

# Section 19 Flood Investigation Report

Llansteffan, Carmarthenshire

JUNE 2024

FINAL REPORT



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This report dated 25 June 2024 has been prepared for Carmarthenshire County Council (the "Client") in accordance with the terms and conditions of appointment dated 22 March 2024 (the "Appointment") between the Client and **Arcadis Consulting (UK)** ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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## Acronyms and Abbreviations

CCC	Carmarthenshire County Council
DCWW	Dŵr Cymru Welsh Water
DPP	Dyfed–Powys Police
FEH	Flood Estimation Handbook
LLFA	Lead Local Flood Authority
NRW	Natural Resources Wales
RMA	Risk Management Authority
S19	Section 19 (report)

## Glossary

Word	Meaning
Catchment	An area in which the rainfall drains to a single watercourse
Lead Local Flood Authority (LLFA)	County councils and unitary authorities which lead in managing local flood risks
Main river	Usually a larger river or stream, defined in law as shown on a Main River Map. Natural Resources Wales has responsibility and powers for these in Wales.
Ordinary watercourse	A watercourse that does not form part of a main river
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority	A Welsh Risk Management Authority is defined in Section 6 of the Flood and Water Management Act 2010 as Natural Resources Wales (NRW); the 22 Local Authorities as Lead Local Flood Authorities (LLFA) and highway authorities; water companies operating in Wales (of which there are currently 4); and the Welsh Government, as highway authority for trunk roads.
Surface water flooding	Also called pluvial flooding. Flooding from surface water runoff as a result of high intensity or prolonged rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.

Fluvial flooding      Flooding as a result of the water level in a river, lake or stream rising and overflowing onto the surrounding banks, shores and neighbouring land.

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Non-return valve      A valve installed on drains that allows fluid to flow through it in only one direction. It is commonly used to prevent surcharge coming up through drainage systems into properties.

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Return period      A standard metric used to assess the occurrence and extent of a flood event, which corresponds with the probability of a flood event in the form of “1 in x year”. For example, a 1 in 100 year flood event has a 1% chance of being exceeded in any year.

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## Executive Summary

On 30 December 2023 and 2 January 2024, Storms Gerrit and Henk landed in the UK, bringing heavy rainfall across Wales. These storms caused localised rainfall and significant flooding in the village of Llansteffan and the surrounding areas, with the most impacted households facing up to 2 feet of internal flooding.

In line with Section 19 of the Flood and Water Management Act 2010, Carmarthenshire County Council (CCC) as the Lead Local Flood Authority (LLFA), has commissioned Arcadis Consulting to undertake an investigation into these flood events. This work has been overseen by a multi-agency project board consisting of CCC, Natural Resources Wales (NRW), Welsh Water (DCWW) and Mid and West Wales Fire Service (MWWFS). This report presents the findings from that investigation.

Several flooding mechanisms were identified, depending on the location of the properties, whether at The Green, upstream of The Green, or at Ferry Point. The flood was generally a result of increased surface water flows in various watercourses. Flooding was also worsened by the fact that the outfalls draining the surface water drainage system onto the beach were buried under sand and thus floodwater from the first storm wasn't drained before the second flood.

While all relevant Risk Management Authorities and emergency services responded during and after the flooding, co-ordination and communication could have been more effective.

In light of the findings of this flood investigation a suite of recommendations for the Risk Management Authorities is presented, ranging from flood risk management measures and community resilience to ongoing maintenance and operational activities. The anticipated timescales for delivery of the recommendations range from short-term to long-term and are detailed in this report.

# 1 Scope and objectives

## 1.1 Background to the investigation

On 30 December 2023 and 2 January 2024 flooding occurred in the Nant Jac watercourse catchment, this was predominantly in the village of Llansteffan, Carmarthenshire, but also in the surrounding area of Ferry Point and the associated catchment of an unnamed watercourse. For the purposes of this report, these together represent “the Llansteffan area”.

Carmarthenshire County Council (CCC) as the LLFA has a responsibility to record and report flood incidents as detailed within Section 19 (S19) of the Flood and Water Management Act 2010:

### Section 19

- (1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—
  - a. which risk management authorities have relevant flood risk management functions, and
  - b. whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.
- (2) Where an authority carries out an investigation under subsection (1) it must—
  - a. publish the results of its investigation, and
  - b. notify any relevant risk management authorities.

Further guidance from Welsh Government has stipulated that reports should be produced for flooding incidents where 20 or more properties experience internal flooding. On that basis, CCC has produced this Section 19 report on the flooding that affected the Llansteffan area for the flood events in which over 20 houses were impacted on both 30 December 2023 and 2 January 2024.

## 1.2 Methodology

As part of the preparation of a Section 19 report for the 30 December 2023 and the 2 January 2024 flood incidents, CCC commissioned Arcadis Consulting to compile an account and analysis of the meteorological and hydrological event data. This analysis will support understanding and communication of the flood event and provide an estimate of the event frequency.

This investigation has been undertaken using a combination of desk and site-based studies to better understand the potential causes of the flooding in the Llansteffan area on those dates. This includes reviews of existing asset information, news reports, footage and photographs of the flooding. In addition, face to face community engagement sessions were undertaken with the affected community (09 and 10 April 2024).

The key tasks for this study were:

- Collect and collate hydrometric datasets and any other relevant data / information.
- Site visit on 20 March 2024

- Review, quality check and analyse all data. Undertake a technical assessment of the data, extracting and visualising key parameters such as storm duration estimates and telemetry data from the surface water drainage system.
- Estimate and document the event frequency from rainfall data to provide a probable range in which the events lie.
- Engagement with the local community and partner organisations to understand the potential mechanisms and impacts of the flood events.
- Make appropriate recommendations and actions based on the Section 19 technical assessment of the flood events.

### 1.3 Risk Management Authorities (RMAs) and stakeholders

#### 1.3.1 Lead Local Flood Authority (LLFA)

The LLFA for the Llansteffan area is CCC, with responsibility for the management of local sources of flood risk - surface water, groundwater and ordinary watercourses in the county. CCC is a Category 1 responder under the Civil Contingencies Act and works in partnership with other flood and coastal RMAs and stakeholders.

#### Carmarthenshire County Council Statutory Duties

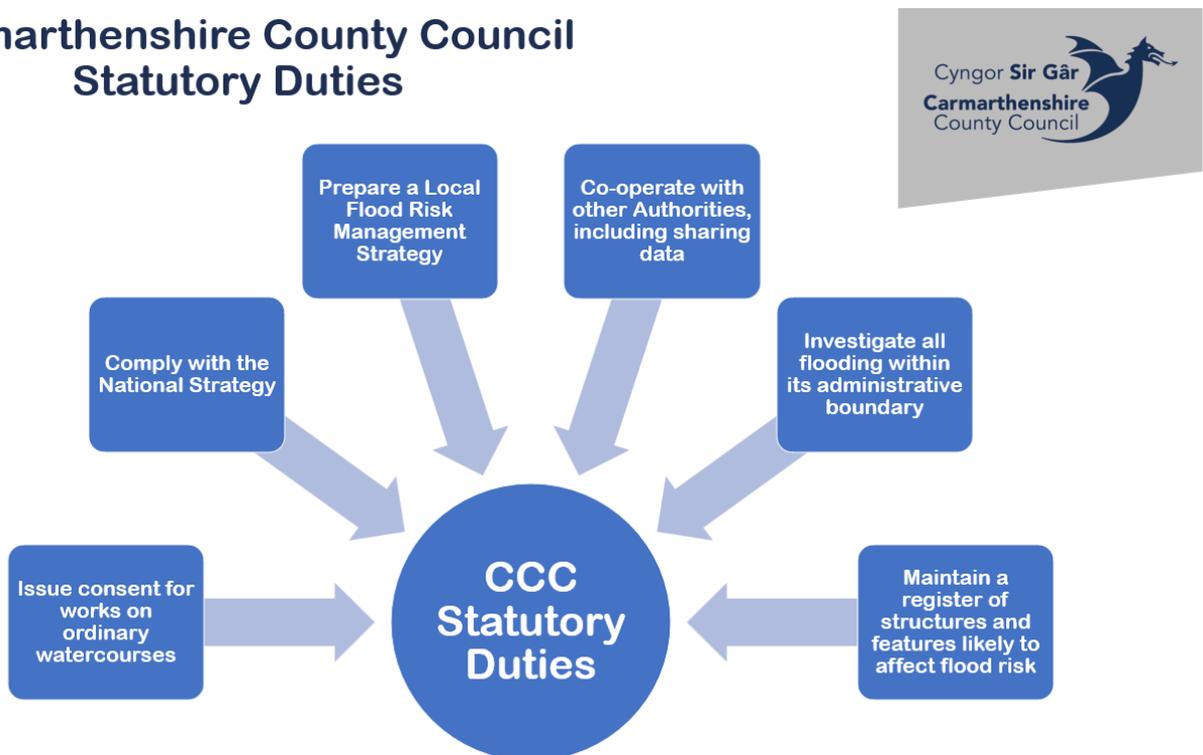


Figure 1-1: Statutory Duties of CCC as an LLFA

#### 1.3.2 Highways Authority

Any flooding on and from highways is the responsibility of and managed by the Highways Authority, which is CCC.

### **1.3.3 Natural Resources Wales (NRW)**

NRW is the body responsible for managing flood risk from main rivers and the sea.

### **1.3.4 Water Utility Company**

Dŵr Cymru Welsh Water (DCWW), as the water utility company, is responsible for managing flood risk from foul, combined and water sewers which they own.

### **1.3.5 Landowners and riparian owners**

Landowners and riparian owners are not statutory risk management authorities. However, they have a responsibility to maintain any natural or artificial channel above or below ground through which water flows e.g. a stream or any culvert. Riparian owners can find further guidance on their responsibilities as landowners in the NRW document “[A guide to your rights and responsibilities of riverside ownership in Wales](#)”.

## 2 Catchment background information

### 2.1 Site Location

This Section 19 report covers Llansteffan and the surrounding community, or “the Llansteffan area”, as shown in Figure 2-1. Llansteffan is a village and community situated on the south coast of Carmarthenshire, Wales, lying on the estuary of the Afon Tywi/River Towy, 11 km south of Carmarthen. Llansteffan village has a population of approximately 424 residents. Ferry Point is located approximately 1 km north-east of Llansteffan and the community is comprised of a small number of residential dwellings and holiday homes. Together these represent “the Llansteffan area” for the purposes of this report.

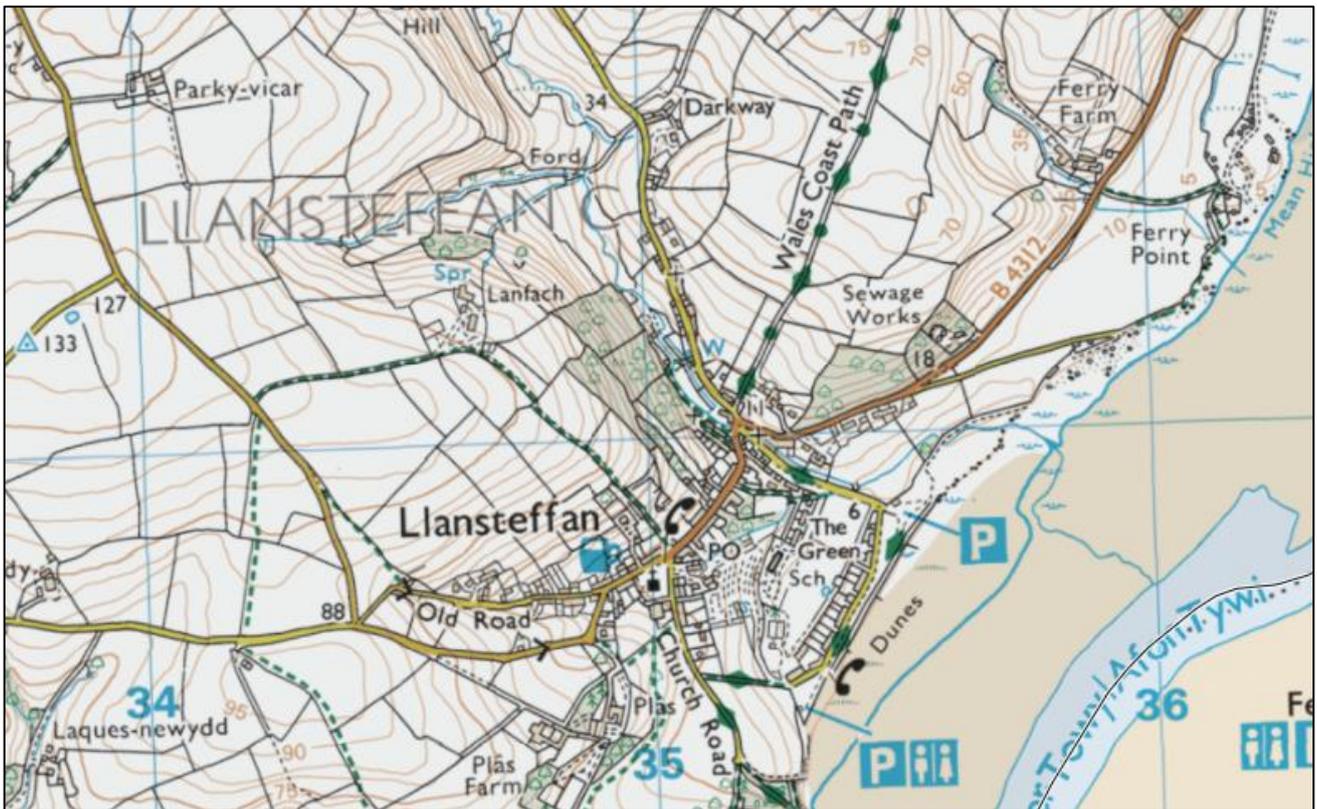


Figure 2-1: OS Map extract of Llansteffan and the surrounding area. Contains OS data © Crown Copyright and database right 2020

### 2.2 Catchment Summary

#### 2.2.1 Topography

Llansteffan is a low-lying coastal community leading up to agricultural areas at higher elevations. The area is influenced by the valleys associated with the watercourses which flow down from the hills upstream into the Towy Estuary. The local topographic context has been assessed using Lidar Data available from the Welsh Government LiDAR viewer.

Local low points have also been identified in Llansteffan. The natural topography has resulted in surface water flowing into and ponding in the Morfa, a marshy playing field that is adjacent to The Green and bounded by Water Lane and Glan-Y-Mor situated at higher elevations. The properties along The Green are located at the bottom of a natural topographical bowl at the lowest elevation in the area and this makes the area susceptible to flood risk from a number of sources, including surface water, fluvial and tidal flooding. The lowest ground level of the properties along The Green is 4.730 mAOD.

The DCWW Sewage Pumping Station is located at a low point behind the Green and due to the elevation the system operates by pumping its contents out of the village to the surrounding sewage network.

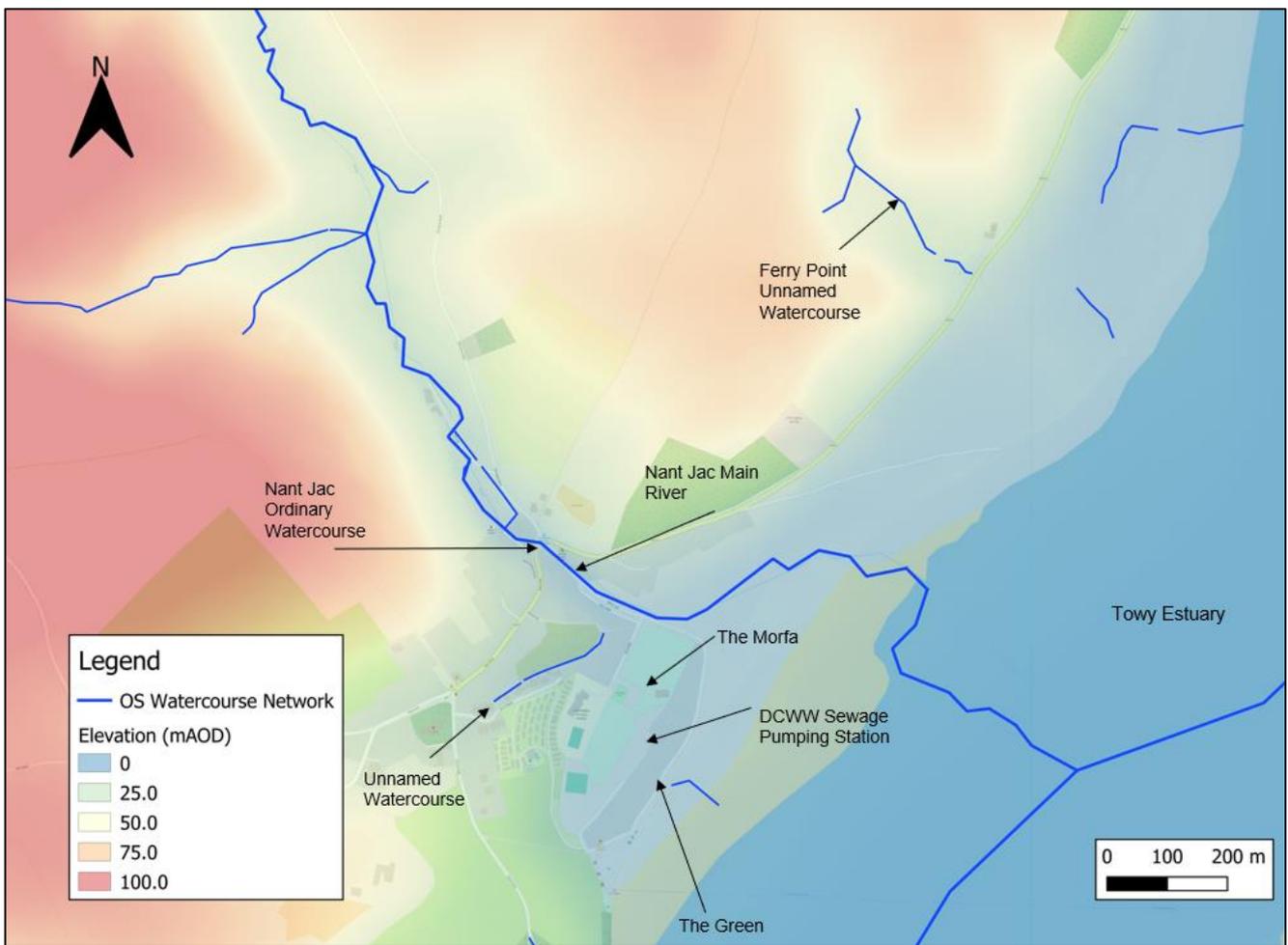


Figure 2-2: Topographic Map (based on Lidar data sourced from <https://datamap.gov.wales/maps/lidar-viewer/>)

### 2.2.2 Sub-Catchments

Based on the data review, a review of the topographical conditions and the hydrology of the catchment, and following consultation with the community regarding the flood events the study area has been categorised into three distinct sub-catchments. These sub-catchments differ by topographical setting and the associated flooding sources and mechanisms. These have been outlined in more detail below.

Sub-Area	Receptors	Details
Upstream of The Green	Residential and commercial properties	<p>Area influenced by surface water overland flows from the largely agricultural catchment upstream. Issues with high levels of sedimentation in runoff due to land use and predominant maize crops. Risk of direct flooding from the Nant Jac watercourse and an unnamed stream, which discharges to the Nant Jac in the vicinity of Glan-Y-Mor. Flood risk influenced by watercourse structures such as High Street Bridge.</p> <p>Flooding in this area is marginally influenced by key assets lower in the catchment including the outfalls associated with the CCC surface water drainage system and the DCWW Sewage Pumping Station.</p>
The Green	Residential properties, sports pavilion/gym, Morfa playing field and DCWW Sewage Pumping Station	<p>Low-lying area susceptible to surface water overland flows from the upper catchment ponding on the Morfa playing fields and The Green. Highly influenced by key assets in the vicinity, including the state of the outfalls associated with the CCC surface water drainage system, which discharge into the intertidal zone of the estuary, and the DCWW Sewage Pumping Station. Risk of flooding from the Nant Jac watercourse when the channel becomes overwhelmed during high flows and overtops the right bank along Water Lane.</p>
Ferry Point	Residential properties and holiday cottages / chalets	<p>Within the catchment of an unnamed watercourse this sub area is located adjacent to the estuary and is susceptible to risk from surface water runoff, sewer flooding and flooding from an unnamed watercourse.</p>

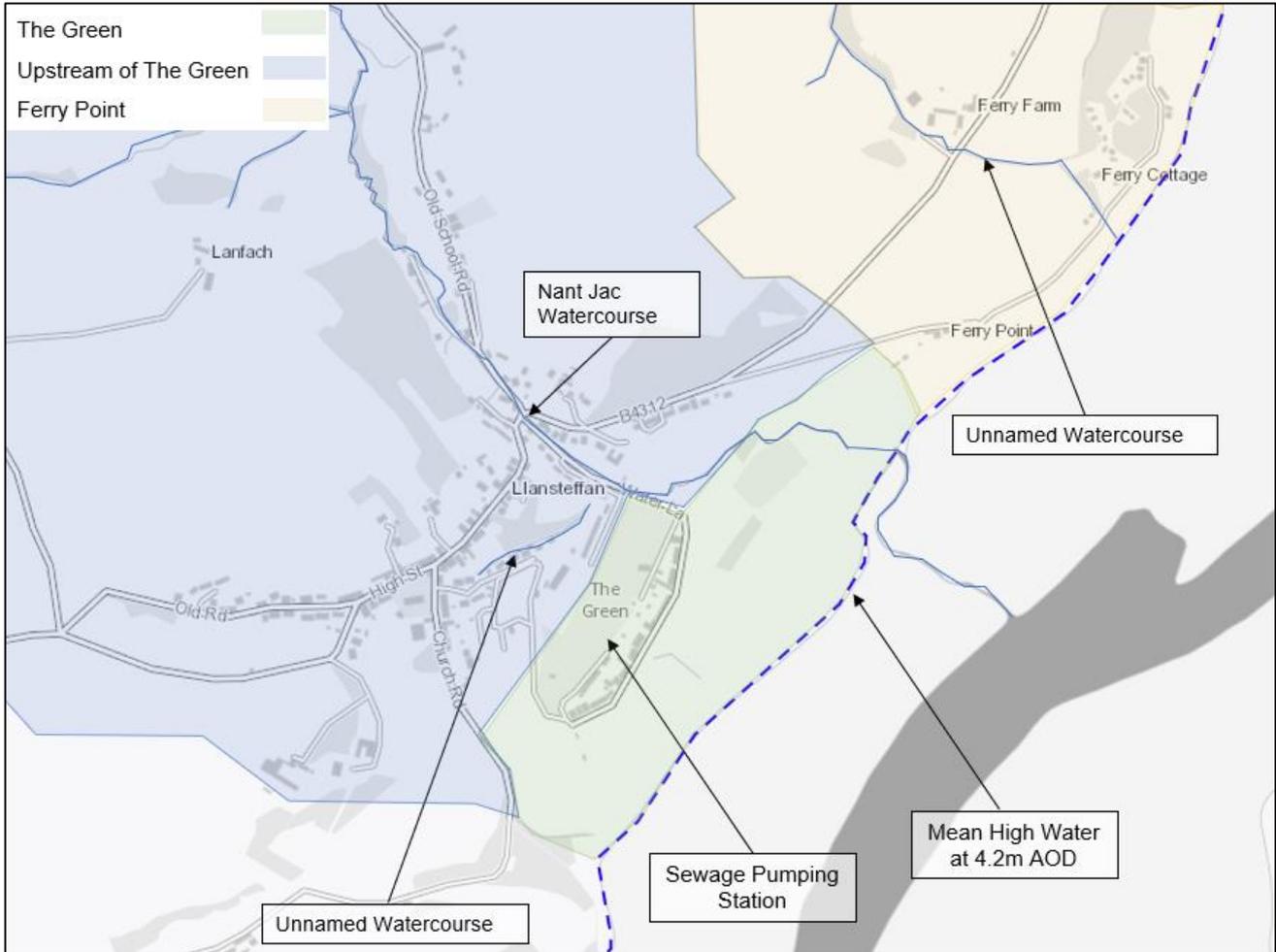


Figure 2-3: Llansteffan Section 19 Sub Areas. Contains OS data © Crown Copyright and database right 2020

### 2.2.3 Geology

The area includes the estuary of the Towy river that flows into Carmarthen Bay. The lower reaches of the Towy have relatively narrow valley floors and the landscape is generally characterised by very long sandy beaches, backed by sand dunes, coastal marshes and flat, low-lying land with a backdrop of former coastal cliffs that rise to between 90-100m.

The British Geological Survey indicates that the bedrock geology of this area is dominated by Devonian Old Red Sandstone characterised by mudstones, siltstones, sandstones and conglomerates which were deposited in fluvial environments, such as meandering channels and floodplains, overlain by superficial sedimentary deposits.

No geotechnical or ground investigation information is available specifically for the Llansteffan area.

### 2.2.4 Flood Risk

NRW has produced [Flood and Coastal Erosion Risk Maps](#) which indicate flood risk from various sources (Figure 2-4, Figure 2-5, Figure 2-6). This shows that areas of Llansteffan and the surrounding area are at high risk of flooding from surface water, rivers and the sea.

For example, The Green is at a high risk of surface water and river flooding (a chance of flooding of greater than 1 in 30 (3.3%)), and medium risk of flooding from the sea (a chance of flooding of between 1 in 200 (0.5%) and 1 in 30 (3.3%)). Low lying areas of Ferry Point are at a high risk of flooding from surface water (a chance of flooding of greater than 1 in 30 (3.3%)) and is predominantly at low risk of sea flooding (a chance of flooding of between 1 in 1000 (0.1%) and 1 in 200 (0.5%)).

The floodplain associated with the watercourses is primarily constrained to the channel and immediate vicinity in the upper catchments. In the lower catchment floodwater leaves the channel and flows downstream into highways and adjacent property boundaries. Floodwater collects in the low lying area of The Green and discharges to the Towy Estuary.

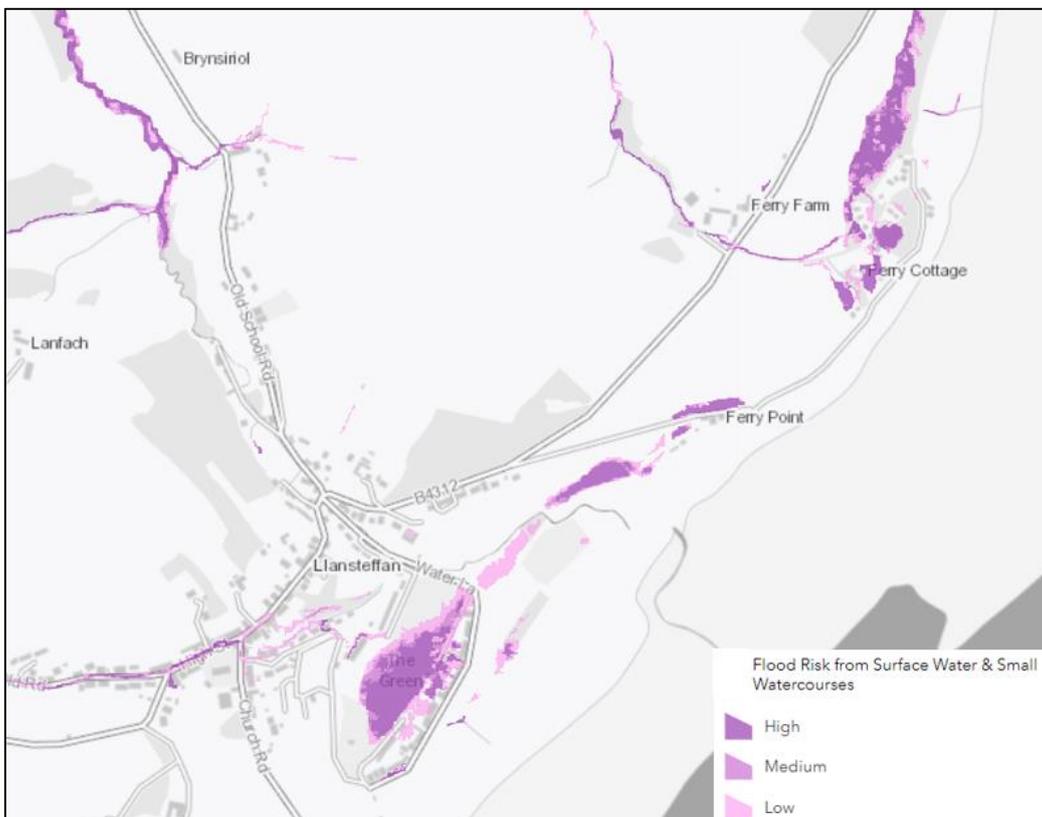


Figure 2-4: Flood Risk from Surface Water & Small Watercourses (Source <https://flood-risk-maps.naturalresources.wales>) Contains OS data © Crown Copyright and database right 2020

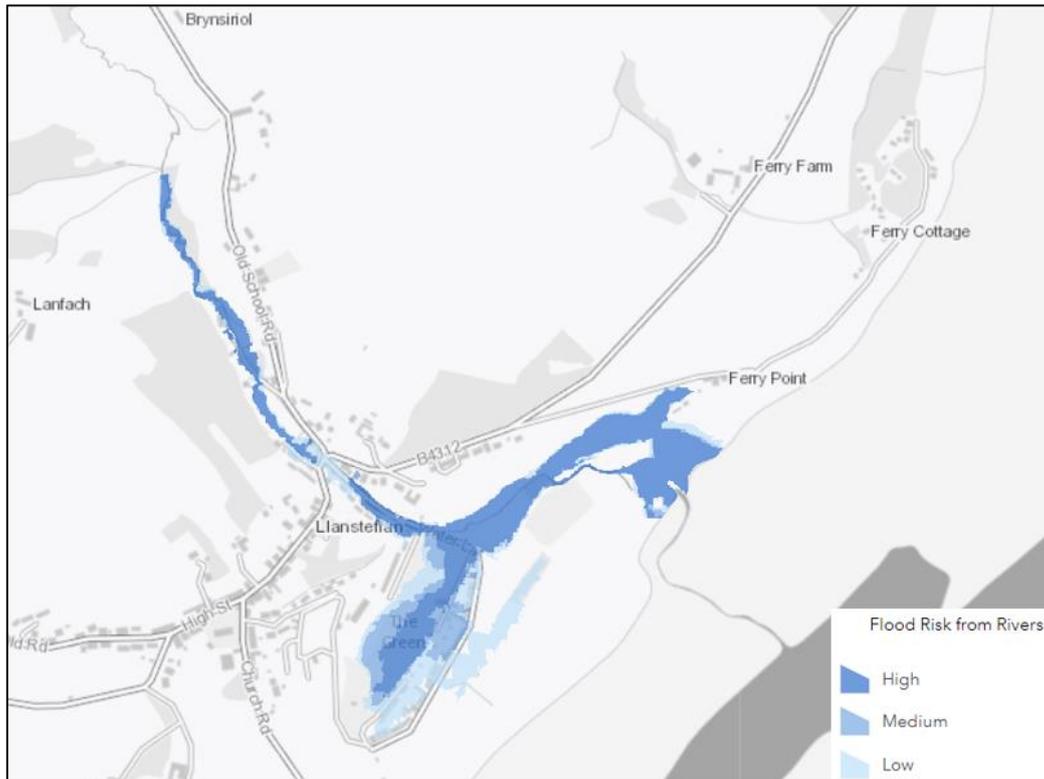


Figure 2-5: Flood Risk from Rivers (Source <https://flood-risk-maps.naturalresources.wales>). Contains OS data © Crown Copyright and database right 2020

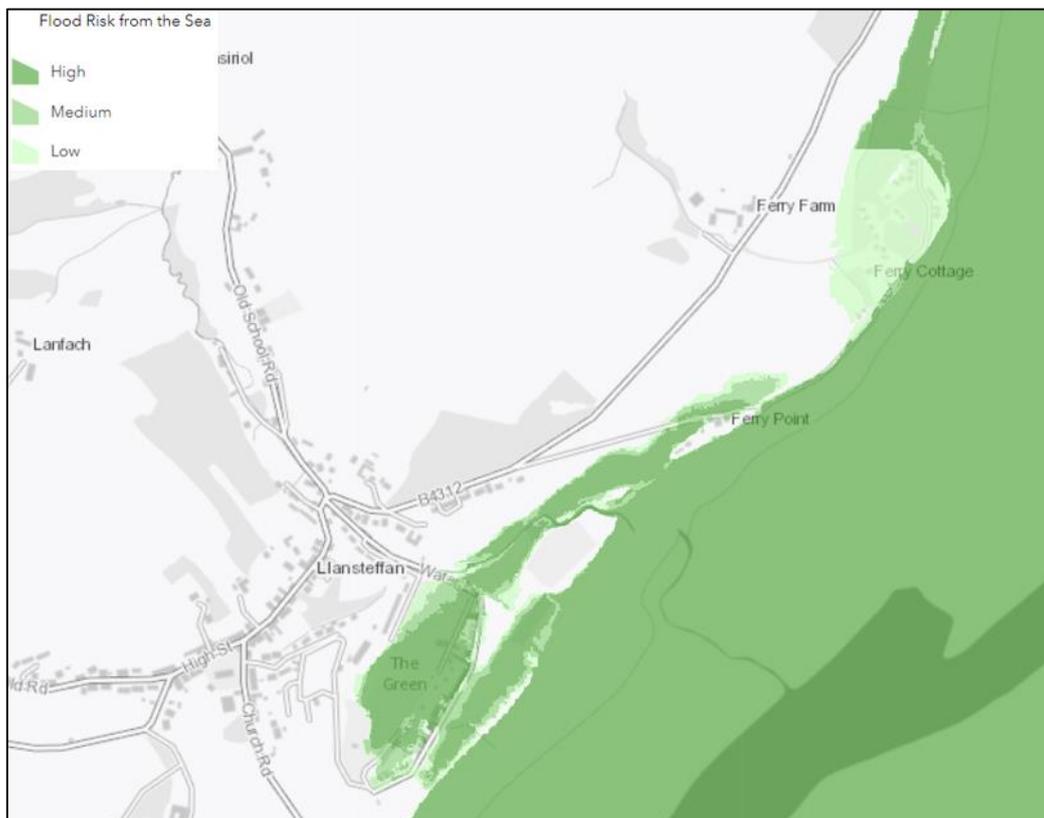


Figure 2-6: Flood Risk from the Sea (Source <https://flood-risk-maps.naturalresources.wales>). Contains OS data © Crown Copyright and database right 2020

### 2.2.5 Flood risk history

Historical flooding reported in the study area is outlined below.

- Flooding of highways and gardens occurred at Glan-Y-Mor in 2002, 2003, 2008 and 2010. This flooding prompted improvement works to the culvert system as outlined in Section 2.2.6.
- Flooding occurred in December 2013 and January 2014 at low points along The Green. Wider flooding was only prevented by over pumping and regular excavation of the outfall on the beach. This flooding prompted improvement works to the drainage system as outlined in Section 2.2.6.
- Frequent flooding has been noted to occur to gardens and properties on The Green from 2015 up to the flood events in Winter 23/24.

### 2.2.6 Works complete to date in response to previous flooding

Based on the historical flooding within the catchment CCC have implemented a series of works with the aim of decreasing the flood risk within the community.

Following the historical flooding of highways and gardens at Glan-Y-Mor, the following works were undertaken:

- A new trash screen and inlet constructed at rear of Glan-Y-Mor
- A new culvert and outfall construction from Glan-Y-Mor to the Nant Jac

Since the installation of the new inlet structure and upgrade works to the culvert flood events have not been recorded at Glan-Y-Mor.

In 2015 a scheme was implemented to better manage the drainage of the Green and involved the construction of a two chamber sump, upgrading of the beach outfalls and construction of a new high level outfall. The upgraded outfall system includes a long outfall to the estuary and a shorter outfall to middle of the beach. The chamber on The Green incorporates a non-return valve. The chamber has been designed to accommodate a pump sometime in the future if flood flow rates exceed outflow capacities. Telemetry was installed in the downstream chamber in October 2023 to monitor water levels and better understand outflow from the outfalls in response to rainfall events.

### 2.2.7 Watercourses

#### Nant Jac

The Nant Jac watercourse has a catchment area of approximately 4.5 km<sup>2</sup> and flows downstream into Llansteffan from its source upstream in largely agricultural land in the vicinity of Llanybri. As the watercourse enters Llansteffan, the channel becomes less natural and more engineered and passes relatively close to properties off Old School Road. The watercourse is culverted under Mill Pond Lane and again further downstream under the High Street, adjacent to Water Lane.

At the top of Water Lane next to the Bethany Baptist Church, the mid-section of the Nant Janc culvert incurred damage during the December-January flood events and underwent significant repair during Spring 2024 as shown in the images below.



*Works at the High Street Bridge. Image taken 19.03.24*



*Looking upstream at the works to the High Street Bridge. Image taken 19.03.24*

Along Water Lane, the retaining wall which forms the right-hand bank of the Nant Jac is approximately 15 cm high (above the road level) with metal railings above it. At certain points, the retaining wall shows signs of damage, particularly in the areas where the stream apparently overtops onto the road. This indicates that the retaining wall is serving a purpose of keeping flows in the channel up to a certain depth. However, this retaining wall may also prevent overtopped water from being able to re-enter the stream lower down.

At the end of Water Lane, the engineered channel of the Nant Jac ends, and the watercourse flows into open fields before flowing into the Towy Estuary. There are some minor bridges associated with footpaths through the fields and the Nant Jac has sharp flow direction changes beneath these bridges. This compromises the efficiency of the flows and there were reports of this section of the watercourse being restricted by debris, including building rubble and a shopping trolley.

Notable levels of sediment in the Nant Jac were observed during the site visit through the catchment particularly in the upper and middle reaches. There are reports from residents of the sediment levels in the Nant Jac increasing significantly during the past three years and a change in the colour of the watercourse from largely clear water to a red/brown colour during the majority of the winter months and during heavy rainfall.

The Nant Jac is classified as a main river from the estuary upstream to the High Street Bridge and as an ordinary watercourse upstream of the High Street Bridge, as outlined in Figure 2.7 below. NRW has powers to maintain the section of main river and serve notice on landowners. CCC has powers to maintain and improve ordinary watercourses, and to serve notice on landowners to carry out works to maintain the flow in the ordinary watercourse, in some circumstances.

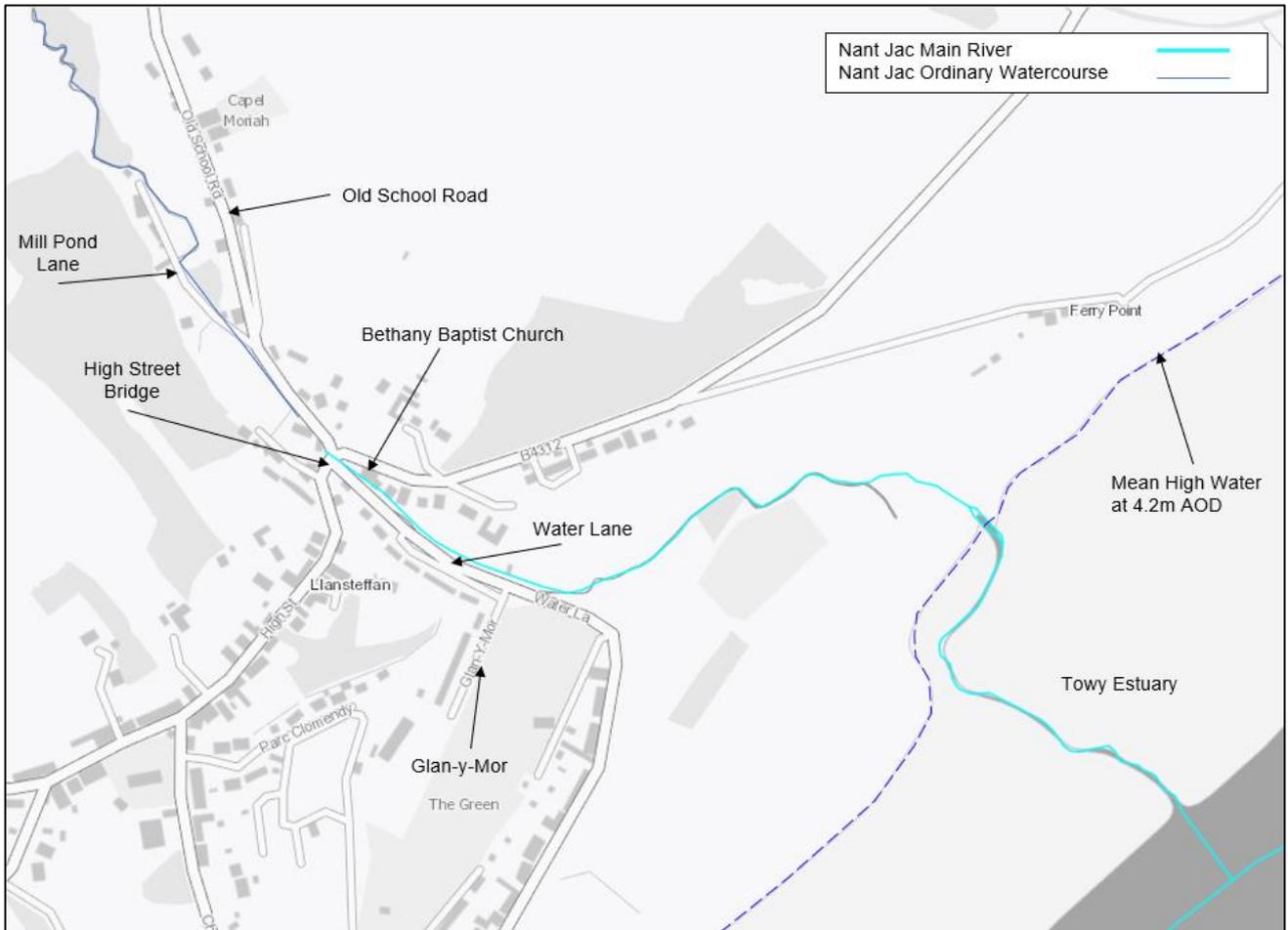


Figure 2-7: Nant Jac main river Extent (Source <https://flood-risk-maps.naturalresources.wales>). Contains OS data © Crown Copyright and database right 2020



*Nant Jac upstream of Mill Pond Lane*



*Nant Jac culverted under Mill Pond Lane*



*Looking downstream at the Nant Jac before the High Street Bridge*



*Looking downstream at the inlet to the High Street Bridge*



*Looking upstream the engineered channel of the Nant Jac along Water Lane*



*Looking downstream where the engineered channel along Water Lane flows into open fields adjacent to the Towy Estuary*



*Looking upstream at the open fields adjacent to the Towy Estuary at the point where the Nant Jac flows into the Towy Estuary*



*Looking downstream at where the Nant Jac flows into the Towy Estuary*

### Ordinary watercourses

There is one ordinary watercourse within Llansteffan and a second ordinary watercourse at Ferry Point.

Within Llansteffan an unnamed stream runs from the church diagonally downhill to the corner of Glan-Y-Mor. Residents noted that this stream is approximately 4 to 5 feet deep behind the houses on Glan-Y-Mor.

Behind these houses is a substantial trash screen that was observed during the site visit (20<sup>th</sup> March 2024) to be operating well. The stream is then culverted underneath the footpath, Glan-Y-Mor and

Water Lane to discharge into the Nant Jac (main river) where it leaves the road and runs across the field.

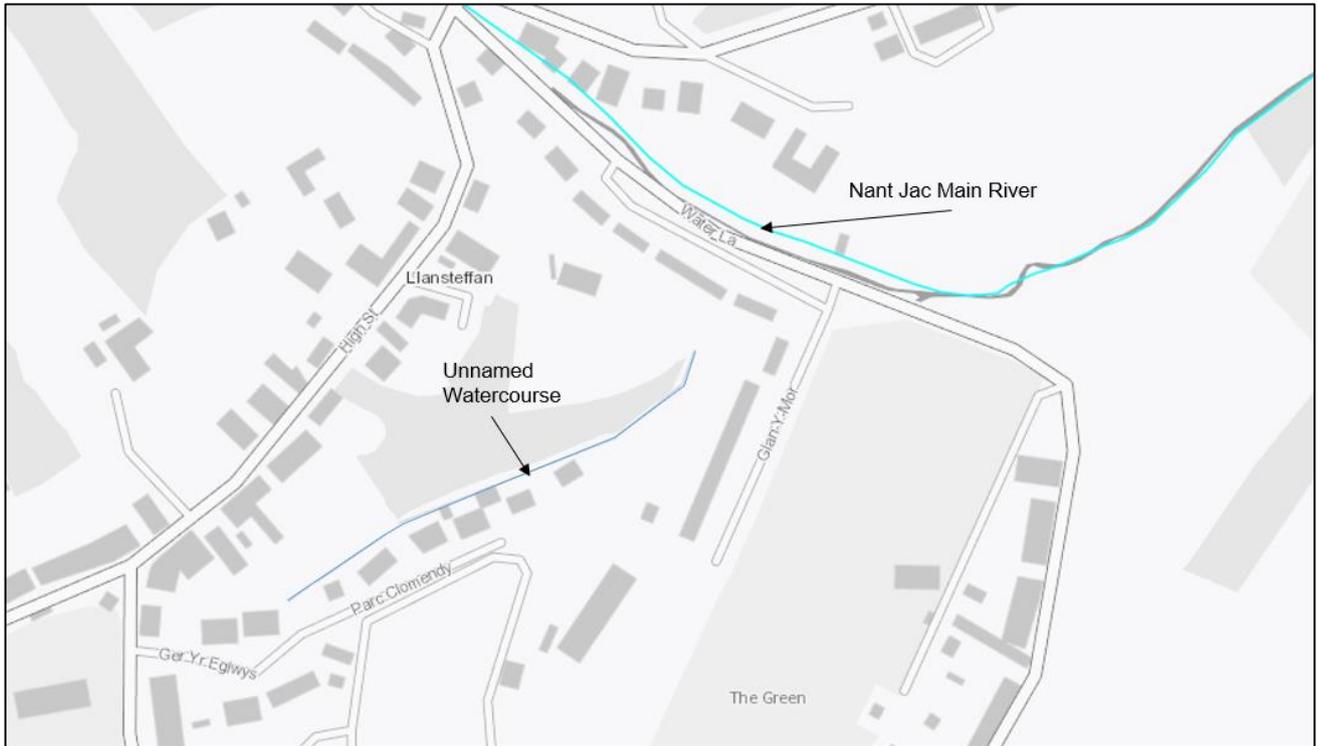


Figure 2-8: Llansteffan Unnamed Watercourse Extent (Source <https://flood-risk-maps.naturalresources.wales>). Contains OS data © Crown Copyright and database right 2020



Unnamed watercourse at Llansteffan



Unnamed watercourse at Llansteffan: debris screen

An unnamed watercourse also originates in agricultural land to the northwest of Ferry Farm. An earth embankment has been constructed along the lefthand bank of the watercourse with the aim of retaining water in the fields to the southwest of Ferry Cottage. The watercourse flows into the Towy Estuary via a culvert and a flap valve under the access road to the residential properties and holiday lets. The management and maintenance of this watercourse falls to the riparian owners, Ferry Farm in the upstream section and the Ferry Point Management Company in the downstream section.



Figure 2-9: Ferry Point Unnamed Watercourse Extent (Source <https://flood-risk-maps.naturalresources.wales>). Contains OS data © Crown Copyright and database right 2020



*Looking downstream towards the Towy Estuary during Winter 23/24 storms*



*Looking downstream towards the Towy Estuary during Winter 23/24 storms*



*Looking downstream at the unnamed watercourse culvert under the access track*



*Unnamed watercourse outfall into the Towy Estuary*

### **2.2.8 Surface Water Drainage and Outfalls**

The management of surface water drainage and highway drainage is the responsibility of CCC in its respective roles as the LLFA and Highways Authority. In general, within the area surface water drains towards the beach by way of highways gullies and surface water drainage systems to an underground storage chamber on The Green and a series of outfalls located in the tidal range of the Towy Estuary.

Where Glan-Y-Mor runs parallel to Water Lane, the road camber slopes towards the houses, where there are several highways gullies for surface water drainage.

Surface water naturally flows into the low-lying areas of the Morfa and The Green. This area is drained by a surface water drainage and culvert system which discharges into two underground storage chambers (a seaward chamber and a landward chamber) located within the sand dune network of The Green. The chambers and associated outfalls were constructed in 2015 to manage the drainage

on The Green. The DCWW Sewage Pumping Station has an overflow storm pump which discharges into the surface water storage chambers during periods of high flows at the Pumping Station. This flow is screened to prevent sewage debris from discharging into the estuary.



Figure 2-10: Surface Water Chambers located on The Green

The landward chamber is twice the size of the seaward chamber. In the landward chamber there is one large inflow on the back wall; it is assumed that this is where all the water from the drainage system enters from the village. This drainage water then exits via the duckbill valve into the seaward chamber which has an invert level of 3.325 mAOD.

Towards the bottom of the seaward chamber there is a duckbill valve with inflow from the landward chamber which prevents seawater ingress. The water level telemetry is located in the seaward chamber and shows a tidal pattern of rising and falling water levels. This is a key data source to correlate rainfall and tidal states for normal periods and flood events. The seaward chamber is gravity fed to three visible outflow pipes to the sea – these are the Middle Outfall, Short Outfall and Long Outfall. The outfalls which serve the storage tanks are outfalls labelled 1-3 in the Beach Outfall section and are marked accordingly on Figure 2-11.

### Beach Outfalls

There are six outfalls on Llansteffan beach, outfalls 1 to 3 serve the underground surface water drainage chambers and a further three outfalls, labelled 4 to 6 drain discrete areas within Llansteffan (see Figure 2-11):

1. **Middle Outfall:** This outfall is located midway within the chamber at an invert level of 4.20m. This primary outfall is fitted with a duckbill valve and was installed approximately two years ago. This outfall is prone to being buried by sand during high tides and the invert level of the outfall is at a height of 3.370m. The duckbill valve itself appears to be operating satisfactorily although there seems to be only small amounts of pressure head to drive the water out. Since the flood events, CCC have been excavating the outfall during high tides to aid the outflow from the chambers until a longer term solution can be implemented.

2. **Short Outfall:** This outfall is located at the highest elevation within the chamber at an invert level of 5.10m and the outfall is further inland than Middle Outfall, as such it appears to be very rarely in operation and it acts as the overflow outfall. It is a concrete pipe of approximately 65 cm diameter, has a debris screen and no flap valve and the invert level of the outfall is at a height of 4.955m.
3. **Long Outfall:** This outfall is at the lowest elevation within the chamber at an invert level of 3.23m and exits at the low water mark and is marked with a post for navigation purposes. This has a flap valve which prevents seawater from entering the seaward chamber. The invert level of the outfall is at a height of -0.680m.
4. **Car park drainage outfall:** This outfall is near the car park and drains the car park itself.
5. **Minor outfall:** This outfall has a 22-centimetre flap valve. It discharges into a gully that drains through the sunken marsh area and dunes onto the beach. This outfall drains the highway along The Green.
6. **Disused outfall:** This outfall is no longer connected to the surface drainage system, is not in use and is located halfway down the beach. It is a long concrete pipe that is now broken in several places and almost buried by sand. The Middle Outfall was installed to replace this approximately 10 to 15 years ago when this linear outfall structure was approximately 1 m above sand level.



Figure 2-11: Outfall Locations. Contains OS data © Crown Copyright and database right 2020

The majority of the outfall invert levels are located within the highly dynamic and influential intertidal zone, below the Mean High Water tide level.

Outfall	Mean High Water m AOD	Outfall Invert Level m AOD
Short		4.955m
Middle	4.2	3.370
Long Outfall		-0.68m

Excavation operations on the beach need to be aware of potential health and safety issues. Around April 2023 there were issues on Llansteffan Beach as a result of sand being disturbed to facilitate capital works relating to the outfalls (installation of duckbill valve on the Middle outfall). This led to the sand becoming soft and there were reported instances of people getting into difficulty. The area was monitored daily and cordoned off with signage during this time. By September 2023, the excavation area was opened again and allowed to backfill naturally which stabilised the sand conditions.

Anecdotal conversations with CCC and local residents indicate an increasing pace of sand aggregation on the beach in the last decade. This highly dynamic environment results in maintenance issues for CCC, especially in relation to the Middle Outfall which is often buried by sand. CCC are currently excavating the outfall after high tides as an interim measure pending the identification of a sustainable long-term solution.

1. Middle Outfall post excavation



2. Short Outfall



3. Long Outfall



4. Car park drainage outfall



5. Minor outfall



6. Disused outfall no longer connected to the surface water drainage system



CCC undertake regular inspections of their assets post-storm and remove blockages as required. Asset maintenance records are available from April 2018, which note the silting up of some outfalls on the beach, as well as slight damage to outfalls and headwalls.

### 2.2.9 Public Sewers

The public sewer network is the responsibility of DCWW. The DCWW sewer map shows a gravity sewer system running along The Green, connecting into the Llansteffan Sewage Pumping Station, which sits behind the row of houses. It is reported that surface water which cannot flow out through the Middle Outfall often backs up into the wastewater system and inundates the wastewater system which then needs pumping. Since October 2023, DCWW have been regularly sending tankers to the Llansteffan Sewage Pumping Station, to remove additional water from the facility, as a result of surface water entering the wastewater system, reducing the capacity for the community to flush the toilets.

DCWW have noted that there is often surface water ingress into their manholes to the point of surcharging when there is high rainfall. This is due to manholes not being watertight.

There is a possibility that there are property and highways surface water drains connecting into the DCWW public sewer network. DCWW are currently undertaking investigations into connectivity.

### 3 Available data

The data available for analysis in the Section 19 report in relation to the two flood events is outlined below.

#### 3.1 Hydrometric gauge data

Table 3-1: Hydrometric gauge data

Gauge name	Record length supplied	Resolution	Source of data
Ferryside Chamber rainfall data	24/12/23 to 05/01/24	1 hour	CCC
Llanendeirne rain gauge data	29/12/23 to 05/01/24	15 minute	NRW
Cynin at St Clears River rain gauge data	05/01/23 to 05/01/24	15 minute	NRW
Llansteffan Green chamber water level and rainfall data	31/12/23 to 02/01/24	1 hour	CCC
HydroMaster Rainfall Data	10/12/23 to 10/01/24	5 minute	CCC

#### 3.2 Other data / information

Table 3-2: Other relevant data / information

Details	Source
Existing Surface Water Drainage drawing (project no. 80/0080/218), dated 01 September 2009	CCC
Cat 1 Llansteffan incidents register	CCC
Internal Flood Incident Summary – Gerrit and Henk	CCC
Videos and photos of the flooding	CCC
Asset maintenance record for outfalls and screens	CCC

Details	Source
Emails about soft sand mitigation on Llansteffan Beach	CCC
Design calculations for Ferryside and Llansteffan Outfalls (ref: 211202-01-100 Rev A), dated 28 January 2022	CCC
Layout plan and sections of pump chamber and storm water outfalls as constructed drawing (ref: 80/0080/517/01 Rev A), dated 02 December 2014	CCC
Valve / grit chamber and outfalls ancillary construction details as constructed drawing (ref: 80/0080/517/02 Rev A), dated 02 December 2014	CCC
Valve / grit chamber plans and sections as constructed drawing (ref: 80/0080/517/03 Rev A), dated 02 December 2014	CCC
Replacement of storm water outfall as constructed valve and grit chamber drawing (ref: 80/0080/517/04 Rev A), dated 02 December 2014	CCC
Llansteffan long outfall post works condition assessment report, dated 09 March 2022	CCC
Photos of outfalls at Llansteffan Beach	CCC
GIS asset information extracts for surface water and foul water sewers at Llansteffan and Ferry Point	DCWW
Met Office Report on Storm Gerrit, 27 to 28 December 2023	Met Office
Met Office Report on Storm Henk, 2 January 2024	Met Office
Questionnaire responses regarding property and curtilage flooding, and relevant photos and videos	Residents
Questionnaire responses regarding flood incident and response provided	Partner Organisations
Briefing note extreme long term rainfall in Wales	NRW

## 4 Flood event characteristics and catchment response

### 4.1 Flood Event Chronology Summary

The following section outlines the characteristics associated with the flood events on 30 December 2023 and 2 January 2024. An outline chronology of the events is outlined below.

25 December 2023	Wettest preceding 5-month period in 189-year record
26 December 2023	DCWW tankering of surface water from The Green Sewage Pumping Station from October 2023
27 December 2023	Saturated ground conditions on The Green and Morfa
28 December 2023	Middle Outfall of surface water drainage system starts to limit drainage from The Green
29 December 2023	Key rainfall event Surface water overland flow Overtopping of watercourses
30 December 2023	Flood Event
31 December 2023	Saturated ground conditions remain
01 January 2024	Key rainfall event Surface water overland flow Overtopping of watercourses
02 January 2024	Flood Event
03 January 2024	Saturated ground conditions remain
04 January 2024	Middle Outfall of surface water drainage system excavated
05 January 2024	Flood water in The Green subsides
06 January 2024	Middle Outfall of surface water drainage system functioning as normal

Figure 4-1: Flood Event Chronology Summary

## 4.2 Antecedent weather conditions

In 2023, the UK recorded its 6<sup>th</sup> wettest October in the series from 1836. The Towy Estuary and the Llansteffan area received ~150% of the 1991-2020 rainfall average in the Autumn between September and November. Six named storms affected the UK from late September to December: Agnes, Babet, Ciarán, Debi, Elin and Fergus. These contributed to exceptionally wet and, at times, stormy weather. Prior to the events on 30 December 2023 and 2 January 2024, Storm Babet (which occurred in October 2023) impacted Llansteffan and the saturated ground conditions remained in the area and wider catchment until next storm events.

Surface water was ponding on the Morfa following Storm Babet and the buried state of the Middle Outfall limited the discharge of surface water from the system and lower catchment into the Towy Estuary from 23 October to 6 November 2023 and again from 27 December up until the first flood event on 30 December. The excess of surface water remaining in this low-lying area resulted in surface water infiltration into the foul sewage system. As a result, DCWW were providing tankers to remove surface water from the sewer system from October to December 2023 to allow the sewage network to function as intended.

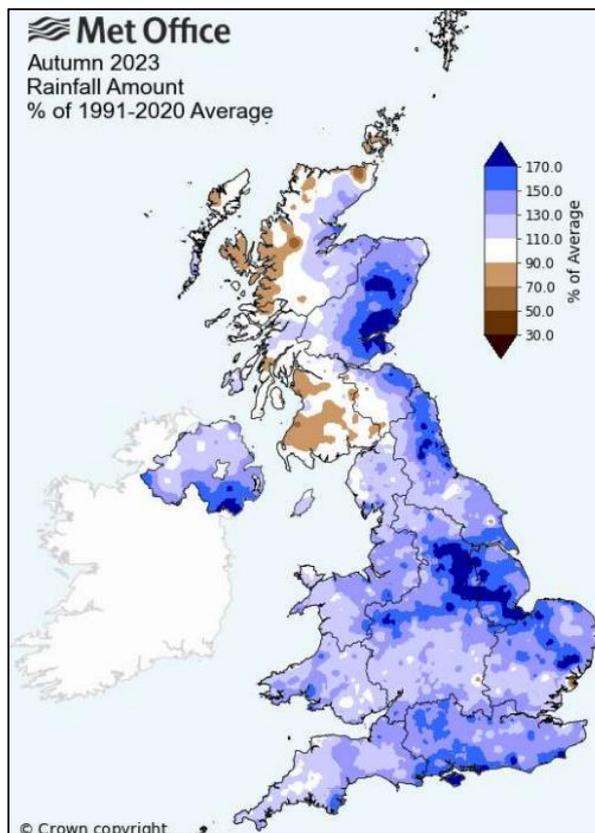


Figure 4-2-2: Autumn 2023 (September, October and November) Rainfall Amount

### 4.2.1 Long term rainfall analysis

NRW have provided a long-term analysis for the Carmarthenshire hydrological area. The longer term rainfall was exceptional, and broke numerous records including the wettest 3-month; 4-month; 5-

month; 7-month; 8-month; 9-month; 12-month; and 18-month period ending in the month of April 2024 in 189 years of data.

The Standardised Precipitation Index (SPI) is recommended by the World Meteorological Organization for monitoring meteorological droughts and can also be used for wet periods. SPI show, for a given location and month, how much the rainfall deviates from the long-term average. This means the indices can be compared between localities with very different rainfall regimes, and between different times of year. The graph below for South West Wales (Figure 4-3) shows the swing to a much wetter period beginning last summer.

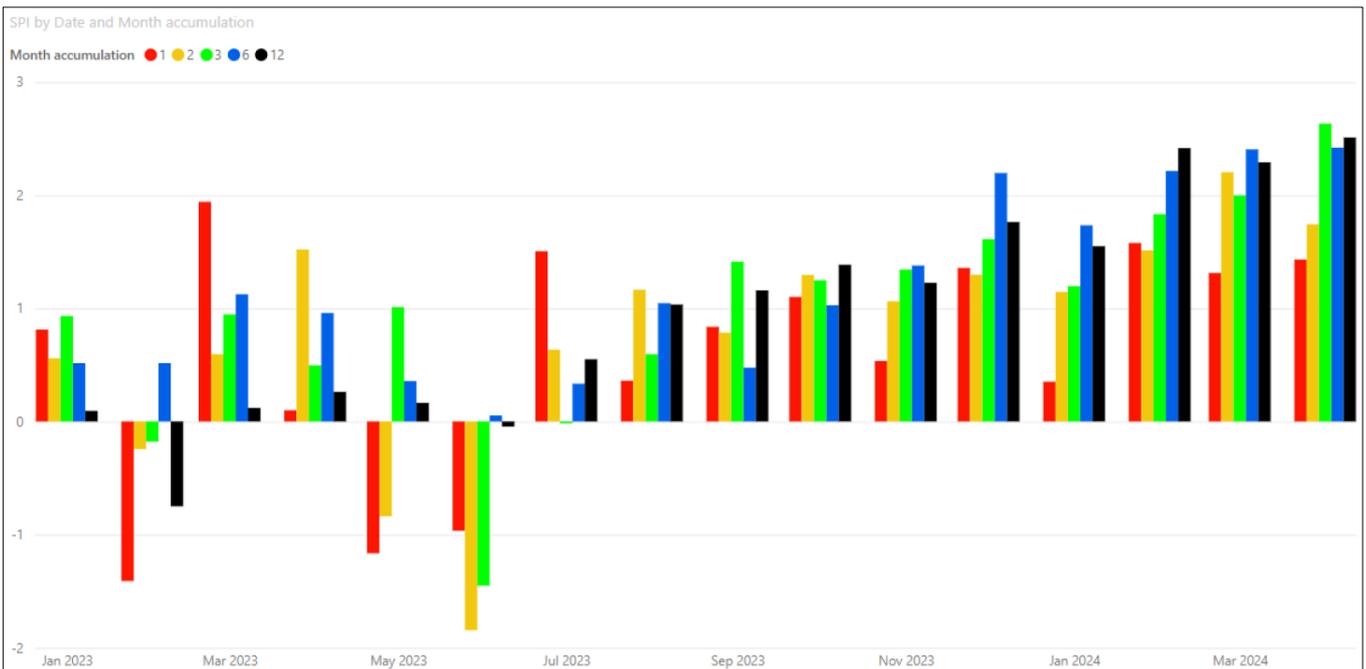


Figure 4-3: Standardised Precipitation Index (SPI) for South West Wales

### 4.3 Event weather conditions

The flood events which impacted properties in Llansteffan and the surrounding area on 30 December 2023 and 2 January 2024 were influenced by two named storms and the details of the storms are outlined below.

#### 4.3.1 Storm Gerrit

Storm Gerrit brought damaging winds and heavy rain to the UK from 27 to 28 December, with Wales one of the worst impacted areas in the UK. In the most exposed locations, winds gusted at over 70 Kt (81 mph) while heavy rain led to increased flooding concerns. This storm contributed to the generally prolonged, very wet and unsettled spell of weather lasting through much of December.

Much of Wales received 30 mm to 50 mm of rain from Storm Gerrit (Figure 4-4). For the October to December 2023 period overall, much of the southern coast of Wales received more than 130% of average rainfall over the 3-month period (Figure 4-5).

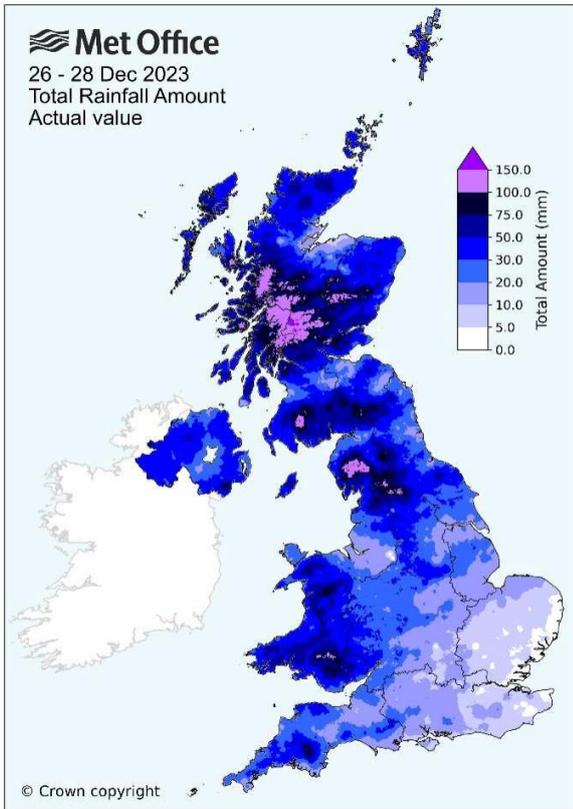


Figure 4-4: Storm Gerrit Total Rainfall Amount

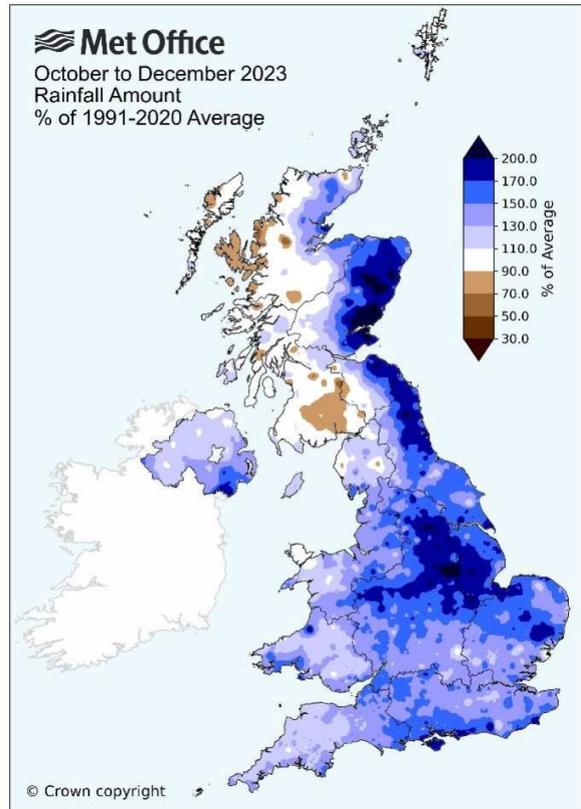


Figure 4-5: October to December 2023 % of Average Rainfall

### 4.3.2 Storm Henk

Storm Henk, the eighth storm of the 2023-24 storm season, brought damaging winds and heavy rain to southern and central parts of Wales and England on 2 January 2024. Winds gusted widely at over 50 Kt (58 mph). Heavy rain from storm Henk contributed to significant flooding problems, following the wet weather during autumn and December 2023. Figure 4-6 shows the rainfall totals for the first two days of 2024, while Figure 4-7 shows the rainfall total for the first four days. 2024 started on a very wet and unsettled note, with over 30 mm of rain falling widely in the first two days of January across most of Wales. In the first four days, most of Wales received over 50 mm of rainfall. South Wales received 50 to 100 mm, and more in some places.

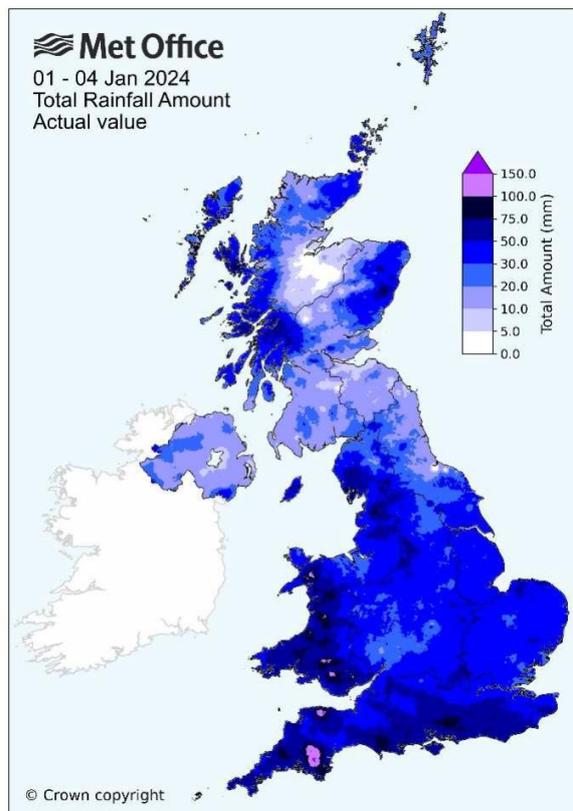
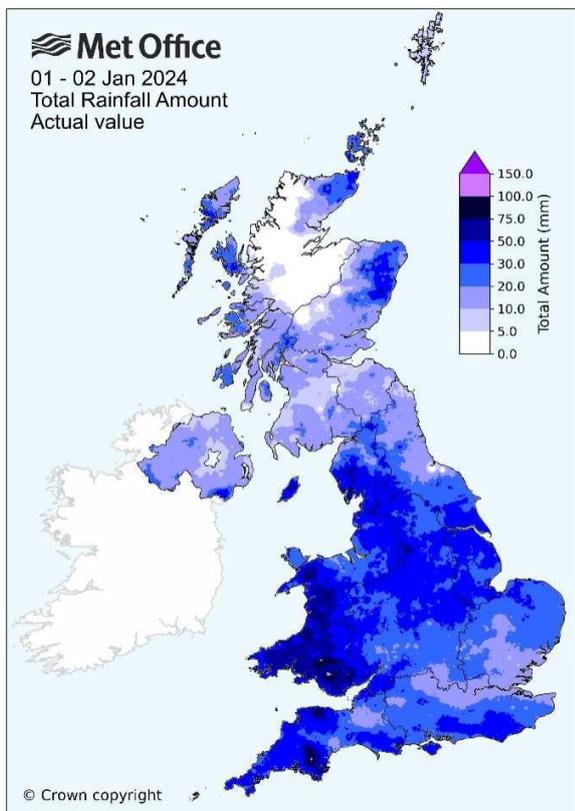


Figure 4-6: 01 – 02 January 2024 Total Rainfall Amount

Figure 4-7: 01 – 04 January 2024 Total Rainfall Amount

An assessment of the rainfall statistics and frequency analysis is contained within Section 5.

### 4.4 Tidal conditions

28 December was the date of the preceding high spring tide and the tidal conditions during the storm events are outlined below. On 30 December internal property flooding was first reported at 15:00 and on 2 January at 11:00 and based on the flooding reported it is unlikely that the tidal conditions impacted on the magnitude of the flood events.

Date	High Tide Time	High Tide level (m above CD)
30 December 2023	08:07	2.03
	20:28	1.64
2 January 2024	09.58	1.34
	22:22	0.86

### 4.5 Surface water drainage system status

Telemetry data is available for the seaward chamber of the surface water drainage system. Over a 10 day period, from the 27 December to 6 of January, the telemetry data in the seaward chamber did not exhibit the longer term pattern of rising and falling water levels in the chamber level associated with the tidal cycle (Figure 4-8 and Figure 4-9). During the period preceding and following the events on 30 December and 2 January the levels in the chamber were on average 1.28 m higher than a period where the longer-term pattern is resumed from 6 to 16 January.

Table 4-1: Telemetry data for the seaward chamber during the flood events

Chamber water depth (m)	27 December to 6 January	6 January to 16 January
Minimum	0.86	0.77
Maximum	4.15	1.90
Average	2.52	1.24

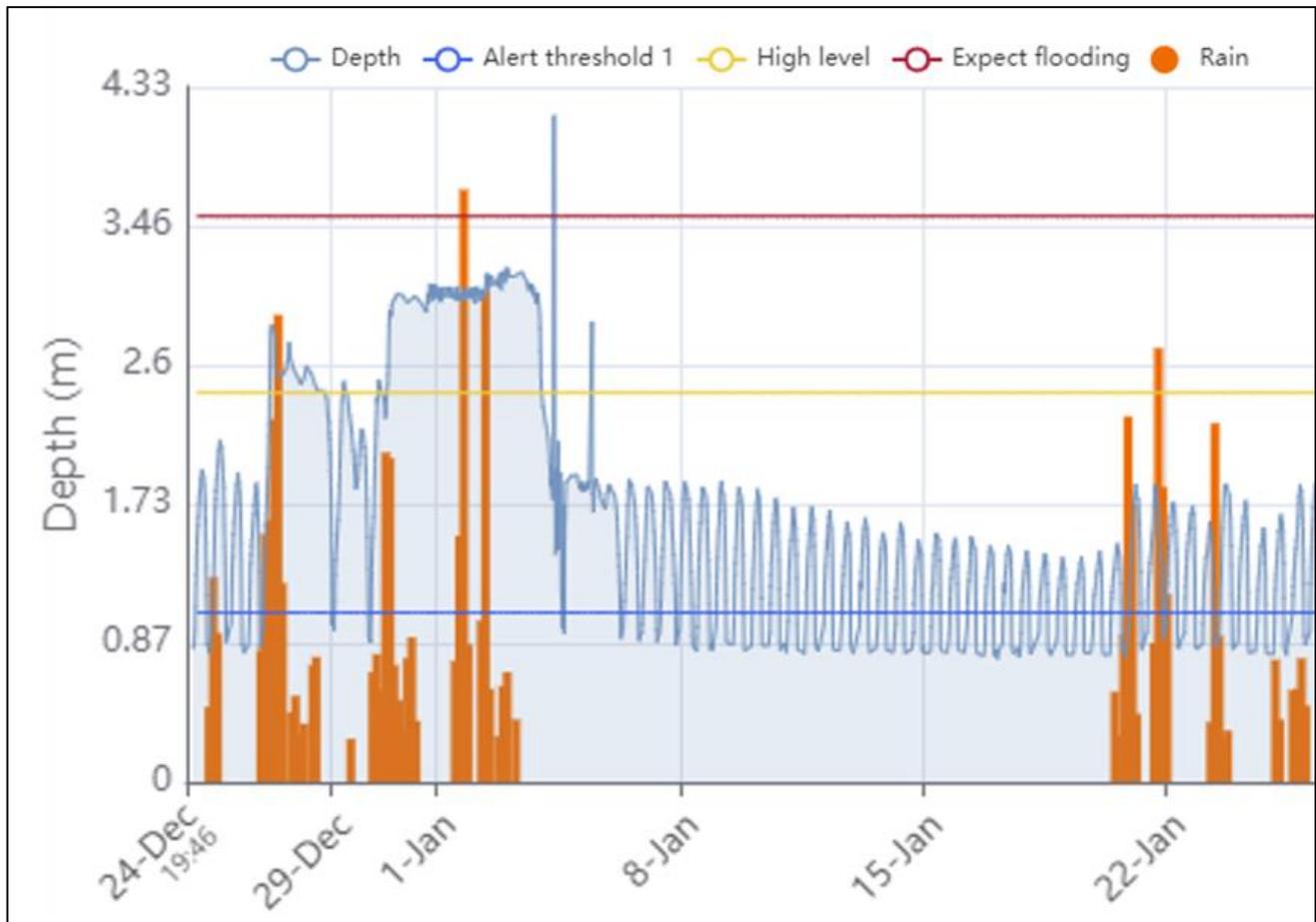


Figure 4-8: Extract from Chamber Telemetry Data Long Term View

Table 4-2: Chamber levels during the storm events

Outfall	Depth of water in chamber before discharge to outfall (m)	30 December 2023		2 January 2024	
		Average water depth in chamber (m)	Maximum water depth in chamber (m)	Average water depth in chamber (m)	Maximum water depth in chamber (m)
Short	2.7				
Middle	1.8	2.35	3.05	3.10	3.19
Long Outfall	0.83				

During the period from 27 December to 6 January, water was not discharging from the seaward chamber, via the outfalls, as per the long-term pattern of discharge, with water depths remaining at a higher level in the chamber at an average depth of 2.52m. During this period the depths exceeded the high-level indicator for the tank for a prolonged period. This indicates that during this period the ingress and discharge from the main Middle Outfall was impeded, in conjunction with the periods of rainfall associated with the flood events on 30 December and 2 January.

During the flood events the water depth reached a sufficient depth to also discharge via the Short Outfall, the invert level of this outfall is located at 4.955 mAOD and this is above the mean high water mark of 4.2 mAOD. This outfall operated as an overflow outfall and given the elevation in the tank the discharge from the gravity fed chamber would not have been sufficient to drain the chamber. The telemetry data indicates the seaward chamber did not drain until 4 January. There is no telemetry for the landward chamber but the invert level for the piped connection between the landward and seaward chambers is at 3.325 mAOD and as such if the seaward chamber cannot discharge, the landward chamber cannot discharge either.

CCC arranged for the Middle Outfall to be excavated and sand was removed from the duckbill valve outfall on 4 January. Following the excavation the water depths in the seaward chamber fell by 1.9 m. The telemetry data shows that the longer term water depth fluctuations within the seaward chamber, associated with the tidal cycle are resumed from 6 January.

The telemetry is recorded in 15-minute intervals. Short term peaks in water depths were recorded in the chamber on 4 January at 09:30 and 5 January at 11:45 for a 15-minute period only and as such this is likely to be due to a temporary fault in the telemetry system.

Section 19 Flood Investigation Report

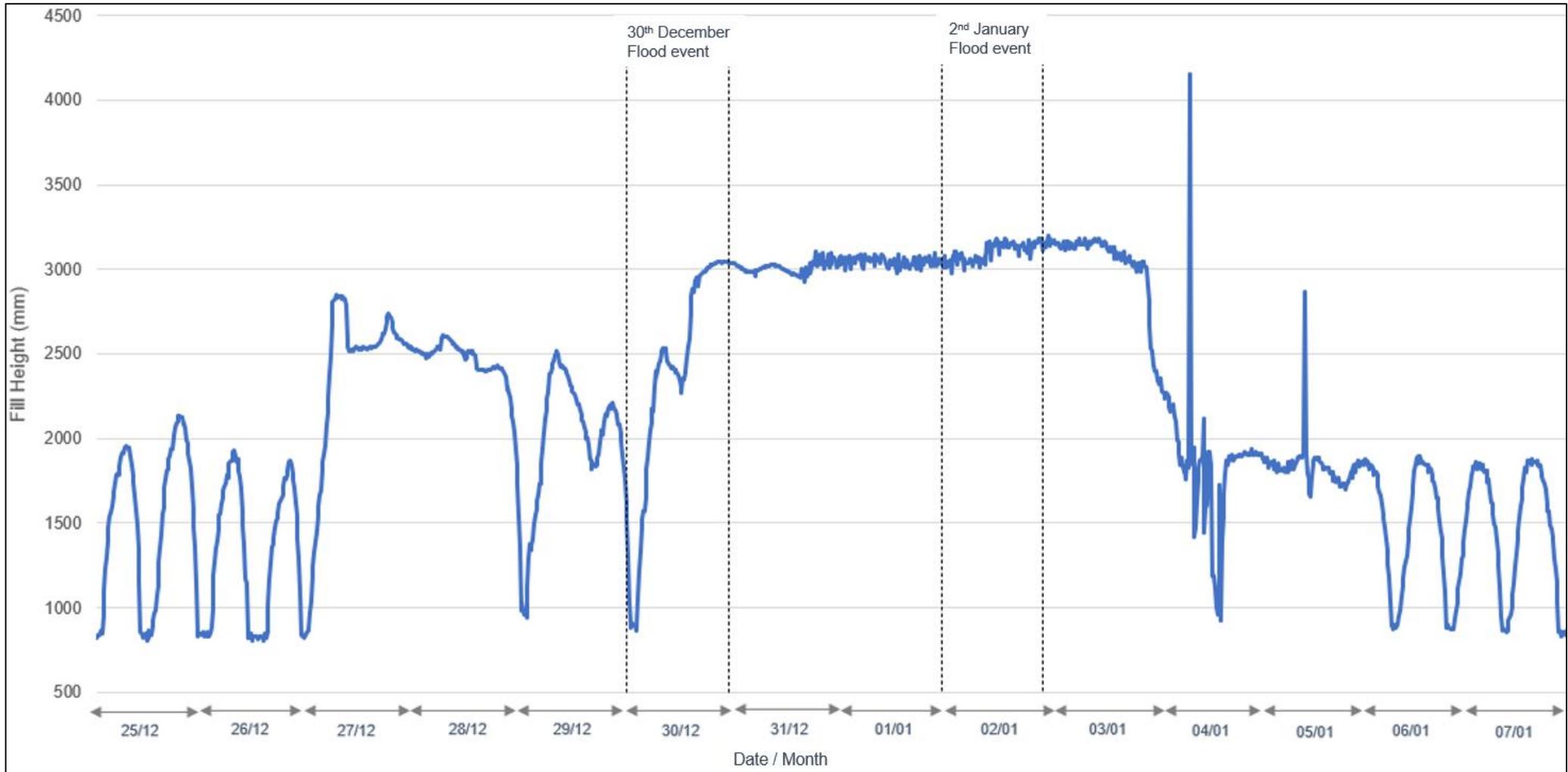


Figure 4-9: Chamber Telemetry Data

## 4.6 Flood alerts and warnings

NRW provide flood warnings for geographically discrete areas and flood alerts for larger areas or catchments. Flood alerts are issued earlier and more often than flood warnings. Within Llansteffan flood warnings are available for The Green and Ferry Point for the Tidal area at Llansteffan South and the wider Llansteffan area has flood alerts for the Lower Towy and Carmarthenshire coast.

Several flood warnings and alerts were sent out by NRW ahead of the storms, warning of high levels in the Towy (river, estuary) and of high tides. Some residents reported that, despite being registered, they did not receive any flood warnings.

On average, it is possible that residents receive an average of at least one flood alert a week during winter months and are often general alerts for the Carmarthenshire coast or Towy (river, estuary), which covers a wider area that is not specific to Llansteffan. Often, when alerts are received there is no flooding in Llansteffan. Residents reported that the flood warnings and alerts available are not particularly relevant and note that flood alerts are not issued when flooding is likely to occur in the Nant Jac catchment.

## 4.7 Potential causes

Approximately 34 properties in Llansteffan and the surrounding communities were affected by flooding to various extents across the two storms in Winter 2023/24. The impacted properties were identified by CCC and recorded in a Flood Incident Record. This has been used as the basis in the Section 19 to determine the impacted properties. For the purposes of the Section 19 report the properties were contacted to complete a flooding questionnaire and to attend a community consultation event and this was to verify the properties reported in the Flood Incident Record. Not all properties potentially impacted completed a questionnaire or attended the community engagement event and as such there is some uncertainty regarding the total number of properties to flood externally or internally and during which flood event. A summary of the level of flooding is shown from Section 4.5.1 below and this is based on the Flood Incident Record data.

Based on the data reviewed as part of this Section 19 report and from consultation from within the community and wider with the Partner Organisations involved a potential Source – Pathway – Receptor – Consequence model has been developed (Figure 4-10).

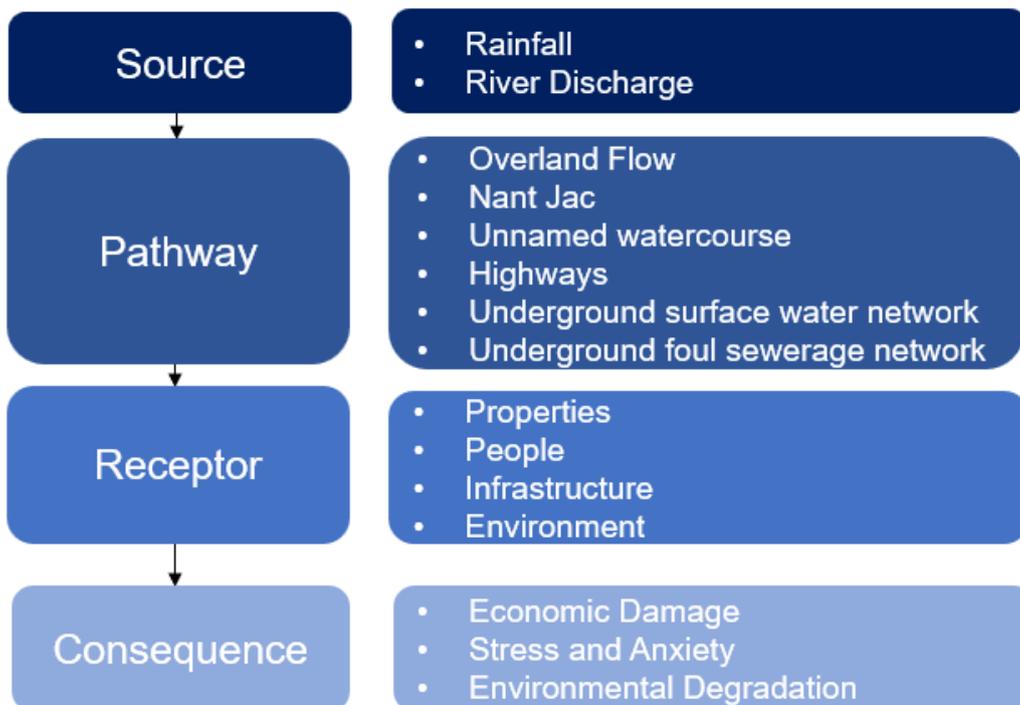


Figure 4-10: Overall Flood Event Potential Source- Pathway – Receptor - Consequence Model

During the winter 23/24 flood events the source was rainfall falling within the saturated catchments and from discharge low points in the banks of watercourses. Water flowed overland and via the highway network downstream towards the lower lying portion of the catchments and the Towy Estuary (Figure 4-11).

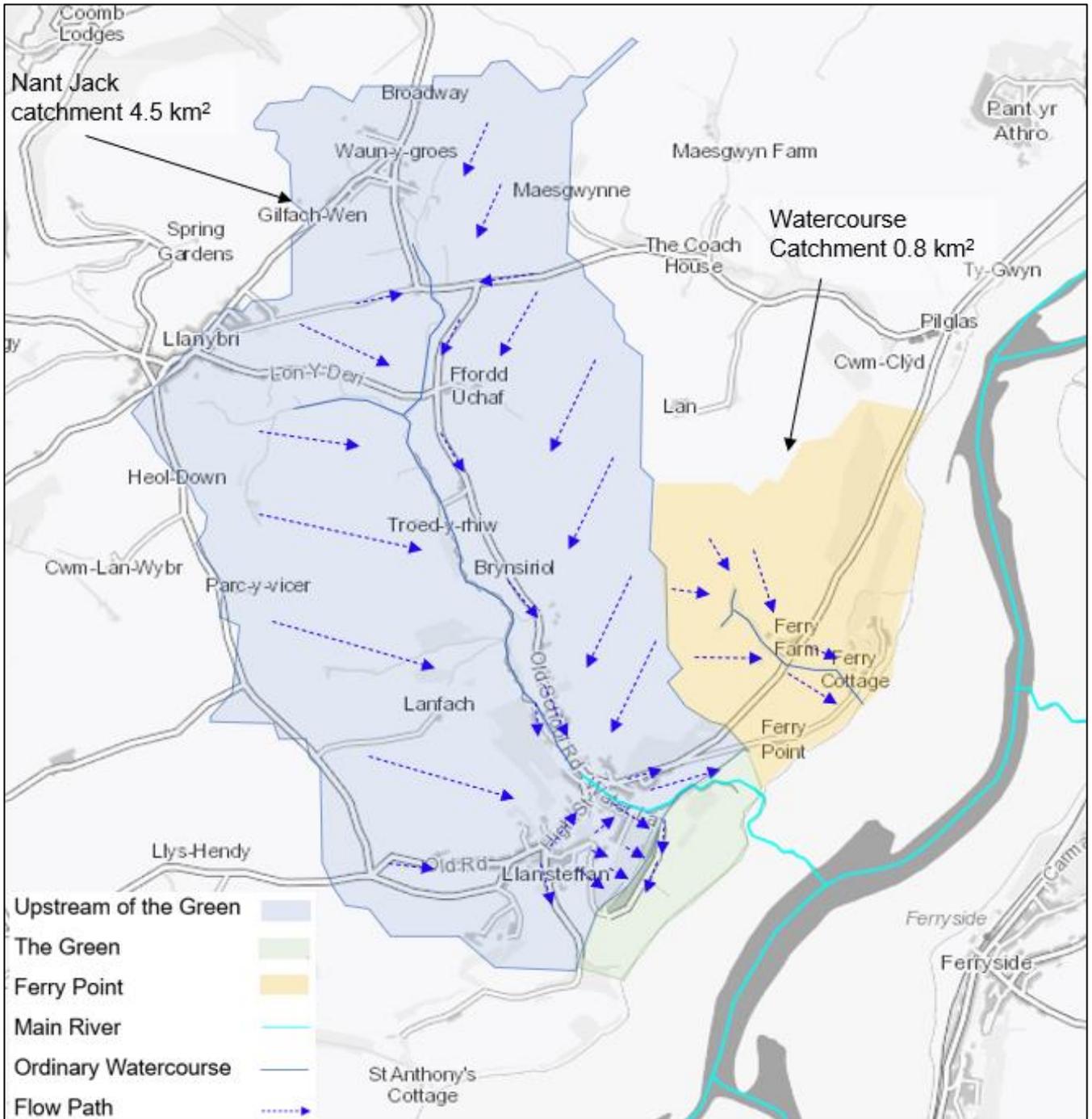


Figure 4-11: Sub-catchments and key flow paths

The following sections have been divided into three areas, which faced different challenges through the events and flooded as a result of different flood mechanisms. These are defined as follows and the properties impacted are based on the questionnaire responses:

1. **Upstream of The Green:** this includes properties from Glan-Y-Mor up to Old School Road, Mill Pond Lane and to Darkway (2 properties experienced internal flooding and 3 property experienced curtilage flooding)

2. **The Green:** properties on The Green, backing onto the Morfa (22 properties experienced internal flooding and 5 properties experienced curtilage flooding)
3. **Ferry Point:** properties on Ferry Point Road (1 property experienced internal flooding and 1 property experienced curtilage flooding; additional properties would have been flooded without pumping measures employed by local landowners)

The properties which experienced internal flooding as a result of the Winter 23/24 events are shown in the figures below. The area which experienced the highest number of internal property flooding was The Green owing to the topographical location in a natural low-lying area. There is evidence that there was more extensive flooding to gardens, outbuildings, sheds and garages but there is limited available data available to confirm the wider extent of the potential damage. There is also anecdotal evidence that at Ferry Point additional properties could have been flooded internally but were not reported as such to CCC.

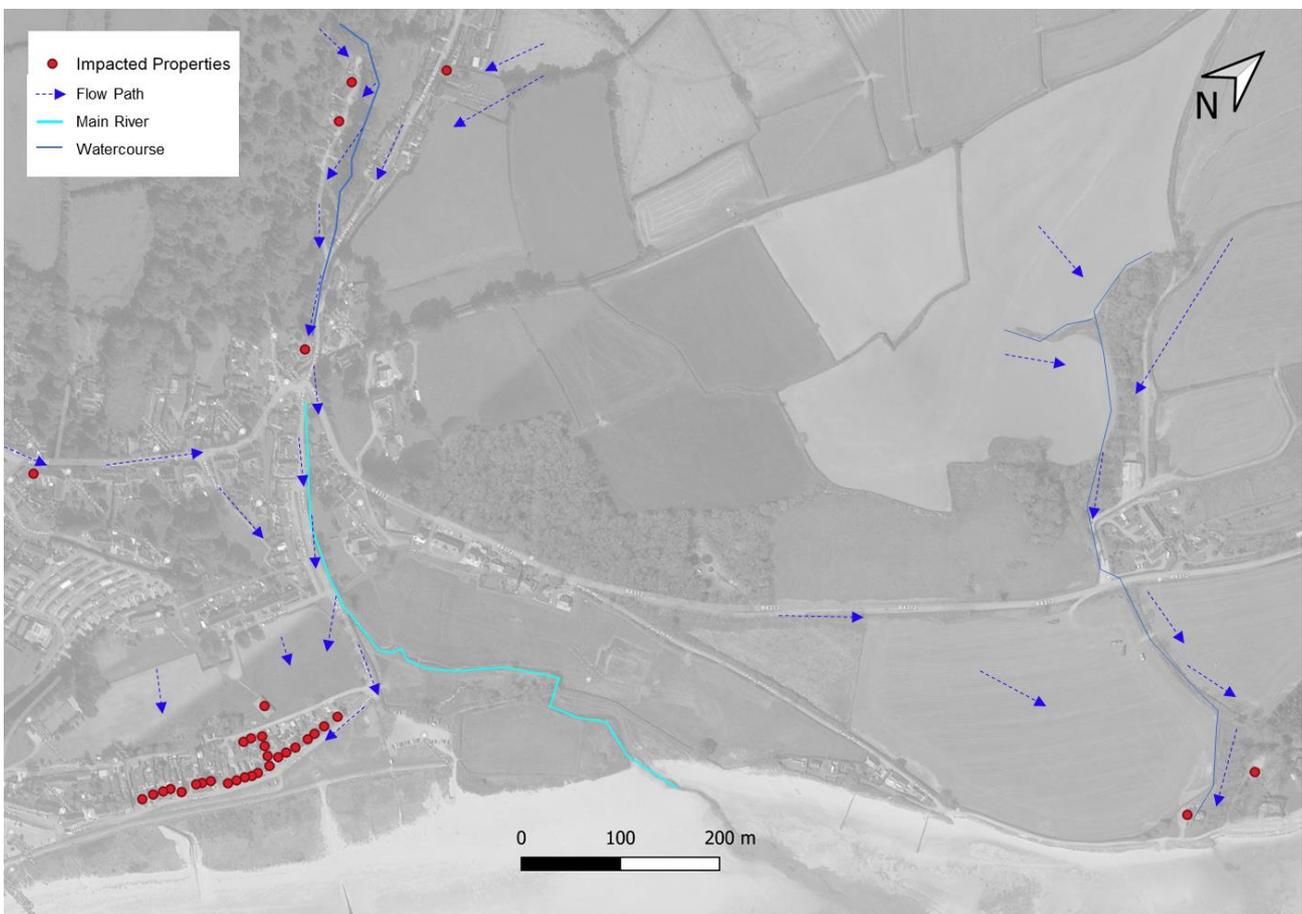


Figure 4-12: Impacted Properties Winter 23/24

#### 4.7.1 Upstream of The Green

A summary of the event chronology is outlined below.

- Surface water runoff during rainfall events flowing down a saturated catchment.
- Heavy levels of reddish brown sediment in the surface water runoff.

- Properties initially impacted during both flood events from flood water via direct overland flow and the highway network.
- Nant Jac capacity exceeded and the watercourse overtopped around Mill Pond Lane, impacting properties and adding additional flood water to the highway network during both flood events.

A summary table is provided below to outline the mechanisms and impacts of the flood events.

Table 4-3: Summary of mechanisms and impacts of the flood events upstream of The Green

Summary	30 December – 2 January Flood Events
No. internal property flooding	2
No. curtilage / property boundary flooding	3
Flood mechanism overview	<p>2 no. property flooded as a result of the overflow from Nant Jac .</p> <p>3 no. properties impacted by surface water runoff from overland flow and from water flowing down the highway.</p>

As outlined in section 4.2, analysis of antecedent conditions indicates a significantly wetter than average autumn and early winter and the water levels within the channel of the Nant Jac were reported to be at least two feet higher than the water levels normally observed.

The initial source of flooding was heavy localised rainfall resulting in overland flow due to the saturated ground conditions. This was routed downstream largely via the road network. The overland flows routed down roads which mobilised substrates resulting in the blockage of road gullies. The visible brown/red colour in the runoff indicates a high level of silt from upstream.

One property internally flooded due to direct ingress of overland flows from upstream catchment. Another property avoided internal flooding from overland flows by routing water away from the property using sandbags.

Following the rainfall the levels in the Nant Jac began to rise rapidly and this resulted in out of bank flow in several locations. Around Mill Pond Lane the narrowing of the Nant Jac (due to natural channel form, fallen trees and vegetation growth) further reduced channel capacity and conveyance, causing external flooding and internal flooding of one property.

Surface water overland flows and flood water from the Nant Jac were routed downstream towards the Morfa and The Green.

### 4.7.2 The Green

A summary of the event chronology is outlined below.

- Ponding of surface water on the Morfa and The Green before the flood events as this area is a low point in the catchment.
- Saturated ground conditions promoted DCWW to tanker surface water from the sewage system from October 2023 onwards.
- Middle Outfall of surface water drainage system starts to limit drainage from The Green from 27 December 2023.
- Properties initially impacted on 30 December 2023 from flood water via direct overland flow flowing from the Morfa.
- Nant Jac capacity exceeded and the watercourse overtopped at Water Lane, impacting properties and adding additional flood water to the highway network and The Morfa.
- Saturated ground conditions remained and on 2 January properties primarily impacted by a rainfall event resulting in the overtopping of the Nant Jac at Water Lane.
- Heavy levels of reddish brown sediment in the surface water runoff.
- Water levels reduced and flood water drained from the Morfa and The Green when the Middle Outfall was cleared on 4 December.

A summary table is provided below to outline the mechanisms and impacts of the flood events.

Table 4-4: Summary of mechanisms and impacts of the flood events at The Green

Summary	30 December – 2 January Flood Events
No. internal property flooding	22
No. curtilage / property boundary flooding	5
Flood mechanism overview	A combination of high water levels causing overtopping of the Nant Jac and surface water flows from upstream. Potential for a suboptimal interaction between the surface water drainage network and sewer network, with the surface water outfalls being a potential critical point of failure.

An analysis of antecedent conditions indicates a wetter than average autumn and early winter. Standing water was present on the Morfa prior to the 30 December event, which indicates that surface water could not effectively drain from the Morfa and the low-lying areas of The Green prior to receiving any further rainfall.

DCWW were providing tankers from October to December 2023 to remove surface water entering the foul drainage system to allow the sewage pumping station to function and provide capacity for residents to flush toilets etc. Surface water was reportedly primarily entering the DCWW foul network in the low-lying areas around the Morfa and The Green and an investigation is underway to confirm

the connection between the two systems. DCWW have provided photos taken on 27 December 2023 (Figure 4-13) and this clearly shows the saturated conditions prior to the flood event and manholes under water. This account aligns with residents' accounts that surface water was unable to drain from the low-lying area prior to the event. This was likely to be as a result of the primary (Middle) outfall from the surface water system being buried under the beach, in conjunction with prolonged periods of rainfall and saturated ground conditions.



Figure 4-13: Images of the Morfa and the vicinity of the DCWW Pumping Station on 27 December 2023

During the 30 December event additional heavy localised rainfall falling on the catchment had limited capacity to drain and infiltrate due to saturated ground conditions. Flood water initially entered back gardens of The Green from the Morfa and when the Nant Jac overtopped along Water Lane later, this caused increased flood water levels on the Morfa and within back gardens and properties along The Green. The situation was compounded by floodwater flowing down the hills and roads leading into

Llansteffan and down to sea level. Some properties on The Green also experienced flooding through their front gardens before it entered from the back gardens.

Some residents managed to drain flood water from properties, however standing water remained in properties, gardens and the Morfa area until the second flood event on 2 January. This flood event was more severe and overtopping of the Nant Jac, via Water Lane, was a predominant factor in the quickly rising water levels during this event. During this event the ground was so saturated that as residents of two properties were attempting to prevent flood water ingress through doors/entrances, that flood water was seeping up through the internal ground flooring of properties.

During both flood events, there was the potential for a suboptimal interaction between the surface water drainage network and sewer network, with the surface water storage chambers and the associated outfalls being a critical point of failure. Telemetry data from the seaward chamber indicates that during the period from 27 December to 6 January, water was not discharging from the seaward chamber, via the outfalls, as per the long-term pattern of discharge, with water depths remaining at a high level in the chamber at an average depth of 2.52m.

Pumping of the flood water was being undertaken by DCWW, the Fire Service and CCC but this did not alter the flood levels. This indicates that the surface water system outfalls could have been the key factor in retaining water levels in the low-lying area of the catchment. By 4 January 2024, the water eventually subsided when the Middle outfall on the beach was excavated, and the water was able to drain out. When the Middle Outfall was cleared the depth within the seaward chamber reduced by 1.9 m over a period of 13 hours.

### 4.7.3 Ferry Point

A summary of the event chronology is outlined below.

- Surface water runoff during rainfall events flowing down a saturated catchment.
- Heavy levels of reddish brown sediment in the surface water runoff.
- Unnamed watercourse capacity exceeded and overtopping of the channel and seepage through the banks impacting properties. Potential blockage of downstream structures.
- Flood water backing up through sewage network.

A summary table is provided below to outline the mechanisms and impacts of the flood events.

Table 4-5: Summary of mechanisms and impacts of the flood events at Ferry Point

Summary	30 December – 2 January Flood Events
No. internal property flooding	1
No. curtilage / property boundary flooding	1*
Flood mechanism overview	Flooding from unnamed watercourse and from overland flow from upstream in the catchment

\* Flooding is understood to potentially be more widespread but limited data available to confirm the exact number

An analysis of antecedent conditions indicates a wetter than average autumn and early winter. The Ferry Point area experienced a flood event, which resulted in internal flooding of properties during Storm Babet which occurred in October 2023.

Following the October 2023 event, modifications were made by the landowner to the unnamed watercourse to increase the capacity and clear vegetation. However, due to the saturated ground conditions in conjunction with high intensity and heavily localised rainfall the channel of the watercourse did not have the capacity to convey the flow to the outfall at the beach without overtopping, resulting in flooding to properties in the area. Videos during the event show seepage of flood water through the informal embankment of the unnamed watercourse.

Flooding at this location could have several causes. Firstly, the downstream culvert could have capacity issues due to an insufficient size or blockages which reduces the volume of water being conveyed from the watercourse. Alternatively, hydraulic inefficiencies in the channel as a result of loss of gradient and a bend in the watercourse could force water out of the bank due to the large volumes of water meeting a bottleneck.

There was clear evidence of internal sewer flooding which indicates that water was backing up through the foul drainage system within properties.

The floodwater was visibly reddish brown, as at the other areas covered within this report, indicating high levels of sedimentation in the runoff from the predominately agricultural land use upstream.

## 4.8 Incident Response

The following section outlines the incident response for the flood events.

### 4.8.1 Carmarthenshire County Council

CCC responds to incidents on a 24-hours a day, 7 days a week basis, either through its regular channels during the working week, or through Delta Wellbeing – the out-of-hours emergency helpline run by CCC.

Residents reported calling Delta Wellbeing during the Winter 2023/24 flood events. Sandbags were requested but did not arrive, and residents were advised by CCC that due to an influx of requests, delays were expected. The CCC policy on sandbags is available online [here](#). Residents noted that Delta Wellbeing was unable to provide helpful advice on specific measures they could take to reduce flooding.

CCC also has an online reporting facility, which is monitored by the CCC Flood Defence Team. It was viewed on 30 December before any incidents were reported in Llansteffan. One incident was reported on 30 December, one on 31 December and one on 1 January. Across the county, many incidents were reported on 2 January, but all impacted residents in Llansteffan were liaising directly with the local Councillor.

A representative from CCC was on site in Llansteffan around midday on 31 December to assess the situation. They worked with the CCC duty team and DCWW (on site and on-call) teams to establish immediate actions with respect to bringing pumps to site. They also requested CCC contractors to

attempt to clean outfall channels on the beach where access could be gained, though faced difficulties due to limited access, soft sand and working between tides.

CCC as the Highways Authority noted that they provided a JCB to assist with a landslip and out-of-hours gangs delivered sandbags to affected areas. Six crews in total attended to flood events.

CCC provided support to the clean-up operation immediately in the aftermath of the flood event and carried out repairs to the carriageway along Water Lane as soon as weather conditions allowed.

The local Councillor was also present to establish the extent of damage caused by the flood event and to listen to evidence of how the flood event occurred from the viewpoint of those affected.

Since the flood event, CCC have been digging out the Middle Outfall following peak high tides to ensure that outflows are not impeded, until a longer term solution can be found.

#### **4.8.2 Natural Resources Wales**

NRW responds to incidents on a 24-hours a day, 7 days a week basis. NRW operates an Incident Communication Centre (ICC), which is the focus for reporting of all incidents from members of the public, professional partners and NRW staff. ICC operatives record, provide an initial assessment of, and assign reported incidents to the pre-identified duty officers for further consideration and/or action.

In addition, NRW provides a service for professional partners and the public through access to information via the NRW website and Floodline (0345 988 1188).

Residents noted they had made contact with NRW on 31 December, which informed residents that they were unable to provide any emergency response service or pumps and advised residents to call the Mid and West Wales Fire and Rescue Service.

Some residents were frustrated that the NRW staff members who were on call at the time to provide phone correspondence were not local to the area and that they were not aware of the localised flood conditions.

#### **4.8.3 DCWW**

Due to the proximity of properties at The Green to the DCWW sewage pumping station, residents had the direct contact details for the Sewerage Manager at this DCWW facility prior to the flood event.

Prior to the flood event DCWW were contacted by residents of The Green who were concerned about standing surface water and the inundation of manholes at the Morfa and The Green. DCWW undertook inspections on 27 December (see Figure 4-13).

The week commencing 25 December DCWW received 12 calls from customers, 6 of these were to report flooding at properties, 1 call was regarding the sewage pumping station and 5 calls were follow up calls wanting updates on the flood situation.

During the flood event on 30 December, residents were in contact with the Sewerage Manager of DCWW via the telephone, who arranged for a pump to be brought from Cardiff to attempt to alleviate the flooding. The pump was in place from the evening of 31 December and was primarily removing surface water.

The week commencing 01 January DCWW received 1 call which related to a query on the pumping station.

DCWW is yet to confirm the extent of the impact caused by the flooding on their networks and whether this contributed to the flooding in Llansteffan. This is part of an ongoing investigation by DCWW and CCC.

#### **4.8.4 Emergency Services**

The Dyfed–Powys Police (DPP) and Mid and West Wales Fire and Rescue Service (Fire Service) were called to attend several incidents. Other residents noted that the Fire Service was unable to help during the early stages of the flood incident for reasons including that they were attending another emergency at a different location. Once on site, the Fire Service rescued several people from their homes and provided pumps to remove floodwater.

Following the event, the Fire Service provided guidance and assistance to residents. They also assisted with salvage operations and isolation of electric supplies to properties. The blue light services did not regard this incident as significant and did not escalate its classification.

#### **4.8.5 Landowners, residents and riparian owners**

As the flooding occurred, residents on The Green and upstream used household level flood prevention methods, including corrugate sheeting to divert water back into the Nant Jac. Some residents were collecting empty sandbags, refilling them with sand from the beach and delivering them to affected houses. Some younger residents assisted in driving to Carmarthen and back to bring sandbags to affected homes.

Several residents noted that they felt helpless in the face of the flooding and did not know the actions they should or could be taking to respond or reduce the impacts.

At Ferry Point, the farmer responsible for the unnamed watercourse had arranged for it to be dug out following the earlier flooding in October 2023. He also provided a pump to help divert flows on 30 December, reducing the flood risk to at least 5 properties in the area.

#### **4.8.6 Overall response coordination**

During the flood events over Winter 2023/24, many residents felt there was a lack of coordination and information sharing between the responders CCC, NRW, DCWW and the Fire Service. At times residents and the local Councillor formed the conduit by which information was shared between responders, rather than directly. The responders have acknowledged that coordination and communication during the flood events could have been better.

However, the response situation was worsened by two factors: firstly, the storms resulted in widespread flooding which required responses across Carmarthenshire, and secondly, the flood events occurred over the Christmas and new year period, with only standby emergency response teams in place as is the norm over such periods.

## 5 Rainfall statistics and frequency analysis

As outlined in Section 3 there is limited catchment specific data available to determine the characteristics of the flood peak data and this is due to the lack of gauged watercourse level and flow data for the catchments concerned.

For the purpose of putting 30 December 2023 and 2 January 2024 flood events in context with the available nearby records and to enable frequency analysis to be undertaken, an assessment of the available rainfall information has been undertaken and it concludes with the likely frequency of the flood events.

### 5.1 Rainfall Analysis

Catchment areas for the Nant Jac and the unnamed watercourse were estimated using the Flood Estimation Handbook (FEH). The Nant Jac catchment was generated from the FEH web service, however due to the small size of the catchment associated with the unnamed watercourse at Ferry Point this catchment area was manually calculated based on topography.

The catchment of the Nant Jac is ~4.5 km<sup>2</sup> and is largely rural from the source near Broadway, with urban areas primarily located in the lower catchment in Llansteffan. The catchment of the unnamed watercourse at Ferry Point is ~0.8 km<sup>2</sup> and is predominantly rural.

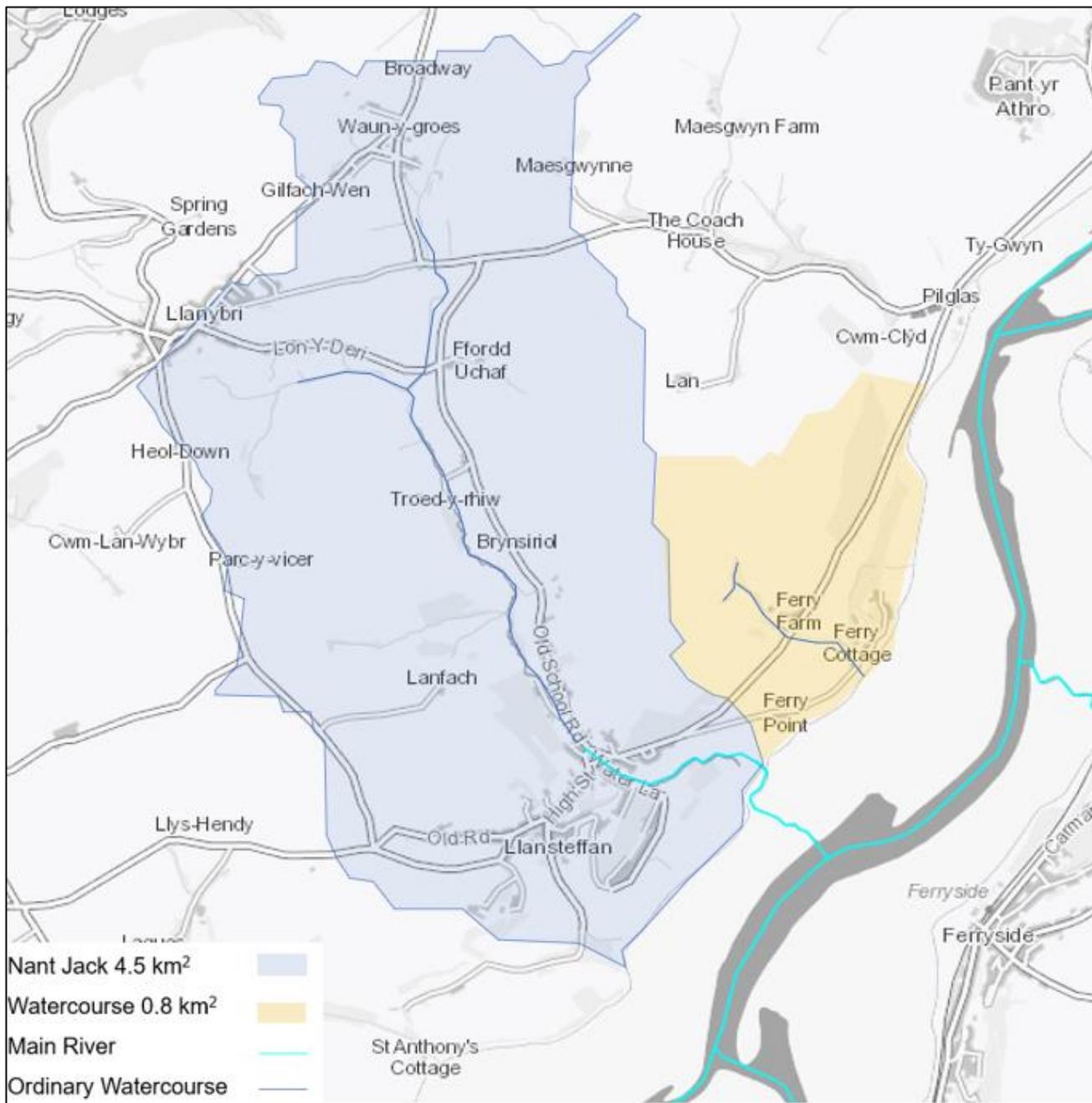


Figure 5-1: FEH Catchment

Rainfall data was obtained from the nearby NRW Llangendeirne rain gauge, located at the coordinates: SN 45472 13724 (Figure 5-22).

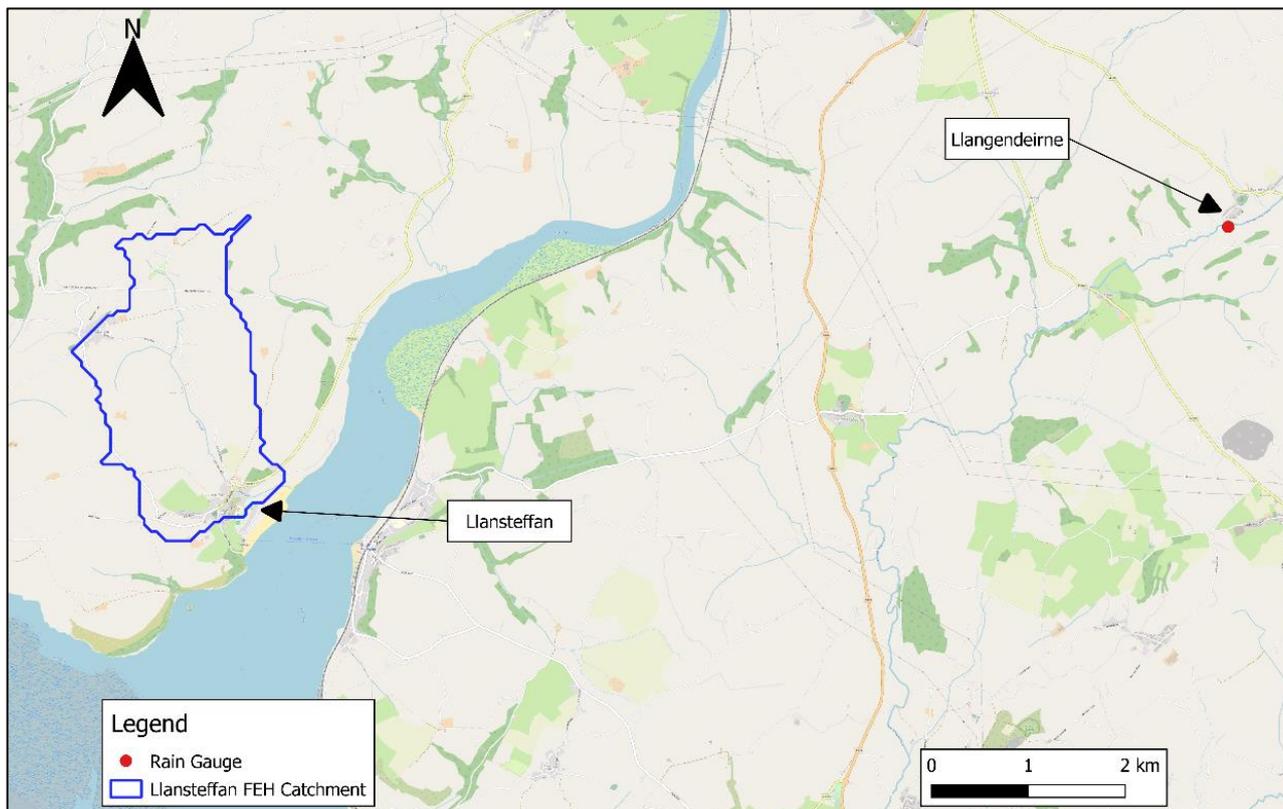


Figure 5-2: Rain gauge location map

The rainfall data has been reviewed and the storm durations and depths have been calculated for the two events. These values have then been put into the Flood Estimation Handbook (FEH) Web Service Event Rarity calculator for the Llansteffan catchment area. The results are in Table 5-1.

Table 5-1: The storm duration, depth and return period for the rainfall events in Llansteffan

Events	30 December 2023	2 January 2024
Start time	10:45	05:30
End time	17:30	13:00
Storm Duration (h)	6.75	7.5
Depth (mm)	19	32
Return Period (year)	N/A	2.02

The rainfall event on 30 December 2023 is too small for FEH to assign it a return period. For a storm duration of 6.75 hrs, the depth of rainfall required for a 1 in 2 year return period is 30 mm. Both events on 30 December 2023 and 2 January 2024 are relatively low magnitude events. This implies that factors outside of the rainfall events have had greater influence on the flooding in Llansteffan. It is

also highly likely that due to the saturated antecedent ground conditions in the area and wider catchment that any additional rainfall falling within the catchment, even during an event of a relatively low magnitude, could result in flooding which would cause a high impact due to the surface water running directly over the ground and into watercourses with limited additional capacity.

The Llangendeirne rain gauge is approximately 10.5 km from Llansteffan so it is possible that this gauge is not representative of the rainfall experienced at Llansteffan.

Additionally, a search of Weather Underground has been undertaken to identify any rain gauges close to the site. Weather Underground is a network of private weather stations, so the reliability of the recorded data is unknown, however, it remains a useful tool for comparison. There is a weather station at Laugharne Sands that recorded 24.1 mm and 29.5 mm for the same time periods on 30 December 2023 and 2 January 2024, respectively. Neither of these sources of data suggest that the rainfall events were greater than a 1 in 2 year event.

Rainfall data for the Nant Jac catchment has been extracted from HydroMaster (Figure 5-33). The total rainfall depths during the flood events from this source are similar to the assessment of the other gauges available and the magnitude of the events are in accordance.

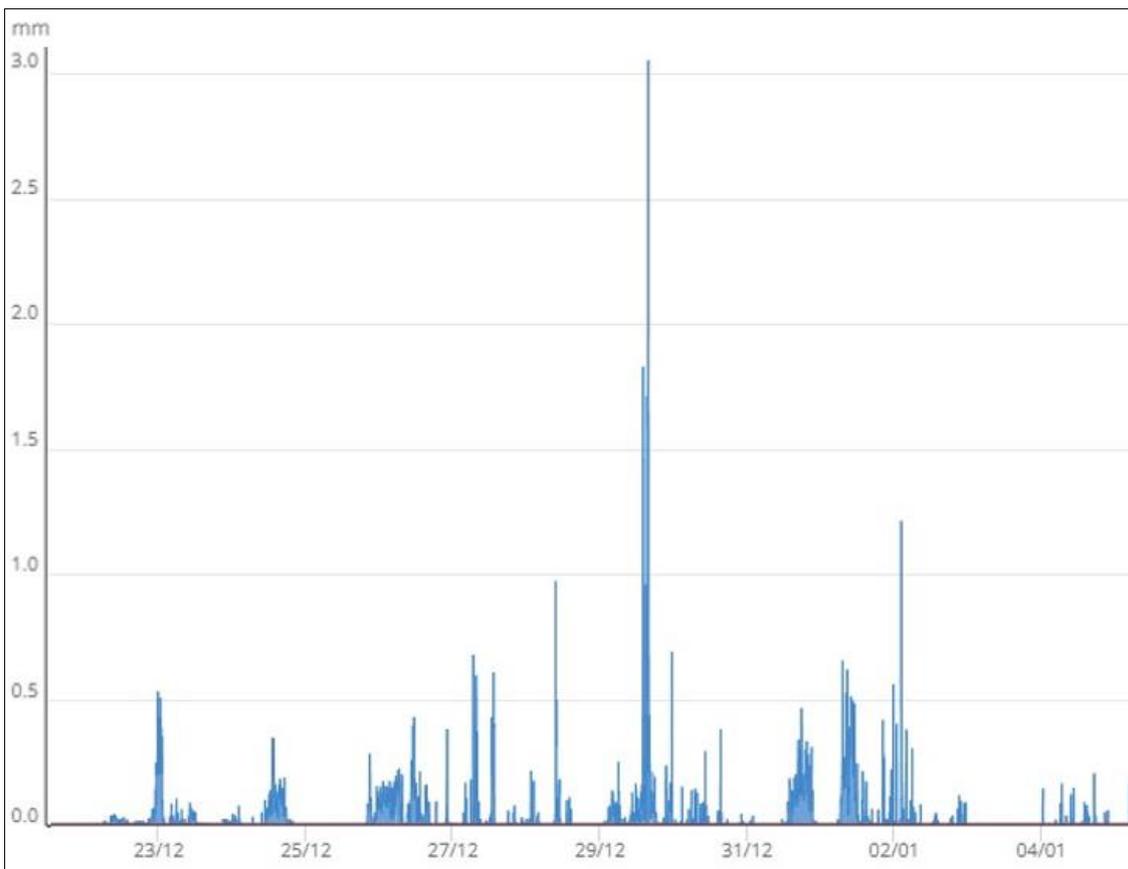


Figure 5-3: HydroMaster Nant Jac 5 minute total

Rain gauge data or radar data is not likely to capture the magnitude of the flood events alone. Due to the limited data available for the catchments it is recommended that further studies are undertaken to establish the hydrology specific to these two small catchments (see Section 6 for further details).

## 6 Summary and conclusions

On 30 December 2023 and 2 January 2024, Storms Gerrit and Henk landed in the UK, bringing heavy rainfall across Wales. These storms caused localised rainfall and significant flooding in the village of Llansteffan and the surrounding areas, with the most impacted households facing up to 2 feet of internal flooding.

Several flooding mechanisms were identified, depending on the location of the properties, whether at The Green, upstream of The Green, or at Ferry Point. The flood was generally a result of increased surface water flows in various watercourses. The breach of the Nant Jac in particular caused a large part of the flooding in Llansteffan around The Green and upstream. Flooding was also worsened by the fact that the outfalls draining the surface water drainage system onto the beach were buried under sand and thus floodwater from the first storm wasn't drained before the second flood. Surface water ingress into the sewerage system was also noted.

While all relevant Risk Management Authorities and emergency services responded during or after the flooding, it has been reported that co-ordination and communication could have been more effective.

In light of the findings of this flood investigation a suite of recommendations have been made, ranging from flood risk management measures and community resilience, to ongoing maintenance and operational activities. The anticipated timescales on these range from short-term to long-term.

## 6.1 Future Actions and Recommendations

Following the assessment of the potential flooding mechanisms associated with the Winter 23/24 flood events the following recommendations and actions have been identified. These are separated into three categories: flood risk management measures, community resilience, ongoing maintenance and operational activities, and ordered by their timescale.

A definition of the timescales is: Short term – weeks to 6 months, Medium term – 6 months to 5 years, Long term – over 5 years

Table 6-1: Future actions and recommendations

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
<b>Flood Risk Management Measures</b>					
FR1	Repairs to Nant Jac High Street bridge	CCC have undertaken repairs to the mid-section of the Nant Janc culvert which incurred damage during the December-January flood events.	CCC	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>Upstream of The Green</li> </ul>
FR2	Continued investigation into the surface water drainage system, the chamber and beach outfalls	Investigations to confirm the current operational standards of the outfalls from the surface water drainage system chambers. Assessment to confirm if measures are required to improve the conveyance from the system and recommend any amendments to the chamber and/or outfalls.	CCC	Short-medium term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
FR3	Further investigation into the sewer network and pumping station	Investigation to confirm connections between DCWW foul and CCC surface networks underway. Once connections are understood proposed mitigation measures can be assessed for effectiveness and implemented.	DCWW	Short to medium term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
FR4	Continued investigation into Nant Jac catchment hydrology and land management	Studies to confirm the hydrological setting of the catchment and the potential impacts of upstream land management practises.	CCC	Short term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
FR5	Continue to explore the potential for improvements to Ferry Point watercourse	Explore the improvements which could be implemented to the watercourse to improve conveyance and reduce the risk of the watercourse/ditch overtopping	Riparian Owners / CCC	Short term ONGOING	<ul style="list-style-type: none"> <li>Ferry Point</li> </ul>
FR6	Reduce surface water ingress into the sewage network (on completion of FR2)	Following the investigation to confirm connections between DCWW foul and CCC surface networks to propose the measures to reduce the water ingress.	DCWW	Medium term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
FR7	Investigate the conveyance of the Nant Jac from High Street Bridge to the sea (following FR3)	Investigate the potential to improve the conveyance of the existing watercourse or provide a diversion to route water away from the receptors more effectively. Undertaking of investigation will be prioritised against other national (Wales-wide) NRW flood risk investigations/activities. Vegetation channel maintenance of the watercourse to reduce the risk and impact of blockages.	NRW	Medium term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
FR8	Assess effectiveness of improving conveyance of the Nant Jac from northern	Potential to improve the conveyance of the existing watercourse or provide a diversion to route water away from the receptors more effectively.	CCC	Medium term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> </ul>

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
	end of Llansteffan to High Street Bridge	Maintenance of culvert system to reduce the risk and impact of blockages.			<ul style="list-style-type: none"> <li>Upstream of The Green</li> </ul>
FR9	Explore potential to re-camber of DCWW access road	The access road behind the houses at The Green is believed to be owned by DCWW. The camber on this road could be directing water towards properties and could be amended to reduce the flow of water towards properties.	DCWW	Longer term	<ul style="list-style-type: none"> <li>The Green</li> </ul>
FR10	Explore the potential to repurpose the Morfa to retain water during heavy rainfall	CCC could assess the benefits of repurposing the Morfa as flood storage. There is also a raised embankment into the Morfa which prevents water flowing from the back access road into the Morfa where it would drain into the surface water drainage. This could be modified to allow drainage into the Morfa.	CCC	Medium term	<ul style="list-style-type: none"> <li>The Green</li> </ul>
FR11	Explore the potential for Natural Flood Management (NFM) upstream to reduce flood flows into watercourses, drainage and sewer networks.	Studies to confirm the hydrological setting of the catchment and the potential impacts of NFM on downstream flood risk.	CCC	Longer term	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> <li>Ferry Point</li> </ul>

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
<b>Community Resilience Measures</b>					
CR1	Continue to improve response coordination and flood event contact procedures	There have been multi-agency meetings to understand capabilities, roles and processes. All responders and stakeholders identified within this report are to continue to work together to ensure that there is a collective understanding of roles and responsibilities before, during and after a flood event. Review of the contact details available for the public during flood events (phone numbers, online portals, etc) and whether the existing procedures are suitable. This is to include the contact procedures during out of office hours. Recommend and implement improvements as appropriate.	CCC / NRW / DCWW / Fire Service	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>• The Green</li> <li>• Upstream of The Green</li> <li>• Ferry Point</li> </ul>
CR2	Explore potential to establish Community Flood Plan and Community Flood Group	A voluntary group of local residents could be established to work on behalf of the wider community to help to try and reduce the impact of future flood events. Although the objectives and actions of the group are defined by the group, elder community members noted that they required support from more able-bodied people to help them with property flood resilience and clean-up measures – this could be taken into account when defining future community response mechanisms. More guidance around community flood action groups can be found from NRW and the <a href="#">National Flood Forum</a> .	Llansteffan community with support from CCC	Short term ONGOING	<ul style="list-style-type: none"> <li>• The Green</li> <li>• Upstream of The Green</li> <li>• Ferry Point</li> </ul>

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
CR3	Explore potential to implement a Pump Mobilisation Plan across Carmarthenshire	A new 8-inch pump has been purchased by CCC for the Carmarthenshire area. Determine a plan to mobilise pumps during flood events.	CCC	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> <li>Ferry Point</li> </ul>
CR4	Enhance community awareness of what to do before, during and after a flood	Many community members noted that they did not know what to do in a flood event or who to contact. It is recommended that all stakeholders come together to align their processes and develop a flood resilience workshop, which can be delivered to the community. This can cover property flood resilience, emergency preparedness and points of contact. CCC should also communicate their sandbag policy to the community effectively.	CCC with RMAs' support	Medium term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> <li>Ferry Point</li> </ul>
CR5	Explore potential for installing Property Flood Resilience measures	Property flood resilience measures can be installed to help keep water out, reduce the impact of damage and allow faster recovery from flooding.	CCC / Llansteffan community	Medium term	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> <li>Ferry Point</li> </ul>
CR6	Explore potential to establish a localised flood warning system (in conjunction with CR2)	Work with the community and look into the viability of a flood warning service on the Nant Jac catchment to provide residents with advanced warning of flood risk.	NRW / Llansteffan community	Longer Term NOT POSSIBLE	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> <li>Ferry Point</li> <li></li> </ul>

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
<b>Maintenance &amp; Operational Activities</b>					
OM1	Complete repairs on the Nant Jac culvert at High Street	Carry out an inspection of the culverted section of the Nant Jac at the High Street Bridge (the point at which it becomes a main river). Structural damage has been noted and is to be confirmed. Structural defects identified will be referred to the riparian owner or appropriate organisation to maintain / report.	CCC	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>• The Green</li> <li>• Upstream of The Green</li> </ul>
OM2	Operational running of the DCWW sewage pumping station	Continued operation of the DCWW sewage pumping station to manage foul water in the catchment.	DCWW	Short term ONGOING	<ul style="list-style-type: none"> <li>• The Green</li> <li>• Upstream of The Green</li> </ul>
OM3	Confirmation of DCWW Pumping Station Capacity (following completion of actions FR1 and FR2)	DCWW are undertaking investigations to confirm the connectivity and capacity of the sewage pumping station.	DCWW	Short term ONGOING	<ul style="list-style-type: none"> <li>• The Green</li> <li>• Upstream of The Green</li> </ul>
OM4	Continue to clear the sand from the duck bill valve and headwall of the Middle Outfall	CCC are regularly clearing the Middle Outfall to allow the surface water drainage system to discharge effectively. This will need to be undertaken until OM7 is complete, and will be done via catchment monitoring triggers, rather than on a peak high tide basis.	CCC	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>• The Green</li> <li>• Upstream of The Green</li> </ul>

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
OM5	Continued maintenance of highways drains	Continued review and maintenance of the highway drains. CCC have increased the frequency of the clearance and maintenance of the highway drainage system. Undertake this in conjunction with OM8.	CCC	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> <li>Ferry Point</li> </ul>
OM6	Continued maintenance of the Nant Jac (main river)	Continued maintenance and review of the Nant Jac. This includes removal of any vegetation, artificial obstructions within the stream. Inspection to remove any existing obstructions and regular maintenance and inspections going forward.	NRW	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
OM7	Continued maintenance of the surface water drainage system outfalls	Continue the inspection regime and review of assets. Currently the Middle Outfall is excavated at peak high tides. Develop a sustainable maintenance regime for the beach outfalls to prevent them from becoming buried or blocked until a long-term solution is found to better manage the flows from the surface water chambers.	CCC	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
OM8	Continued maintenance of highways drains and surface water drainage system	Continue and review the inspection regime of CCC assets. The surface water system has been jetted and a CCTV survey undertaken to understand connections, condition and capacity. Residents note a consistent blocking in highways drains along Water Lane and have reported it regularly. CCC to carry out regular checks and maintenance as required.	CCC	Short term <b>COMPLETE</b>	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>

Ref	Action	Description	Owner / lead organisation	Timescale	Sub Area Applicability
OM9	Investigation of land management practices	Investigate land management practices and the potential to impact on runoff and sediment loads in the catchment.  To be led by CCC with support from NRW. The local community or flood group could be involved in data collection.	CCC / NRW / Llansteffan Community	Longer term	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
OM10	Explore potential for the replacement of manhole covers	DCWW reported that the manhole covers are not watertight and are allowing surface water ingress into the wastewater sewers. Replacement of manhole covers with watertight alternatives would reduce this.	DCWW	Medium term ONGOING	<ul style="list-style-type: none"> <li>The Green</li> <li>Upstream of The Green</li> </ul>
OM11	Regularly inspect and maintain conveyance of the unnamed Ferry Farm-Ferry Point watercourse	Maintenance is required of the unnamed watercourse. This includes removal of any artificial obstructions within the stream. Inspection to remove any existing obstructions and regular maintenance and inspections going forward.	Riparian Owners	Short term	<ul style="list-style-type: none"> <li>Ferry Point</li> </ul>

Photographs of the event

## Appendix A

Photographs of the event

## Upstream of the Green



*Figure 1: Flooding on Mill Pond Lane as a result of high water levels in the Nant Jac. Taken on 31 December 2023.*



*Figure 2: Flooding on Mill Pond Lane as a result of high water levels in the Nant Jac. Taken on 31 December 2023.*

Photographs of the event



*Figure 3: Damage to Mill Pond Lane as a result of flooding. Taken on 2 January 2024.*



*Figure 4: Damage to Mill Pond Lane as a result of flooding. Taken on 2 January 2024.*

## The Green



*Figure 5: Flooding at the junction of The Green and Water Lane. Taken 31 December 2023.*



*Figure 6: Water Lane flooding. Taken during Winter 23/24 flood events (date unknown)*

Photographs of the event



*Figure 7: Surface water run-off on Old School Lane. Taken during Winter 23/24 flood events (date unknown)*



*Figure 8: Flooding of the Morfa. Taken during Winter 23/24 flood events (date unknown)*

Photographs of the event



*Figure 9: Internal flooding in the Llansteffan Sports and Social Club. Taken during Winter 23/24 flood events (date unknown)*



*Figure 10: Internal flooding at The Green. Taken during Winter 23/24 flood events (date unknown)*

Photographs of the event



*Figure 11: Curtilage flooding at The Green. Taken during Winter 23/24 flood events (date unknown)*



*Figure 12: Flooding at The Green. Taken during Winter 23/24 flood events (date unknown)*

**Ferry Point**



*Figure 13: Curtilage flooding at Ferry Point. Taken during Winter 23/24 flood events (date unknown)*



*Figure 14: Curtilage flooding at Ferry Point. Taken during Winter 23/24 flood events (date unknown)*

Photographs of the event



*Figure 15: Internal flooding at Ferry Point. Taken during Winter 23/24 flood events (date unknown)*



*Figure 16: Outfall at Ferry Point (date unknown)*

## Appendix B

### Community Engagement Summary

The following accounts of what happened during the flood events have been identified from consultation with the community and the partner organisations.

#### Previous Flood Events

Previous flood events have been noted by residents in the area and the reports are associated with the distinct sub areas and the associated predominant flood mechanisms.

Sub-Area	Flood History
Upstream of The Green	<p>There are reports by residents of frequent flooding to gardens, driveways and internal property flooding from surface water runoff directly from the agricultural land use upstream in the catchment. The reports of this specific flood mechanisms are from the past 2- 3 years since the land use upstream in the catchment has been converted to predominately maize crops. This is resulting in a higher volume of surface water runoff during rainfall events causing frequent damage to gardens and driveways.</p> <p>Where the houses are level with the Nant Jac upstream, residents reported that their gardens have flooded to circa 20 mm two to three times in the last 30 years. It was formerly unusual for the stream to overtop and run down Mill Pond Lane but this has reportedly occurred five times over Winter 2023/24, causing damage along the road.</p>
The Green	<p>The majority of residents noted that flooding of the scale of the Winter 2023/2024 has not occurred in the time they have been living in Llansteffan and longstanding residents who have lived in The Green for 30 to 60 years have never experienced internal flooding.</p> <p>Some households noted frequent minor outdoor flooding (front / back gardens) during previous heavy rainfall. Reports of issues with surface water not being able to drain from the Morfa and The Green effectively have been reported and this worsens the ponding of surface water on the DCWW access lane to the Sewage Pumping Station, which flows towards the gardens of properties on The Green.</p> <p>The properties at the lowest elevation are located towards the middle of The Green. Surface water runoff from upstream naturally flows into this area. These properties report frequent flooding from a combination of surface water and sewer flooding, whereby the foul sewer network can be overwhelmed by surface water ingress, resulting in water backing up through toilets and showers within properties. In the autumn/winter of 2023 DCWW were providing tankers to remove excess surface</p>

water from the sewer system to provide sufficient capacity to manage the foul flows at the pumping station and allow residents to flush toilets.

Frequent flooding of the gardens and the curtilage of the lowest lying properties has also been reported on a frequent basis during high rainfall or prolonged periods of wet weather. DCWW and CCC are aware of the ongoing flood risk in the area and investigations are ongoing to determine the connections between the DCWW foul and CCC surface water drainage systems to determine the flood mechanisms in more detail.

A common factor reported in all previous nuisance flooding and internal flooding is the inability for the surface water drainage system to drain the Morfa and The Green effectively via the chambers and the main Middle Outfall. This is often due to the outfall being buried under sand and reports state that the frequency and severity of flooding has increased since this new outfall was installed ~ 2 years previously.

The Mid and West Wales Fire and Rescue Service noted that the area is known to flood and have had a number of incidents at this location in the past.

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**Ferry Point** Prior to the Winter 2023/2024 events this area is at risk of flooding from surface water overland flow from upstream and overtopping of the unnamed watercourse due to capacity issues. Flooding occurred during the October 2023 storm prior to the winter 23/24 flood events. Prior to this event the unnamed watercourse was cleared and re-profiled to increase the capacity of the watercourse. An earthen bund has been constructed along the left bank of the watercourse to try and prevent water flowing towards receptors in this area and towards open green spaces and agricultural land.

There are reports of frequent flooding to property curtilages and internal flooding as a result of poor maintenance to the lower portion of the watercourse and the culvert under the access road.

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## Flood warnings

Residents noted that they had received flood warnings from NRW ahead of the storms, warning of high levels in the Towy Estuary and of high tides. Some residents however noted that they are registered for flood warnings but did not receive any.

On average, it is possible that residents receive an average of at least one flood warning a week during winter months and are often general warnings for the Carmarthenshire coast or Towy. Often, when warnings are received there is no flooding in Llansteffan. Residents reported that the flood warnings available are not particularly relevant and note that flood alerts are not issued when flooding is likely to occur in the Nant Jac catchment.

## Winter 23/24 Event: What happened?

### Upstream of The Green

Prior to the flood event there were reports that the Nant Jac was exceptionally high for the majority of November and December with water levels at least two-three feet higher than the previous two years. The water within the channel was a reddish brown and previously the water in the channel was clearer.

Damage to the High Steet Bridge occurred following the October 2023 event and flooding upstream on the Nant Jac could be influenced by the condition of the bridge/culvert.

In the morning of 30 December 2023, residents noted that it started raining at approximately 08:00. Residents report that the first indication of a likely flood event was due to water flowing down Old School Road. Within 2 hours, the rain had picked up and was starting to rapidly increase the levels of the Nant Jac. Internal flooding occurred around 14:45 to a depth of approximately 100 mm internally and 200 mm externally in the Mill Pond Lane Area. Further downstream on Old School Road, the Nant Jac overtopped the banks near the Mill and water flowed through gardens and onto the highway. Water within the Nant Jac was not following effectively through the High Street Bridge/culvert.

On 2 January 2024, residents reported internal flooding starting to become a concern from rainfall and the Nant Jac around 09:45. Some residents were able to divert water away from properties and back to the Nant Jac through the use of corrugated sheeting.

Due to the volumes of water and the ground levels sloping down to The Green, residents noted significant damage to the road surfacing, including the washing away of gravel. The roads were acting as rivers with no where for water to go, with water running down Old School Road. It is unclear if this was water from the Nant Jac or from surface water overland flow.

On both 30 December 2023 and 2 January 2024, residents at Glan-Y-Mor noted that water was flowing down Glan-Y-Mor and Water Lane where they run parallel to the Nant Jac during the flooding. This came close to flooding certain properties through their front doors, and residents noted concerns about the air bricks.



*Nant Jac upstream of Mill Pond Lane*



*Nant Jac overtopping the bank at Mill Pond Lane*



*Surface water runoff along Old Road*



*Surface water runoff along the High Street*

### **The Green**

Standing water was present on the Morfa prior to the 30 December event. Several residents who have lived in Llansteffan for over 30 years recollected that the Morfa used to be a marshland and has since become a playing field.

Residents reported rain in Llansteffan in the morning of 30 December 2023, though not to an intensity that was initially worrying to the residents. Within a few hours, residents noticed that the intensity of the rain had increased dramatically. By approximately 15:00, water levels had risen quickly and water was starting to enter the properties through the back lane of The Green.

Flood water initially entered from the Morfa and was relatively clear. When the Nant Jac overtopped the banks at Water Lane the colouration of the water changed to a muddy brown. A combination of flows from the Morfa and the Nant Jac flowed down highways and towards The Green.

Following this flood, standing water was left in the Morfa and around The Green as water could not drain from the system via the buried outfall on the beach. Residents at Glan-Y-Mor noted that water had stopped flowing down the road.

On 2 January 2024 at approximately 11:00, residents noted that water was entering their properties again very quickly. A 'wave' of water from the Nant Jac overtopping the channel and flowing towards The Green was reported.

During the second flood event, residents noted flood levels reaching 18" to 2 feet internally at its worst. The event on 2 January was more severe with higher flood depths and some residents reported flood water coming up through the floors/ground.

One of the key factors which exacerbated the flood impacts on several households, especially during the second flood event was a lack of coordination and unclear remits of different services and partners during the emergency.

Pumping of the flood water was being undertaken by DCWW, the Fire Service and CCC but this did not alter the flood levels. By 4 January 2024, the water eventually subsided when the outfalls on the beach were excavated, and the water was able to drain out.

The floodwater is visibly reddish brown in colour and leaves a silt when the water is drained. This indicates run-off from land upstream. Elder residents in the community have identified this silt as a slip hazard, noting that several people have fallen when walking as a result of the silt. This also presents a hazard on highways.

Residents along The Green noted that they were aware of their flood risk from the sea but were not expecting flooding as a result of surface water and were therefore unprepared to respond quickly when the event occurred.



*Flooding to the back of The Green*



*Water ponding on the Morfa and The Green*



*Water overtopping the Nant Jac along Water Lane*

*Water overtopping the Nant Jac along Water Lane*

### Ferry Point

When it rains, water runs off the fields above Ferry Farm and onto Llansteffan Road, down an unnamed watercourse and culvert that runs down to the beach. The watercourse was cleared out and reprofiled following a flood event in October 2023. On 30 December at around 15:30, this watercourse overflowed and gushed out across the field and into the properties at Ferry Point.

There is an embankment which has acted historically as a flood defence but this is not well maintained and during the flood event water was seeping through the embankment. It is believed that the culvert in the field at Ferry Point may have been blocked as this is not frequently maintained by the riparian owner and is also too small to cope with the flows received, particularly during a large storm event.

The internal flooding reached at least 2 feet within the properties and there was clear evidence of sewerage in the flood water. Assistance from a local farmer came in the form of a pump and this was pumping ~1,000 litres per minute for several hours. This helped to alleviate the flooding and reduced water levels and prevented wider flooding. The water levels were so high the property was evacuated during the event. The water stayed in the property for two days and much longer in the garden.



*Recently re-profiled watercourse channel*



*Flooding of property curtilage at Ferry Point*

## Common perceptions regarding the flood events

Common perceptions and themes emerged from the public consultation regarding both flood events on 30 December and 2 January.

### Maintenance

- Highway gullies frequently blocked contributing to overland flow
- Concerns over the functionality of the Primary High Level Outfall as this is frequently buried by sand. Perception flood risk and drainage problems increased since this was installed ~2 years ago
- Concerns about DCWW sewage pumping station capacity, functioning and the frequency of tankering from the facility
- Lack of maintenance of DCWW access track
- Removal / infill of drainage ditch within The Morfa resulting in poorer drainage conditions

### Land Use

- Changes to upstream land use and extensive maize crops perceived to have resulted in increased frequency and depths of surface water entering the village
- Extensive maize farming resulted in a change in colour of the surface water runoff and within watercourses from clear to a red/brown colour
- Concerns new residential development in the village putting additional pressure on surface water drainage system and DCWW pumping station

### Watercourses

Unclear on responsibilities and roles regarding the maintenance for the Nant Jac

Perceived lack of short and long term maintenance of main river and ordinary watercourse

Watercourses require dredging to improve flows

Concerns over the structural condition of the High Street Bridge and risk of collapse

Constraints and blockages present in upper and lower reaches of the Nant Jac

### Event Response

Not knowing who to contact regarding the flood event

Unable to access help or understand the processes they should be following

Not being able to reach CCC or NRW through the contact details listed

Lack of coordination in response amongst CCC, NRW, DCWW and the fire service

Slow deployment of pumps to reduce water on the Morfa and The Green

Poor coordination regarding clean up post event

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