Local Flood Risk Management Strategy Part 1

Non-Technical Strategic Summary
Contents

1. Introduction ................................................................................................................. 6
2. Flood risk in Plymouth ................................................................................................. 8
3. Tidal Flooding in Plymouth ......................................................................................... 10
4. Fluvial Flooding in Plymouth ...................................................................................... 14
5. Surface Water Flooding in Plymouth ......................................................................... 16
6. Flood Risk Management in Plymouth ........................................................................ 19
7. Catchment-based summaries ..................................................................................... 22
8. The Local Flood Risk Management Strategy ............................................................. 29
1. Introduction

Environment Agency data indicates that up to 6% of homes in Plymouth are at risk from flooding during a 1 in 100 year event. This flooding is expected to increase in severity and frequency as a result of the sea level rise and extreme weather predicted as a result of climate change. Plymouth needs to be prepared for, and resilient to these changes. In addition, growth in Plymouth, leading to construction of more homes, business units and roads needs careful management to prevent surface water flooding problems.

This document provides an overview of flood risks for the City and a non-technical summary of the Local Flood Risk Management Strategy produced for managing them in accordance with the Flood and Water Management Act 2010, and the Plymouth and South West Devon Joint Local Plan (DEV35). [https://plymswdevonplan.co.uk/policy/so11/dev35](https://plymswdevonplan.co.uk/policy/so11/dev35)

The Local Flood Risk Management Strategy (LFRMS) is produced by Plymouth City Council as Lead Local Flood Authority (LLFA). Other Risk Management Authorities (RMAs) collaborating with Plymouth City Council to manage flooding are the Environment Agency (EA) and South West Water (SWW). Responsibilities for managing flood risk across the city are assigned as follows:

- **Tidal** - EA and PCC (LLFA)
- **Fluvial (rivers)** - EA (main rivers) and PCC (ordinary watercourses)
- **Surface water** - PCC (LLFA)
- **Public Sewers** - SWW
- **Groundwater** - LLFA

The Plymouth LFRMS sets out the principles by which these RMAs will manage these risks, namely:

- Effective planning of new development, taking current and future flood risk into account
- The improved management of surface water for future developments
- Ensuring Sustainable Drainage Systems (SuDS) meet PCC and national design criteria.
- A consistent standard of flood defence, within practical and financial limitations

This document is supported by the Local Flood Risk Management Strategy Part 2 – Technical Guide.
How often will floods happen?

Because it is difficult to predict the frequency and scale of a flood event, we talk about future flood events in terms of the likelihood, or probability, of a flood of a particular scale occurring at a particular time. More serious events happen less frequently and so have a lower probability of occurring.

For example, a large-scale flood may have a 1% probability of happening in a year. This is also expressed as on average we would expect to experience a flood of this scale once every 100 years. This is sometimes referred to as a 100 year flood event, but this does not mean that it will happen precisely every one hundred years, the interval between these events could be longer or much shorter than 100 years.

These probabilities are used as thresholds to help us to understand risk. For example, we might say that a flood defence structure provides a flood protection of a 1 in 100 year event, or a one in 200 year event. In these terms it is important to understand the likelihood of these thresholds being exceeded, so engineers will talk in terms of ‘exceedance’, or Annual Exceedance Probability (AEP). Table 1 below illustrates the terminology.

<table>
<thead>
<tr>
<th>Chance of flooding occurring in any given year (Annual Exceedance Probability - AEP)</th>
<th>Equivalent Return Period</th>
<th>Frequency</th>
<th>Flood Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>1 in 1 year (annually)</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>50%</td>
<td>1 in 2 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>1 in 5 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>1 in 10 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4%</td>
<td>1 in 25 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2%</td>
<td>1 in 50 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1%</td>
<td>1 in 100 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2%</td>
<td>1 in 500 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1%</td>
<td>1 in 1000 years</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Terminology of probability and risk

---

2. Flood risk in Plymouth

Flooding threatens to cause increasingly frequent and severe disruption in Plymouth to people and to businesses1. This section outlines the flood risk according to its source, and its location.

Sources of Flooding

The flood risk in Plymouth is from four sources, which can combine at certain times and places:

- **Tidal** – flooding from the sea as a result of storm-driven tidal surges and wave height. The majority of the City is elevated above the level at risk of flooding from the sea, however low lying coastal areas are at risk from tidal flooding, with the exposed coastal frontages at risk from flooding caused by the overtopping of large waves.

- **Fluvial** – rivers and streams can overtop their banks after heavy rainfall because of insufficient channel capacity, blocked culvert screens or channel restrictions. Development within the floodplains of many of the watercourses that flow through the City area put those properties at risk of fluvial flooding.

- **Surface water** - Due to the amount of hard surfacing in the city which prevents rainwater soaking into the ground, the city relies on surface water sewers to discharge this water to surrounding watercourses and the sea. The majority of the sewers are ‘combined’ and carry foul and surface water. When the capacity of a sewer is exceeded water flows overland towards lower ground which can result in flooding of property and infrastructure. Because of the large amount of combined sewerage, the Environment Agency have identified most of the urban area of Plymouth as a ‘Critical Drainage Area’ (CDA), where the existing drainage system is considered to be at or close to its capacity. Development in these CDA areas is subject to higher standards for surface water management.

- **Groundwater** - Groundwater flooding occurs as a result of water rising up from the underlying rocks or from water flowing from springs, typically after periods of sustained rainfall. Groundwater flows can continue for some time after the rainfall event. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels.

It is the City Council’s view that it is not the responsibility of the City Council to manage groundwater problems on private land. It is the responsibility of individual householders to prevent groundwater from entering their property. Should it be determined that the groundwater has been diverted onto a property
by artificial means by Third Parties, and that it is having detrimental effect upon the property, then the City Council does have legislative powers to take action against those Third Parties.

**Adapting to Climate Change**

Research predicts that climate change will have direct consequences for flood risk. Flood risk is anticipated to increase as a result of higher sea levels and increased intensity of storm events. In planning for Plymouth’s future, it’s important to consider these increased risks. Allowances for climate change are divided into different epochs, and the projections used for sea level rise and storm events, as recommended by the National Planning Policy Framework, are shown in Table 2:

<table>
<thead>
<tr>
<th>Table 2. Climate change projections (Climate change allowances for planners. Environment Agency 2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1990 - 2025</strong></td>
</tr>
<tr>
<td>Sea level rise*</td>
</tr>
<tr>
<td>Rainfall intensity</td>
</tr>
<tr>
<td>River flows</td>
</tr>
<tr>
<td>Wave heights</td>
</tr>
</tbody>
</table>

*Net sea level rise (mm per year)

It’s predicted that rainfall events will increase in intensity (i.e. more rain will fall in a shorter space of time). We also expect that these severe events will happen more often. This means an increase in surface water run off that can cause watercourses in the city to overtop, and sewers to be overwhelmed.

An example of an intense storm is one that affected Coverack in Cornwall in 2017, where 200mm of rain fell in three hours, flooding 50 properties. To date, this is the most intense storm ever recorded in the UK.

As a result of warming oceans and the melting of arctic sea ice we expect sea levels to continue to rise. We also expect more storms of greater intensity (e.g. stronger winds and larger waves). The combination of these two factors greatly increase the risks of coastal flooding through higher sea levels and the overtopping of coastal flood defences, and an increase in the duration of the prevention of surface water discharge from sewers, known as tidelocking. Coastal properties will also be more vulnerable to storm damage from large waves and associated debris.

In order to adapt to these expected effects of climate change, we need to:

- consider carefully where new development is located
- make development more resilient to flood risks and storm events
- improve the capacity of the sewer system to drain surface water
- divert surface water from the drainage system through installing new surface water drains to replace combined sewers
- apply sustainable drainage systems to new development and consider retrofitting in high risk areas.
3. Tidal Flooding in Plymouth

This section summarises the nature of flooding from the sea across Plymouth:

- Plymouth has over 60km of coastline from Tamerton Lake to Jenniclliff Bay including the Tamar and Plym estuaries.
- Tidal flooding is most often the result of extreme high tides which may combine with tidal surges and storm events. The Plymouth shoreline is also vulnerable to wind and wave action that can lead to overtopping of defences.
- Tidal flooding affects residential and commercial property, key strategic transport links and critical infrastructure.
  - Areas that have the greatest number of properties at risk from tidal flooding are Barbican (Sutton Harbour), Marsh Mills and Stonehouse.

Other areas at risk include:

- Millbay and parts of Union Street
- Hooe
- Oreston
- Devonport (Torpoint Ferry slipway)
- Marsh Mills
- The Ride (Saltram)
- Turnchapel
- Embankment Road & Laira
- West Hoe
- Stonehouse Pool
- Royal William Yard
- Little Ernesettle.

- There are key tidal flood defences at:
  - Sutton Harbour lock gates
  - Marsh Mills (Longbridge Road/Marsh Close)
  - Mount Batten breakwater
  - Plymouth Sound Breakwater
  - Royal William Yard.

- Areas with the lowest standard of protection are the Barbican (Sutton Harbour), Turnchapel, Hooe, and Oreston.
- Areas with flood defence assets in the poorest condition are Embankment Road, The Hoe, Oreston and Hooe
- High tide levels can prevent surface water outfalls from discharging to the sea. This ‘tide locking’ effect can increase fluvial or surface water flooding.
The Plymouth Coastal Modelling Study

- A Plymouth Coastal Modelling Study (2018) undertaken by the Environment Agency assessed the current and future wave climate in Plymouth Sound. The study investigated how offshore storm waves interacted with the Plymouth shoreline, also assessed the roles of the Plymouth and Mount Batten breakwaters.

- The study found that wave overtopping can contribute to surface water flooding and increase the risk of flooding for some parts of Plymouth where water is trapped behind sea defences. There is also a risk of damage and risk of harm to people.

- The study also identified which areas are at risk under different storm conditions. Key facts from the study are:
  - The majority of Plymouth’s coastline is at an increased risk of coastal flooding when offshore waves are travelling from the south.
  - There are a number of areas adjacent to Plymouth’s foreshore at risk from surface water flooding and this flooding is increased by wave overtopping and tidal flooding.
  - Removing Plymouth Breakwater leads to higher energy wave conditions within Plymouth Sound between the mouths of the River Tamar and the River Plym.
  - Removing Mount Batten Breakwater increases the wave climate between Sutton Harbour and along the River Plym.

- Figure 1 shows the areas at risk from tidal flooding and identifies which areas have an increased risk of flooding from wave overtopping.
Figure 1. Tidal flood risk areas and wave overtopping areas
**Future tidal flood risk:**

Current climate change scenarios predict an increase in sea levels and severity of storms around Plymouth. This is likely to increase the risk of tidal flooding for more properties.

- Figure 2 shows the location of current and future tidal flood risk in the city.
4. Fluvial Flooding in Plymouth

This section summarises the nature of flooding from rivers and watercourses across Plymouth:

- There are a total of 137 km of watercourses in Plymouth, with 106 km designated as ordinary watercourse.
- Fluvial flooding in Plymouth has the potential to affect residential and commercial property, key strategic transport links and critical infrastructure.
- Due to the steep topography of Plymouth, watercourses can respond extremely rapidly to rainfall such that watercourse levels can rise and cause flooding with little warning, often known as flash flooding. These areas are defined as ‘Rapid Response Catchments’ by the Environment Agency.
- Key areas at risk from fluvial flooding are:
  - Plympton, associated with the Tory Brook and Long Brook, and Borringdon Stream and Chaddlewood Stream,
  - Marsh Mills associated with the River Plym
  - Tamerton Foliot
  - Weston Mill
  - Stonehouse, associated with the Pennycomequick Stream
  - Billacombe Brook, Plymstock

- ‘Critical Culverts’ and key fluvial flood defences located on Plymouth’s watercourses have been identified in the LFRMS. These features and assets play an important role in flood defence and need to be maintained to reduce the risk of flooding to property, critical infrastructure and transport links.
- High watercourse levels can prevent highway drainage and surface water outfalls from discharging and may increase or cause additional surface water flooding.
- Figure 3 details the location of fluvial flood risk in the city and of the critical culverts which are most sensitive to flood events.

Plymouth City Council is working with the Environment Agency to improve our understanding of fluvial flooding in Plymouth. This includes carrying out detailed surveying of the rivers and watercourses and using this information to produce hydraulic models that can more accurately predict the areas at risk from flooding and the nature of flooding itself, including depths and velocity.
Figure 3. Fluvial flood risk, showing critical culverts (i.e. culverts most sensitive to flood events)
5. Surface Water Flooding in Plymouth

This section summarises the nature of flooding from surface water run off caused by intense rainfall Plymouth:

- Plymouth is mainly urban with large impermeable areas which, combined with steep-sided catchments, leads to high rates and volumes of surface water run-off. This causes watercourse and drainage systems within the catchment to respond rapidly to rainfall events leading to the hydraulic overloading of the sewerage and drainage systems.
- Surface water flooding in Plymouth has potential to affect residential and commercial property, key strategic transport links and critical infrastructure.
- Plymouth has a significant number of combined sewerage systems that take both foul and surface water flow. These sewers can be overwhelmed due to the large surface water flows entering the system. This ‘surcharging’ of the combined sewers can lead to sewage spills and flooding and the operation of Combined Sewer Overflows (CSO’s) which can have pollution implications.
- Pollution from surface water flooding can have a significant detrimental impact on Bathing Water Quality at designated bathing beaches at East and West Hoe.
- Surface water flooding can be linked to fluvial and tidal flooding where high watercourse and tide levels can prevent surface water outfalls from discharging, causing additional or prolonged flooding. Sea water can infiltrate the sewer network and reduce the capacity for surface water storage and conveyance.
- The majority of Plymouth has been designated by the Environment Agency as a Critical Drainage Area where the sewerage system is at or over its acceptable limit.
- PCC has identified 14 Locally Significant Areas at risk from flooding at:
  - Colebrook and Golden Square
  - Longbridge Road, Plympton
  - Stenlake Place, Laira
  - Laira Avenue
  - Union Street & Octagon
  - St Levan Road, Keyham
  - Lipson Road, Greenbank
  - Wellhay Close, Elburton
  - The Broadway, Plymstock
  - Dean Cross, Plymstock
  - Billacombe Road, Plymstock
  - Market Road, Plympton
  - Edgcumbe Avenue, Stonehouse
  - Elburton Road, Plymstock.
The Plymouth Preliminary Flood Risk Assessment (PFRA) Review in 2017 identified 1km square areas at significant risk from surface water flooding, where residential properties, and or critical infrastructure is at risk. Figure 4 shows the location of the PFRA 1km ‘Blue Squares’.

PCC has defined a ‘Local Significant Area for Surface Water flooding’ as where there are 10 residential properties or one critical infrastructure asset (e.g. railway, hospital) is at risk (as recorded on the National Receptor Dataset).

Details of plans for managing surface water for these ‘Blue Square’ areas are included in the Local Flood Risk Management Strategy Part 2 – Technical Guide.

Figure 4. PFRA Areas
**Integrated Urban Drainage Model (IUDM)**

Plymouth City Council is working with South West Water and the Environment Agency in a joined up approach to collectively reduce the risk of flooding in Plymouth.

SWW have, with contributions from PCC and the EA, developed an Integrated Urban Drainage Model (IUDM), which is a computer modelling tool used to manage flood risk from all sources. This helps identify existing risk management development options for urban areas.

The IUDM is driven by the need to reduce the impact of polluted sewer discharges on bathing water quality, the water environment in general and flooding from surcharged sewers.

There are ten IUDM areas currently in progress and these are shown in Figure 5.

![Figure 5. IUDM Area in Plymouth](image-url)
6. **Flood Risk Management in Plymouth**

**Local Flood Risk Management Strategy**

Plymouth has been divided into 16 water catchment areas, defined by the hydrology of each catchment. The catchments are shown in Figure 6.

![Figure 6 Local Flood Risk Management Strategy Catchments](image)

The flood mechanism and flood risk for each catchment has been assessed and the flood Issues, Objectives and Strategy for each catchment has been identified and reviewed.
Properties at Risk from Flooding

The estimated number of residential and commercial properties at risk of flooding in Plymouth for different types of flood event is shown in Table 2.

Table 2. Number of Properties at risk of flooding in Plymouth

<table>
<thead>
<tr>
<th>Source of flooding</th>
<th>Flood Event (Flood Zone 3)*</th>
<th>Number of properties at risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal only flooding</td>
<td>0.5 % AEP 1 in 200 year return period</td>
<td>962</td>
</tr>
<tr>
<td>Fluvial flooding from Main Rivers</td>
<td>1 % AEP 1 in 100 year return period</td>
<td>441</td>
</tr>
<tr>
<td>Surface water flooding** (including ordinary watercourses)</td>
<td>1 % AEP 1 in 100 year return period</td>
<td>5047</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>6450</td>
</tr>
</tbody>
</table>

*Flood Zone 3 is land having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of tidal flooding. Flood Zone maps are published and updated by the Environment Agency.

** May include some dwellings that are also at risk from fluvial and/or tidal flooding

Note: Property numbers based on National Receptor Dataset and EA flood mapping

Infrastructure Flood Risk

Flooding also presents risks to key transport road and rail links and utilities such as gas, water, and electricity infrastructure.

Environment Agency flood risk mapping indicates that there is 21km of resilient road network in Plymouth in Flood Zone 3, and at risk from fluvial or tidal flooding (1% AEP (1 in 100 year return period) for fluvial flooding, 0.5% AEP (1 in 200 year return period) for tidal flooding.

Surface water flood risk mapping indicates that there is 86.6km of resilient road network at risk from flooding from a 1% AEP (1 in 100 year return period) flood event, with 56.1km at risk of depths greater than 150mm.

Figure 7 shows how the estimated properties at risk from flood risk areas around Plymouth.
Figure 7 Estimated Properties at risk from flooding
7. Catchment-based summaries

The Plymouth Local Flood Risk Management Strategy identifies all the water catchments in Plymouth. All water catchments in Plymouth are affected by flood risk from one or more sources.

For detailed maps and information on the Issues, Objectives and Strategies for each catchment, refer to the LFRMS (Part 2) Technical Guide.

The location of the catchments, and the issues which characterize them are indicated in Figure 8 and summarised in the following paragraphs by catchment.
Figure 8 Local Flood Risk Management Strategy Catchments Summaries
Crownhill catchment

The Crownhill catchment is at risk from surface water flooding which requires management of drainage (through the use of sustainable drainage systems for new developments) and sewerage networks to reduce this risk. There is also a history of flooding and pollution incidents in the Forder Valley Stream. Surface water improvements have been made to reduce flooding in Forder Valley Road, and drainage improvements as part of the Forder Valley Road Improvements aim to reduce flooding and improve water quality in the Forder Valley Stream.

Dockyard catchment

There is a high risk of surface water flooding, particularly around the St Levan road area. There is risk of tidal flooding and wave overtopping affecting the ferry slipways from Devonport to Torpoint, and adjacent Ministry of Defence land.

Hamoaze catchment

The area around Wolseley Road and Weston Mill is at risk from flooding from surface water due to the limited capacity of the combined sewerage system and ‘tide-locked watercourses and outfalls. Watercourse improvements have been made to protect properties in Honicknowle Lane. The areas around Riverside, the Dockyard, and Little Ernesettle are at risk from wave overtopping and future tidal flooding, associated with sea level rise.

Marsh Mills catchment

The flood risk from the River Plym and from tidal flooding is significant in the May’s Marsh and Marsh Mills area, and particularly for transport infrastructure (Marsh Mills roundabout, the railway line and the B3416) Much of the area is predicted to flood to a depth of 1.5m or greater during a 1 in 200 year (0.5% AEP) tidal flood event in 2110. This severity of flooding is significantly higher than now, increasing because of the predicted effects of sea level rise.

Flooding in this area is managed by raised flood banks and walls, however there are risks that these could be overtopped without ongoing maintenance and upgrades.

Surface water flooding is also a risk in Laira Avenue and Lipson Vale as they are low-lying and surface water outfalls can be tidelocked during high tide events, making it difficult to drain rain water away. Individual property protection for high risk properties is being employed while a broader strategy to reduce the risk of flooding is developed with SWW and the EA.
Millbay and City catchment

Millbay is a tidal inlet much of which has been reclaimed and now comprises the eastern end of Union Street and the Octagon area. It is very low-lying and sewers can become tide-locked preventing surface water from draining away during high tides.

There are areas of tidal flood risk in the immediate vicinity of the docks, the extent of which and the depth to which they flood will increase over time with sea level rise. The Plymouth Coastal Modelling Study indicates that any wave overtopping is likely to drain back to the sea without penetrating inland. Future sea level rise presents a risk of overtopping of sea defences leading to flooding in Bath Street, Martin Street, and Union Street/Octagon. This risk of tidal flooding has been mitigated with defences comprised of raised ground levels in connection with new developments in Millbay.

Sewerage capacity has been improved with improvement works on Millbay tanks, which increases the capacity to store surface water which cannot be discharged to the sea. Improved surface water sewer infrastructure is planned to improve the capacity of the sewers and to separate surface water from foul and combined sewers.

Plym Valley catchment

The sources of flood risk in this catchment are from fluvial and surface water run-off, plus tidal flooding in the south of the catchment. In the south, residential properties in Marsh Close and Longbridge Road area are at risk from tidal flooding from the River Plym.

In the north of the catchment there are operational sewerage system issues around Glenholt and the Glenholt pumping station which have caused some pollution incidents in the River Plym. SWW are upgrading the Glenholt pumping station.

SWW have investigated urban diffuse pollution incidents and identified situations where private foul sewerage has been incorrectly connected to the surface water drainage network.

Plympton Longbrook catchment

This catchment is at risk from tidal, fluvial and surface water flooding. The main issue is surface water causing flooding due being unable to get into the Long Brook, rather than the Long Brook overtopping. The catchment is recognized as having a rapid response to rainfall, and there are also issues from agricultural land run off causing algal growth and pollution of watercourses.

Flood risk can be reduced by improving the surface water connection to and the capacity of the Long Brook, and reducing the tidal influence on the existing sewerage and drainage systems.
SWW have developed an IUDM model for this area to help identify existing risk management development options.

**Plympton Tory Brook catchment**

The flood risk in this catchment is from fluvial sources such as the Tory Brook, Stoggy Lane Stream, Chaddlewood Stream and Boringdon Stream which are all designated as Main River watercourses and managed by the Environment Agency. There is also a risk of flooding from surface water run-off and inadequate combined sewerage capacity.

The watercourses in this catchment respond rapidly to rainfall which limits flood warning options, however flood risk can be managed by improving the capacity of the watercourses and separating surface water from the combined sewerage network.

SWW have developed an IUDM model in this catchment to help identify existing risk management development options. Surface water improvements have been completed to reduce the risk of surface water flooding Colebrook and Golden Square.

**Plympton Woodford catchment**

Flood risk is mainly from fluvial and surface water sources, which may be exacerbated by blockage of structures.

**Pomphlett Lake catchment**

There is a risk of tidal flooding around Oreston, Hooe and Turnchapel which is predicted to increase in the future with predicted sea level rise. Wave overtopping at Oreston can also increase surface water flooding. The Plymouth Coastal Modelling Study indicates that the Mountbatten breakwater provides protection from waves propagating from the open sea into the Cattewater. A risk of large waves causing overtopping and flooding behind Batten Bay has been identified in the Plymouth Coastal Modelling Study.

There is a risk of surface water flooding in the rest of the catchment, particularly in Dean Cross, Billacombe Road and the Broadway which is caused by insufficient sewerage capacity. Pollution from this catchment impacts on Bathing Water quality at Plymouth’s designated bathing beaches, so the potential for this should be reduced.

SWW have developed an IUDM model in this catchment to help identify existing risk management development options.

**Royal William Yard catchment**

This catchment is at risk from tidal flooding, specifically around Cremyll Street and Royal William Yard which is increased by wave overtopping. This risk would be expected to increase as sea levels rise due to the impacts of climate change.
Saltram catchment
This is a predominantly rural catchment with existing natural flow routes, though there is significant residential development in the south of the catchment. There is a risk of tidal and fluvial flooding from the River Plym along the Ride. A potential source of pollution is from Chelson Meadow and future development, which would impact on Bathing Water quality at Plymouth’s designated bathing beaches.

Stonehouse Creek catchment
The Pennycomequick Stream is culverted watercourse for most of its length from Milehouse to Stonehouse Creek. The culverted nature of this watercourse causes problems as water can only enter into the culvert in specific areas. The culvert also has a finite capacity and flooding occurs during times of heavy rain when the capacity is exceeded. Flooding also occurs when the flap valves at Stonehouse Bridge are either not working properly or are locked by high tides and the Pennycomequick Stream cannot discharge.

Sutton and Laira catchment
This area is affected by flood risk from fluvial and surface water sources. The high land in this area is impacted by surface water flooding flowing into urbanised valleys and the watercourses close to Embankment Road are constrained by long culverts. The ability for these watercourses to discharge into the Plym Estuary is impeded during high tides and during periods of tidal flooding.

Surface water flooding is also an issue on Embankment Road and Gdynia Way, which can be exacerbated by high tidal water levels and wave overtopping.

On the Western bank of the Plym estuary there is a risk of tidal flooding to key infrastructure (railway main line, Laira Depot railway sidings and works, and Embankment Road), to areas identified for possible development, and existing residential areas such as Stenlake Terrace. Much of this area is predicted to flood to a depth of 1.5m or greater during a 0.5% AEP tidal flood event in 2110. A section of flood wall adjacent to the highway mitigates some of this risk.

The Barbican area (Sutton Harbour) is at risk from tidal flooding and is currently protected by a tidal flood gate. This area is susceptible to deep flooding should the flood defences fail and the upgrade in their level is required due to the predicted impact of sea level rise. Mountbatten breakwater also provides protection to Sutton Harbour from waves from the open sea.

At West Hoe, wave overtopping can increase the depth and extent of surface water flooding around Pier Street and Radford Road.
**Tamerton Lake catchment**

The watercourse flowing through Tamerton Foliot is raised above the bottom of the valley. If flood water leaves the channel in this area it flows overland and can lead to flooding of residential and commercial property, before rejoining the watercourse once it returns to the valley bottom. There is limited sewerage capacity and discharging CSOs cause pollution. Also this is a steep catchment that responds very quickly to rainfall.
8. The Local Flood Risk Management Strategy

Plymouth and South West Devon Joint Local Plan (DEV37 - Managing flood risk and water quality impacts) and the Local Flood Risk Management Strategy incorporate and build upon the Plymouth Preliminary Flood Risk Assessment (PFRA) and Strategic Flood Risk Assessments (SFRA). These should be considered with the PFRA and SFRAs together as meeting the requirements of the Flood and Water Management Act 2010 and the National Planning Policy Framework to provide evidence to manage flood risk in the form of a local flood risk management strategy. It also constitutes a supporting document for the Plymouth and South West Devon Joint Local Plan, which will replace the Core Strategy as the local development plan for Plymouth.

**Objective**
To reduce the risk of current and future flooding in Plymouth, providing protection to people, places and property.

**Strategic Framework**

PCC will maintain a strategic framework that allows the City’s flood risks to be documented and understood, and for flood risk management authorities to co-ordinate activities, share knowledge and develop effective flood risk management solutions for the City.

This framework comprises partnership working arrangements, a programme of studies and investigations, policies to guide decision-making, and arrangements for coordinated implementation.

**The Partnership Approach**

Plymouth City Council, South West Water and the Environment Agency (the Risk Management Authorities: RMAs) will collaborate in managing flood risk and managing flood protection assets by means of regular liaison meetings at technical and strategic level (no less than twice per annum).

PCC will review the strategy at 5 yearly intervals to ensure that changes in local circumstances and improvements in knowledge regarding flood risk are taken into account in flood risk management.
Investigations and Evidence

1. PCC will investigate events in which 10 or more dwellings are flooded or one or more critical service\(^2\) affected. This information will be used to identify causes and help in defining solutions and prioritising works.

2. Registers are kept of flood management assets for ordinary (PCC) water-courses and tidal defences (PCC) to ensure that information is available to enable prioritisation and planning of works, and strategy revision.

3. PCC, EA, SWW collaborate in commissioning studies to inform combined work priorities.

---

\(^2\) Critical Services (as defined in PFRA):
EA critical service location is based on information contained within the NRD dataset. This data includes all critical services considered to be nationally significant. A review has been undertaken with Plymouth City Council’s Civil Protection Unit to ensure that it contains all critical service information that is relevant for Plymouth.
Policy

1. **Standards of protection.** PCC will require/maintain a standard of protection for new works in Plymouth of 1% AEP with a 40% allowance for climate change for fluvial flooding and surface water drainage. Tidal defences are required to provide a minimum level to 4.81 m AOD.

2. **Sustainable drainage systems (SuDS).** PCC require sustainable urban drainage for all new developments in a Critical Drainage Area or where there are concerns regarding flooding, in accordance with National Planning Policy Guidance. In addition, the proposed drainage system should conform to the requirements of Plymouth’s Local Flood Risk Management Strategy Part 2: Technical Guide (which may set a higher standard in response to local circumstances). Arrangements should be put in place to ensure maintenance sufficient to preserve system performance over the life-time of the development.

3. **Coastal defences.** Plymouth’s shoreline is made up of hard defences interspersed with small sections of natural shore that is subject to coastal erosion. The preferred policy to the year 2105 identified in the South Devon and Dorset Shoreline Management Plan from Mount Batten breakwater to Tamerton Lake is ‘Hold the line’, and defences will be maintained in line with this policy subject to the availability of funds. The small section of undeveloped coast to the south of Mountbatten Breakwater (Batten Bay and Jennicliff Bay) is subject to a ‘no active intervention’ policy.

4. **Development Planning and Regeneration.** PCC will take flood risks into account in planning for future development, by applying the sequential test as required in the National Planning Policy Framework (NPPF), and through requiring the submission of Flood Risk Assessments and sustainable drainage strategies where deemed necessary.

Implementation

1. Annual assessment to guide the implementation of these priorities will be undertaken at a catchment scale, in relation to:
   - needs arising from flood incidents (assessed as they arise)
   - opportunities to align works and funding as development takes place
   - opportunities to align scheduling and funding of schemes by RMAs, to enhance the overall reduction of flood risk, the cost effectiveness of works, and the optimization of wider benefits.

2. PCC has identified designated features and structures as flood management assets where appropriate, and will control works that may impact upon the flood management function of any asset through a consents process. The criteria for designating critical assets are set out in Part 2: Technical Guide. This is to ensure that the standard of protection for the city is not diminished.