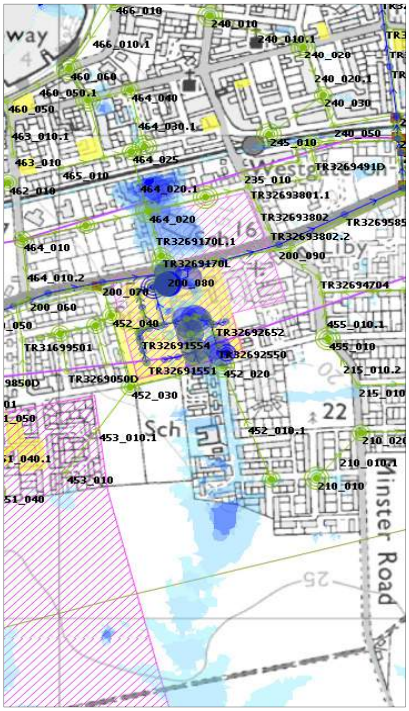
Flood History	None.
Constraints	Receptors, Redevelopment, Available Land.
Receptors	Schools, Fire Station, Utilities, Retirement/Residential Home, Residential Areas, Main Road.
Opportunities	Redevelopment / development (SHLAA sites) and upstream attenuation of overland flows from the upper catchment.

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	240



Rainfall Return Period	1 in 100 Year
Critical Duration	240



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Initial flooding from the overwhelmed sewer network and overland flows from the upper catchment.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	49	7	£141,533
1 in 100 Year	45	7	
1 in 100 Year + CC (2080's)	75	8	

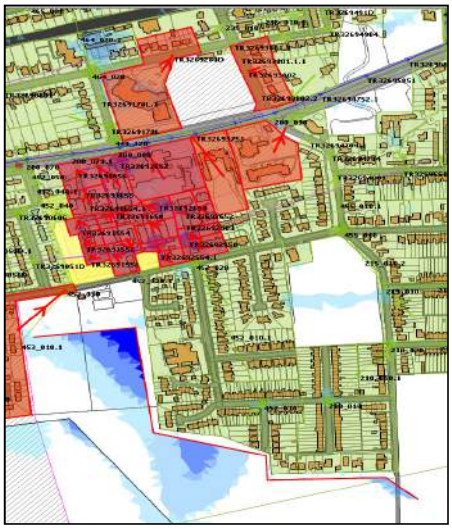
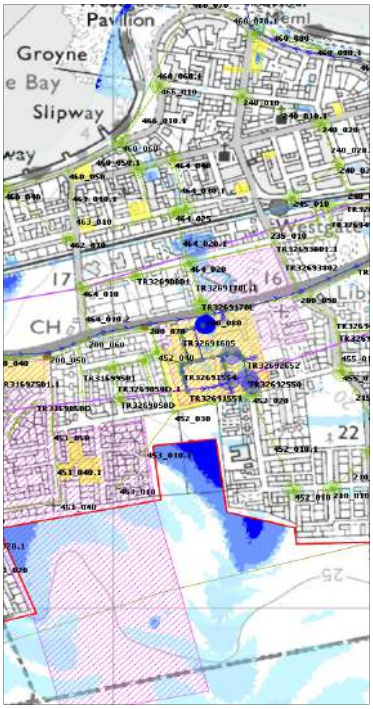
Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	Yes	Upper catchment	No
	Agricultural processes	Yes	Upper catchment	No
	Use of Green Infrastructure	Yes	Upper catchment	No
2. Attenuation / Retention	Floodplain storage	Yes		Yes
	Wetland creation/river restoration	Yes		No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No channels	No
	Increase maintenance regime	No	No channels	No
	De-Culverting	No	No channels	No
	River engineering i.e.	No	No channels	No
	Diversion channels	No	No channels	No
	Raised Defences	No	No channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		Yes
	Green Roofs	Yes		Yes
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		No
	Increased maintenance regime	Yes		No
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
School, College, Residential,, TDC Planning Team, Southern Water

Preferred Intervention

Attenuation & Retention - Surface Water Removal
 
Comments
Remove surface water from local combined sewer network and attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties downstream.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land manage
3	
4	
5	

Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Canterbury Road
Opportunity Area Reference	Area 5
Properties at Risk (1 in 100 Year)	87
Average Annual Damages	£124,683
Preferred Intervention	Attenuation
Indicative Capital Construction Cost	£1,020,935
Present Value Damage Avoided	£1,424,615
Cost Benefit Ratio	1.40
Key Stakeholders	Landowner, Utilities, Kent CC Highways, English Heritage, Residents
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

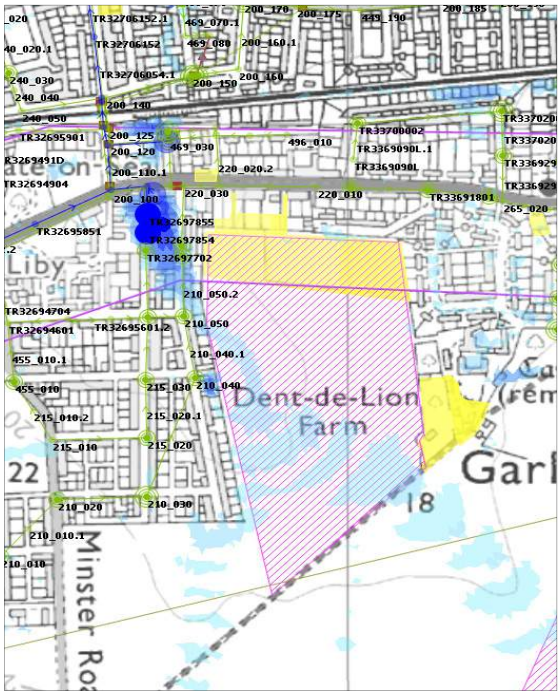
Evidence Base

Flood History, Constraints, Receptors, and Opportunities

Flood History	The EA historic flood mapping shows areas that are flood prone (blue zone).
Constraints	Receptors, Land Ownership and Management.
Receptors	Farm Land, Residential Areas, Recreational Area.
Opportunities	Upstream attenuation of overland flows from the upper catchment and redevelopment / development (SHLAA sites).

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	240



Rainfall Return Period	1 in 100 Year
Critical Duration	120

Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Overland flow from upper catchment. Flooding to the north of Canterbury Road is caused by an overwhelmed sewer network.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	73	2	£124,683
1 in 100 Year	85	2	
1 in 100 Year + CC (2080's)	103	2	

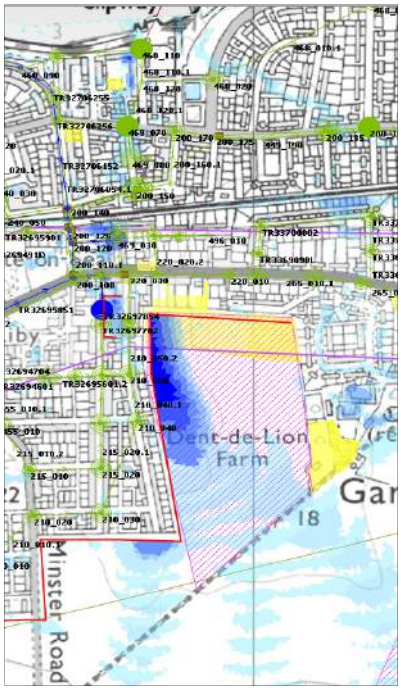
Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	Yes	Upper catchment	No
	Agricultural processes	Yes	Upper catchment	No
	Use of Green Infrastructure	Yes	Upper catchment	No
2. Attenuation / Retention	Floodplain storage	Yes		Yes
	Wetland creation/river restoration	Yes		No
	SUDS - new/retrospective	Yes		No
3. Increased Channel Conveyance	Carry on existing maintenance	No	No Channels	No
	Increase maintenance regime	No	No Channels	No
	De-Culverting	No	No Channels	No
	River engineering i.e.	No	No Channels	No
	Diversion channels	No	No Channels	No
	Raised Defences	No	No Channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		No
	Green Roofs	Yes		No
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		No
	Increased maintenance regime	Yes		No
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Landowner, Utilities, Kent CC Highways, English Heritage, Residents

Preferred Intervention

Attenuation

Comments
Attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties downstream.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Consider Areas 2, 4, and 5 as one opportunity in subsequent work and consider benefits of land manage
3	
4	
5	

Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Canterbury Road
Opportunity Area Reference	Area 6
Properties at Risk (1 in 100 Year)	1
Average Annual Damages	£16,433
Preferred Intervention	Surface Water Removal
Indicative Capital Construction Cost	Please see Area 7
Present Value Damage Avoided	-£952,549
Cost Benefit Ratio	Please see Area 7
Key Stakeholders	College, Southern Water
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

Evidence Base

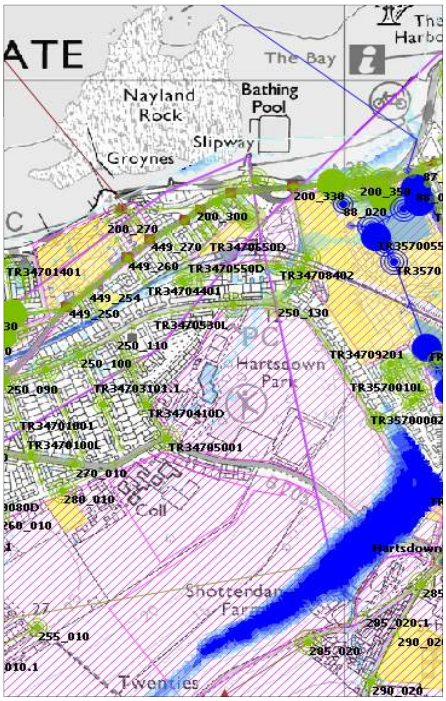
Flood History, Constraints, Receptors, and Opportunities

Flood History	None.
Constraints	Receptors, Land Ownership and Management.
Receptors	College
Opportunities	Surface water removal to reduce known backing up from a pinch point under the railway bridge on All Saints Ave.

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	60

Rainfall Return Period	1 in 100 Year
Critical Duration	240



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Ponding and localised runoff and backing up from a known pinch point under the railway bridge on All Saints Ave.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	0	1	£16,433
1 in 100 Year	0	1	
1 in 100 Year + CC (2080's)	0	1	

Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	Yes	Upper Catchment	No
	Agricultural processes	Yes	Upper Catchment	No
	Use of Green Infrastructure	Yes	Upper Catchment	No
2. Attenuation / Retention	Floodplain storage	No		No
	Wetland creation/river restoration	Yes		No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No Channels	No
	Increase maintenance regime	No	No Channels	No
	De-Culverting	No	No Channels	No
	River engineering i.e.	No	No Channels	No
	Diversion channels	No	No Channels	No
	Raised Defences	No	No Channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		Yes
	Green Roofs	Yes		Yes
	Improve capacity of piped	Yes		Yes
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		No
	Increased maintenance regime	Yes		No
5. Planning Activities	Development Control	Yes		No
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		No
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	No		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	No		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
College, Southern Water

Preferred Intervention

Surface Water Removal
Comments
See Area 7 for option development and preferred option.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	KCC to contact school / academy to explore opportunities for SUDS retrofit.
3	
4	
5	

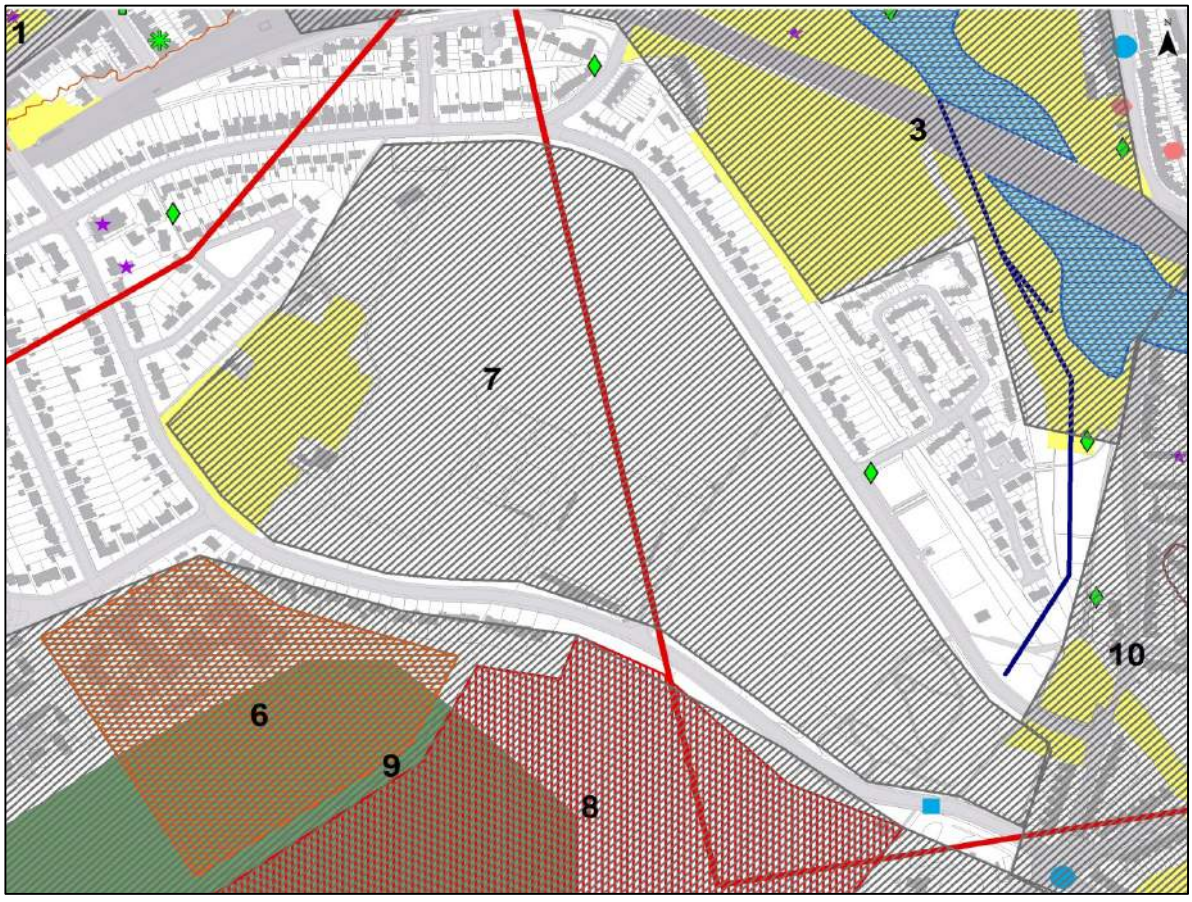
Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Canterbury Road
Opportunity Area Reference	Area 7
Properties at Risk (1 in 100 Year)	31
Average Annual Damages	£112,884
Preferred Intervention	Attenuation & Retention - Surface Water Removal
Indicative Capital Construction Cost	£2,544,063
Present Value Damage Avoided	£2,381,100
Cost Benefit Ratio	0.94
Key Stakeholders	College, Margate Football Club, TDC Parks and Leisure, TDC Planning Team
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

Evidence Base

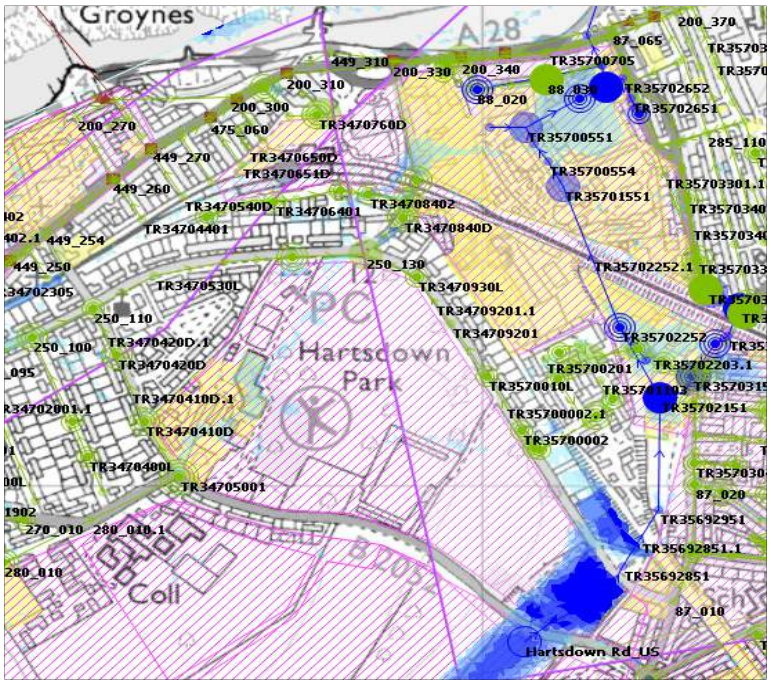
Flood History, Constraints, Receptors, and Opportunities



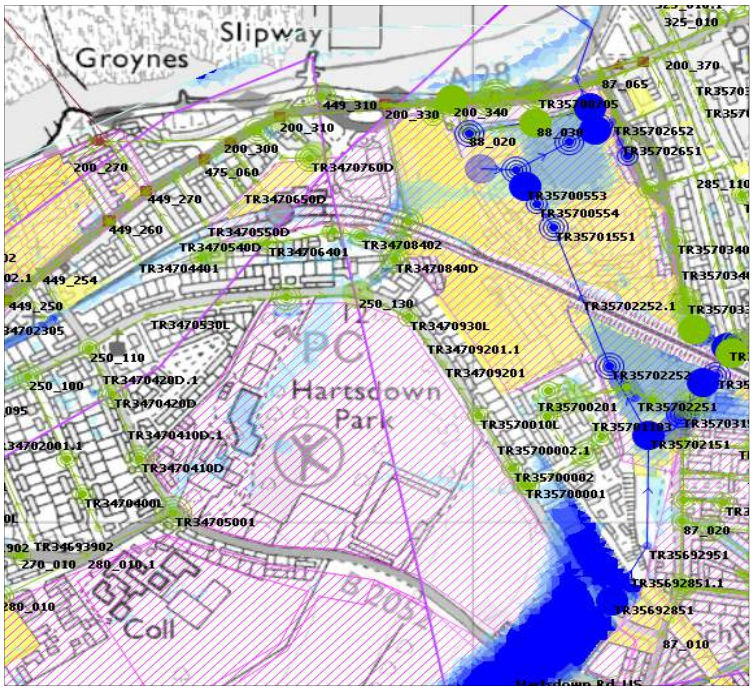
Flood History	Thanet District Council have a record of flooding on the Hartsdown Road.
Constraints	Receptors, Redevelopment, Land Ownership and Management.
Receptors	Sports Club, Recreational Area, Football Grounds, Nursery
Opportunities	Upstream attenuation of overland flows from the upper catchment and redevelopment / development (SHLAA sites).

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	60



Rainfall Return Period	1 in 100 Year
Critical Duration	120



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Overland flow from upper catchment/Tivoli Brook. Ponding and runoff into residential areas to north and east. Local sewer network becoming overwhelmed to the north and west.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	20	1	£112,884
1 in 100 Year	28	3	
1 in 100 Year + CC (2080's)	35	3	

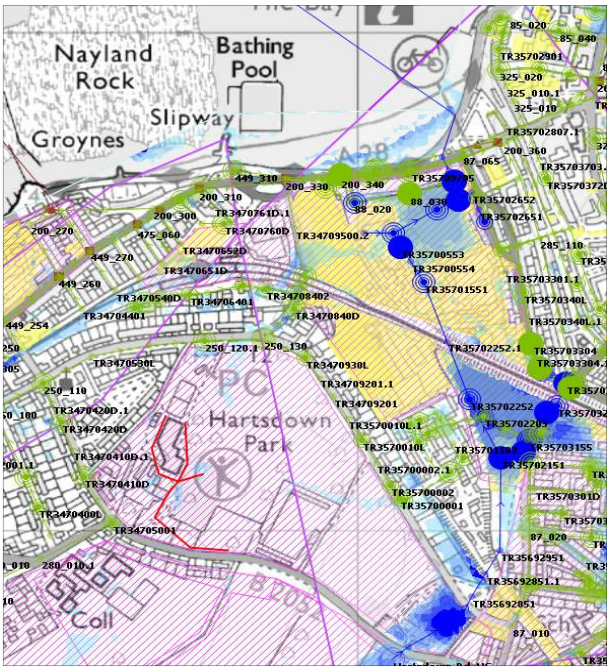
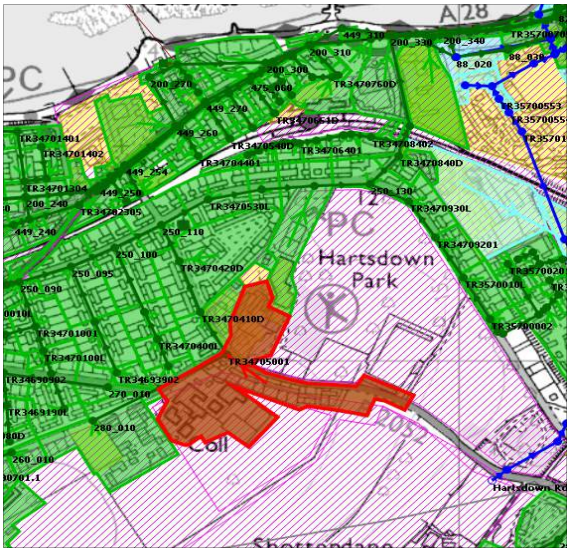
Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	Yes	Upper Catchment	No
	Agricultural processes	Yes	Upper Catchment	No
	Use of Green Infrastructure	Yes	Upper Catchment	No
2. Attenuation / Retention	Floodplain storage	Yes		No
	Wetland creation/river restoration	Yes		No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No Channels	No
	Increase maintenance regime	No	No Channels	No
	De-Culverting	No	No Channels	No
	River engineering i.e.	No	No Channels	No
	Diversion channels	No	No Channels	No
	Raised Defences	No	No Channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		Yes
	Green Roofs	Yes		Yes
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		No
	Increased maintenance regime	Yes		No
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
College, Margate Football Club, TDC Parks and Leisure, TDC Planning Team

Preferred Intervention

Attenuation & Retention - Surface Water Removal
 
Comments
Remove surface water from local combined sewer network and attenuate flows from the upper catchment by landscaping, so as to reduce the risk of flooding to properties downstream.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Incorporate opportunity into the regeneration of the Margate Football Club.
3	
4	
5	

Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Canterbury Road
Opportunity Area Reference	Area 8
Properties at Risk (1 in 100 Year)	11
Average Annual Damages	£18,995
Preferred Intervention	Attenuation
Indicative Capital Construction Cost	£1,454,058
Present Value Damage Avoided	-£164,701
Cost Benefit Ratio	-0.11
Key Stakeholders	Cricket Club, TDC , Residents, Landowner
Lead & Responsible Partner	EA
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

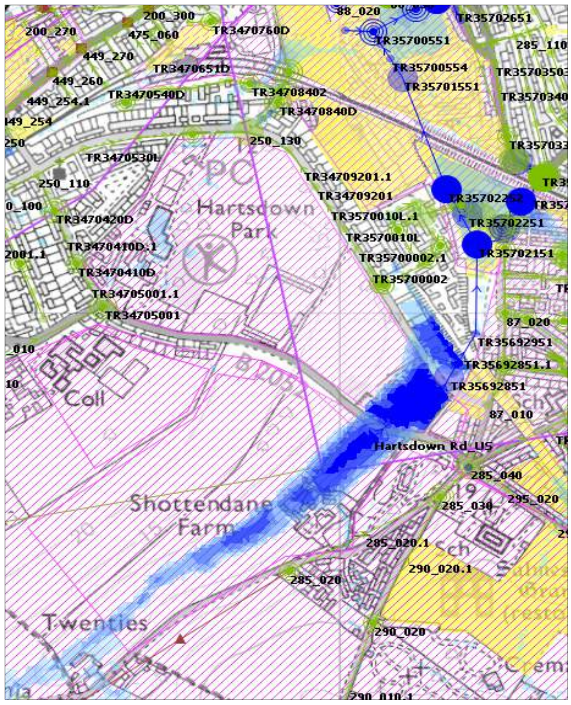
Evidence Base

Flood History, Constraints, Receptors, and Opportunities

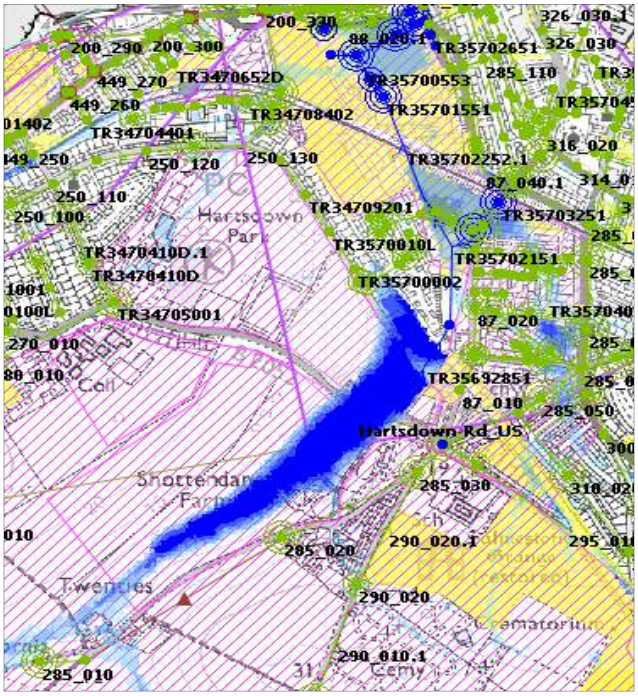
Flood History	Thanet District Council have a record of flooding on the Hartsdown Road and have advised that the cricket pitch is flood prone.
Constraints	Receptors, Land Ownership and Management.
Receptors	Cricket Club, Recreational Area
Opportunities	Upstream attenuation of overland flows from the upper catchment.

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	240



Rainfall Return Period	1 in 100 Year
Critical Duration	240



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Overland runoff from upper catchment.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	4	1	£18,995
1 in 100 Year	10	1	
1 in 100 Year + CC (2080's)	21	1	

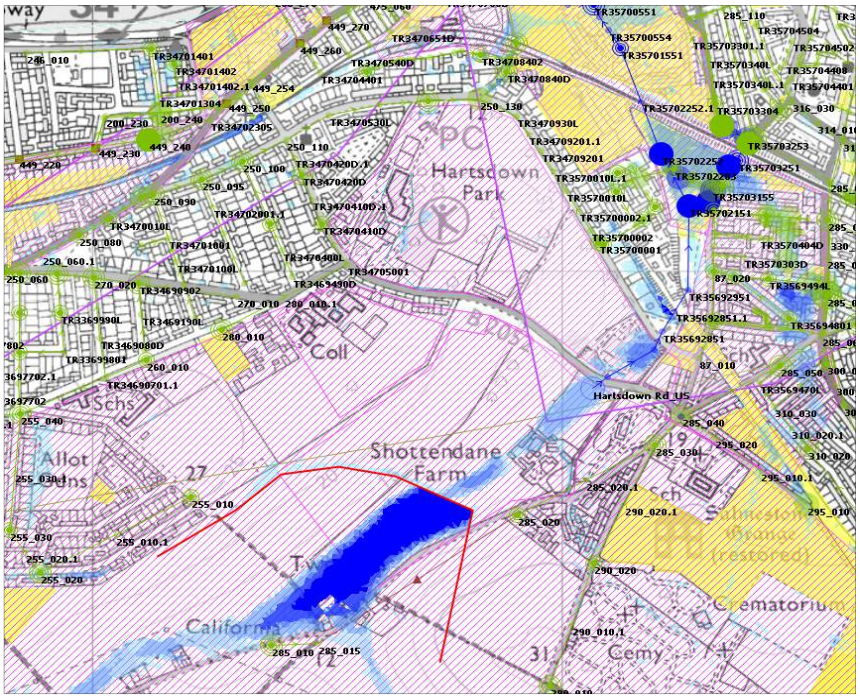
Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	Yes	Upper catchment	No
	Agricultural processes	Yes	Upper catchment	No
	Use of Green Infrastructure	Yes	Upper catchment	No
2. Attenuation / Retention	Floodplain storage	Yes		Yes
	Wetland creation/river restoration	Yes		No
	SUDS - new/retrospective	Yes		No
3. Increased Channel Conveyance	Carry on existing maintenance	Yes		No
	Increase maintenance regime	Yes		No
	De-Culverting	No		No
	River engineering i.e.	Yes		No
	Diversion channels	No		No
	Raised Defences	No		No
4. Other Infrastructure Improvements	Pumping	No	Largely rural	No
	Managing exceedance flows	Yes		No
	Green Roofs	No	Largely rural	No
	Improve capacity of piped	No	Largely rural	No
	On-line storage (existing/new)	No	Largely rural	No
	Off-line storage (existing/new)	No	Largely rural	No
	Continue existing maintenance of	No	Largely rural	No
	Increased maintenance regime	No	Largely rural	No
5. Planning Activities	Development Control	Yes		No
	SUDS Strategy	Yes		No
	Blue Development Corridors	Yes		No
	New Development	Yes		No
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	No	Largely rural	No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Cricket Club, TDC , Residents, Landowner

Preferred Intervention

Attenuation

Comments
Attenuate flows from the upper catchment, so as to reduce the risk of flooding to properties downstream. This should be considered during further design work and in combination with other options.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Investigate the feasibility and benefits of upstream storage and land management techniques to Margate.
3	
4	
5	

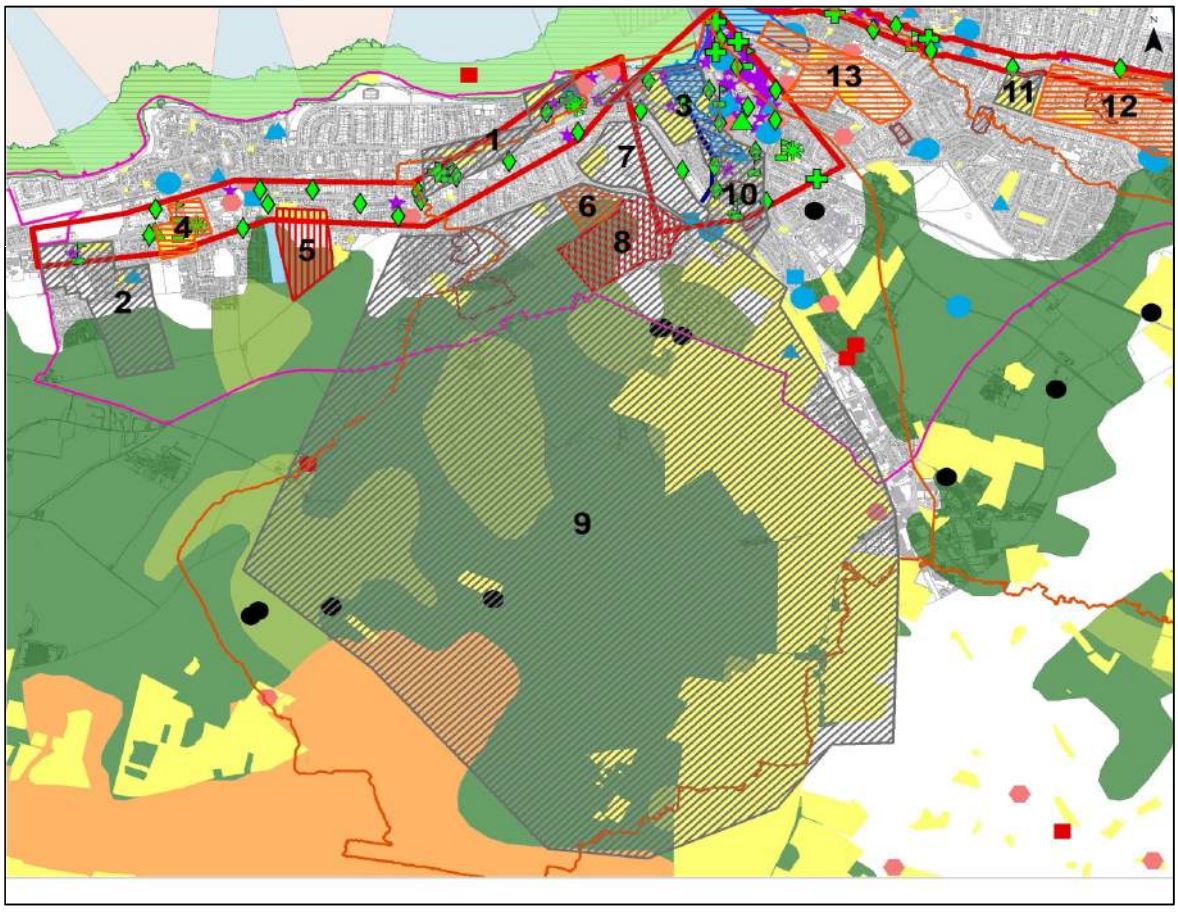
Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	EA
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	High Street & Tivoli Brook
Opportunity Area Reference	Area 9
Properties at Risk (1 in 100 Year)	113
Average Annual Damages	£1,929,966
Preferred Intervention	Planning Activities
Indicative Capital Construction Cost	N/A
Present Value Damage Avoided	
Cost Benefit Ratio	N/A
Key Stakeholders	Residents, Margate Football Club, TDC Parks and Leisure, TDC Planning Team
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014
Deadline / Timeline	For inclusion in next draft of the Local Plan.

Evidence Base

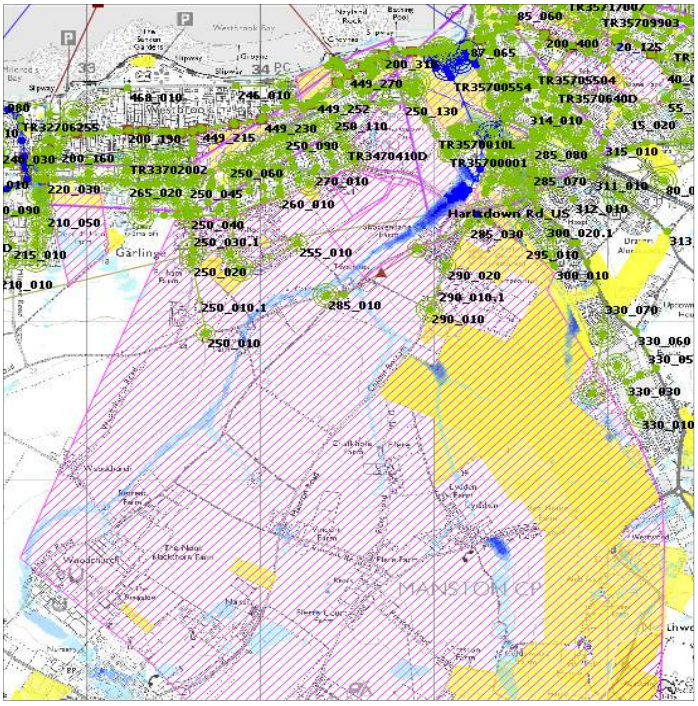
Flood History, Constraints, Receptors, and Opportunities



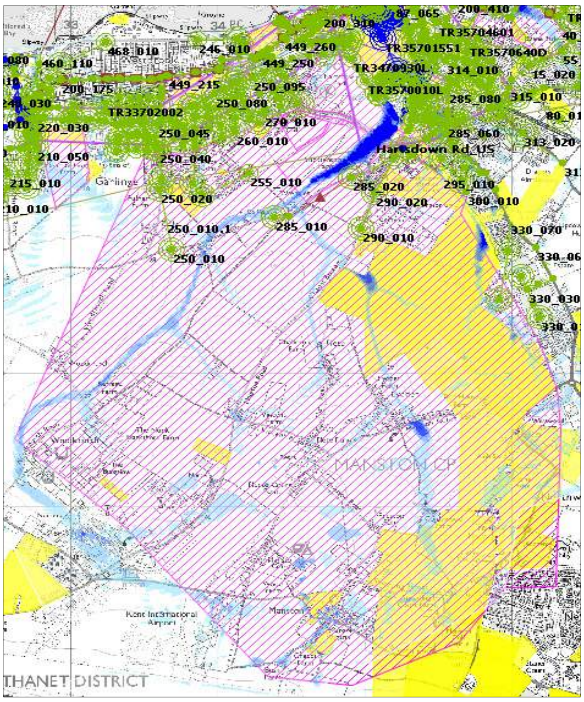
Flood History	Thanet District Council, Kent County Council, and Kent Fire and Rescue have records of flooding in this strategic opportunity area.
Constraints	Receptors, Redevelopment, Land Ownership and Management.
Receptors	Farm land, Residential Areas.
Opportunities	Redevelopment / development (SHLAA sites).

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	240



Rainfall Return Period	1 in 100 Year
Critical Duration	120



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Overland runoff from upper catchment and manhole surcharge.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	60	27	£1,929,966
1 in 100 Year	82	31	
1 in 100 Year + CC (2080's)	87	26	

Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	Yes	Upper catchment	No
	Agricultural processes	Yes	Upper catchment	No
	Use of Green Infrastructure	Yes	Upper catchment	No
2. Attenuation / Retention	Floodplain storage	Yes		No
	Wetland creation/river restoration	Yes		No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	Yes		No
	Increase maintenance regime	Yes		No
	De-Culverting	Yes		No
	River engineering i.e.	Yes		No
	Diversion channels	Yes		No
	Raised Defences	Yes		No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		No
	Green Roofs	Yes		No
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		Yes
	Increased maintenance regime	Yes		Yes
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	No	Largely rural	No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Residents, Margate Football Club, TDC Parks and Leisure, TDC Planning Team

Preferred Intervention

Planning Activities
To be developed as part of planning
Comments
Promote surface water removal techniques in the development process (SHLAA sites) and promote adhoc surface water removal where able.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Establish development principles in the Local Plan / Core Strategy.
3	
4	
5	

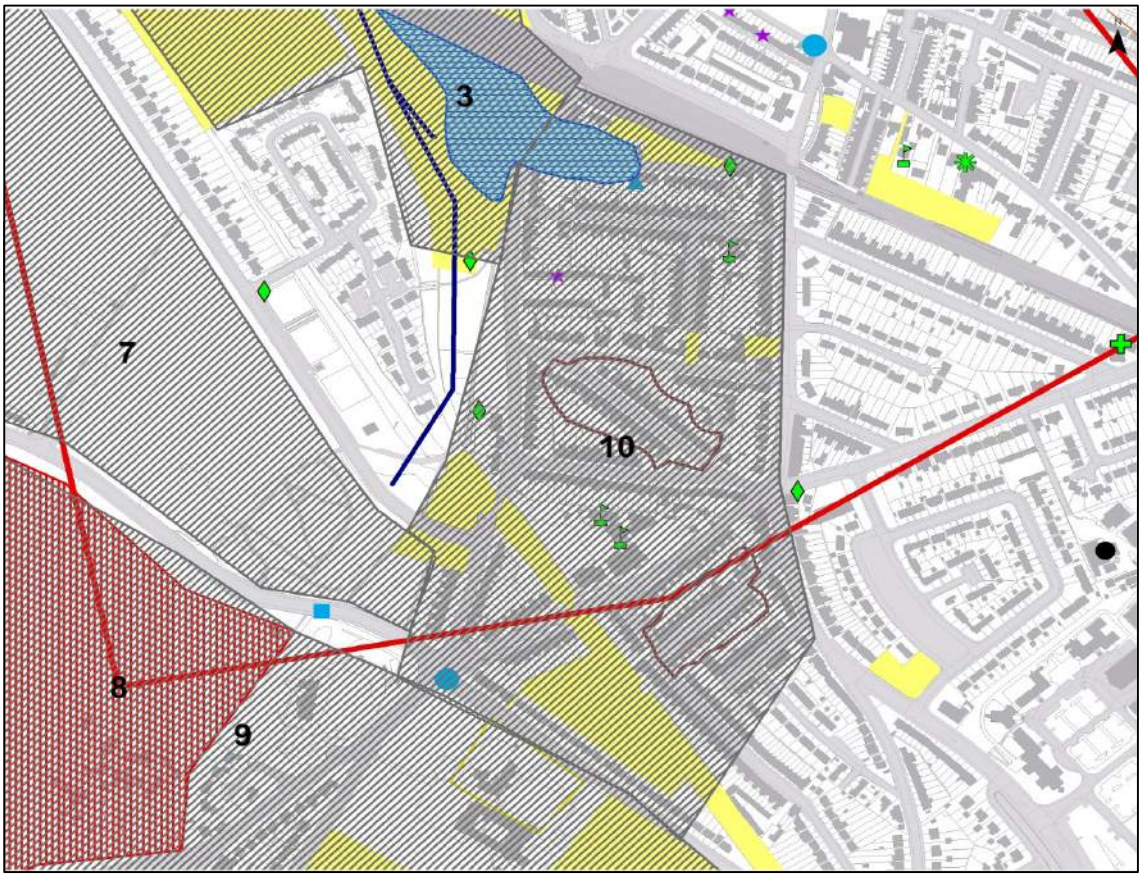
Deadline / Timeline	For inclusion in next draft of the Local Plan.
Review Date	-
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	High Street & Tivoli Brook
Opportunity Area Reference	Area 10
Properties at Risk (1 in 100 Year)	273
Average Annual Damages	£452,151
Preferred Intervention	Planning Activities
Indicative Capital Construction Cost	N/A
Present Value Damage Avoided	
Cost Benefit Ratio	N/A
Key Stakeholders	Residents, Network Rail, TDC Planning Team, Southern Water
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014
Deadline / Timeline	For inclusion in next draft of the Local Plan.

Evidence Base

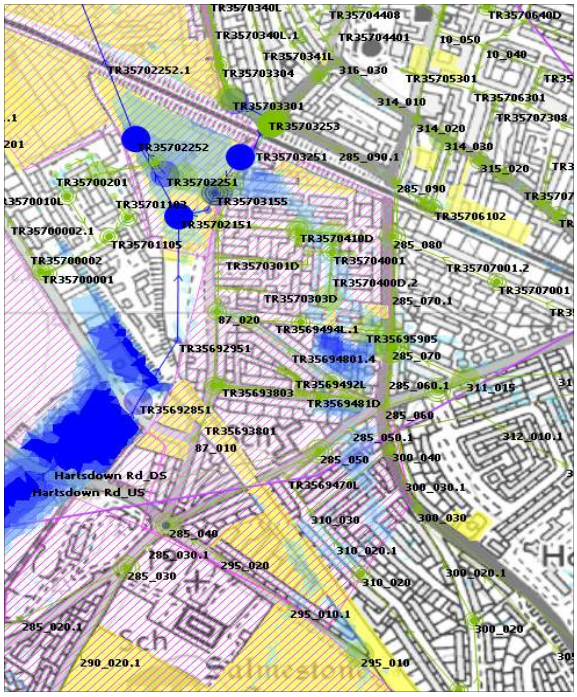
Flood History, Constraints, Receptors, and Opportunities



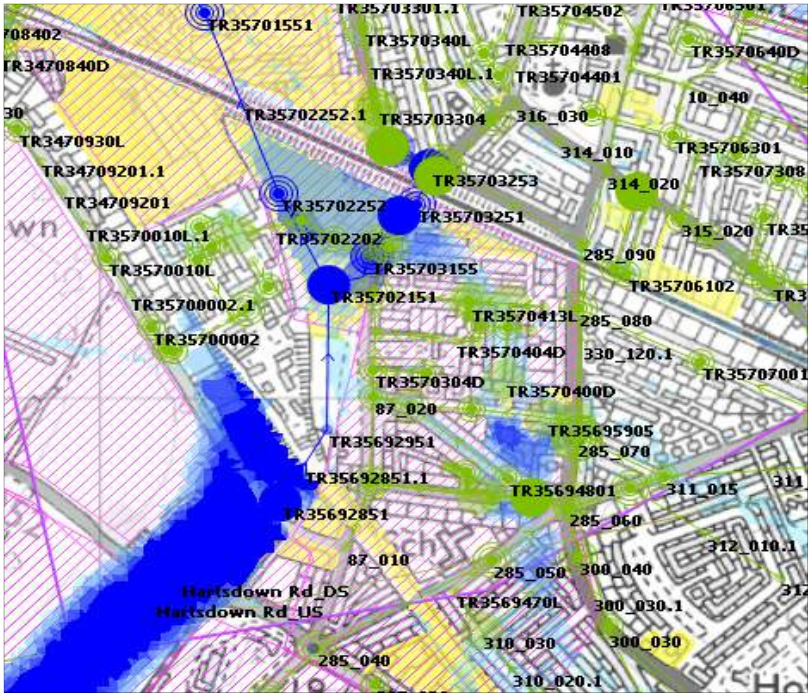
Flood History	This has historically been a flood prone area, as indicated by the blue zone (EA data), the sewer flooding extent, and flood incidents recorded by Kent County Council and Kent Fire
Constraints	Receptors, Redevelopment, Available Land.
Receptors	Residential Areas, Schools, Utilities, Listed Building.
Opportunities	Redevelopment / development (SHLAA sites) and Tivoli Brook regeneration / management.

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	240



Rainfall Return Period	1 in 100 Year
Critical Duration	120



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Sewer network becoming overwhelmed and overland runoff from the upper catchment.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	216	12	£452,151
1 in 100 Year	259	14	
1 in 100 Year + CC (2080's)	272	14	

Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	No	Urban area	No
	Agricultural processes	No	Urban area	No
	Use of Green Infrastructure	No	Urban area	No
2. Attenuation / Retention	Floodplain storage	No	Limited space	No
	Wetland creation/river restoration	No	Limited space	No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No Channels	No
	Increase maintenance regime	No	No Channels	No
	De-Culverting	No	No Channels	No
	River engineering i.e.	No	No Channels	No
	Diversion channels	No	No Channels	No
	Raised Defences	No	No Channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		No
	Green Roofs	Yes		No
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		Yes
	Increased maintenance regime	Yes		Yes
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Residents, Network Rail, TDC Planning Team, Southern Water

Preferred Intervention

Planning Activities
To be developed as part of planning
Comments
Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Establish development principles in the Local Plan / Core Strategy.
3	
4	
5	

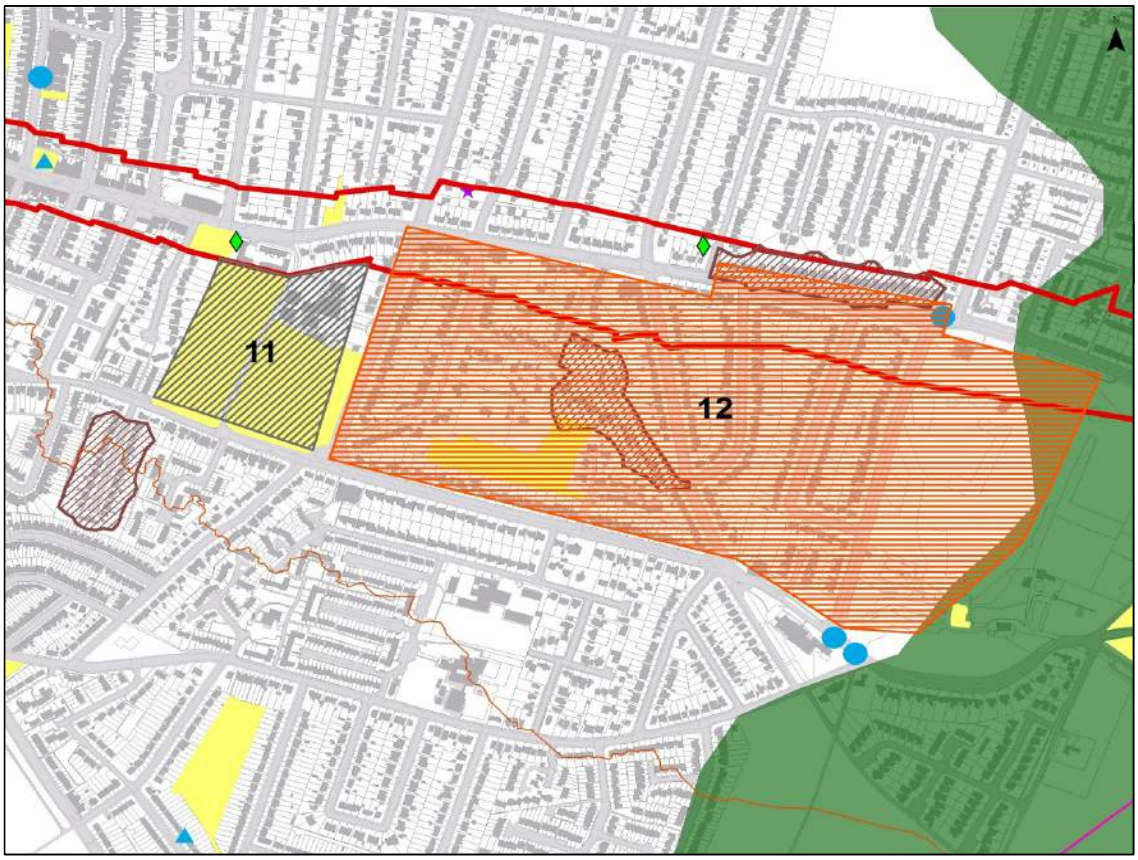
Deadline / Timeline	For inclusion in next draft of the Local Plan.
Review Date	-
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Northdown Road
Opportunity Area Reference	Area 11
Properties at Risk (1 in 100 Year)	1
Average Annual Damages	£3,299
Preferred Intervention	Planning Activities
Indicative Capital Construction Cost	N/A
Present Value Damage Avoided	
Cost Benefit Ratio	N/A
Key Stakeholders	Residents, TDC Planning,
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014
Deadline / Timeline	For inclusion in next draft of the Local Plan.

Evidence Base

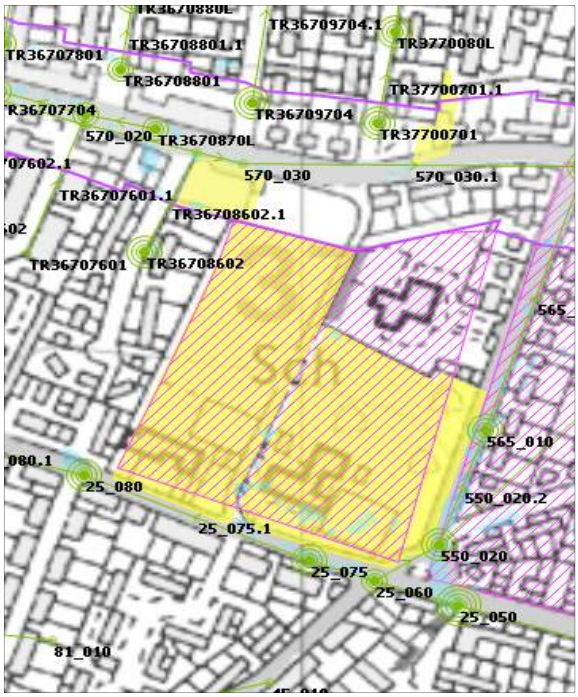
Flood History, Constraints, Receptors, and Opportunities



Flood History	None.
Constraints	Receptors, Redevelopment, Available Land.
Receptors	Utilities, School, Residential Areas, Main Road.
Opportunities	Redevelopment / development (SHLAA sites).

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	30



Rainfall Return Period	1 in 100 Year
Critical Duration	60

Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Sewer network becoming overwhelmed.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	0	0	£3,299
1 in 100 Year	0	1	
1 in 100 Year + CC (2080's)	0	1	

Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	No	Urban area	No
	Agricultural processes	No	Urban area	No
	Use of Green Infrastructure	No	Urban area	No
2. Attenuation / Retention	Floodplain storage	No	Limited space	No
	Wetland creation/river restoration	No	Limited space	No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No Channels	No
	Increase maintenance regime	No	No Channels	No
	De-Culverting	No	No Channels	No
	River engineering i.e.	No	No Channels	No
	Diversion channels	No	No Channels	No
	Raised Defences	No	No Channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		No
	Green Roofs	Yes		No
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		Yes
	Increased maintenance regime	Yes		Yes
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Residents, TDC Planning,

Preferred Intervention

Planning Activities
To be developed as part of planning
Comments
Pursue surface water removal techniques through the redevelopment process (SHLAA sites) and promote adhoc surface water removal where able.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Establish development principles in the Local Plan / Core Strategy.
3	
4	
5	

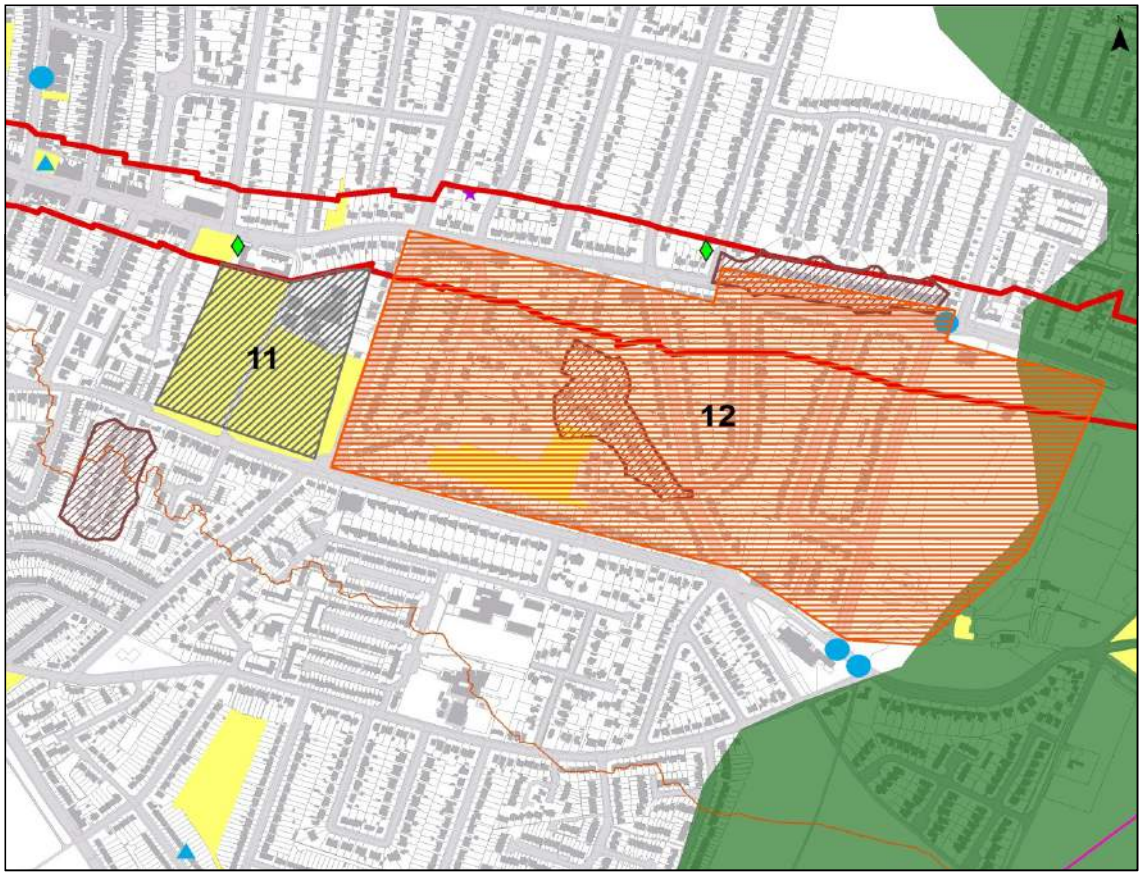
Deadline / Timeline	For inclusion in next draft of the Local Plan.
Review Date	-
Lead & Responsible Partner	TDC
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	Northdown Road
Opportunity Area Reference	Area 12
Properties at Risk (1 in 100 Year)	114
Average Annual Damages	£172,309
Preferred Intervention	Attenuation, Retention - Surface Water Removal, & sewer upgrades
Indicative Capital Construction Cost	£10,977,607
Present Value Damage Avoided	£1,946,464
Cost Benefit Ratio	0.18
Key Stakeholders	Residents, Southern Water, TDC Planning, Kent CC Highways
Lead & Responsible Partner	SW
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

Evidence Base

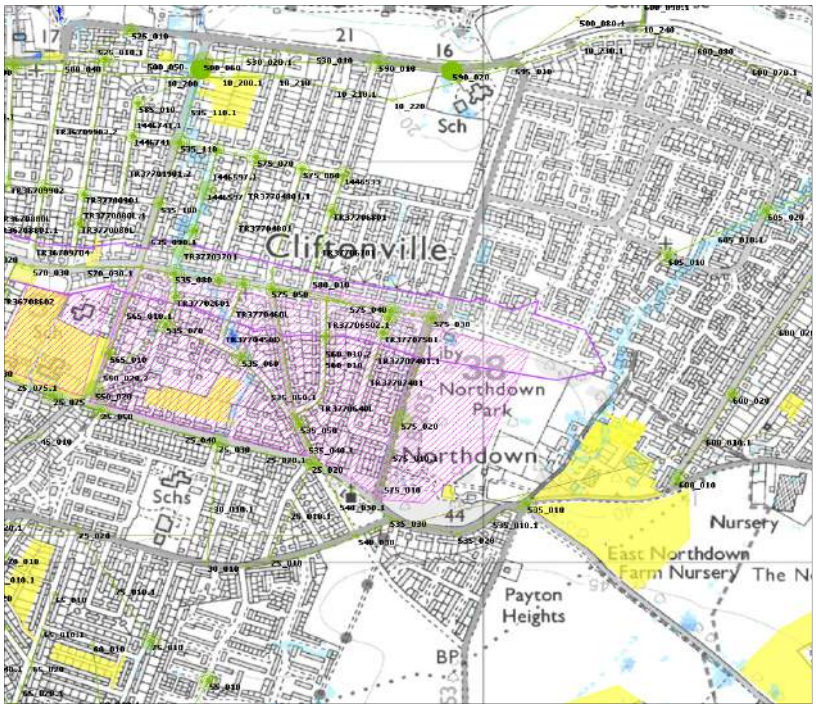
Flood History, Constraints, Receptors, and Opportunities



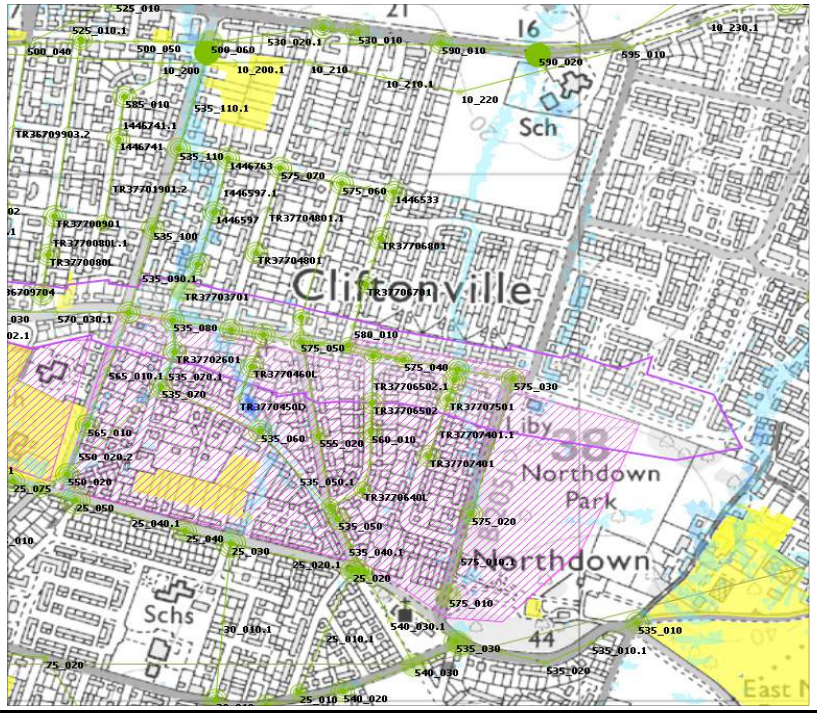
Flood History	This has historical been a flood prone area, as indicated by the sewer flooding extents and flood incidents recorded by Kent County Council.
Constraints	Receptors, Redevelopment, Land Ownership and Management, Available Land.
Receptors	Place of Worship, Residential Areas, Main Road, Utilities.
Opportunities	Redevelopment / development (SHLAA sites), attenuation of overland flows in the park area, roadway storage in the grassed verges.

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	240



Rainfall Return Period	1 in 100 Year
Critical Duration	60



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Sewer network becoming overwhelmed and overland flows running down roads from the upper catchment.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	80	5	£172,309
1 in 100 Year	108	6	
1 in 100 Year + CC (2080's)	137	6	

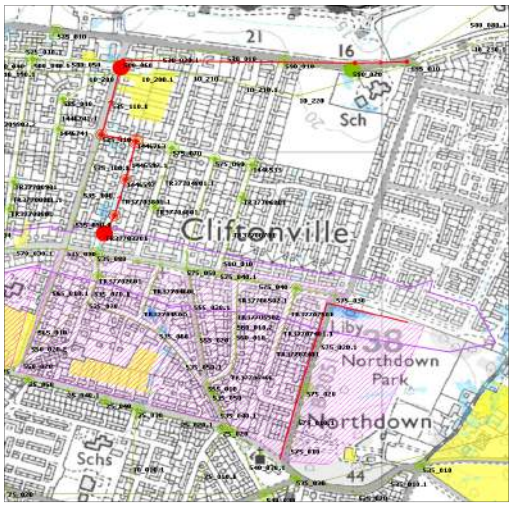
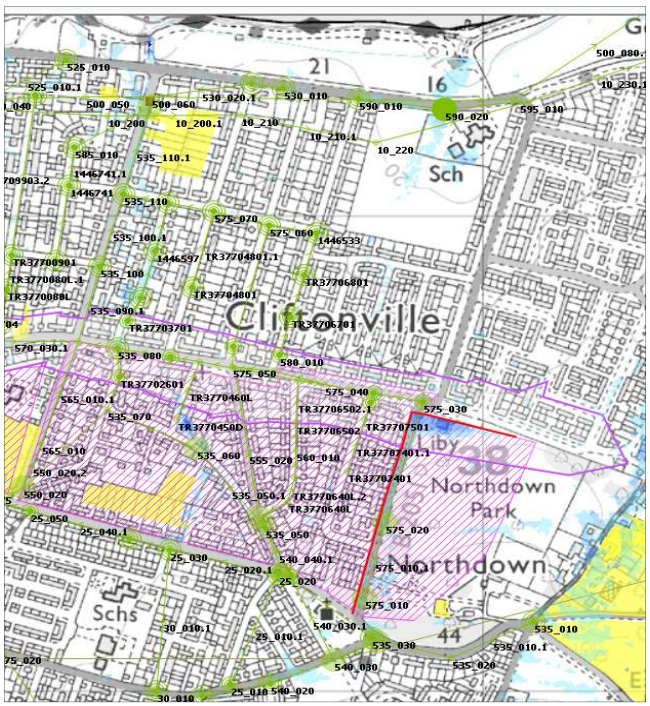
Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	No	Urban area	No
	Agricultural processes	No	Urban area	No
	Use of Green Infrastructure	No	Urban area	No
2. Attenuation / Retention	Floodplain storage	No	Limited space	No
	Wetland creation/river restoration	No	Limited space	No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No Channels	No
	Increase maintenance regime	No	No Channels	No
	De-Culverting	No	No Channels	No
	River engineering i.e.	No	No Channels	No
	Diversion channels	No	No Channels	No
	Raised Defences	No	No Channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		Yes
	Green Roofs	Yes		Yes
	Improve capacity of piped	Yes		Yes
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		No
	Increased maintenance regime	Yes		No
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Residents, Southern Water, TDC Planning, Kent CC Highways

Preferred Intervention

Attenuation, Retention - Surface Water Removal, & sewer upgrades
  
Comments
Remove surface water from local combined sewer network and attenuate flows from the upper catchment by directing flows to Dane Park,so as to reduce the risk of flooding to properties downstream.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Investigate the feasibility of re-directing overland flows for storage in Northdown Park alongside Southern
3	
4	
5	

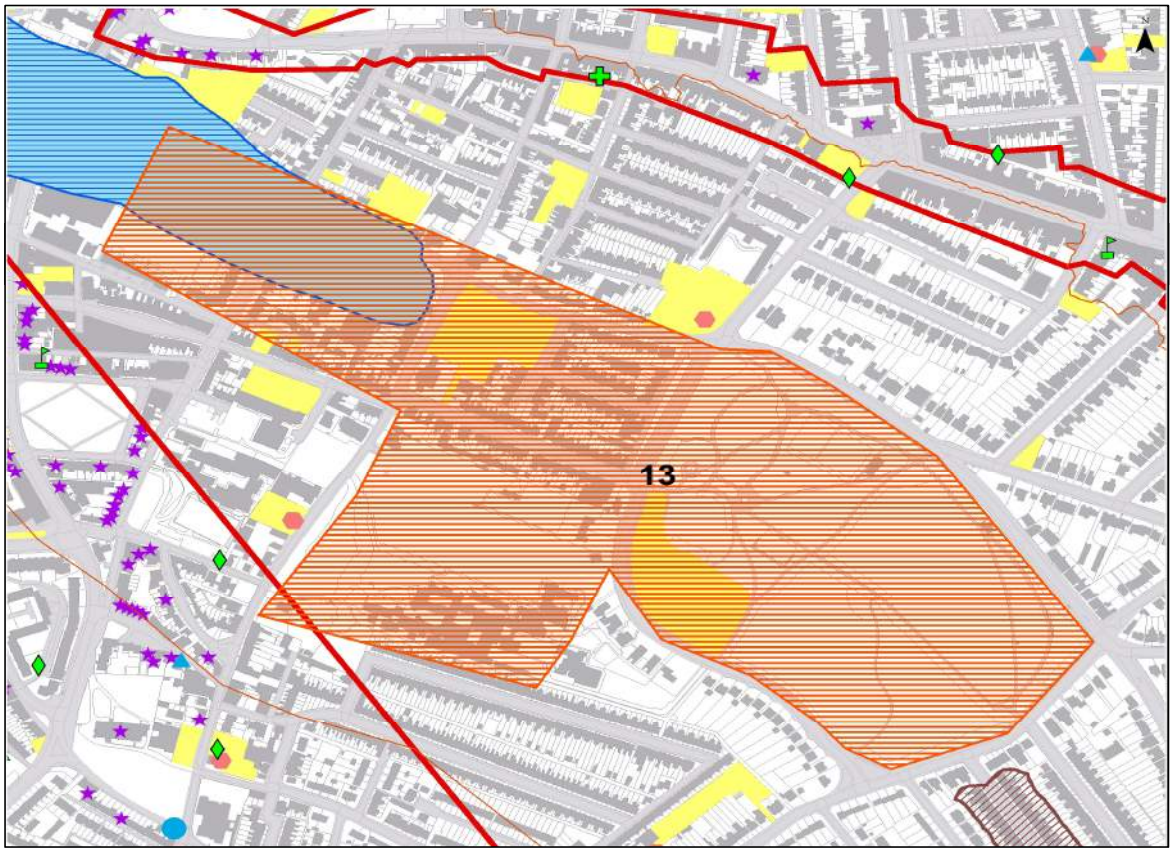
Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	SW
Date Agreed	07/02/2014

Summary

Key Flood Risk Area	High Street & Tivoli Brook
Opportunity Area Reference	Area 13
Properties at Risk (1 in 100 Year)	88
Average Annual Damages	£417,514
Preferred Intervention	Attenuation & Retention - Surface Water Removal
Indicative Capital Construction Cost	£7,174,666
Present Value Damage Avoided	£5,849,309
Cost Benefit Ratio	0.82
Key Stakeholders	Local Businesses, Residents, TDC Parks and Leisure, TDC Planning Team, Southern Water
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014
Deadline / Timeline	07/07/1905

Evidence Base

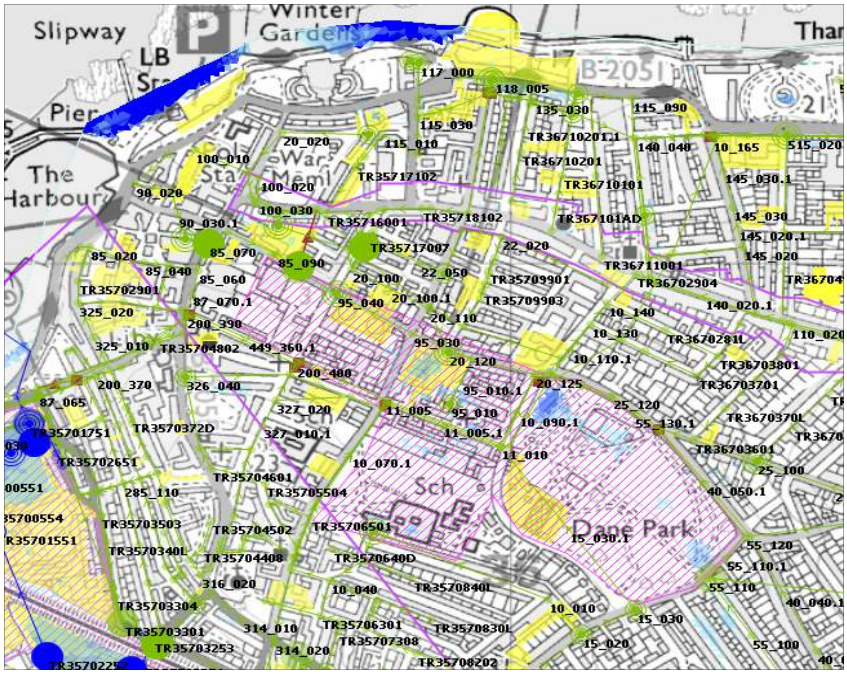
Flood History, Constraints, Receptors, and Opportunities



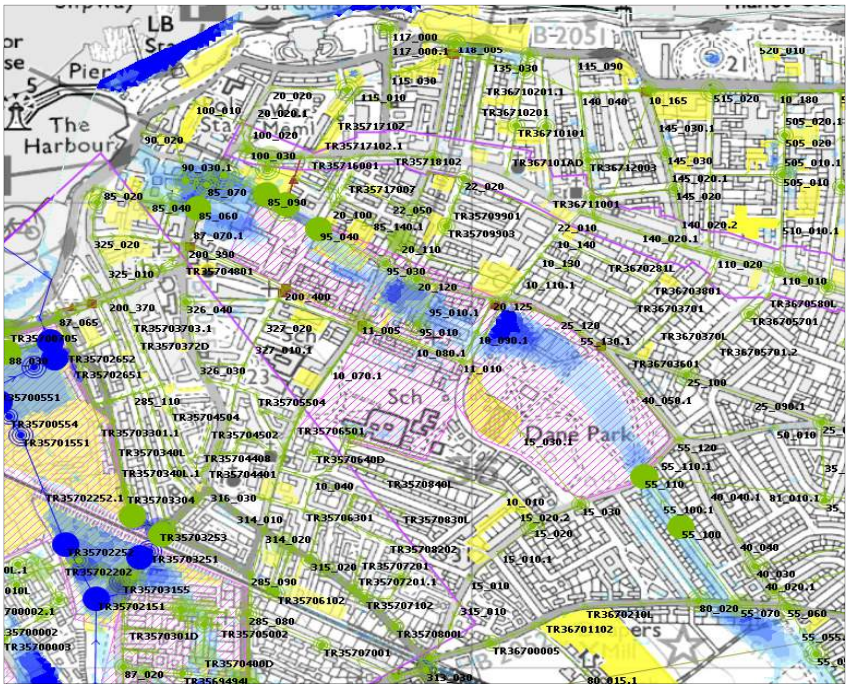
Flood History	This has historical been a flood prone area, as indicated by the blue zone (EA data).
Constraints	Receptors, Redevelopment, Land Ownership and Management, Available Land.
Receptors	Medical Facilities, Leisure Facilities, Residential Areas, Recreational Area.
Opportunities	Upstream attenuation of overland flows in Dane Park, surface water removal, and redevelopment / development (SHLAA sites).

Flood Risk Source, Mechanism, and Pathway

Rainfall Return Period	1 in 30 Year
Critical Duration	360



Rainfall Return Period	1 in 100 Year
Critical Duration	360



Overview of Key Flood Risk Sources, Mechanisms, and Pathways
Sewer network becoming overwhelmed and overland flows running down roads (Park Crescent Road). Note: model requires refinement in this area, as it has not been modelled in detail and the model is currently predicting flows to run through the park.

Flood Risk Damage Estimates

Rainfall Return Period	Number of Properties at Risk		Average Annual Damages
	Residential	Commercial	
1 in 30 Year	68	7	£417,514
1 in 100 Year	79	9	
1 in 100 Year + CC (2080's)	87	10	

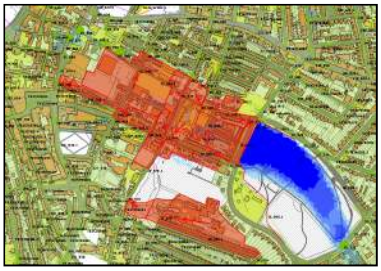
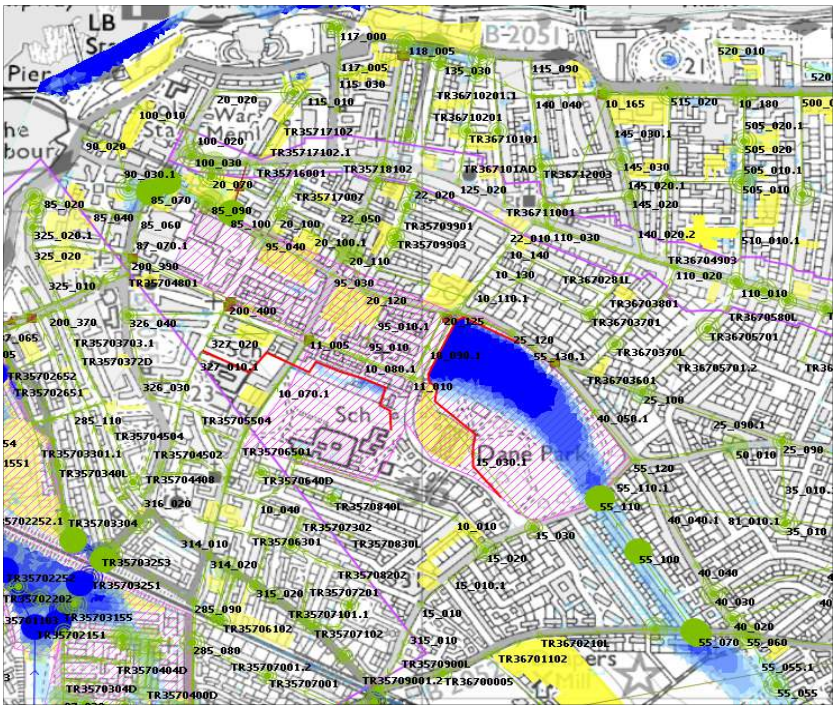
Shortlisting of Interventions

Interventions	Option	Potential	Comments	Considered
1. Rural land use change	Afforestation	No	Urban area	No
	Agricultural processes	No	Urban area	No
	Use of Green Infrastructure	No	Urban area	No
2. Attenuation / Retention	Floodplain storage	Yes	In the Park	Yes
	Wetland creation/river restoration	No	Limited space	No
	SUDS - new/retrospective	Yes		Yes
3. Increased Channel Conveyance	Carry on existing maintenance	No	No Channels	No
	Increase maintenance regime	No	No Channels	No
	De-Culverting	No	No Channels	No
	River engineering i.e.	No	No Channels	No
	Diversion channels	No	No Channels	No
	Raised Defences	No	No Channels	No
4. Other Infrastructure Improvements	Pumping	Yes		No
	Managing exceedance flows	Yes		Yes
	Green Roofs	Yes		Yes
	Improve capacity of piped	Yes		No
	On-line storage (existing/new)	Yes		No
	Off-line storage (existing/new)	Yes		No
	Continue existing maintenance of	Yes		No
	Increased maintenance regime	Yes		No
5. Planning Activities	Development Control	Yes		Yes
	SUDS Strategy	Yes		Yes
	Blue Development Corridors	Yes		No
	New Development	Yes		Yes
6. Resilience	Flood awareness	Yes		No
	Emergency & disaster	Yes		No
	Property level protection /	Yes		No
7. Monitoring / Advise / Survey	Asset inspection	Yes		No
	Flood warning and forecasting	Yes		No
	Improve Hydrometric network	Yes		No
8. Further assessment	Investigation of past flooding	Yes		Yes
	Survey of affected areas (e.g. condition surveys)	Yes		No
	Detailed modelling	Yes		Yes

Key Stakeholders

Provisionally Identified
Local Businesses, Residents, TDC Parks and Leisure, TDC Planning Team, Southern Water

Preferred Intervention

Attenuation & Retention - Surface Water Removal
 
Comments
Remove surface water from local combined sewer network and attenuate flows from the upper catchment by landscaping, so as to reduce the risk of flooding to properties downstream.

Actions

As Agreed by Partner Organisations	
1	Improve evidence base through model improvements and detailed review into historical flooding.
2	Investigate the feasibility of optimising flood storage in Dane Park.
3	
4	
5	

Deadline / Timeline	07/07/1905
Review Date	07/07/1905
Lead & Responsible Partner	KCC
Date Agreed	07/02/2014

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