Torbay Council
Level 1 Strategic Flood Risk Assessment

October 2008

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1.0 EXECUTIVE SUMMARY

1.1 What is a Strategic Flood Risk Assessment

A Strategic Flood Risk Assessment (SFRA) is an overview of flood risk within a specific area. It aims to provide general guidance to planning officers, developers and other interested people about areas where flood risk is an issue. This is important because flooding of properties causes disruption, large and expensive damages, distress, and can result in loss of life.

It is a government requirement that flood risk is considered in the process of allocating land for development and recommends that sites should be allocated for development in descending order of flood risk. This is documented in Planning Policy Statement 25 Development and Flood Risk (PPS 25).

This SFRA covers the Torbay area, and its main objectives are as follows:

- To provide a reference and policy document that will be part of the evidence base to inform the Local Development Framework and any subsequent plans.
- To ensure that Torbay Council meets its obligations under the latest planning guidance, PPS25.
- To provide a reference and policy document for use by the general public and developers to advise and provide information on their obligations under PPS 25
- To use as a tool to inform the development control process about the potential risk of flooding associated with future planning applications and the basis for requesting specific Flood Risk Assessments, if necessary.
- Emergency planning process

1.2 Flood Risk in Torbay

Within Torbay there are 17 watercourses of which 8 have been classified as main rivers due to the significant history of flooding.

Torbay also has an extensive coastline extending from the boundary with Teignbridge to the boundary with South Hams.

Much of the study area is urban, comprising the three main towns of Torquay, Paignton and Brixham. Because people have settled near watercourses and the coast, this means that there is a risk of flooding to these towns within Torbay.

The risk is mostly from watercourse flooding in the middle and lower reaches of the main catchments, from the sea in coastal areas, from surface water runoff, and from combined sewer flooding in various catchments throughout Torbay. In localised areas there is a risk of flooding on low lying land where ground water is becoming an increasing concern.

All areas are potentially at risk from flooding, or have the potential to make flood risk worse elsewhere. Some areas are at a higher risk of flooding than others; many areas are at little or no risk. It is the combination of a number of factors that contribute to making an area at risk from flooding. These are settlement location, including

proximity to a watercourse or the coast, climate, geology and topography. The risk of flooding can become greater when there are extreme storms or when taking into account the predicted effects of climate change.

Significant areas within Torbay are at risk from flooding including parts of Higher Brixham, Paignton Town Centre, Kings Ash Road, Totnes Road, Occombe Valley, Torquay Town Centre, together with the coastal areas around Torquay, Paignton and Brixham.

Some areas at risk of flooding within Torbay have either natural or man made defences, which can act to decrease flood risk in specific areas.

Climate change will increase the risk of flooding. However, this may be mitigated through planning new developments in a way, which avoids building in high risk areas, and by improving existing or creating new flood defences.

It is essential that Local Development Framework planning and development control policies address the risk of flooding, building on those already identified within the Adopted Torbay Local Plan. This SFRA is the start of this process. It provides guidance on how to identify which areas lie within a flood risk area and the implications for plan making and planning applications in taking this flood risk into account.

In addition the SFRA will identify the different policies for the various flood risk areas within Torbay and provide strategies for managing the flood risk. These strategies include, making space for water, sustainable drainage, improving habitat for wildlife, opening culverts, together with considering ingress and egress to properties.

1.3 Flooding History in Torbay

There have been flooding incidents in places within Torbay over many years. For example in 1999 major flooding occurred in Torquay town centre, Paignton town centre, Higher Brixham, Churston and Galmpton. In October 2004 a high tide combined with strong easterly winds caused coastal flooding from the sea in the seafront areas of Paignton, Torquay and Goodrington.

Some places, like Higher Brixham, Occombe Valley, Galmpton and Paignton Town Centre have had or are having flood defences built in order to reduce the risk of flooding happening again. It should be noted however that many areas of Torbay that suffer flooding have had no flood defences constructed.

Where defences are in place it is important not to be complacent about the risk of flooding. Flood defences are constructed to protect areas from a flood of a certain size (standard of protection). There is always a risk that a storm will occur which is larger than the standard of protection, or that the defence will fail. This is why the Flood Zones produced by the Environment Agency do not take into account flood defences and they provide a precautionary extent of the predicted flooding by assuming the defences are not in place.

It is also important to note that due to climate change the defences that were constructed in the past may not now have the standard of protection, which is thought necessary.

1.4 Data

The SFRA uses the best available data at the time of writing, collected from the Environment Agency and Torbay Council. The SFRA is a live document. It retains value by being kept up to date with latest information, for example by incorporating the Environment Agency Flood Zones information that is regularly updated. In addition all records of new flooding events from all sources will be incorporated into the updates of the SFRA.

The quality of the data collected and produced varies and where less reliable information or assumptions have been made a precautionary approach is used to identify the need to get more detailed information.

The main point to remember is that the advice given in this document is a guide to help identify the level of flood risk and whether further information is needed. It is essential to be aware of the potential risk to life and property, in order to make informed decisions about the need for further information and action if necessary.

In most cases before a decision is made about the suitability of a site for development in terms of flood risk, more detailed investigations will have to be made by the developer in the form of a site specific flood risk assessment. In addition when considering the suitability of land for developments the sequential risk based approach as identified within PPS25 must be followed.

1.5 Definition of Important Terms

Floods are not regular, evenly spaced or similar events. They are independent, randomly spaced throughout time and they vary in size. This means that when stating the size of a flood, averages have to be used. The following terms are particularly useful when describing the size of a flood.

- Return Period: When we speak of a 1 in 100 year flood we mean that the peak flood flow on average will be exceeded only once in a 100 year period. It does not mean that you will only get one storm of this magnitude every 100 years, it could happen at any time and more often than once in 100 years.
- Probability: The probability that an event of a particular magnitude will occur in any one year can be found by dividing 1 by the return period of the flood in question. For example, the probability of a 1 in 50 year flood occurring in 2007 is 0.02 or 2%.

The return periods 1 in 1000 years and 1 in 100 years are used by the Environment Agency to estimate the flood extents from rivers and 1 in 200 years for the sea. These flood extents are represented on the Flood Map as Flood Zones 2 and 3 respectively. PPS 25 uses these Flood Zones for categorising flood risk, as shown below, in order to guide planning decisions.

- Flood Zone 3 has a high probability of flooding (1 in 100 years or greater for fluvial and 1 in 200 years or greater for tidal flooding).
- Flood Zone 2 has a medium probability of flooding (between 1 in 1000 years and 1 in 100 years for fluvial and 1 in 1000 years and 1 in 200 years for tidal flooding))
- Flood Zone 1 has a low probability of flooding (less than 1 in 1000 years)

PPS 25 advises that a sequential approach to land use in terms of flood risk is applied. This means that development will be allowed in high risk areas only if there are no reasonably available sites in the area of lower risk; the development is suitable and appropriate measures to mitigate against the risk of flooding are already present or will be employed.

1.6 Study Outputs

The main outputs from the study are a series of maps covering the whole of Torbay and this report. They have been produced to indicate areas where there is a risk of flooding and where proposed developments should be avoided because of the flood risk. The maps together with this report will enable consistent and suitable planning policy and development control decisions to be made with respect to flood risk using the latest information. The evidence will inform decisions on land allocations in the forthcoming Local Development Documents as well as at a site specific level for individual planning applications.

The flood risk maps show current flood risk using the Environment Agency flood zones and potential flood risk areas as identified by Torbay Council. It should be noted that the plans contained within this report identify the flood risk at the date the report was published. Updated plans are available on the Torbay Council web site.

A floodplain is an area that would naturally be affected by flooding if a watercourse rises above its banks, or high tides and stormy weather causes flooding in coastal areas. The flood maps show three different kinds of areas as identified below:

- Environment Agency Flood Zone 3 is the area that could be affected by flooding either from rivers, watercourses or the sea, if there were no flood defences. This area could be flooded from the sea by a flood that has a 0.5% (1 in 200 years) or greater chance of happening each year, or from a river or watercourse by a flood that has a 1% (1 in 100 years) or greater chance of happening each year. This is described as a high risk area.
- Environment Agency Flood Zone 2 shows the additional extent of an extreme flood from rivers, watercourses and the sea. These areas are likely to be affected by a major flood with up to a 0.1% (1 in 1000 years) chance of happening each year. This is described as a low to medium risk area.
- Land not identified in Zones 2 and 3 lies within the Environment Agency Flood Zone 1 which has little or no risk

It must be made clear that these zones show the extents of the natural floodplain if there were no flood defences or other man made structures and channel improvements.

1.7 Technical Guidance

As part of the SFRA, technical guidance has been produced for planning officers and interested parties that should be used when considering, at a strategic level, the suitability of a site for development in terms of flood risk. By following the guidance within this report it will be possible to assess the suitability of a site for development and what is required from a developer in order to support a planning application.

In addition, some specific details about flood risk, which apply in Torbay, have been documented as a guide for planners. Details are provided about:

- Tidal and coastal flooding
- Ground water
- Flood defences
- Rapid inundation zones
- Surface water runoff and sustainable urban drainage systems (SUDS)
- Managed coastal retreat and river erosion
- Flood warning and evacuation procedures
- Combined sewer flooding
- High risk surface water catchments

1.8 Recommendations

The SFRA makes a number of recommendations:

- Every application for development or change of land use must be considered by the planning department in terms of its potential flood risk.
- It is the developers responsibility to provide site specific flood risk assessments with any planning application if stated as required in PPS 25.
- All site specific flood risk assessments must be considered by Torbay Council and or the Environment Agency as part of the planning consultation process and their comments applied where possible.
- Land which is found to be unsuitable for one type of development due to flood risk may still be suitable for other types of use. The PPS 25 guidance can be used to suggest suitable alternative land uses.
- The data contained within this SFRA constitutes the best available data at the time of writing.
- The SFRA should be used to steer strategic growth and site specific allocations in the Local Development Framework to reasonably available site at lowest flood risk. This includes investigating the impact of proposals for new development in the vicinity of and particularly upstream of areas sensitive to flooding.
- The Local Development Framework policies controlling development should reflect the guidance in the SFRA. They may in future require amendments if the SFRA is updated.

1.9 Conclusions

Flooding is an important issue, which must not be ignored. In the future, it is likely that flooding will occur more frequently and more severely due to climate change.

By using the SFRA in combination with site specific flood risk assessments, it is possible for Torbay Council to meet its obligations under PPS 25 applying the risk based sequential approach to all stages of planning, steering new developments to areas at the lowest risk of flooding. This means that land for development can be allocated in a sustainable way.

2.0 INTRODUCTION

2.1 Study Objectives

This work has been undertaken to provide a detailed assessment of the extent and nature of the risk of flooding within Torbay together with its implications for land use planning. The Strategic Flood Risk Assessment will enable the risk based sequential approach to be applied at all stages of the planning process. It will inform the LDF and development control decisions.

Data used in this study has been collected on the basis of best available within the available timescale. It is inevitable that the outputs from a study of this nature will require updating as additional and more accurate data becomes available.

2.2 Torbay Council

Torbay consists of the three towns of Torquay, Paignton and Brixham. Ground levels vary across the district from approximately 120m AOD inland to approximately 2m AOD at the coast.

Within the Torbay catchment area there are 17 watercourses of which 13 discharge directly to the English Channel, 2 discharge to the River Dart, 1 discharges to the River Teign and 1 discharges to the public combined sewer system. The names, locations and catchment areas for these watercourses are highlighted on drawing numbers TC/9/7/15 –3/2, 4/2, 5/2, and 6/2.

Following severe flooding in 1999 the Galmpton watercourse was enmained by the Environment Agency. Due to the severity of this flooding the Environment Agency applied to the Minister for Environment to recategorise this ordinary watercourse into a main river. As a result, funding for a flood alleviation scheme could be secured by the Environment Agency, rather than Torbay Council having to attempt to secure funding, if it had remained an ordinary watercourse. In addition seven watercourses that have historically suffered major flooding were categorised as critical ordinary watercourses. In April 2006 these critical ordinary watercourses were enmained and re-categorised as main rivers. Although the remaining nine watercourses have a history of flooding, this flooding is of only a minor nature and therefore the watercourses are categorised as ordinary watercourses. These watercourses are listed in Section 4.2 and their characteristics outlined in Section 5.

The responsibility for the main rivers, watercourses and flood defences that are located along the lengths of the watercourses lie with different organisations e.g. Torbay Council as land drainage authority, the Environment Agency, riparian owners and South West Water.

The responsibility of each organisation is outlined below:

Under the Land Drainage Act 1991 local authorities are classified as the land drainage authority and they are responsible for managing the flood risk from ordinary watercourses. Additionally, if the local authority is a coastal authority they are responsible for the risk provided by coastal erosion and coastal flooding. Local

authorities have permissive powers to carry out improvement works to flood defences and they provide an emergency response during major incidents.

Highway authorities are responsible for ensuring that the public highway is free from surface water flooding. Also where watercourses pass either under the public highway or within the boundary of the public highway the highway authority becomes a riparian owner of the watercourse and as such are responsible for the maintenance of the watercourse.

The Environment Agency is responsible for flood risk management arising from main rivers as well as flooding from the sea. They maintain, operate and improve flood defences and provide a 24 hour flood warning service and emergency response. Although they are not responsible for ordinary watercourses they have to consent any works being undertaken on a watercourse. The Environment Agency is responsible for reporting to DEFRA on government targets.

The water companies are only responsible for managing the flood risk from the public sewerage system in accordance with the guidelines set by the water regulator OFWAT.

Riparian owners are identified as the landowner adjacent to a main river or ordinary watercourse. Riparian landowners have certain rights and responsibilities in relation to the watercourses flowing through or adjacent to their property. These “riparian rights” are based on common law and have been defined as a result of legal cases over many years. As a riparian owner they are responsible for the maintenance of the watercourse through their property and they are not allowed to impede the flow of water along the length of the watercourse.

Finally DEFRA are a government body and they are responsible for policy and providing strategic guidance in regards to flood management.

In addition to flooding from watercourses, Torbay has a history of coastal flooding and in certain locations flooding from the public sewer network is also a problem. The responsibility for managing coastal flooding lies with the Environment Agency and Torbay Council and the responsibilities for flooding from the public sewer network lies with South West Water.

The area within Torbay is under pressure for more development, as there is a need to provide more space for housing as well as business growth. The Strategic Flood Risk Assessment will help steer development to areas at the lowest probability of flooding, which will not increase the risk elsewhere.

2.3 Definition of Flood Risk

Floods are not regular, evenly spaced or similar events. They are independent, randomly spaced throughout time and they vary in size. This means that when stating the size of a flood, averages have to be used. The following terms are particularly useful when describing the size of a flood.

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- Flood Zone 1 has a low probability of flooding (less than 1 in 1000 years)

PPS 25 advises that a sequential approach to land use in terms of flood risk is applied. This means that development will be allowed in high risk areas only if there are no reasonably available sites in the area of lower risk; the development is suitable and appropriate measures to mitigate against the risk of flooding are already present or will be employed.

2.4 Interface with other Flood Risk Maps

The Environment Agency has issued all Local Planning Authorities Flood Zone Maps with the latest updates being issued in the summer of 2008. These maps are of particular relevance to the Strategic Flood Risk Assessments as they show flood risk in terms of the PPS 25 Zones as defined in Section 2 of this report. These maps have been produced based on a relatively coarse national hydrological model combined with a new national digital terrain model sourced from side aperture radar techniques, giving a vertical accuracy of +/- 50cm. However, where better modelling is available, the Environment Agency has included the outputs in the Zone 3 extent.

As the majority of defences within Torbay are designed for events greater than 1% the Strategic Flood Risk Assessment maps for the 1% and 0.1% events have been taken from the same source as the Environment Agency flood zone maps. It should be noted that the EA plans do not cover flood risk from all ordinary watercourses and therefore the flood risk from these watercourses has been identified as part of the production of the SFRA report.

2.5 Climate Change

As the Strategic Flood Risk Assessment is a long term planning document it is necessary to consider the potential impacts of climate change in terms of risk of

flooding from rivers, watercourses and the sea. This meets the requirements of PPS 25.

Predicting the effects of climate change on river and watercourse flows is uncertain however sea level rise has already been recorded. In the future it is thought that in the south west there could be increases in the amount of winter rainfall and the intensity of storms. It is also thought that sea levels may rise due to global warming.

Updated guidance on how to consider climate change has been published within PPS 25 and UKCIP02 climate change prediction. This identifies that current sea levels could rise by 8mm per year up to 2055 and 11.5mm/year between 2055 and 2085. This would result in sea levels rising by 400mm by 2056 and 745mm by 2085. Peak rainfall intensities and river flows are predicted to rise by 10% by 2056 and 20% by 2085. These figures are due to be reviewed by UKCIP in 2009.

It is important to remember that PPS 25 requires individual planning applications for development and strategic allocations in the Local Development Framework to consider the long term flood risk for the lifetime of new buildings. This could extend beyond 2056, depending on the type of use proposed.

3.0 PROJECT OUTPUTS

3.1 Mapping

The principal project output is the mapping of the District showing land classified to PPS 25 Zones as set out in Table 3.1 below:

Table 3.1

Flood Risk Zones in PPS 25

Flood Zone	Level of Risk	Definition
1	Low Probability	This zone comprises land assessed as having a less than 1 in 1000 (0.1%) annual probability of river or sea flooding in any year.
2	Medium Probability	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% -0.1%) in any year,
3a	High Probability	This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (1%) or a 1 in 200 or greater annual probability of flooding from the sea (0.5%) in any year.
3b	The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRA's should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

For full details of the above table see Table D.1 of PPS 25.

In addition to the flood zones any new developments should be classified for flood risk vulnerability in accordance with Table D2 of PPS 25. This classification is based on: the risk to human life posed by flooding, closely followed by the implications for human stress, health and well being.

Based on the flood zones and flood risk vulnerability table 3.2 below has been reproduced from PPS 25 identifying whether certain development is appropriate, should not be permitted or the use of the exception test is required for each flood zone. It should be noted that, even when the exception test is identified as being required within table 3.2, prior to carrying out the exception test a sequential test for the site must be carried out.

Table 3.2

Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception Test Required	Yes	Yes
Zone 3a	Exception Test Required	Yes	No	Exception Test Required	Yes
Zone 3b	Exception Test Required	Yes	No	No	No

Key:
Yes = Development is appropriate
No = Development should not be permitted

The maps accompanying this report show land classified to the appropriate PPS 25 Flood Risk Zone 1, 2, 3a and 3b. These maps have been produced for the present day (2006) and for 50 years time (2056) with the impact of climate change on river flows and sea level rise. The maps have been produced digitally with OS mapping as a backdrop. In addition maps have been produced showing areas at risk from sewer flooding during the 2% storm event. These areas have been included within flood risk zone 3a.

The flood risk zones are identified by using colour hatching. The differentiation between zones 3a (high probability) and 3b (the functional floodplain) can be seen from the underlying OS mapping and site visits. The potential rapid inundation zones behind raised defences have been identified.

4.0 DATA ASSESSMENT CRITERIA AND PROCESS

4.1 General Criteria

It is required that flood risk zones are defined in accordance with the criteria set out in PPS 25. For land at risk from fluvial flooding, these criteria require differentiation according to the sequential characterisation of flood risk as shown in Table 3.1.

In addition, it is required that rapid inundation zones are identified. It has been agreed that for the purpose of this study rapid inundation is defined as the filling of an area of land to a depth of 0.3m within 30 minutes of the failure or overtopping of the defence.

Within this report the influence of tidal conditions on fluvial flooding from the watercourses and main rivers has been taken into account. In addition the report highlights the risk of flooding around the Torbay coastline from overtopping or failure of the coastal defences.

The principal criterion for differentiation between the PPS 25 Zone 2 and 3 is the 1% (100 year) event.

4.2 Source of Risk

4.2.1 Fluvial Flooding

With respect to strategic flood risk within Torbay, the watercourses that have been appraised can be divided into three distinct types. These are as follows:

- Environment Agency Main River – Galmpton Watercourse

Following major flooding along the Galmpton Watercourse in 1999, which resulted in the tragic death of one resident, the Environment Agency en-mained the watercourse in order to undertake flood alleviation works. These works were constructed in 2002 and were designed to provide a 2% (1in 50 year) protection.

- Main Rivers – Aller Brook, Occombe Valley Watercourse, Victoria Stream, Clennon Valley Watercourse, Yalberton Watercourse, Churston Watercourse and Higher Brixham Watercourse.

As a result of regular flooding to properties and major infrastructure over the past ten years the above seven watercourses have been classified as main rivers. The catchment area serving all of these watercourses is complex with many surface water sewers and highway drains discharging directly to the watercourse. Specific information relating to each watercourse can be found later within this report.

- Ordinary Watercourses – Maidencombe Watercourse, Watcombe Watercourse, River Fleet, Ilsham Valley Watercourse, Torre Valley Watercourse, Cockington Stream, Hollicombe Watercourse, Broadsands Watercourse, Lupton Watercourse.

Over the past ten years there is a history of flooding from the majority of these watercourses however the level of flooding has been only minor.

4.2.2 Coastal Flooding

As Torbay is a coastal authority many sections of the sea wall act as flood defences. During high tides, which coincide with easterly winds, these flood defences can be overtopped. This overtopping results in significant flooding around the bay, with properties and infrastructure being at risk. The main locations at risk from coastal flooding are:

- Torre Abbey Fields, Torquay
- Livermead, Torquay
- Paignton and Preston Greens, Paignton
- Goodrington Park, Paignton
- Broadsands
- Brixham Town Centre
- Torquay Harbour Area

In the majority of cases coastal flooding only affects the public highway and open space resulting in the temporary closure of the sea front roads. However, during severe storms in 2004 numerous properties in the vicinity of Paignton and Preston Green suffered flooding. The areas at risk from coastal flooding are identified on the flood zone maps.

4.2.3 Sewer Flooding

The responsibility for the public sewer network within Torbay lies with South West Water. In the majority of sewer catchments with Torbay the sewers are combined i.e. they receive both foul and surface water run-off. Where recent developments have been constructed the sewer system comprises separate foul and surface water sewers. In addition within the low-lying area of Paignton town centre there are separate combined and surface water sewers.

Over the past fifteen years South West Water have invested over £50million in Torbay in order to reduce the risk of flooding. Recent flood alleviation schemes have included the installation of various storage tanks together with the strategic upsizing of numerous lengths of sewer. The protection provided by the sewer system ranges from 10% (1in 10 years) to 3.3% (1 in 30 years).

As a result of the flood alleviation works the number of properties at risk from sewage flooding has been vastly reduced. South West Water have identified significant funding to carry out further flood alleviation works during the AMP 4 period (2005 – 2009)

As the combined sewer system within Torbay is only designed for between the 10% and 3.3% storm events it is difficult to predict the level of flooding that would be expected from the sewer system for the 1% and 0.1% events. As a result areas that would be at risk from sewer flooding have been included in the flood zone maps based on a 2% storm event.

4.2.4 Highway Flooding

The responsibility for the public highway and highway drainage lies with Torbay Council as the highway authority. In the majority of catchments highway drainage drains to the public combined sewer system however in certain locations there are separate highway drains discharging to watercourses or coastal waters. Where ground conditions are suitable some road gullies discharge to soakaways.

Road gullies are designed to deal with storm events having a return period of between 1 in 2 and 1 in 5 years (50% and 20% storm events). As a result during severe storm events flooding to the highway occurs, however in the majority of instances this flooding does not affect properties.

In addition to highway flooding occurring as a result of the hydraulic design of the gullies being exceeded, flooding can also occur due to poor maintenance of the gully. A further cause of highway flooding is as a result of blockages to the gully grating from fallen leaves or debris, not allowing surface run-off to enter the gullies and hence flooding occurring.

Due to the nature and location of highway flooding being unpredictable, areas that are known to have suffered highway flooding are shown on the maps contained within this report. These maps are included to highlight the risk of flooding however the location of highway flooding will not preclude development in the area.

4.2.5 Flood Zone Maps

In order to differentiate between the flood zones 1, 2 and 3 it is necessary to plot the 1.0% and 0.1% flood outlines. As noted earlier in the report, both of these outlines have been taken from the Environment Agency extreme flood outline plans. All of these plans have been checked in order to confirm that the flood outlines incorporate all properties that are identified on the historical flooding records.

4.3 Rapid Inundation Zones (See Table 8.2)

Rapid inundation has been taken as the development of 30cm depth of floodwater within 30 minutes of overtopping or breaching of flood defences. Rapid inundation zones have been identified as appropriate behind all raised defences having a standard of protection greater than 1%. The width of the zone is defined in relation to the potential head of water contained by the defence and to local barriers to the spread of water away from the defence, such as road embankments.

5.0 SPECIFIC FLOOD DATA

5.1 Introduction

Assessment of flood extents for main rivers, critical ordinary watercourses and ordinary watercourses have been made with the assumption that all flooding has resulted due to the studied watercourse alone, rather than the flooding being due to overland flow, sewer flooding or any other source. During the study investigations have been undertaken into flooding history and any flood assessments undertaken for these watercourses.

All watercourses within Torbay are inspected on an annual basis and the results of these surveys are reproduced as a watercourse asset survey. The results of the latest watercourse asset surveys have been reviewed as part of this study.

Where a property is identified as being at risk this means that it has been assessed that in a flood event of severity 1% or greater water would reach the level which was likely to cause flood damage to residential or commercial property.

5.2 Environment Agency Main River

5.2.1 Galmpton Watercourse

This watercourse flows North/easterly from the high ground at Kennels Road through the village of Galmpton before discharging to the River Dart at Galmpton Creek. The overall length of the watercourse is approximately 1.5km.

Although the watercourse discharge location is affected by tidal conditions, the tides have very little effect on the hydraulic performance of the watercourse.

The catchment area serving this watercourse can be divided into two distinct areas separated by the Paignton to Kinsgwear Steam Railway. Upstream of the railway the watercourse is predominantly open and the watercourse is fed by surface water run-off from the farm fields. Downstream of the railway the catchment becomes more urban and the watercourse comprises a combination of open and culverted sections. The catchment area for this section of watercourse comprises the majority of the housing area where surface water sewers and highway drains have been connected to the watercourse allowing surface water run-off from buildings and roads to discharge to the watercourse increasing the risk of flooding.

Following the severe flooding that occurred in December 1999, which resulted in the tragic death of a resident in Galmpton Glade, the Environment Agency recategorised the watercourse to main river in order to carry out a flood alleviation scheme. The flood alleviation scheme was completed in 2003 and involved the hydraulic upsizing of culverts, duplication of culverts and the provision of an overland collection system in the low-lying area of Galmpton Glade. The flood alleviation scheme was designed to provide protection for the 2% storm event.

Based on the historical flooding data together with the detailed hydraulic assessments carried out as part of the flood alleviation scheme the area at risk from flooding for

the 1% storm event is highlighted on drawing number TC/9/7/15 – 5/3. As can be seen from this plan there are 34 properties at risk from flooding.

5.3 Main Rivers

5.3.1 Aller Brook

The Aller Brook is located to the North West of Torbay and the watercourse flows out of Torquay, through Teignbridge along the Aller Valley before discharging into the River Teign. The section of watercourse, which passes through Torbay is approximately 3km in length.

The head of this watercourse lies within the Barton Lands development area, however tributaries are also located within the development around Torbay Hospital. From Barton Lands the watercourse is mainly open however virtually all of the tributaries around Torbay Hospital have been culverted.

In order to allow the surface water run-off from the Barton Lands Development to discharge to the Aller Brook the developer had to construct a storage lagoon to the rear of the Sainsbury's supermarket. This storage lagoon has been designed to contain the 0.5% event. The discharge from the lagoon is controlled by means of a hydrobrake.

Prior to the construction of this storage lagoon there was a history of flooding to properties along the length of the Aller Brook. The discharge from the storage lagoon has not resulted in any increase in risk of flooding downstream however the lagoon has not reduced the risk of flooding to properties either.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen from this plan there are 15 number properties at risk from flooding for the 1.0% event and a further 7 properties at risk for the 0.1% event.

It should be noted that the Aller Brook between Torbay boundary and the upstream connections to the storage lagoon became main river on 1st April 2006. The remaining sections of the watercourse together with its tributaries will remain as ordinary watercourses.

5.3.2 Occombe Valley Watercourse

The Occombe Valley Watercourse rises near the ring road and flows in an easterly, then south-easterly direction before discharging to coastal waters at Preston Sands. The overall length of this watercourse is approximately 6.4km.

The outfall for this watercourse is via a culvert, which discharges onto the beach below mean high water springs. As a result during high tides the hydraulic capacity of the outfall is restricted.

The initial 3km of this watercourse is open as it passes through farm fields and open space. However once the watercourse reaches Occombe Valley Road the majority of

its length to the outfall is culverted. Downstream of Washington Close the culvert bifurcates however the two culverts merge again under Paignton Green immediately prior to discharging to coastal waters.

In the initial stages the watercourse only receives surface run-off from farm fields and open space however as the watercourse enters the urban areas of the catchment it receives discharges from surface water sewers and highway drains. These discharges are unrestricted and result in the risk of flooding downstream being exacerbated.

In order to reduce the risk of flooding to properties both in and downstream of Washington Close, Torbay Council have created an above ground flood storage area within Coombe Park. This storage area was created by constructing an earth bund at the downstream boundary of the park and controlling the continuation flow through the earth bund by using a small diameter culvert. Since the completion of this scheme there have been no reports of surface water flooding in Washington Close however there is still some reports of flooding to properties further downstream.

The culvert in OccombeValley Road immediately upstream of Coombe Park has a history of surcharging and collapses, which result in overland flow. As a result of the steepness of the road this overland flow continues down the road and floods up to 5 properties at the junction of Occombe Valley Road and Shorton Valley Road. During the past five years Torbay Council as the highway authority have carried out reconstruction works to this culvert.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 4/3. As can be seen from this plan there are 421 number properties at risk from flooding for the 1.0% event and a further 14 properties at risk for the 0.1% event.

It should be noted that the Occombe Valley watercourse between Occombe Valley Road and the discharge location on Preston Sands became main river on 1st April 2006. The remaining section of the watercourse will remain an ordinary watercourses.

5.3.3 Victoria Stream

The Victoria Stream lies within the low-lying area of Paignton town centre and discharges to coastal waters at two locations. The first discharge location is below Paignton Sands near Paignton pier and the second discharge location is through the wall within Paignton Harbour. At both of these locations the outfall is affected by tidal conditions restricting the hydraulic performance of the outfalls. The overall length of the watercourse is 1.8km and for the majority of its length the watercourse is culverted.

The catchment serving this watercourse is totally urban with surface water sewers, highway drains, and land drainage discharging directly to the culverted watercourse. In addition to the surface water sewers cross connections exist between the surface water system and the combined sewer system. When the outfall from the culverted watercourse is tidelocked and there is a heavy storm event, in order to reduce the risk of flooding from the surface water system flows are allowed to discharge into the

combined sewer system. However during heavy rainfall the combined sewer system in this area is already surcharged hence the discharge of additional surface water increases the risk of flooding from the combined sewers. Historically when flooding has occurred within this catchment it has been very difficult to attribute the source of the flooding due to the cross connections and tidal influence on the surface water system.

Following extensive flooding in this catchment during October 1999 when over 100 properties where affected by flooding Torbay Council undertook a detailed evaluation into the causes of the flooding. This evaluation resulted in the production of the Paignton Town Centre Flood Alleviation Scheme Project Appraisal Report. In order to secure funding for this scheme Torbay Council successfully applied to DEFRA for grant aid funding in 2004/05.

The construction works for this flood alleviation scheme were completed in April 2007. The principal works associated with this scheme include the construction of a new pumping station in Paignton Green which will allow the culverted watercourse to discharge to Paignton Harbour during all tidal conditions, the abandonment of all cross connections between the surface water and combined systems and the hydraulic upsizing of various culverts. This flood alleviation scheme has been designed to cater for the 1.0% event. However, many properties within this low-lying area of Paignton are also susceptible to coastal flooding from overtopping of sea defences.

Although historically we have only received reports of 100 properties being flooded within the catchment, hydraulic modelling of the watercourse indicates that prior to the flood alleviation scheme being constructed there were actually over 400 properties at risk from flooding within the catchment.

Based on the historical flooding data together with the hydraulic modelling works the areas at risk from flooding for the 1%and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 4/3. As can be seen from this plan there are 415 number properties at risk from flooding from both the watercourse and coastal waters for the 1.0% event and a further 118 properties at risk for the 0.1% event.

It should be noted that the complete length of the Victoria Stream became main river on 1st April 2006.

5.3.4 Clennon Valley Watercourse

This watercourse initially flows southerly and the easterly discharging to coastal waters at Goodrington Sands. The overall length of the watercourse is approximately 4.1km.

The outfall for this watercourse comprises a culvert laid along the beach and discharging below mean high water springs. As a result the hydraulic capacity of the outfall is severely restricted during high tide levels. This has during heavy rainfall resulted in deep flooding and closure of Dartmouth Road, which is one of the two main roads linking Paignton and Brixham.

The initial section of the watercourse is rural however a new flood storage pond was constructed during the late 1990's in Great Parks in order to allow surface water from the new housing development to discharge to the watercourse. The allowable rate of discharge from this development is controlled by on line tanks with an internal hydrobrake flow control. The storage pond was originally designed for the 2% storm event.

Downstream of this new development, between Kings Ash Road and Totnes Road there are numerous other housing developments that have been constructed over the years where surface water run-off has been connected directly to the watercourse. From Totnes Road the watercourse passes through the grounds of Paignton Zoo and then through Clennon Valley nature reserve and sports pitches. Within the zoo grounds and the nature reserve numerous ponds have been constructed on the watercourse.

Historically this watercourse has suffered flooding on a regular basis to properties and major highways including Kings Ash Road, Totnes Road and Dartmouth Road. As a result of this flooding on more than one occasion both the main roads linking Paignton to Brixham, Kings Ash Road and Dartmouth Road have had to be closed to traffic. In addition flooding from this watercourse has been reported to the grounds of Paignton Community College.

Based on the historical flooding data and the flood risk mapping the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 4/3. As can be seen from this plan, there are 35 number properties at risk from flooding for the 1.0% event and a further 4 properties for the 0.1% event.

It should be noted that the Clennon Valley watercourse between Great Parks storage pond and the discharge location on Goodrington Sands became main river on 1st April 2006. The remaining section of the watercourse upstream of Great Parks storage pond will remain an ordinary watercourse.

5.3.5 Yalberton Watercourse

The Yalberton Watercourse is the longest watercourse within Torbay having an approximate length of 9.5km however the overall length of the watercourse is 12km. The final 2.5km from where it departs from Torbay until its outfall to the River Dart at Stoke Gabriel lies within the South Hams. Although this watercourse discharges into a tidal river the tides have very little effect on the performance of the watercourse and certainly no effect on the performance of the watercourse as it passes through the Torbay area.

Over the majority of the watercourse the catchment is rural with run-off from farm fields being the main contribution to flows. However, there are a number of areas of development where the surface water run-off discharges to the watercourse. These areas include properties in Totnes Road/Stoke Road, Yalberton Industrial Estate and the Long Road Industrial Estate.

In order to allow surface water run-off from the Yalberton Industrial Estate to discharge to the watercourse, the developer was required to construct an above ground

storage area in farm fields above Stoke Road. This storage area was designed to accommodate the 2% storm event and the continuation flows are controlled using a hydrobrake. Should this storage volume be exceeded, flows will overtop the storage bund and discharge to the downstream watercourse increasing the risk of flooding downstream.

Historically flooding has occurred from this watercourse upstream of the storage pond at Totnes Road. In addition on a number of occasions when the storage pond has been exceeded flooding to roads and properties downstream has been reported.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 4/3. As can be seen from this plan, there are 39 number properties at risk from flooding for the 1.0% event and a further 2 properties at risk for the 0.1% event.

It should be noted that the Yalberton watercourse between Totnes Road and the discharge location to the River Dart at Stoke Gabriel became main river on 1st April 2006. The remaining section of the watercourse upstream of Totnes Road will remain an ordinary watercourse.

5.3.6 Churston Watercourse

This watercourse flows north easterly from Alston Farm through farm fields to the rear of Churston village from where the watercourse sinks and becomes subterranean before discharging at Elbury Cove. The length of the above ground watercourse is approximately 0.83km and for the majority of its length it is open. The only sections of the watercourse that are culverted are under Alston Lane, Dartmouth Road and a section under the garden of Hayes Court, Elberry Lane.

The catchment is predominantly made up of farm fields however surface water run off from roads and Churston village discharge into the watercourse.

Historically flooding has been a major problem from this watercourse with internal flooding to numerous properties in Churston Village. Following the severe flooding that occurred in 1999 Torbay Council funded the reconstruction of the culvert under Dartmouth Road in order to provide a vastly improved hydraulic capacity. In addition to the upsizing of the culvert a new trash screen was fitted at the upstream end of the culvert in order to stop debris blocking the culvert. Since this work was completed only minor flooding to fields and gardens has been reported.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 6/3. As can be seen from this plan, there are 24 number properties at risk from flooding for the 1.0% event and a further property is at risk for the 0.1% event.

Due to the historical flooding this watercourse was identified as a critical ordinary watercourse and as a result from 1st April 2006 it became a main river.

5.3.7 Higher Brixham Watercourse

The Higher Brixham Watercourse flows south-westerly from Kennels Road and discharges to coastal waters at Brixham Outer Harbour. The overall length of this watercourse is approximately 2.9km. Although the discharge location is tidal the tides have very little effect on the hydraulic performance of the watercourse.

The upstream section of this watercourse is rural and is fed by surface water run-off from fields. However downstream of Rowan Way the catchment becomes urban and is fed by surface water run-off from housing developments. In this downstream section the watercourse has been culverted for approximately 60 % of its length.

Historically, major flooding has occurred along the urban sections of the watercourse with up to 100 properties being at risk from flooding. Following severe flooding in 1999 Torbay Council investigated in detail the watercourse and the causes of the flooding. Based on the findings of these investigations a flood alleviation scheme was designed. Torbay Council made a successful application to DEFRA for grant aid funding for this flood alleviation scheme.

Construction works commenced on site in January 2005 and the scheme included the following works

- Construction of a flood storage area upstream of Rowan Way
- Hydraulic upsizing of numerous lengths of culverted watercourse
- The purchase of a covered surface water reservoir, which was converted into a flood storage tank
- The duplication of various culverts in order to increase the hydraulic capacity

All construction works were completed in June 2005 and the designed level of protection is for the 1.5% storm event.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 6/3. As can be seen from this plan, there are 477 number properties at risk from flooding for the 1.0% event and a further 41 properties at risk for the 0.1% event.

Due to the historical flooding this watercourse was identified as a critical ordinary watercourse and as a result from 1st April 2006 it became a main river.

5.4 Ordinary Watercourse

5.4.1 Maidencombe Watercourse

This watercourse is approximately 0.4km long and flows through Maidencombe in a north-easterly direction before discharging into the English Channel. For the majority of the watercourses length it is open however where it passes under roads the watercourse has been culverted.

Historically only minor flooding has occurred from this watercourse. This flooding has only affected farm fields, footpaths and some minor public highways. There are no properties currently at risk from flooding along this watercourse.

Based on the historical flooding data the area at risk from flooding for the 1% storm event is highlighted on drawing number TC/9/7/15 – 3/3.

5.4.2 Watcombe Watercourse

This watercourse is only 0.3km in length and flows from Teignmouth Road discharging to the English Channel at Watcombe Beach. The watercourse has very little historical flooding and there are no properties at risk from flooding along this watercourse.

5.4.3 River Fleet

Originally the River Fleet flowed from the Watcombe area of Torquay in a southerly direction, through Torquay town centre eventually discharging into Torquay harbour. However during the late 1890's, as the town developed the lower reaches of the watercourse were converted to a public combined sewer.

As a result the River Fleet now only exists as a watercourse between Watcombe and Hele Cross roads where the watercourse discharges into South West Water's combined sewers. The overall length of remaining watercourse is just over 2km of which the majority has been culverted as development has taken place.

Historically, flooding has occurred along the various open sections of the watercourse particularly to the rear Teignmouth Road, Winstone Avenue and Firlands Road. This flooding has resulted due to a lack of hydraulic capacity in the culverts and trash screens becoming blocked during storm events.

Although no internal flooding has been reported during storm events external flooding to properties in Winstone Lane and Teignmouth Road have occurred on a regular basis. In addition flooding has occurred to numerous roads along the length of the watercourse.

As discharges from the River Fleet into the combined sewer system can exacerbate the risk of flooding downstream, the risk of flooding for the 1% storm event has been assessed for the combined sewer as it passes through Torquay Town Centre.

Based on the historical flooding data and the flood risk mapping, the area at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen there are 512 number properties at risk from flooding for the 1% storm event and a further 110 properties are at risk for the 0.1% event.

5.4.4 Ilsham Valley Watercourse

The watercourse in Ilsham Valley is approximately 0.66km in length and discharges to the English Channel at Meadfoot Beach. For the majority of the length the

watercourse is open however the downstream section as it passes South West Water's pumping station and under Meadfoot Sea Road is culverted.

As part of South West Water's works to construct the pumping station a wetland area has been constructed along the line of the watercourse.

Historically only minor flooding has been reported from this watercourse and no properties are at risk from flooding.

Based on the historical flooding data and the flood risk mapping, the area at risk from flooding for the 1% storm event is highlighted on drawing number TC/9/7/15 – 3/3.

5.4.5 Torre Valley Watercourse

The Torre Valley watercourse flows southerly from Lawes Bridge to the Torquay Recreation Ground and eventually discharges to the English Channel on Torre Abbey Beach. A tributary of the watercourse drains from Sherwell Valley and joins the main watercourse at the Torquay recreation Ground. The watercourse has a length of approximately 2km and for the majority of its length it is culverted.

As the watercourse discharges directly to coastal waters at times of high tides the discharge through the downstream sections of the watercourse is restricted as the water level within the watercourse matches the tide level. As a result the Torquay Recreation Ground is susceptible to flooding from both the watercourse and coastal waters.

The upper sections of the watercourse receive flows from a large catchment area as a result of surface water sewers and highway drains discharging directly to the watercourse. This increased catchment area has exacerbated the risk of flooding downstream to properties, roads, the Torquay Recreation Ground and the grounds of Cockington School. Historically flooding has been reported to properties in Old Mill Road together with highway flooding in Old Mill Road and Rathmore Road.

Based on the historical flooding data the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen from this plan, there are 5 number properties at risk from flooding for the 1.0% event.

5.4.6 Cockington Stream

The Cockington Stream flows south-easterly through Cockington Village before discharging to coastal waters at Livermead beach. Although the stream discharges directly to coastal waters the outfall is at a level which means that its hydraulic capacity is not affected by high tides.

The overall length of the watercourse is 1.5km and for the vast majority of its length the watercourse is open with the only culverts being under roads and the railway. Downstream of Cockington village the watercourse passes through Cockington nature reserve where the watercourse has been widened to form lakes. Some developments near the watercourse have surface water sewers discharging directly to the

watercourse however the majority of the surface water run-off discharging to the watercourse is from fields.

Historically, flooding has occurred downstream of Cockington Village and upstream of the culvert passing under the railway near the sea front. This flooding has affected a couple of properties together with the highway.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen from this plan, there are 4 number properties at risk from flooding for the 1.0% event.

5.4.7 Hollicombe Stream

The Hollicombe stream rises near the ring road and flows south easterly discharging to the English Channel at Hollicombe Beach. Although the stream discharges directly to coastal waters the capacity of the outfall is not affected by tidal conditions.

The overall length of the watercourse is approximately 2.5km and for the majority of its length it is open. However, from Old Paignton Road through the gas works and under Hollicombe Park the watercourse has been culverted with the exception of approximately 30m of open watercourse in the gas works.

The catchment serving this watercourse is predominantly fields however in the downstream sections there is surface water from a housing development, which discharges directly to the watercourse.

Two above ground flood storage areas exist along the watercourse, one being located within the upstream section at Hollicombe Woods and the second approximately threequarters of the way down the watercourse at Old Paignton Road.

Historically, flooding has only been reported in the downstream section of this watercourse at Old Paignton Road, the gas works site, Torbay Road and Hollicombe Park. Although no properties are flooded at present, the flooding to the old gas works site is extensive with the flood waters running out of the bottom of the site directly across Torbay Road which forms one of the main roads between Torquay and Paignton.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen from this plan, there are no properties at risk from flooding for the 1.0% event.

5.4.8 Broadsands Watercourse

This watercourse is approximately 0.3km long and discharges to coastal waters at Broadsands beach. For the majority of its length the watercourse is open however, it is culverted as it passes through the sea wall and to where it outfalls onto the beach. At the outfall a flap valve is fitted which stops tidal waters entering the watercourse.

As the outfall for this watercourse is below high water spring tide levels, during high tides the outfall becomes tidelocked resulting in an increased risk of flooding should a storm event occur simultaneously with a high tide.

The upstream catchment serving the watercourse comprises surface water sewers from the housing developments in Brunel Road and Broadsands Road. In the lower catchment the open sections of the watercourse are served by run-off from farm fields together with the paved car park.

Historically, where flooding has been reported only the low-lying fields and car park have been affected. There are no properties at risk from flooding for the 1% storm event.

Based on the historical flooding data and the flood risk mapping, the area at risk from flooding for the 1% storm event is highlighted on drawing number TC/9/7/15 – 5/3.

5.4.9 Lupton Watercourse

The Lupton watercourse flows south westerly from Kennels Road, through Brixham town centre before discharging to Brixham inner harbour near the Prince of Orange statue. The overall length of this watercourse is approximately 2.7km. The catchment serving this watercourse can be divided into two distinct areas. Firstly, a rural area from Kennels Road to Monksbridge Road where the watercourse is fed by surface water run-off from fields. Secondly, the urban area from Monksbridge Road to the outfall where the watercourse is fed by surface water sewers and highway drainage. Within the first area the watercourse is predominantly open and within the second area the majority of the watercourse is culverted.

As the watercourse discharges to Brixham inner harbour through the harbour wall, at the outfall there is a tidal flap valve to stop flooding from seawater within the town centre. At times of high tides the capacity of this outfall is severely restricted increasing the risk of flooding to Brixham town centre should a storm event occur.

Historically this watercourse has only suffered from minor flooding to the highway and some properties in Monksbridge Road and New Road.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 1% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 6/3. As can be seen from this plan, there are 196 number properties at risk from flooding for the 1.0% event and a further 3 properties for the 0.1% event.

5.5 Coastal Flooding

As Torbay is a coastal authority many sections of the sea wall act as flood defences. During high tides, which coincide with easterly winds, these flood defences can be overtopped. This overtopping results in significant flooding around the bay, with properties and infrastructure being at risk. There are 8 main locations at risk from coastal flooding and further details regarding the location and the number of properties at risk are provided below.

5.5.1 Torquay Harbour Area

The harbour wall around Torquay inner harbour acts as a flood defence. At various locations around the harbour wall surface water drains discharge directly to the harbour. These outfalls are fitted with tidal flap valves to in order stop tidal waters entering the drainage system. However as a result of high tides coinciding with easterly winds the harbour walls have been overtopped on occasions resulting in flooding. In addition during very high tides, the surface water outfalls become tidelocked and should a major storm occur at the same time as a high tide the risk of flooding in the low-lying areas around Torquay harbour is increased.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen from this plan, there are 97 number properties at risk from flooding for the 0.5% event and a further 2 property for the 0.1% event

5.5.2 Torre Abbey Beach

The sea wall from Torquay outer harbour to Corbyn Head acts as a flood defence and protects the low-lying areas of Torre Abbey meadow and Torquay recreation ground from coastal flooding during high tides. However should a high tide occur with an easterly wind there is a severe risk of coastal flooding.

When coastal flooding occurs the main coast road has to be closed, causing major traffic disruption. In addition flooding is reported on both Torre Abbey meadow and Torquay recreation ground. In the recent past flooding of this nature has resulted in severe damage to the sea wall, pavements, roads, cars and services. However, flooding at this location does not result in many properties being flooded.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen from this plan, there are 4 number properties at risk from flooding for the 0.5% event and a further 3 properties are at risk for the 0.1% event

5.5.3 Livermead

The sea wall from Corbyn Head to Livermead Cliffs acts as a flood defence and protects the low-lying areas around Livermead from coastal flooding. However, should a high tide occur with strong easterly winds there is a severe risk of coastal flooding.

When coastal flooding occurs the main coast road between Torquay and Paignton has to be closed resulting in major traffic disruptions.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 3/3. As can be seen from this plan, there are 2 number properties at risk from flooding for the 0.5% event and no additional properties are at risk for the 0.1% event.

5.5.4 Preston Sea Front

The sea wall from Hollicombe Gardens to the Redcliff Hotel acts as a flood defence and protects the low-lying areas around Preston Green from coastal flooding during high tides. However should a high tide occur with a strong easterly wind there is a risk of overtopping of the sea wall resulting in flooding to Preston Green and Marine Parade. In the more sever storm events flooding also affects Esplande Road and the adjoining properties.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 4/3. As can be seen from this plan, there are 34 properties at risk from flooding for the 0.5% event and a further 9 properties at risk from flooding for the 0.1% event

5.5.5 Paignton Sea Front

The sea wall from Redcliffe Hotel to Paignton Harbour acts as a flood defence and protects the low-lying areas of Paignton Town Centre, stretching from the Eastern Esplande to Dartmouth Road, during high tides. However, at times of high tides and strong easterly winds there is a risk that the sea wall will be overtopped resulting in extensive flooding to Paignton Green, public highways, internal and external properties and public open spaces.

In addition to the coastal flooding problem in this area, flooding also occurs during high tides that coincide with storm events due to the hydraulic overload of Victoria Stream. As a result it is sometimes very difficult to differentiate from which source the flooding has occurred.

As ground levels in the low-lying area of Paignton are predominantly below highest astronomical tide levels it can be seen that once the flood defence has been overtopped the area suffering flooding is extensive, as can be seen on the flood risk maps. The area at risk for the 1% storm event stretches from the Eastern Esplanade to the railway and from Sands Road to the Redcliffe Hotel.

The area from the railway to Dartmouth Road and from Elmsleigh Road to Paignton bus station currently floods on a regular basis from South West Water’s surface water and combined sewers. The surface water sewers from this area discharge into the culverted section of Victoria Stream and hence to Paignton harbour. As mentioned previously this outfall is tidelocked during high tides, therefore should a storm event occur whilst there is a high tide flooding is possible. Following completion of the Paignton Town Centre Flood Alleviation Scheme this tidelocking will be removed and as a result the risk of flooding from the surface water sewers will be reduced. It should be noted, however that this area is also at risk from coastal flooding during the 0.1% storm events.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number

TC/9/7/15 – 4/3. As can be seen from this plan, there are 413 number properties at risk from flooding for the 0.5% event and a further 90 property for the 0.1% event

5.5.6 Goodrington Beach

The sea wall from Roundham Head to Cliff Park Road acts as a sea defence protecting the low-lying area of Goodrington Park during high tides. However, at times of high tides and strong easterly winds there is a risk that the sea wall will be overtopped resulting in extensive flooding to Goodrington Park, buildings, Quay West, the railway, Dartmouth Road, Youngs Park Road and Tanners Road.

The existing sea wall protecting Goodrington Park is in poor condition with the sheet pile toe protection having failed. As a result there is a risk that this sea wall could overturn which would result in flooding to Goodrington Park during every high tide. Torbay Council have successfully, applied to DEFRA for grant aid funding, to carry out a scheme to reconstruct the sheet pile toe protection and this scheme was completed in February 2007.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 4/3. As can be seen from this plan, there are 44 properties at risk from flooding for the 0.5% event and a further 66 properties are at risk from flooding for the 0.1% event

5.5.7 Broadsands Beach

The sea wall at Broadsands beach acts as a flood defence protecting the low-lying car park and farmland during high tides. However at times of high tides and strong easterly winds there is a risk that the sea wall will be overtopped resulting in coastal flooding.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number TC/9/7/15 – 5/3. As can be seen from this plan, there is 1 property at risk from flooding for the 0.5% event however ground levels quickly rise as you travel inland from the sea wall and therefore there are no additional properties at risk from flooding for the 0.1% event

5.5.8 Brixham Harbour

The sea wall around Brixham inner harbour acts as a flood defence protecting the low-lying area of Brixham town centre. However at times of high tides and strong easterly winds there is a risk that the harbour wall will be overtopped. This overtopping will result in flooding to highways and properties around the quayside and through Bank Lane up to Brixham Town Hall. In addition some of the new properties constructed alongside Brixham Marina are also susceptible to coastal flooding during extreeme events.

Based on the historical flooding data and the flood risk mapping, the areas at risk from flooding for the 0.5% and 0.1% storm events are highlighted on drawing number

TC/9/7/15 – 6/3. As can be seen from this plan, there are 202 properties at risk from flooding for the 0.5% event and a further 68 properties are at risk from flooding for the 0.1% event

5.6 Sewer Flooding

The public sewer system within Torbay is the responsibility of South West water and as mentioned previously the system consists of predominantly a combined sewer system. In certain areas such as Paignton Town Centre, Cockington and the newer developments, separate foul and surface water sewers exist. The combined and surface water systems have been designed to accommodate between the 10% and 3.33% storm events. However, it is known that in certain areas properties have been flooded during storm events greater than 10%.

During storm events, where the sewer system is beaten significant flooding occurs to properties and infrastructure. Within Torbay there are seven sewer catchment areas and details of the flood risk identified for the 2% storm event are provided below.

It should be noted that the sewer flooding identified within the SFRA only refers to flooding that has occurred as a result of hydraulic overload to the sewer system during sever storm events. Flooding resulting from blockages, collapses or pumping station failures within the sewer system have not been included. Within the flood risk maps for sewer flooding certain properties have been identified as being at risk from sewer flooding, however, to date these properties may not have actually suffered flooding.

5.6.1 Torquay – Babbacombe Catchment

The majority of this catchment is served by combined sewers, which drain, from St Marychurch by gravity to Ilsham Valley pumping station from where flows are pumped for treatment. Within the catchment area there are two major areas where sewer flooding has historically occurred. These are at Ansteys Cove Road and Babbacombe Road. At both locations flooding occurs due to inadequate hydraulic capacity within the sewer system during sever storm events resulting in the sewers surcharging and manhole covers lifting. Flooding within this catchment is mainly confined to highways.

The catchment area is shown on drawing number TC/9/7/15 – 7/2 together with the flood risk area for the 2% storm event.

5.6.2 Torquay – Upton/Town Centre Catchment

This is the largest catchment within Torquay and is served predominantly by combined sewers, which drain, by gravity from the Watcombe area, through the town centre to Ilsham Valley pumping station from where flows are pumped for treatment. In addition to the surface water run-off from highways and buildings being connected to the surface water system, the River Fleet discharges at a controlled flow rate to the combined sewer system at Hele.

As a result of hydraulic overload of the combined sewer system there are at least eight major locations where sewer flooding occurs within this catchment. Flooding at these

locations ranges from highway flooding up to major flooding of shops and businesses within Union Street and Fleet Walk. As can be seen from the flood risk maps there are many properties within this catchment that are at risk from sewer flooding during the 2% storm event.

The catchment area is shown on drawing number TC/9/7/15 – 7/2 together with the flood risk area for the 2% storm event.

5.6.3 Torquay – Torre Valley Catchment

This catchment is served by a mixture of combined sewers, together with separate foul and surface water sewers especially within the Barton Lands, Edginswell, Sherwell Valley and Cockington areas of the catchment. The combined sewers discharge by gravity from Newton Road to Fleet Street pumping station, from where flows are lifted and discharge into the Upton/Town Centre catchment.

Within this catchment there are a number of areas during severe storms at risk from both combined and surface water sewer flooding, especially the low lying areas around Torquay Harbour. The majority of this flooding affects highways however during severe storms properties are known to flood.

The catchment area is shown on drawing number TC/9/7/15 – 7/2 together with the flood risk area for the 2% storm event.

5.6.4 Paignton – Catchment Area A

This catchment serves the low lying areas of Paignton from Hollicombe to Clennon Valley and is served totally by a combined sewer system with the exception of the area around the town centre between Station Lane, Sands Road and Garfield Road where a separate surface water system exists. The combined sewer serving this catchment drains by gravity to Clennon Valley pumping station from where flows are lifted to the head end of the Grange Court to Brokenbury treatment works tunnel.

During storm events there are numerous locations within the catchment that suffer flooding from the combined sewers. Flooding ranges from highway flooding where manhole covers have been lifted to severe property flooding to numerous properties within the low lying area of Paignton Town Centre as a result of the combined sewers surcharging back along private connections and entering the property.

The catchment area is shown on drawing number TC/9/7/15 – 8/2 together with the flood risk area for the 2% storm event.

5.6.5 Paignton – Catchment Area B

This catchment serves the higher areas of Paignton such as Foxholes, Great Parks and Collaton St Mary. With the exception of new developments, which are served by separate foul and surface water systems, the catchment is served by a combined sewer system. The combined sewers drain by gravity directly to the head end of the Grange Court to Brokenbury tunnel.

During severe storms there are areas of the catchment that suffer from combined sewer flooding. These are located at Grange Court, Kings Ash Road and Totnes Road. At these locations flooding has been reported to both the highways and properties.

The catchment area is shown on drawing number TC/9/7/15 – 8/2 together with the flood risk area for the 2% storm event.

5.6.6 Broadsands, Brunel, Hookhills, Galmpton and Churston Catchments

These catchments are served mainly by separate systems and the foul system discharges either directly to the Grange Court to Brokenbury tunnel or as at Churston and Galmpton flows are pumped directly to the inlet works of the sewage treatment works.

Although the area is served by separate systems there are locations within these catchments where surface water is entering the foul system and hence during heavy rainfall flooding to roads and properties has been reported.

The catchment area is shown on drawing number TC/9/7/15 – 9/2 together with the flood risk area for the 2% storm event.

5.6.7 Brixham Catchment

Brixham is served by one sewer catchment area with sewers draining by gravity along the natural valley to the town centre where they are transferred via a tunnel to Oxen Cove pumping station. At Oxen Cove pumping station flows are pumped to the inlet works of Brokenbury sewage treatment works.

During severe storm conditions flooding has been reported at a number of locations throughout the catchment area. This flooding ranges in severity including highway flooding, flooding to school grounds and internal flooding to properties.

The catchment area is shown on drawing number TC/9/7/15 – 10/2 together with the flood risk area for the 2% storm event.

5.7 Highway Flooding

Road gullies are designed to deal with storm events having a return period of between 50% and 20% (1in 2 and 1 in 5 year return period). As a result during severe storm events flooding to the highway occurs, however in the majority of instances this flooding does not affect properties.

In addition to highway flooding occurring as a result of their hydraulic design being exceeded, flooding can also occur due to poor maintenance of the gully. A further cause of highway flooding is as a result of blockages to the gully grating from fallen leaves or debris, not allowing surface run-off to enter gullies and hence flooding occurring.

Areas of highway that have had reported flooding problems due to either hydraulic overload or blockages are identified by red dots on drawing numbers TC/9/7/15-11/1, TC/9/7/15-12/1, TC/9/7/15-13/1 and TC/9/7/15-14/1.

It should be noted that the plans for highway flooding contained in this report highlight the areas that are known to have flooded at sometime in the past. The inclusion of the risk of flooding to the highway will not preclude development in the area of the identified highway flood risk.

6.0 RISK BASED APPROACH TO FLOOD RISK ASSESSMENT

Where developments are proposed in flood risk areas the developers must employ a risk based approach as outlined in PPS 25 in order to show that the risk of flooding has been carefully considered and where necessary mitigation has been proposed. The risk based approach is outlined below:

- A strategic approach through policies in local development documents which avoid adding to the cause or "sources" of flood risk, by such means as avoiding inappropriate development in flood risk areas and minimising run-off from new development onto adjacent and other downstream property and into the river system;

- Managing flood "pathways" to reduce the likelihood of flooding by ensuring that the design and location of the development maximises the use of sustainable drainage systems, the performance of river/coastal systems and flood defence infrastructure, and takes account of the likely routes and storage of floodwaters and places where it can influence flood risk downstream;

- Reducing the consequence of flooding on the "receptors" by avoiding inappropriate development in areas at risk from flooding.

For all developments in flood risk areas together with those developments in catchment areas draining into the flood risk areas a flood risk assessment must be submitted with any planning application. The approach taken for the flood risk assessment is outlined below:

- Flood risk assessments should be carried out to the appropriate degree at all levels of the planning process to assess the risks of all forms of flooding to and from development taking climate change into account and to inform the application of the sequential approach.

- This strategic flood risk assessment has been carried out to identify the catchment wide flooding issues which affect Torbay. The information contained within this report will provide the information required to apply the sequential approach outlined below. Policies in local development documents should set out site specific requirements for flood risk assessments to be submitted with planning applications in areas of flood risk identified in the SFRA.

- Minimum requirements for all levels of flood risk assessment are given in Annex E of PPS 25. Further guidance is given in the Practice Guide to accompany PPS 25.

6.1 The Sequential Approach

Annex D of PPS 25 provides clear guidance on application of the sequential approach in relation to flood risk. This approach is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. It can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new water-incompatible

developments in reasonably available areas of little or no risk should be explored, prior to any decision to locate them in areas of higher risk. Potential sites for new housing can be considered "reasonably available" if the available part of the criteria set out in Housing Land Availability Assessments: Identifying land for housing development (ODPM; 2005) is, or is reasonably expected to be met within five years of the LDD or planning application submission.

6.2 The Sequential Test

The risk based Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding (Zone 1).

The Flood Zones are the starting point for the sequential approach. Zones 2 and 3 are shown on the flood risk maps contained within this document with Flood Zone 1 being all the land falling outside Zones 2 and 3. These Flood Zones refer to the possibility of sea and river flooding only, ignoring the presence of existing defences.

The overall aim of the decision maker should be to steer new developments to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, decision makers identifying broad locations for development and infrastructure, allocating land in spatial plans or determining applications for development at any particular location should take into account the flood risk vulnerability of the land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision makers consider the suitability of sites in Flood Zone 3, taking into account the flood risk vulnerability of land and applying the Exception Test if required.

Within each Flood Zone, new development should be directed first to sites at the lowest probability of flooding and the flood vulnerability of the intended use matched to the flood risk of the site, e.g. higher vulnerability uses located on parts of the site at the lowest probability of flooding.

A LPA must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone information from the SFRA and applied the Sequential Test, and where necessary, the Exception Test, in the site allocation process. In cases where development cannot be fully met through the provision of site allocations, LPA's are expected to make a realistic allowance for windfall development, based on past trends.

The Sequential Test should be used by LPA's to determine planning applications where LDD policies have not applied the Sequential Test when allocating sites. In this instance it is the responsibility of the developer to assemble the relevant evidence for their site to allow the LPA's planning officer to do this.

6.3 The Exception Test

Application of the Sequential Test should ensure that more vulnerable property types, such as residential housing (see Table D2 of PPS 25), will not be allocated to areas at high risk of flooding. In exceptional circumstances, there may be valid reasons for a development type which is not entirely compatible with the level of flood risk at a

particular site to nevertheless be considered. In these circumstances, it will be necessary for the LPA or developer to demonstrate that the site qualifies for development in the manner proposed by passing all elements of the Exception Test.

The Exception Test should only be applied following application of the Sequential Test. There are three stringent conditions, all of which must be fulfilled before the Exception Test can be passed. These conditions are as follows:

1. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the Local Development Document (LDD has reached the submission stage) the benefits of the development should contribute to the Core Strategy's Sustainable Appraisal (SA).

2. The development must be on developable previously-developed land or, if it is not on previously-developed land, that there are no reasonable alternative sites on developable previously-developed lane; and

3. A site specific Flood Risk Assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

With regards to part 1 of the test, if a planning application fails to score positively against the aims and objectives of the SA, the LPA should consider whether the use of planning conditions and/or Section 106 Agreements of the Town and Country Planning Act 1990, could make it do so. Where this is not possible the Exception Test has not been satisfied and planning permission should be refused.

In the absence of a SA, the developer/LPA will have to provide a reasoned justification detailing how the planning application provides wider sustainability benefits to the community that outweigh flood risk. LPA's may consider the use of a sustainability checklist for this purpose.

Guidance on part 2 of the test can be found within Planning Policy Statement 3: Housing. With regards to 3 and the definition of safe development, see Chapters 5 and 6 of the Practice Guide Companion to PPS 25. It is the responsibility of the developer to develop a comprehensive flood risk management strategy for the site in question, covering:

- The design of any flood defence infrastructure;
- Access;
- Operation and maintenance;
- Resident awareness;
- Flood warning; and
- Evacuation procedures and funding arrangements

6.4 Applying The Sequential Approach To Other Sources Of Flooding

PPS 25 states that a development proposal in any of the three Flood Zones must take into account vulnerability to flooding from other sources as well as from rivers and

the sea. The principle of locating development in lower risk areas should be applied to other forms of flooding. Information regarding the probability of other forms of flooding may not always be available and in many situations, the physical processes which may lead to flooding may be poorly understood. If information is available, it is likely that this will be measured and stored in ways that are quite different to river flow and tidal data used to generate the Flood Zones. In many cases this will preclude the accurate mapping of flood risk probability from other sources within the SFRA, however expert judgement can be used to identify those areas in which flood risk from other sources of flooding is likely to be higher. The sequential approach may then be applied in an effort to steer new developments away from the higher risk areas.

6.5 Windfall Sites

Proposed developments for "windfall" sites will by definition not derive from an allocation in a LDD that has been sequentially tested. Such sites will, therefore, need to be subject to the Sequential and, if necessary the Exception Tests at the planning application stage. Planning applications that are submitted as windfall sites where the Sequential Test has already been applied satisfactorily will also be subject to the Exception Test in the circumstances set out in Table D1 of PPS 25. The Exception Test should only be applied after the Sequential Test has been satisfied. When applying the Exception Test for planning applications, the developer is expected to demonstrate to the LPA that the application delivers wider sustainability benefits that outweigh the flood risk implications of developing a site. To help assist the application of the Exception Test to these sites, LPA's are advised to create a series of locally targeted sustainability checklists based on the aims and objectives of the LDD SA framework. In the absence of a sustainability Appraisal, the checklist should reflect the Government's sustainability strategy.

6.6 Flood Risk Vulnerability Classifications

The principal driver for the classification of flood risk vulnerability in Table D2 of PPS 25 is the risk to human life posed by flooding, closely followed by the implications for human stress, health and well being. The extensive loss of life, which occurred in the 1935 floods, along the east coast of England, are a reminder of the devastating effect that floods can have on communities.

The EA/Defra research has developed a Flood Risk to People Calculator. The outcome from the calculation is defined as acceptable or unacceptable, according to the following criteria, related to annual average individual risk:

a) Development must not significantly increase the individual risk of death. Significance is taken as greater than 1.5 times increase in individual risk; and

b) The probability of death must be less than 0.01 per cent, or 1 in 10,000 per year, which is equivalent to the risk of being killed in a car accident, or being killed at work.

New developments should be categorised according to Table D2 of PPS 25, where land uses are different from those included in the table, a risk based approach should

be adopted to ensure that any increase in risk to life is kept to an absolute minimum. The flood risk to people calculator may provide a useful tool for assessing these risks. Ultimately, it is the responsibility of the planning authorities to decide what level of risk is acceptable.

7.0 STRATEGIES FOR MANAGING FLOOD RISK

7.1 General

Where developments are proposed within a catchment area discharging into a flood risk area, whether it be from rivers, watercourses, coastal or sewer flooding the developer must submit a flood risk assessment with the planning application. The catchment areas and flood risk areas are highlighted on the plans contained within this report. The flood risk assessment must follow the risk-based approach outlined in section 6 of this report. In addition the developer must identify how he proposes to deal with surface water run-off from his site and how he will mitigate the risk of flooding for the lifetime of the development.

7.2 Torbay Council Strategies for Managing Flood Risk

The following strategies have been developed by Torbay Council for managing flood risk and these strategies must be considered for all proposed developments. The strategies are as follows:

- Making Space for Water
- Managing Surface Water
- Sustainable Drainage
- Climate Change
- Improving Habitat for Wildlife
- Considering Egress/Ingress to Properties
- Opening Culverts

Details of each strategy are identified below.

7.3 Strategy 1 Making Space For Water

At the planning application stage, an appropriate Flood Risk assessment will be required to demonstrate how flood risk from all sources of flooding to the development and flood risk to others will be managed now and taking climate change into account. All areas identified as having a flood risk or being located within a catchment area containing a flood risk downstream of the development must submit a Flood Risk Assessment with their planning application.

The Flood Risk Assessment should identify and assess the risks of all forms of flooding to and from the development and demonstrate how the flood risks will be managed, taking climate change into account. For major developments in Flood Zone 1, the Flood Risk Assessment should identify opportunities to reduce probability and consequence of flooding.

As part of this strategy the developer is encouraged to deal with excessive flood risk by allowing areas of the development such as open space to flood. The developer should also utilise other areas of the development such as highways to act as carriers of floodwater to the open space designed for dealing with the excessive flood risk. When designing flood storage and carriers of this nature the developer must ensure

that there is no risk of flooding to properties or that the flooding is not to a depth that will result in a risk to the public.

7.4 Strategy 2: Managing Surface Water

Flooding results both from sources external to the development site and rain falling onto and around the site. The sustainable management of the rainfall, described as surface water, is an essential element of reducing future flood risk to both the site and its surroundings. Assessment of surface water and drainage will be required as part of the Flood Risk Assessment.

Undeveloped sites generally rely on natural drainage to convey or absorb rainfall, the water either soaking into the ground or flowing across the surface into watercourses, providing a natural flow of environmental and ecological benefit.

The effect of development is generally to reduce the permeability of at least part of the site. This markedly changes the site response to rainfall. Without specific measures, the volume of water that runs off the site at peak run-off rate is likely to increase. Inadequate surface water drainage arrangements in new developments can threaten the development itself and increase the risk of flooding to others.

The effective disposal of surface water from the development is a material planning consideration in determining proposals for the development and use of land. It will always be much more effective to manage surface water flooding at and from new developments early in land acquisitions and design process rather than resolve problems after development. Site layout should be influenced by topography. The location of buildings where surface water may flow naturally, or as a result of development, under extreme circumstances must be avoided if possible.

Surface water arising from a development site should as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. This must be demonstrated as part of the Flood Risk Assessment.

7.5 Strategy 3: Sustainable Drainage

The term sustainable drainage systems (SUDS) is frequently used to cover the whole range of sustainable approaches to surface water drainage management including:

- Source control measures including rainwater recycling and drainage.
- Infiltration devices to allow water to soak into the ground, that can include individual soakaways and communal facilities.
- Filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns.
- Filter drains and porous pavements to allow rainwater and run-off to infiltrate into permeable material below ground and provide storage if needed.
- Basins and ponds to hold excess water after rains and allow controlled discharge that avoids flooding.

Torbay Council promotes the use of SUDS for the management of surface water run-off. All SUDS schemes should comply with Building Regulations 1000, Part H on sustainable rainwater drainage which give priority to the use of infiltration drainage systems over first watercourses and then sewers.

Site layout and surface water drainage system should cope with events that exceed the design capacity of the system; the excess water can be safely stored on or conveyed from the site without adverse impacts.

The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a development site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

For new development it may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the site. There may be circumstances where it is appropriate for infiltration attenuation storage to be provided outside the development site, if necessary through the use of a Section 106 agreement.

7.6 Strategy 4: Climate Change

There is an increasing body of scientific evidence that global climate is changing as a result of human activity. Past, present and future emissions of greenhouse gases are expected to cause significant global climate change during this century. The nature of climate change at a regional level will vary however for the UK projections indicate that more frequent short duration high intensity rainfall and more frequent periods of long duration rainfall will be expected together with sea level rise. These kinds of changes will have implications for river and watercourse flooding together with local flash flooding.

In order to assist with the assessment of vulnerability to climate change the Government established the UK Climate Impacts Programme (UKCIP). Scenarios of future climate change in the UK were produced for the UKCIP in 2002 and published by DEFRA. Since the publication of this document the scenario information has been revised, expanded and developed and the latest guidance was published by DEFRA in October 2006.

Global sea level will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west. Allowances for the regional rates of relative sea level rise shown below should be used as a starting point for considering flooding from the sea, along with the sensitivity ranges for wave height and wind speed in preparing flood risk assessments.

The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels, assuming no change in storminess. There may also be secondary impacts such as changes in wave heights due to increased depths, as well as possible changes in the frequency, duration and severity of storm events. A 10%

sensitivity allowance should be added to offshore wind speeds and wave heights by the 2080s.

Extensive, low-lying coastal lands are particularly susceptible to flooding. Changes to the drivers associated with coastal erosion (surges, waves, coastal sediment supply and morphology, and relative sea level rise) will effect probability of flooding to new developments.

Administrative Region	Net Sea Level Rise (mm/yr.) Relative to 1990			
	1990 – 2005	2005 – 2055	2055 – 2085	2085 – 2115
South West	3.5	8.0	11.5	14.5
Offshore Wind Speed	+5%	+5%	+10%	+10%
Extreme Wave Height	+5%	+5%	+10%	+10%

The climate changes already seen in the UK suggests that winters will become wetter by as much as 20% by the 2050's. A shift in seasonal pattern of rainfall is also expected, with summers and autumns becoming much drier than at present.

In making an assessment of the impacts of climate change on flooding from the land, river, watercourse, sewer and sea as part of the flood risk assessment, the sensitivity ranges identified below may provide an appropriate precautionary response to the uncertainty about climate change impacts on rainfall intensities together with river and watercourse flows.

Parameter	1990 – 2025	2025 – 2055	2055 – 2085	2085 – 2115
Peak Rainfall Intensity	+5%	+10%	+20%	+30%
Peak River/Watercourse Flow	+10%	+20%	+20%	+20%

Knowledge and understanding of climate change is continuing to grow. The next UKCIP scenarios, due in 2009, are expected to provide more detail on regional climate changes and to express this information in probabilistic terms. The most up-to-date guidance on climate change and flooding from the EA, DEFRA and UKCIP should be considered in the preparation of site specific flood risk assessments.

7.7 Strategy 5: Improving Habitat for Wildlife

As part of the detailed design for flood alleviation measures the developer should consider whether it is possible to improve the habitat for wildlife by using buffer strips or wildlife corridors. This would be implemented where considering the use of filter strips, swales or basins and ponds. All of these will provide ideal habitat for various different species of birds and other wild life. In addition, the developer should consider the type and nature of planting at these features and at areas where flooding may occur.

7.8 Strategy 6: Consider Egress/Ingress to Buildings

As part of the Flood Risk Assessment the developer must demonstrate that the finished floor level of buildings is above the 1 in 100 year flood level. In addition the

developer must demonstrate that during a flood event the egress and ingress for pedestrians to the property will not be adversely affected.

7.9 Strategy 7: Opening Culverts

Where an existing main river, watercourse of ditch has been culverted and crosses a development site the developer should investigate the possibility of opening the culvert pipes. (i.e. removing the culvert and returning the main river, watercourse or ditch to its open condition.) Prior to carrying out this work the developer must demonstrate that the design of the naturalisation will not result in an increased risk of flooding to the site and elsewhere. The Environment Agency under the Land Drainage Act must approve all works of this nature.

8.0 TECHNICAL GUIDANCE FOR PLANNING OFFICERS AND DEVELOPERS

8.1 General Guidance

The government aims to reduce the risks to people and the developed and natural environment from flooding by discouraging further built development within flood risk areas. Government guidance has been produced for local planning authorities to help them when allocating land for development in order to meet this aim. This guidance is contained in a document called Planning Policy Statement 25 (PPS 25).

In undertaking the SFRA this guidance has been examined and used to provide a robust and consistent system for assessing flood risk anywhere within the local planning authority area.

In order to assist with the process, we draw attention to the following issues within the Torbay Council area.

8.2 Areas Sensitive to Flooding

Due to past flooding incidents certain areas have been highlighted by Torbay Council drainage engineers as sensitive to flooding. Any development in the vicinity of these areas, especially upstream, should be investigated regarding the potential impact of new development on these areas. Table 8.1 below shows the areas which are particularly sensitive to flooding within Torbay.

8.3 Rapid Inundation Zones

Fast flowing water or deep flooding that occurs quickly can create a risk of loss of life. This can happen if flood defences fail or is overtopped, or in steep catchments through flash flooding. This type of flooding for the purpose of the SFRA is referred to as Rapid Inundation.

Rapid inundation zones are characterised for this SFRA as a flood of 30cm depth of floodwater within 30 minutes of overtopping or breaching of flood defences. It is prudent to consider that where raised defences are designed with a standard of protection of greater than 1 in 100 years, the area designated within Flood Zone 3 should be regarded as a rapid inundation zone. This is because water behind the raised defence can build up to a level higher than the surrounding land. If the raised defence collapsed, or water spills over the top of the defence, a large amount of floodwater could very quickly flood nearby land.

Table 8.2 identifies areas in Torbay where there is a potential for rapid inundation.

Table 8.1
Areas Particularly Sensitive to Flooding

Location	Source of flooding	Reason
Torquay Town Centre	Combined Sewers	Flood alleviation tanks designed for 1 in 25 year storm event (4%). Storms greater than this may result in flooding due to capacity of system being exceeded.
Torquay Harbour	Tidal	High tides and easterly winds can result in flooding. In addition surface water outlets to harbour can become tide locked.
Torre Abbey/ Torquay Sea Front	Tidal	High tides and easterly winds can result in flooding.
Torquay Recreation Ground	Torre Abbey Watercourse	High tides causes tide locking meaning Torre Abbey stream cannot discharge leading to backing up and causing flooding.
Livermead Sea Front	Tidal	High tides and easterly winds can result in flooding.
Cockington	Cockington Watercourse	High flows exceeding capacity of watercourse causing flooding.
Torbay Road, Hollicombe	Hollicombe Watercourse	High flows exceeding capacity of watercourse causing flooding.
Shorton Valley/Occombe Valley	Occombe Valley Main River	High flows exceeding capacity of culverts causing flooding.
Paignton Town Centre	Victoria Stream Main River/Tidal	Tide locking means the main river cannot discharge leading to backing up and flooding during heavy rainfall. In addition high tides and easterly winds can result in severe flooding.
Paignton and Preston Sea fronts	Tidal	High tides and easterly winds can result in severe flooding.
Kings Ash Road, Totnes Road and Dartmouth Road	Clennon Valley Main River	High flows exceeding capacity of culverts causing flooding. In the lower reaches tide locking reduces the capacity of the outlet leading to backing up and flooding.
Goodrington	Tidal	High tides and easterly winds can result in flooding.
Totnes Road, Stoke Road	Yalberton Main River	High flows exceeding capacity of culverts causing flooding.
Churston Village	Churston Main River	High flows exceeding capacity of culverts causing flooding.
Alston Farm	Field run-off	Rainwater unable to soak into ground causing flooding
Galmpton	Galmpton Main River	High flows exceeding capacity of culverts causing flooding.
Higher Brixham	Higher Brixham Main River	High flows exceeding capacity of culverts causing flooding.
Brixham Town Centre	Tidal	High tide levels can lead to flooding

Table 8.2
Areas where there is potential for Rapid Inundation

At Risk Location	Reason
Downstream of Stoke Road Flood Storage Area	The dam located on the Yalberton main river, has an area behind it to store a certain amount of water. Should the capacity of the storage area be exceeded water will overtop the dam resulting in severe flooding downstream.
Downstream of the storage lagoon at The Willows	The storage lagoon, located on the Aller Valley main river, can store a certain amount of water behind the controlling raised embankment. If this capacity be exceeded or the embankment fail significant flooding would occur to the existing developments within the Aller Valley.
Downstream of Great Parks storage lagoon	The storage lagoon, located on the Clennon Valley main river, can store a certain amount of water behind the controlling raised embankment. If this capacity be exceeded or the embankment fail significant flooding would occur to the existing downstream developments.
Downstream of Coombe Park storage pond	The storage pond, located on the Occombe Valley main river, can store a certain amount of water behind the controlling raised embankment. If this capacity be exceeded or the embankment fail significant flooding would occur to the existing downstream developments.
Downstream of Laywell Reservoir	The underground storage tank at Laywell reservoir, located on the Higher Brixham main river, can store a certain volume of water. Should this volume be exceeded excess flows will overtop the weir and discharge downstream. These excess flows would result in significant flooding to the existing properties downstream.

8.4 Tidal and Coastal Flooding

Some areas of Torbay are at risk from flooding from high tides because they are low-lying land near the coast. This is known as tidal flooding. Areas at risk from tidal flooding include low-lying areas such as Paignton town centre, Preston sea front, Goodrington and Brixham town centre.

If high tides combine with strong easterly winds, then the winds can create waves, which can crash against sea defences causing spray. In sever storms waves can crash over defences leading to flooding in nearby low-lying land. This is called coastal flooding. It can also cause damage to structures through the force of the waves and the material and debris being carried by the waves. Areas at risk from coastal flooding

include Torre Abbey, Livermead, Paignton town centre, Preston sea front, Goodrington and Brixham town centre.

8.5 Ground Water

Ground water flooding occurs when water stored below ground reaches the surface. It does not have to occur near a river, or even when it is raining, and is often associated with porous ground such as sands, gravels, limestone and chalk.

Overall ground water flooding within Torbay is not a major problem. However it is known that it could be a problem in low-lying coastal areas such as the Torquay Harbour area, Paignton town centre and Brixham.

It is a PPS 25 requirement that the potential effects of ground water flooding must be assessed in any FRA.

8.6 Defences

Proposed development in or near areas where there is an existing flood defence must be closely examined in order to ensure that future development does not reduce the standard of protection provided by those defences for existing developments. Furthermore, it should not be assumed that the standard of protection provided by the defence is still as quoted when the defences where designed. Changes in flood estimation procedures and allowances for climate change can mean that the standard of protection may have been decreased. It is very important that this is investigated during a flood risk assessment to ensure that existing and new development has the appropriate level of protection; for the 1% probability flood for protection from watercourse and river flooding and the 0.5% probability flood for protection from coastal flooding.

8.7 Surface Water Runoff and Sustainable Urban Drainage Systems (SUDS)

Surface water flooding happens usually from very heavy rainfall when the water cannot soak away into the ground or find its way into drains. This type of flooding can happen away from rivers, such as water flowing off fields and along roads. It can be a particular problem in urban areas where there is little grass and lots of roads, pavements and driveways.

Flood risk from surface water flooding is of concern within the study area. A number of flood incidents have occurred within the area caused by surface water alone, or in combination with watercourse flooding. The Environment Agency flood maps do not identify flood risk due to surface water flooding.

Any change in land use will result in a change to the surface water runoff, which is generated from the site. In order to meet PPS 25 considerations, the effect of this change in runoff must be quantified and investigated in order to gauge any potential affect on flood risk from surface water within the development site itself and in the off site vicinity. Where surface water runoff may be increased, this must be dealt with using Sustainable Urban Drainage Systems (SUDS). The general principle of PPS 25

is that the amount and rate of water flowing off the site must not increase from the situation before it is developed.

SUDS are techniques designed to control surface water runoff before it enters the watercourse and to mimic the natural drainage processes. In addition they can treat the water in order to reduce the amount of pollutants entering the receiving waters. These techniques can be implemented at all scales and in most urban settings.

8.8 Managed Coastal Retreat

The idea of managed coastal retreat is about planning for the threat of rising sea levels by looking at the options available to protect the coastline. In some areas it may not be suitable to build bigger flood defences to protect against flood risk. It may even be necessary to remove some defences, especially on eroding cliffs, which could provide extra material such as sand and silt for the sea to deposit elsewhere. Managed coastal retreat may also mean setting back sea walls so that beaches, salt marshes and other natural features can help in defending from the sea.

As part of the study area is adjacent to the coast, in the future, managed coastal retreat may become a relevant planning issue for the area. PPS 25 notes that development in flood zone 3 or close to eroding cliffs should avoid coastal areas which will, or may in the future, be needed for managed coastal retreat.

Much of the coastline in Torbay consists of cliffs and where beaches exist they are backed by concrete or masonry sea walls. At present there are no known plans for managed coastal retreat within Torbay and it is unlikely this will be an option in the foreseeable future due to the nature of the area.

More information on the risk of cliff erosion can be found in the Lyme Bay Shoreline Management Plan, held by Torbay Council.

8.9 Flood Warnings and Evacuation Procedures

Within the study area, as for the rest of England and Wales, the responsibility for flood warning rests with the Environment Agency. The Environment Agency provides flood warnings for designated flood warning areas. Within the study area the designated flood warning areas are as follows:

South Devon Coast between Plymouth and Lyme Regis

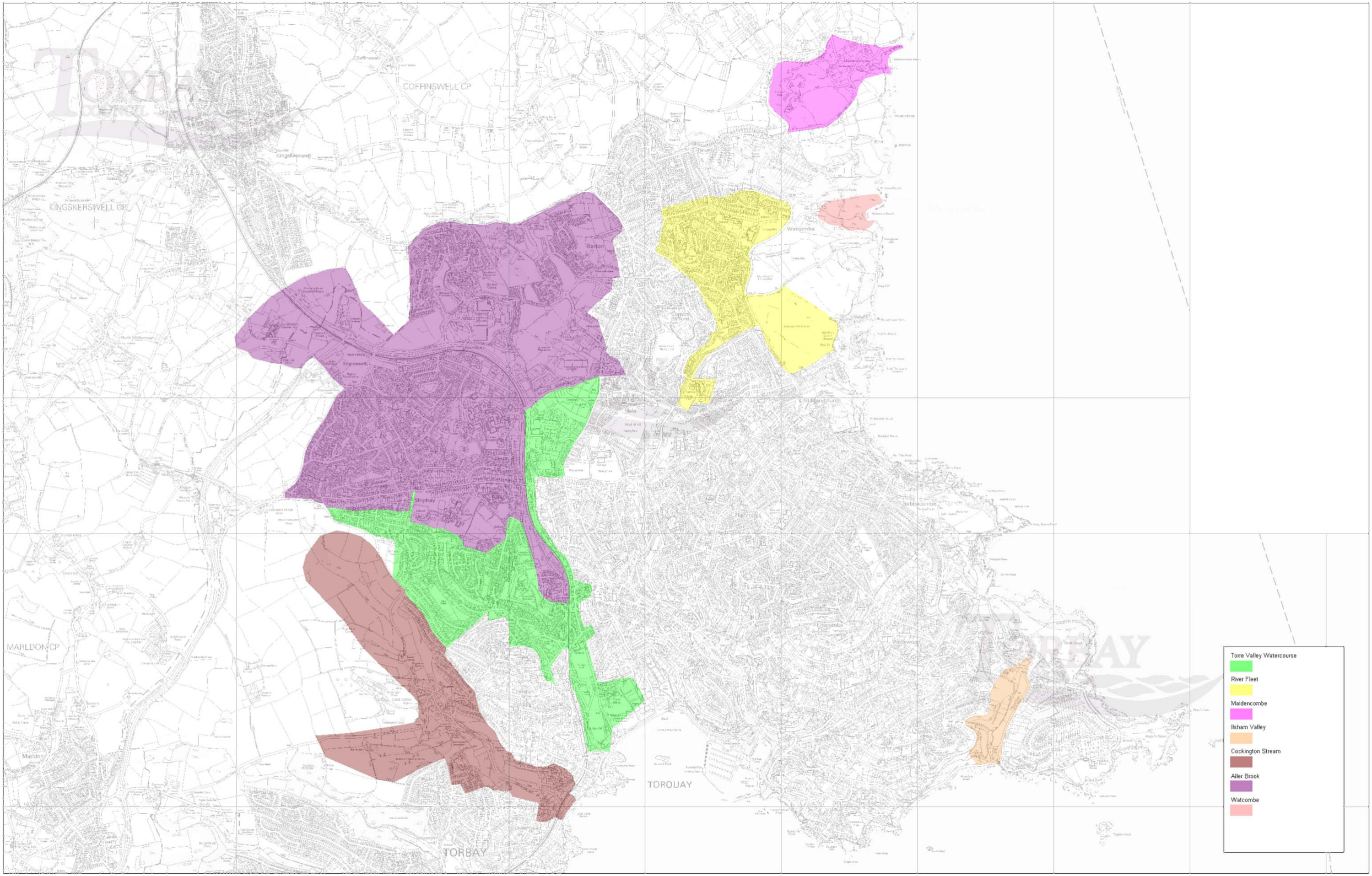
The Environment Agency provides an indirect and direct flood warning system. The indirect flood warning system is based around the Floodline dial up and listen service. The Floodline number is 0845 988 1188. Television and radio services also broadcast flood warnings.

The direct warning service requires people in at risk properties to register their telephone number with the Environment Agency. They can then receive automatic warning messages if a flood is likely.

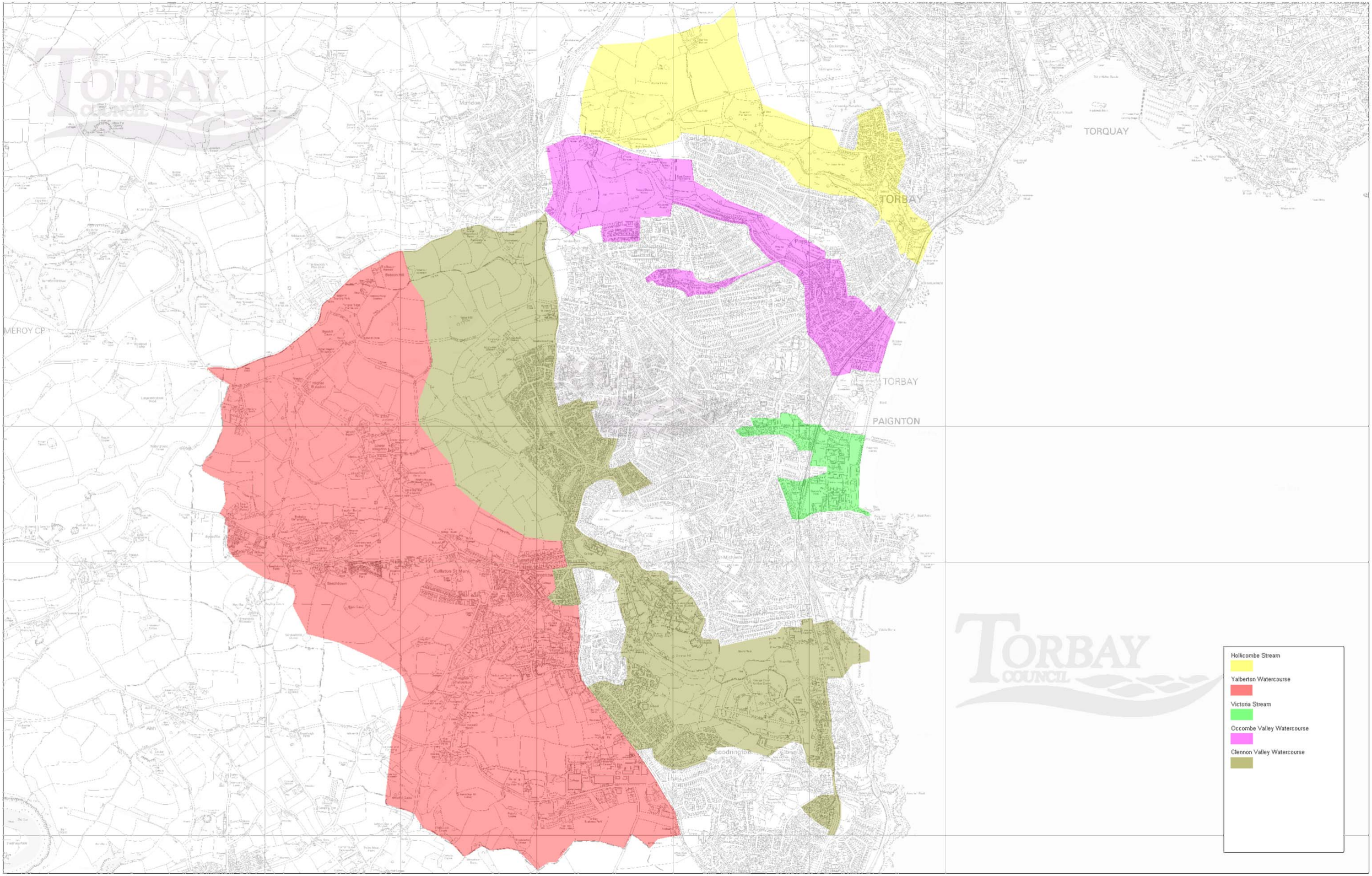
Flood evacuation planning is a function of the Torbay Council Emergency Planning Department, with input from the Environment Agency and other relevant organisations. Evacuation planning exists for certain urban centres at risk from flooding from the sea. Within the study area the low-lying area around Paignton town centre has a Major Incident Plan in place.

Safety and evacuation procedures should be addressed for developments within Environment Agency flood zone 3 and for civil infrastructure within flood zone 2 such as schools and hospitals. Provisions such as refuges and safe exit routes out of the site which are above flood levels should be incorporated into the design of such sites. Access for emergency vehicles will also need to be considered.

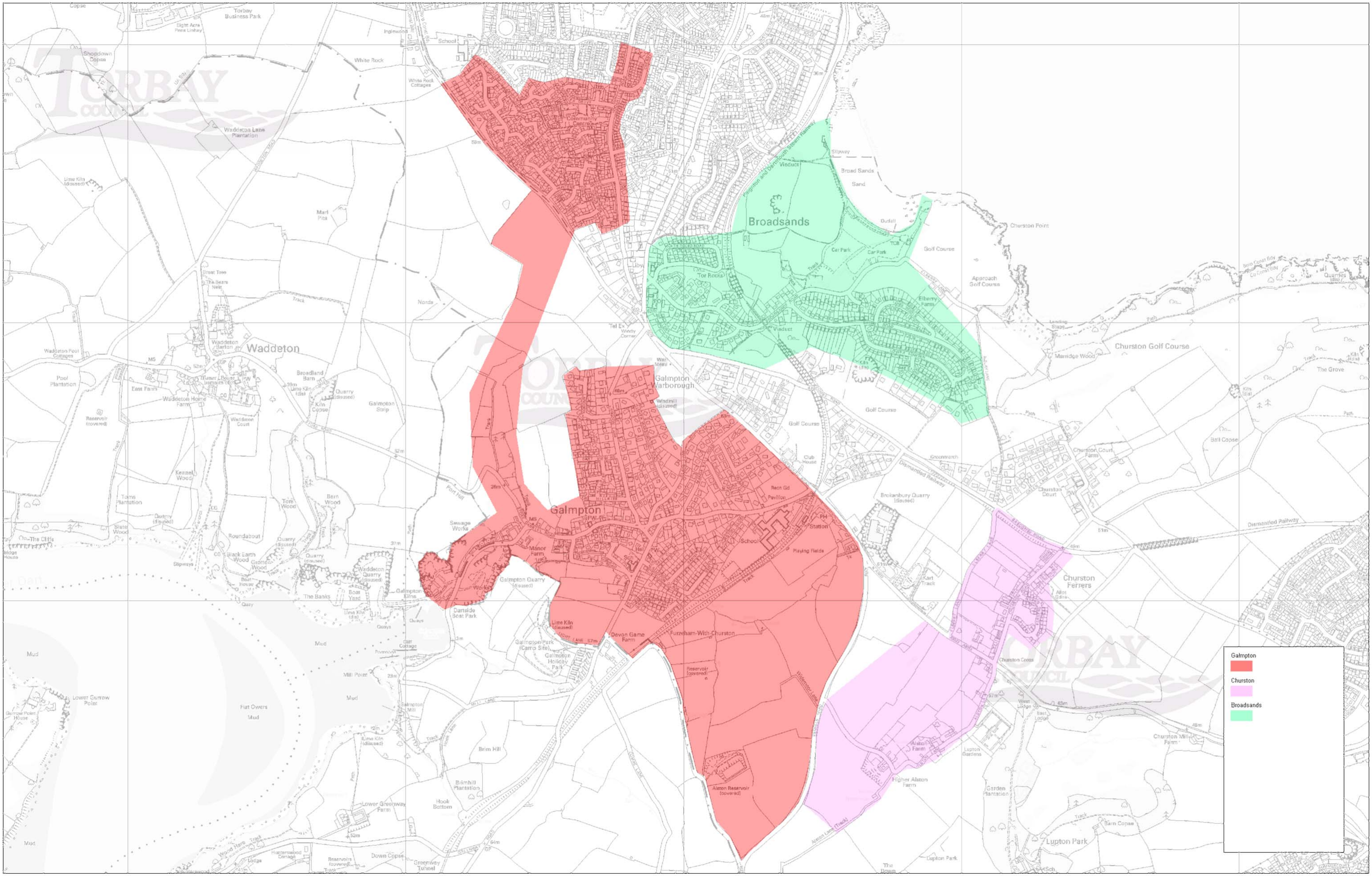
Any major development within the urban areas with an existing Major Incident Plan should consider the impact of new development on the existing plan. It should be ensured that the procedures can be applied to the new development or modified if necessary in conjunction with Torbay Council and the Environment Agency.



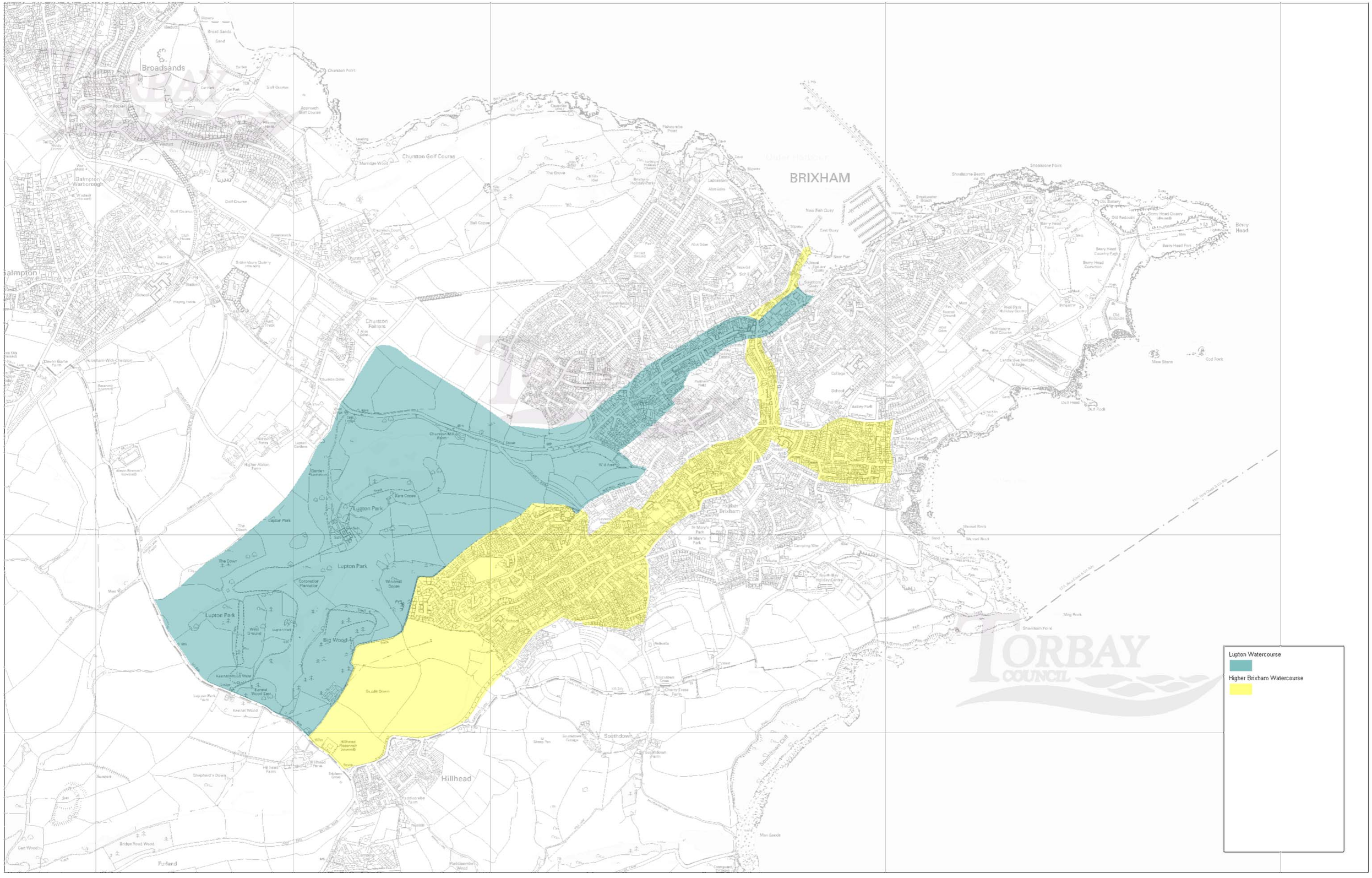
TORQUAY - Catchment Areas TC/9/7/15 - 3/2



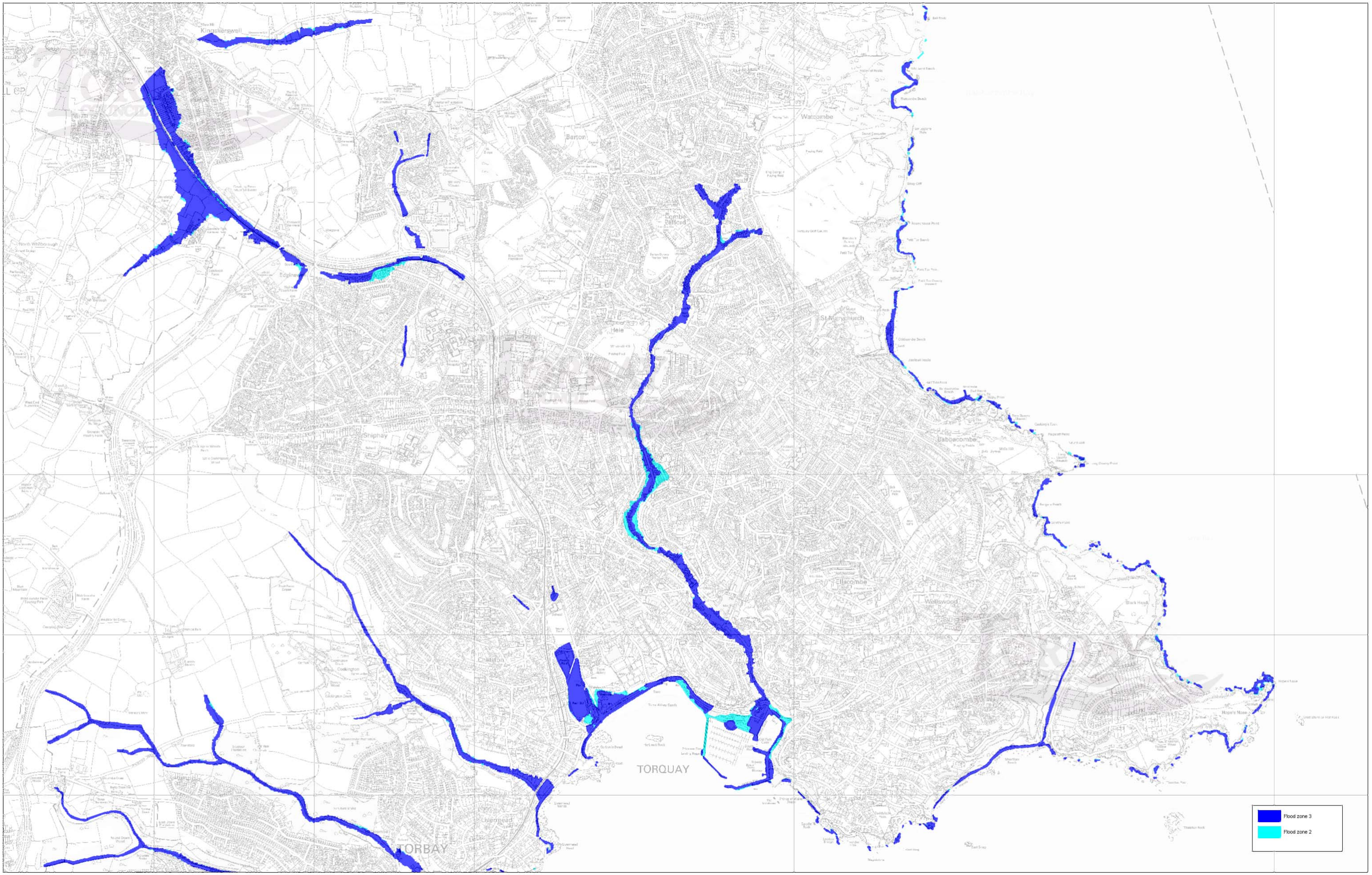
PAIGNTON - Catchment Areas TC/9/7/15 - 4/2



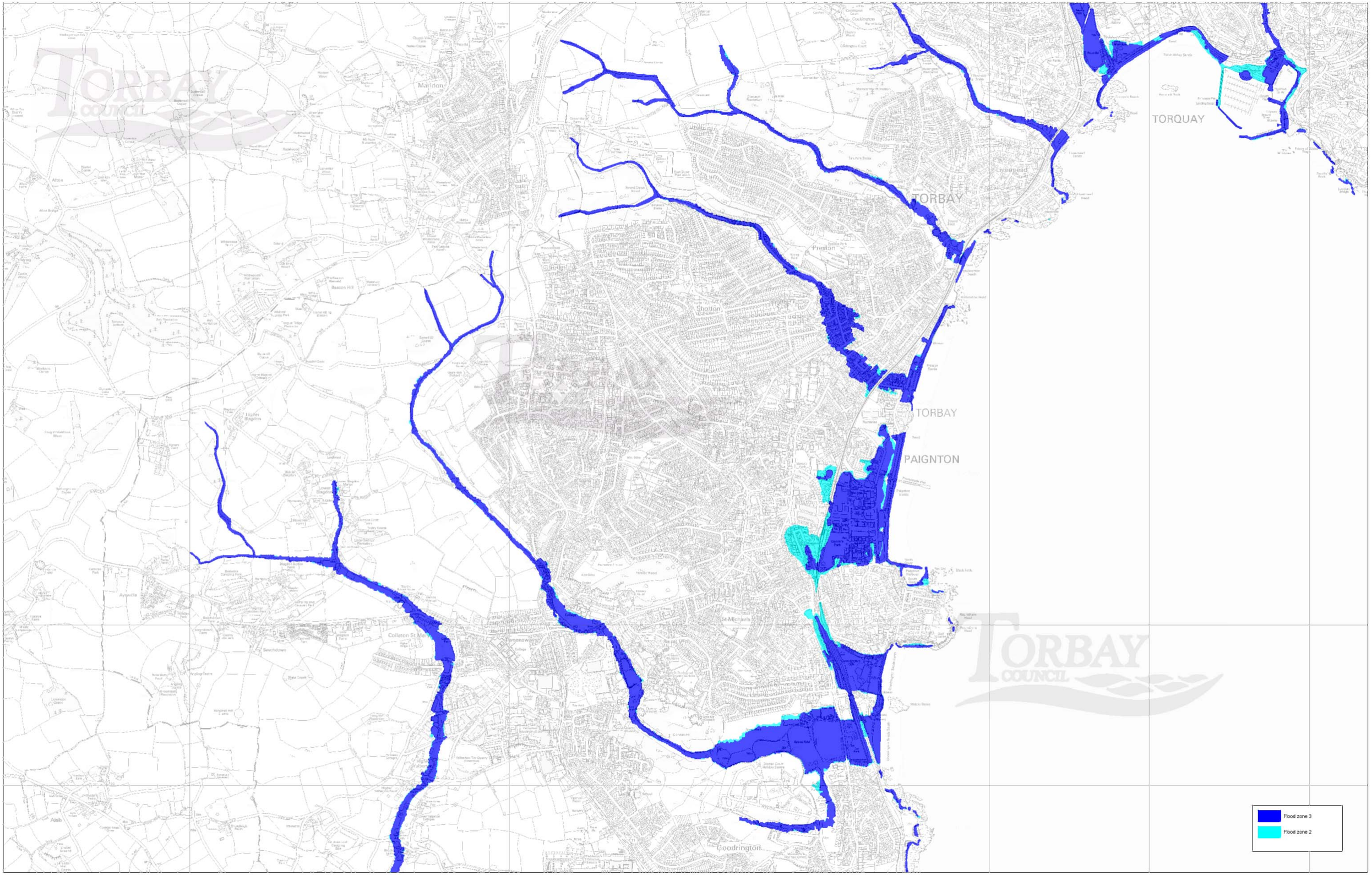
GALMPTON - Catchment Areas TC/9/7/15 - 5/2



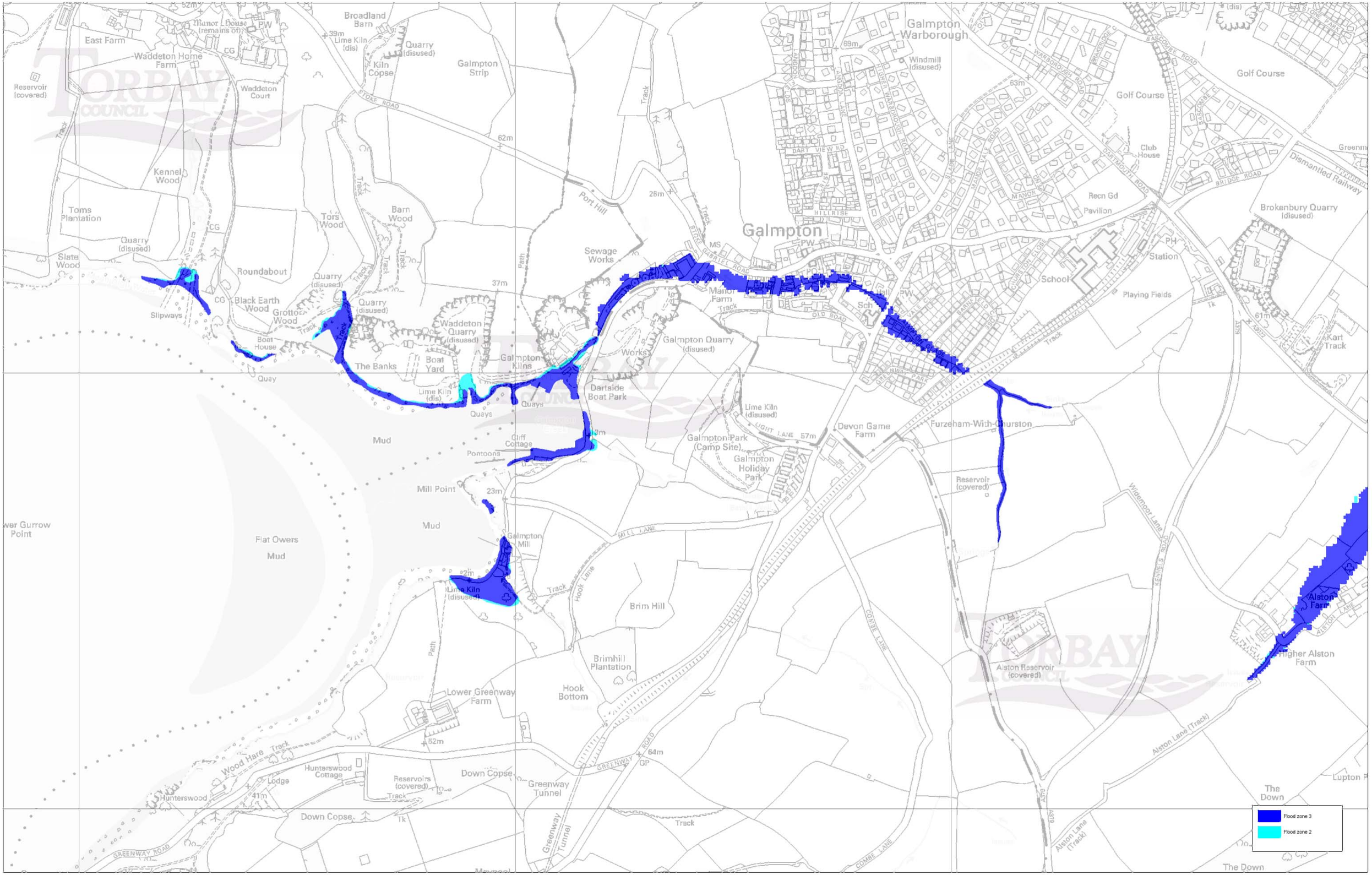
BRIXHAM - Catchment Areas TC/9/7/15 - 6/2



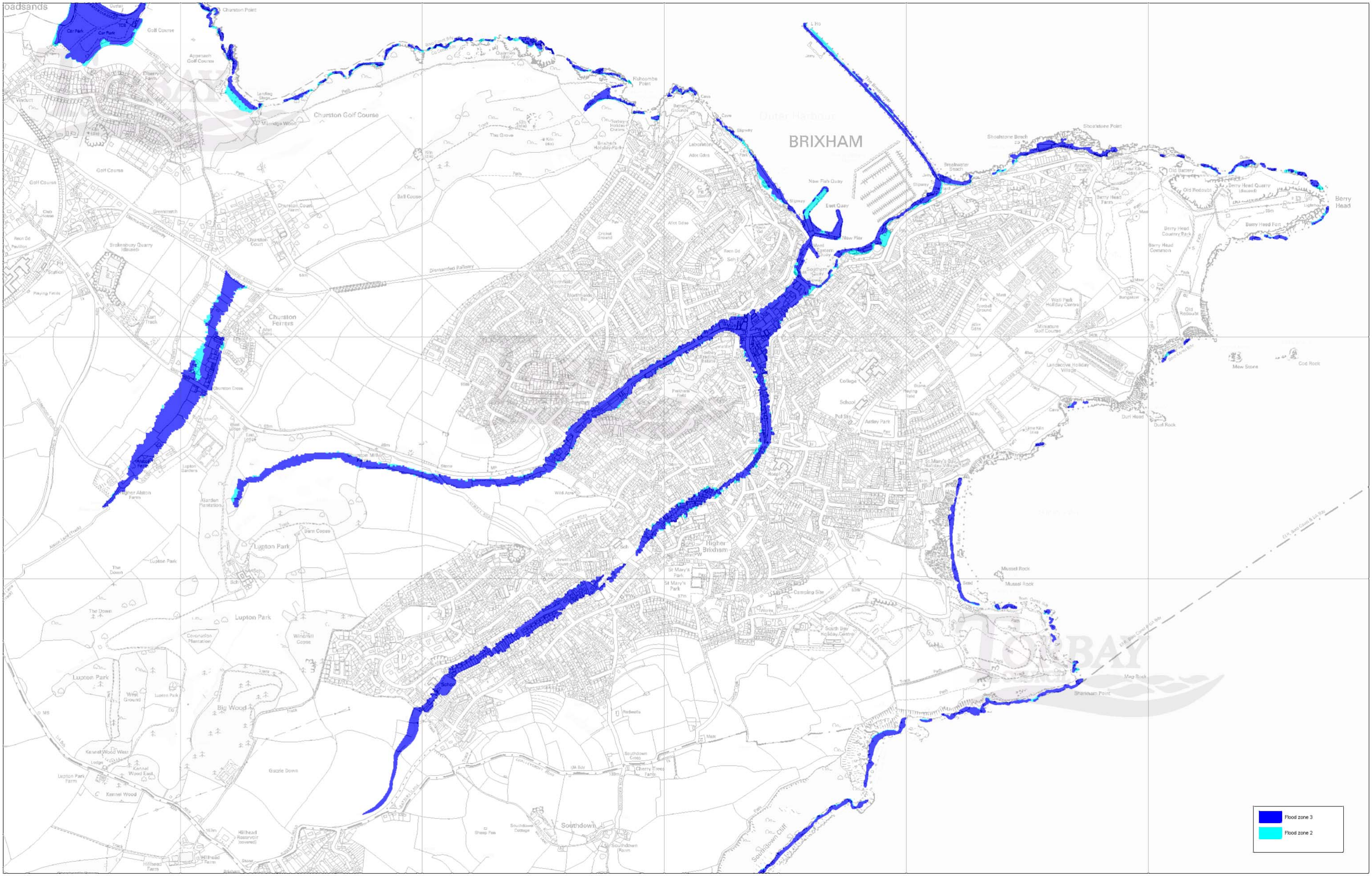
TORQUAY - Flood Risk Areas TC/9/7/15 - 3/3



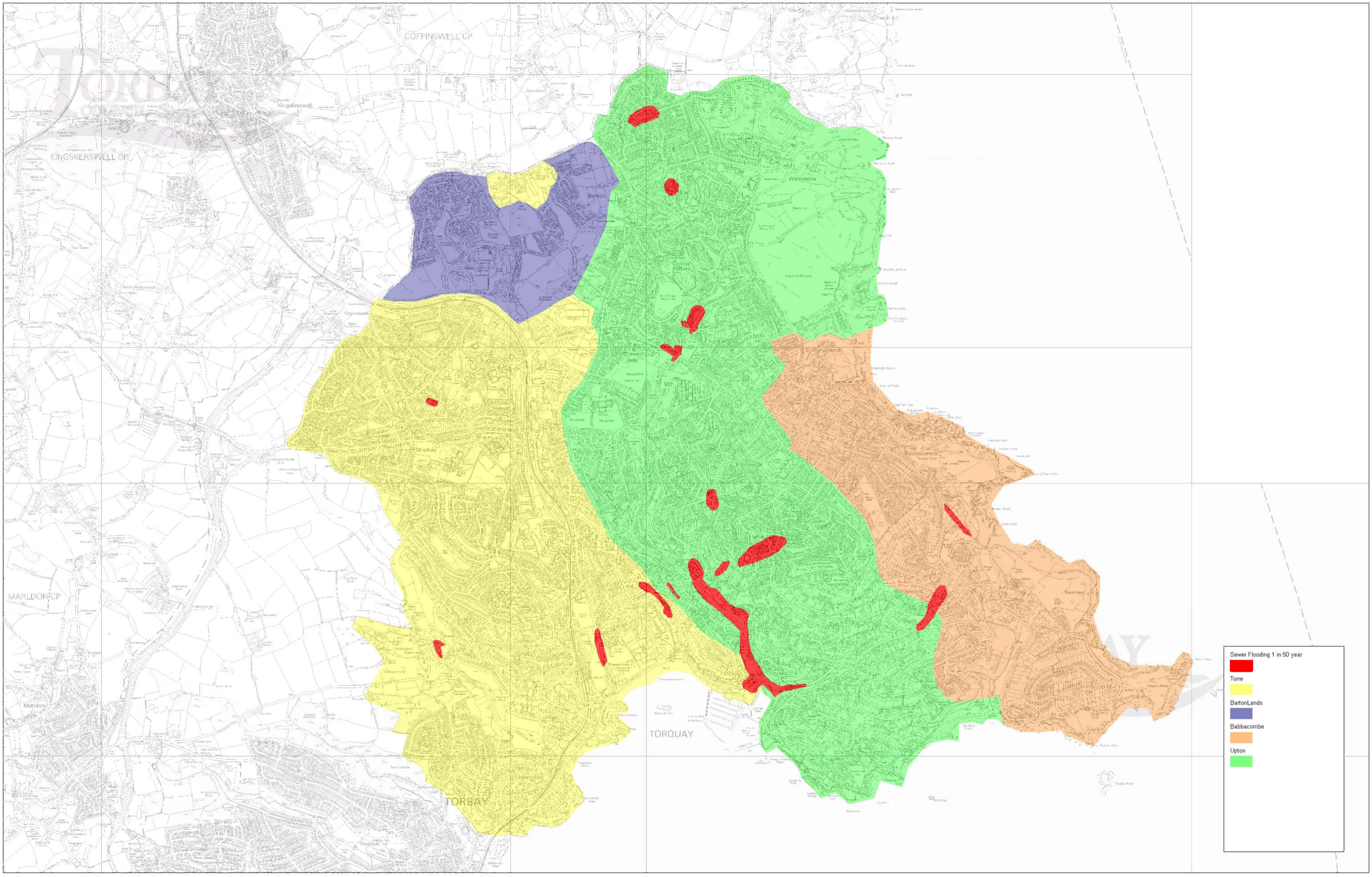
PAIGNTON - Flood Risk Areas TC/9/7/15 - 4/3



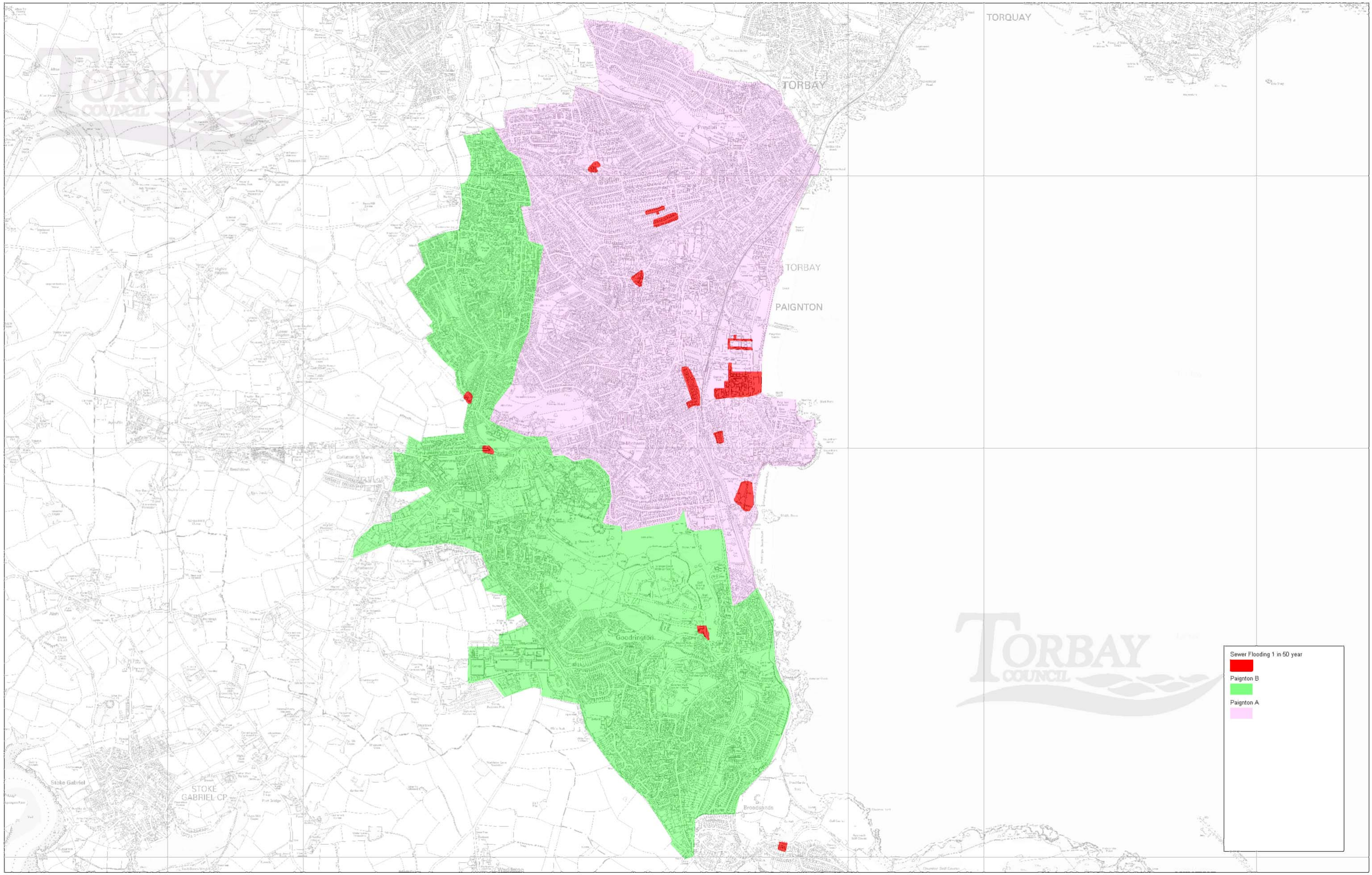
GALMPTON - Flood Risk Areas TC/9/7/15 - 5/3



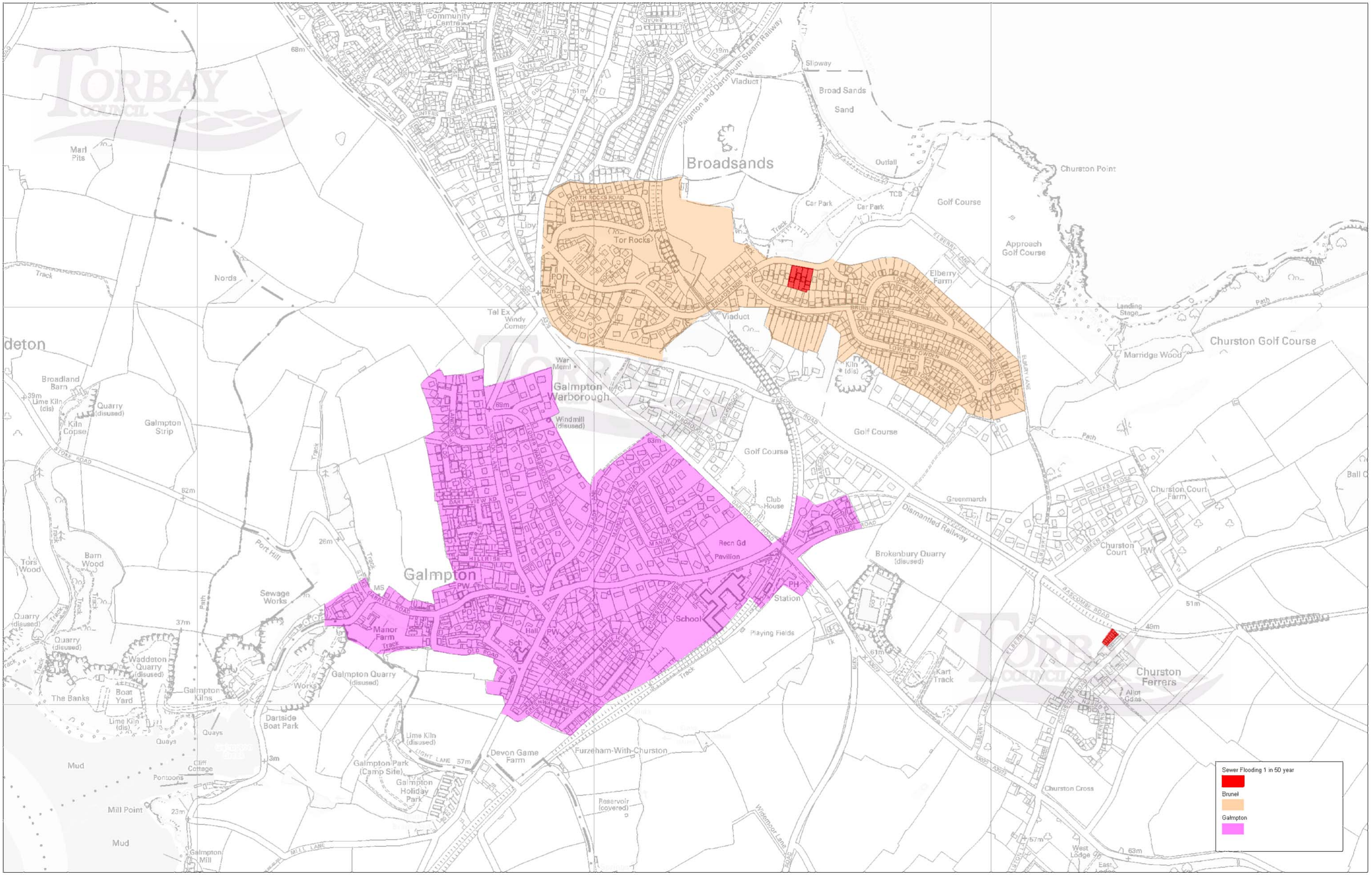
BRIXHAM & CHURSTON - Flood Risk Areas TC/9/7/15 - 6/3



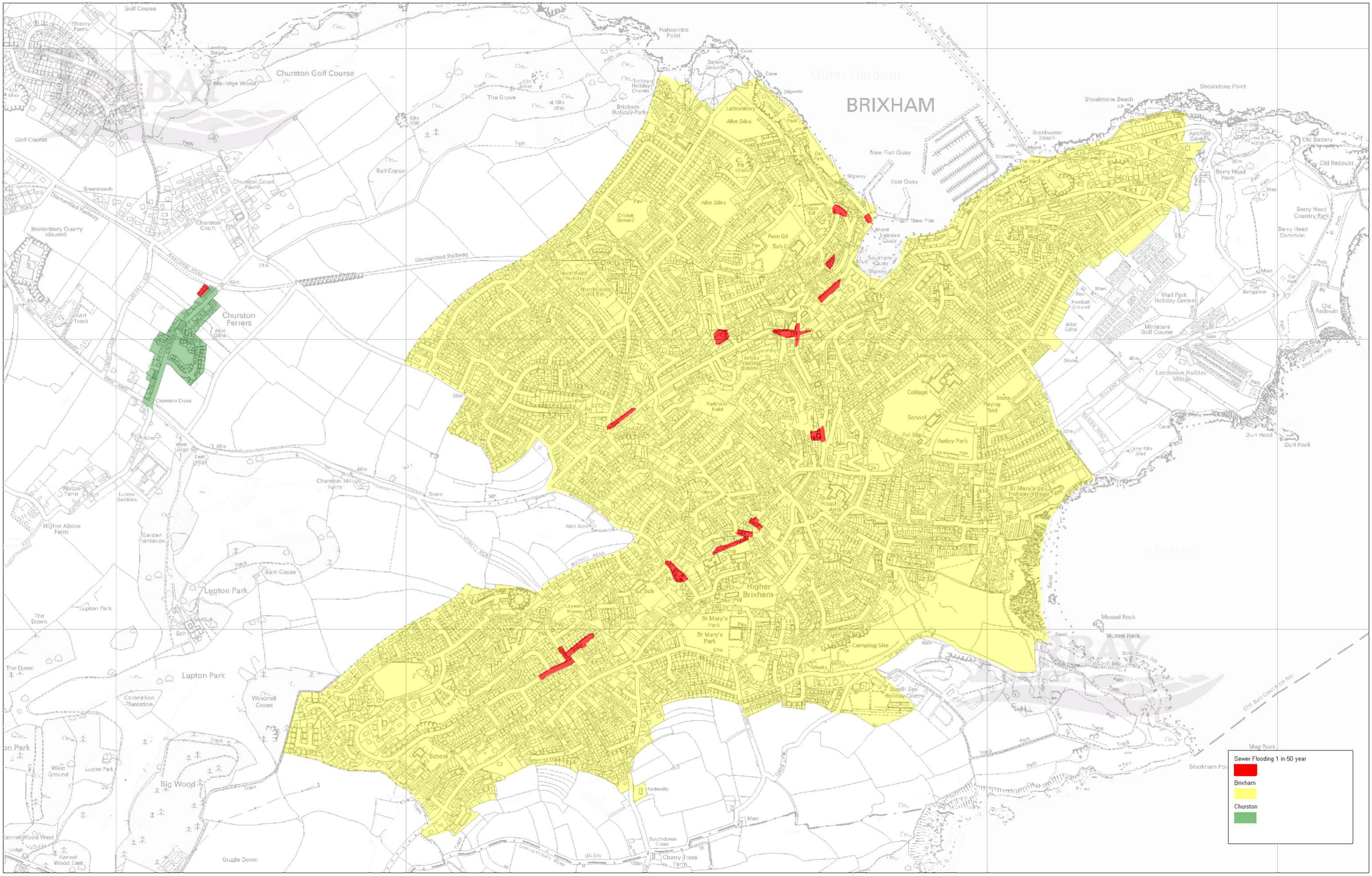
TORQUAY - Sewer Catchment Areas and Flood Risk Areas TC/9/7/15 - 7/2



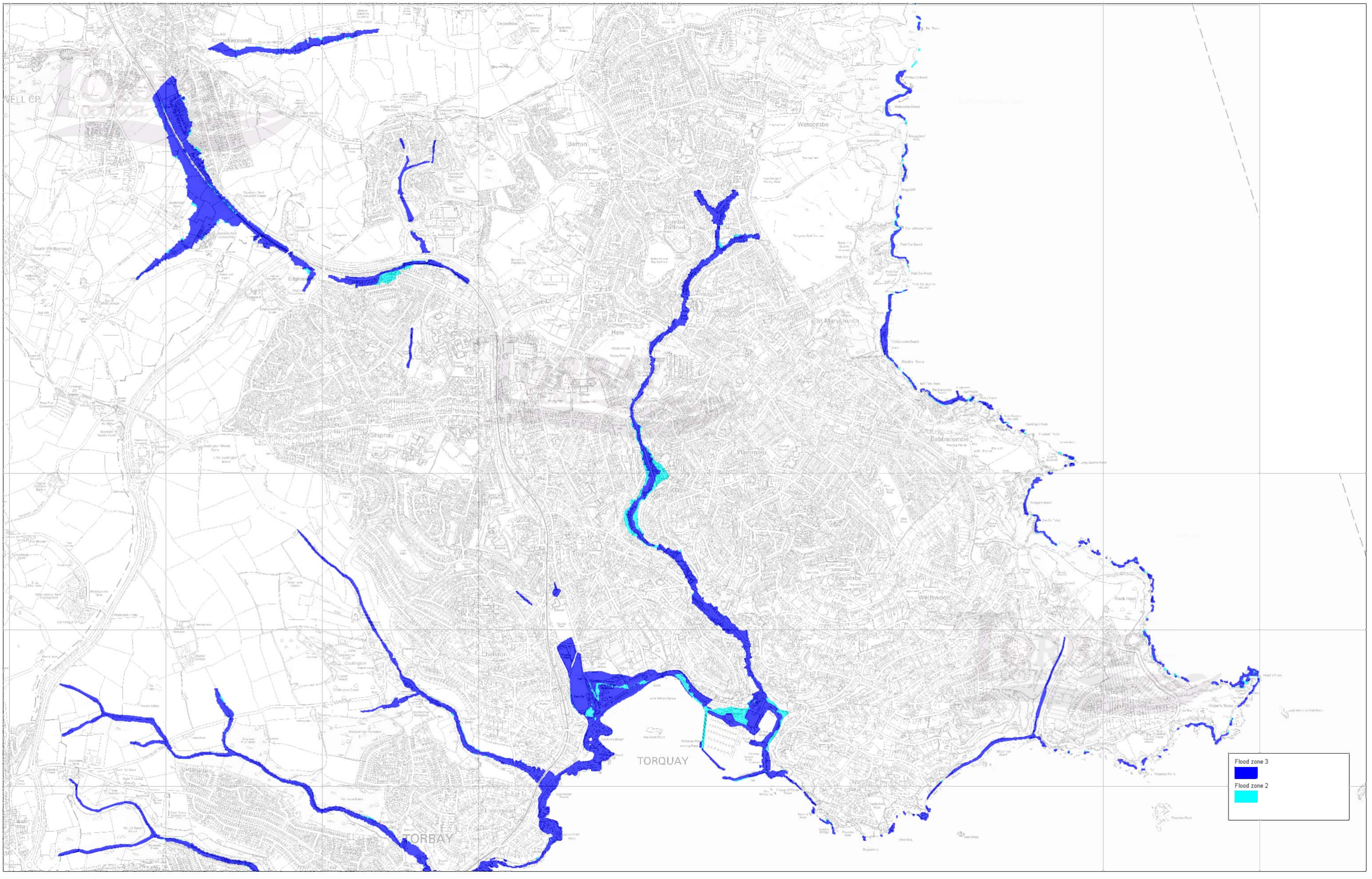
PAIGNTON - Sewer Catchment Areas and Flood Risk Areas TC/9/7/15 - 8/2



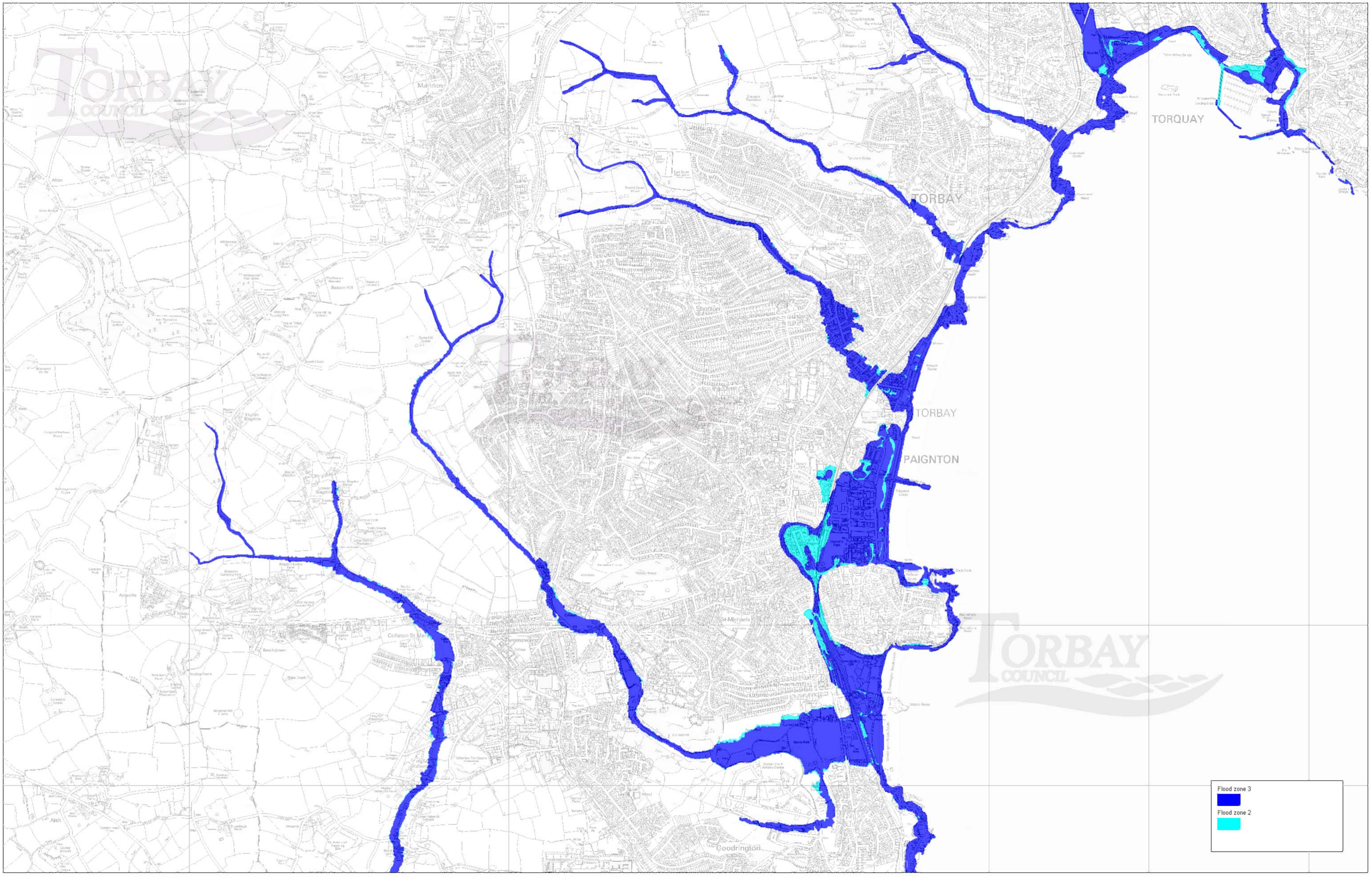
GALMPTON & BRUNEL - Sewer Catchment Areas and Flood Risk Areas TC/9/7/15 - 9/2



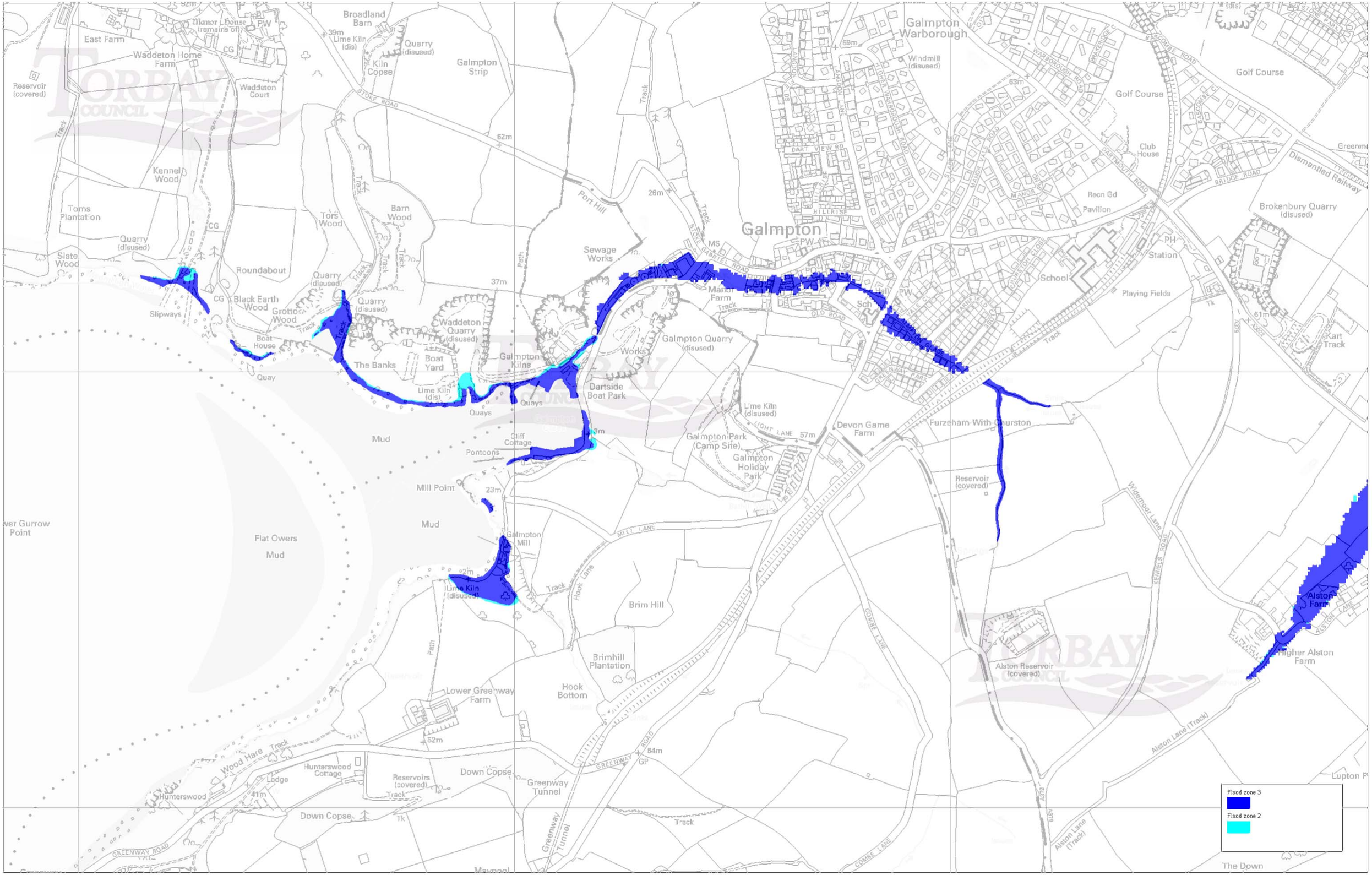
BRIXHAM & CHURSTON - Sewer Catchment Areas and Flood Risk Areas TC/9/7/15 - 10/2



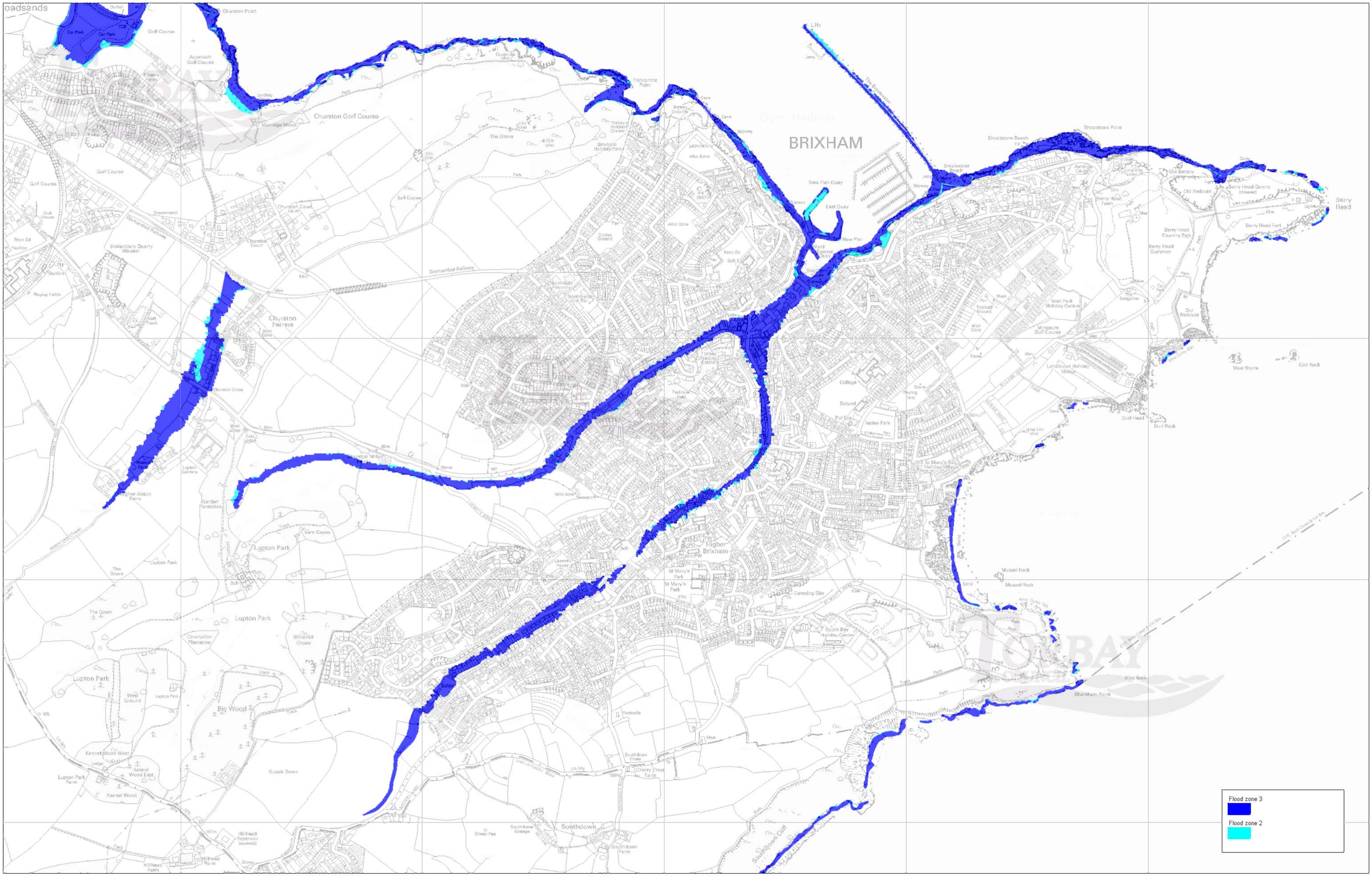
TORQUAY - Flood Risk Areas 50 Year Projection TC/9/7/15 - 3/4



PAIGNTON - Flood Risk Areas 50 Year Projection TC/9/7/15 - 4/4



GALMPTON - Flood Risk Areas 50 Year Projection TC/9/7/15 - 5/4



BRIXHAM - Flood Risk Areas 50 Year Projection TC/9/7/15 - 6/4

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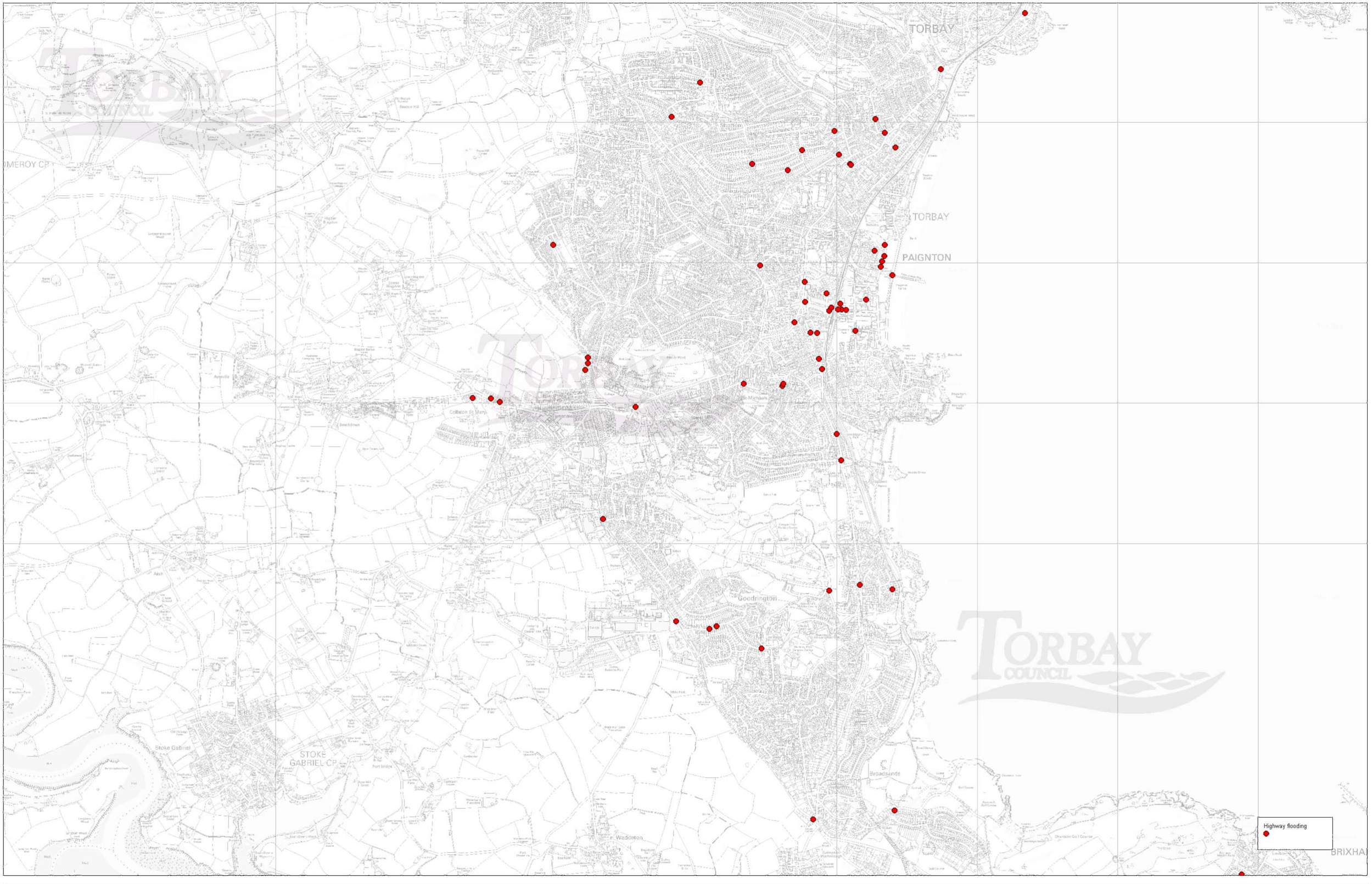
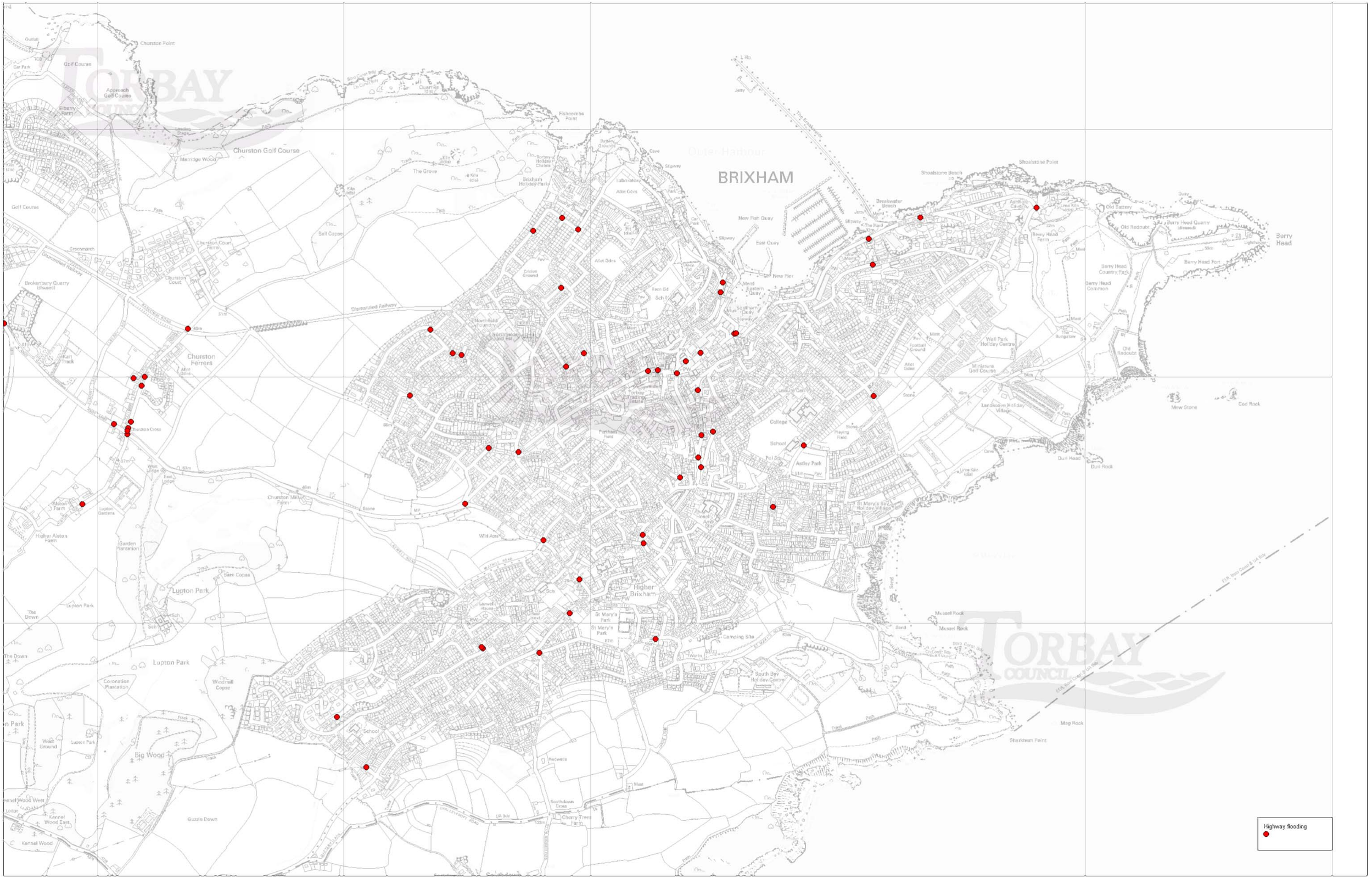
TORQUAY - Locations of Historic Highway Flooding TC/9/7/15 - 3/5



PAIGNTON - Locations of Historic Highway Flooding TC/9/7/15 - 4/5

GALMPTON - Locations of Historic Highway Flooding TC/9/7/15 - 5/5



BRIXHAM - Locations of Historic Highway Flooding TC/9/7/15 - 6/5