1 Appendix B.1 – Ceredigion Flood Risk Review

1.1 Historical flooding

Ceredigion has a history of recorded flood events caused by multiple sources of flooding. Significant flood events within the Ceredigion County Council authority area (which have been taken from NRW's recorded flood extents dataset and Ceredigion County Council records and reports on historical flood incidents) are recorded below in Table 1-1. Every effort has been made to include the most significant flood events within the county in Table 1-1, however the list is not exhaustive. Developers are encouraged to consult the LLFA and NRW about historical flood risk to a proposed development site. A summary of the spatial distribution of historical sewer flooding incidents by electoral ward is summarised in Table 1-2.

No records of groundwater flooding or flooding from artificial sources were made available at the time of writing.

Table 1-1 Flooding incidents by year

Year of flood event	Location	Flood Incident
December 1965	Aberaeron	Channel capacity exceeded.
March 1981	Aber Cerdin Mill	Flooding of Aber Cerdin Mill from the River Cerdin. Up to 0.38 max depth. Flooded 11/03/1981 however major flooding also occurred on 22/03/1981.
March 1981	Llechryd	Flooding of Llechyrd and Manordeifi area. No further information available.
March 1981	Pontrhydfendigaid	Channel capacity exceeded causing flooding of 4 properties. No further information available.
October 1987	Lampeter	Channel capacity exceeded. Lampeter and Cwmann areas flooded (8 properties in Lampeter and 3 properties in Cwmann affected). Assumed source River Teifi. Lampeter University Flooding from the River Dulais.
October 1987	Tregaron	Channel capacity exceeded. Flood water ran down streets and affected properties in Tregaron Square, Chapel Street, Doldre. Assumed source was the River Brennig.
October 1987	Llanybydder	Channel capacity exceeded. Station Terrace flooded including shops. 9 properties cellars flooded and their gardens. On Bridge Street the bank cellar flooded. Total 10 cellars, 16 houses and 5 businesses. The max depth of water in these properties was 1 ft. Source of the flooding was the River Teifi.
October 1987	Pontrhydfendigaid	Channel capacity exceeded of the River Teifi. Causing flooding of at least 6 properties.
October 1987	Cenarth	Channel capacity exceeded.
October 1987	Drefach	Channel capacity exceeded.
October 1987	Llechryd	Water supply intake works and pumping station affected. Water supply disrupted, mainly due to quality problems.
October 1987	Llandysul	Channel capacity exceeded.
October 1987	Aberaeron	Channel capacity exceeded.
October 1989	Glan-yr-Afon	Channel capacity exceeded.

Year of flood event	Location	Flood Incident
		Glan-yr-Afon industrial estate flooding. Flood level of recorded as 8.69mAOD.
March 1990	Eglwys Fach – Dyfi Estuary	Overtopping of tidal defences.
March 1990	Glandyfi – Dyfi Estuary	Overtopping of tidal defences.
March 1990	Afon Clettwr – Dyfi Estuary	Overtopping of defences.
March 1990	Aberystwyth	Channel capacity exceeded. Glan-yr-Afon industrial park flooded.
January 1997	Ynys Las	Operational failure/ breach of defence. Tidal surge filled the estuary, northerly winds pushed water up the Afon Leri and caused a circular failure of the bank and a 70m breach. This flooded the surrounding area.
March 1999	Aberystwyth	Channel capacity exceeded of the River Rheidol. Glan-yr-Afon industrial park flooded.
November 2000	Glanwern, Borth	Channel capacity exceeded.
November 2005	Pont-Tyweli	Channel capacity exceeded.
June 2007	Lampeter	16 properties were affected by surface water flooding due to exceedance of the drainage systems on 11th June 2007
June 2012	Dol-y-Bont	River Leri flooded, resulted in flooding to Riverside Caravan Park and internal flooding to 19 properties.
June 2012	Capel, Bangor	Channel capacity exceeded of the River Rheidol. 19 properties in total were internally flooded, in addition to caravans at the nearby caravan park.
June 2012	Aberystwyth	Channel capacity exceeded of the River Rheidol. Numerous properties within Railway Terrace were flooded during the event. Flood event caused serious flooding to the retail park. It is also expected that a hydraulic lock caused by high tide at Aberystwyth Harbour and peak flows of the River Rheidol would have prevented discharge of water into the harbour.
June 2012	Dol-y-Bont	Overtopping of defences on the River Rheidol. Approximately 19 properties and 11 static caravans were affected.
June 2012	Borth	Overtopping of defences. Approximately 33 properties (residential and commercial) affected.
June 2012	Tal-y-bont	Channel capacity exceeded. Flooding was worsened when a wall collapsed into Afon Ceulan. Approximately 26 properties were affected.
October 2012	Cardigan	A total of 17 properties were flooded internally as a result of heavy and intense rainfall. Specific areas which experienced internal flooding of residential/commercial properties were Morgan

Year of flood event	Location	Flood Incident
		Street, St Mary Street, Church Street, Feidr Fair, Castle Street, Tivy View, and Manarafon.
January 2014	Aberystwyth	Wave overtopping from the promenade at the Marina; heading north along Marine Terrace to Victoria Terrace. Numerous properties were affected mainly at basement level caused by tidal surge water flowing along Marine Terrace and Victoria Terrace.
January 2014	Borth	Wave overtopping from the south end of Borth heading north to the Golf Course. Approximately 12 residential and 2 commercial properties were affected by the event. Properties were affected by tidal surge water and drainage systems being surcharged.
October 2018	Adpar/Newcastle Emlyn	Storm Callum caused torrential rain and strong winds over large parts of the UK. In Ceredigion 31 commercial and residential properties flooded internally and/or externally from a combination of fluvial water from the River Teifi and pluvial surface water discharging onto the highway network from private land.
February 2020	Llechryd, Aberporth, Talsarn	During February 2020, Wales experienced four noteworthy rainfall events which had an impact on areas within Ceredigion. These storms included Ciara, Dennis, and George (the fourth was unnamed) which all occurred within three weeks. Records show that 288mm of rain fell on average across Wales, which is more than four times the monthly average in some areas. The heavy and intense rainfall caused the overtopping of many Main Rivers. As a result of the February 2020 storms a total of 4 properties across Ceredigion were flooded. There was widespread flooding within Ceredigion including in Llechryd and areas near to the River Teifi and River Aeron.
January 2021	Llechryd	Flooding caused by Storm Christoph which resulted in the overtopping of the River Teifi. The flood event affected Llechryd Bridge and several other areas in the the lower Teifi catchment.
June 2021	North Ceredigion	During the flooding incident, a number of watercourses were unable to cope with the level of rainfall experienced in the previous week which resulted in saturated ground conditions. A total of 120 properties flooded internally. Settlements which experienced internal flooding of residential/commercial properties were: Talybont, Dolybont, Borth, Capel Bangor, Penrhyncoch, Llanbadarn Fawr, Llanfarian, Clarach, Goginan, Penbontrhydybeddau. All records to date indicate that flooding took place within the floodplains of the various rivers/watercourses; with the majority of caravan parks affected by the flooding due to their location. Flooding was also caused as a result of structural defects to bridges and culverts.

1.2 Fluvial

The main watercourses within Ceredigion are:

- Bowstreet Brook
- River Arth
- River Aeron
- River Ceri
- River Clarach
- River Dovey
- River Leri
- River Mydr
- River Rheidol
- River Teifi
- River Wyre
- River Ystwyth

These watercourses are all classified as NRW Main Rivers. Maps showing the extent of the flood outlines from the NRW FMfP – Rivers in Ceredigion are provided in Appendix B.2.

The River Dovey forms a boundary between the counties of Ceredigion and Gwynedd, rising in Lake Creiglyn Dyfi, Snowdonia National Park, and flowing in a south westerly direction via the town of Machynlleth, before discharging into Cardigan Bay at Aberdyfi. The main tributary of the River Dovey within Ceredigion is the River Leri which flows in a westerly direction to Borth and then northerly until it converges with the River Dovey.

The floodplain of the River Dovey is not hugely significant within Ceredigion. The greatest flood risk along this watercourse within the county boundary is at Eglwys Fach, where the River Einion converges with the River Dovey. FMfP Flood Zone 2 and 3 are both present, presenting a high fluvial risk.

The River Leri presents an extensive fluvial flood risk in the lower reaches, between Borth and the River Dovey. FMfP Flood Zone 2 and 3 are significant in this area, representing the highest level of fluvial flood risk. NRW fluvial flood defences are present along the right bank of the River Leri, extending between Borth and the River Dovey estuary. However, the area behind these fluvial flood defences is not classified as a TAN-15 Defended Zone.

The River Rheidol rises in the headwaters of the Nant-y-Moch Reservoir in the Cambrian Mountains and flows in a southerly direction to Devil's Bridge before flowing westerly to Aberystwyth, where it discharges into the sea at Cardigan Bay.

The floodplain of the River Rheidol is fairly confined and remains within close proximity to the watercourse in the upper reaches. In the middle to lower reaches of the river, FMfP Flood Zone 2 and 3 are present and extend up to a few hundred metres from the watercourse, predominantly impacting rural and agricultural land. In the lower reaches of the River Rheidol FMfP Flood Zone 2 and 3 cover a widespread area of the floodplain. These impact agricultural areas in the surrounding area to the east of Aberystwyth and also presents a high risk of fluvial flooding to industrial and commercial development in Aberystwyth and Glanyrafon, as well as the A44 which is one of the main routes to the town of Aberystwyth. NRW fluvial flood defences are located along the River Rheidol to the north of Glanyrafon and along sections of both banks in Aberystwyth. As a result of these flood defences, the areas located behind them are classified as TAN-15 Defended Zones.

The River Ystwyth rises near to Plynlimon in the Cambrian Mountains and flows in a general north westerly direction to the sea at Cardigan Bay, just south of Aberystwyth. Its floodplain is confined in the upper reaches and remains within close proximity to the watercourse. In the middle reaches the floodplain begins to extend and FMfP Flood Zones 2 and 3 covers a larger area, predominantly impacting land used for farming. Near to the mouth of the River Ystwyth FMfP Flood Zone 3 covers a large expanse of land to the east of Rhydyfelin. NRW fluvial flood defences are located along the left bank of the River Ystwyth in this area, providing a minimum standard protection of 1 in 100 years. Additionally, as a result of these fluvial flood defences the land located behind them is classified as a TAN-15 Defended Zone.

The River Wyre is a small river which is sourced to the north of Bronant, near to Cwm-yr-Olchfa. It flows in a northerly direction through Lledrod, and then flows in a westerly direction via Llangwyryfon to Cardigan Bay where it discharges into the sea at Llanrhystud. The Wyre Fach is the main tributary of the River Wyre. It flows to the south of the River Wyre from near to Llangwyryfon in a south westerly and then north westerly direction, converging with the River Wyre to the east of Llanrhystud. The floodplain of the River Wyre and its tributaries is fairly confined to the river corridor, and FMfP Flood Zone 2 and 3 are only present within close proximity to the river.

The River Aeron is sourced from Llyn Eiddwen which is located to the west of Bronant, and flows in a general southerly direction to Llangeitho before flowing south west then north west at Tal-Sarn to Aberaeron. The River Aeron flows via Aberaeron and discharges into the sea at Cardigan Bay. Main tributaries of the River Aeron include the Aeron Fach, River Meurig, and River Mydyr. The River Mydr is sourced to the south of Mydroilyn and flows in a general northerly direction before converging with the River Aeron at Llanaeron. FMfP Zone 2 and 3 are present within close proximity to the River Mydr.

In the upper and lower reaches of the River Aeron fluvial flood risk is relatively confined to the watercourse, with FMfP Flood Zone 2 and 3 present only within approximately 100m of the watercourse. The greatest fluvial flood risk is presented between Llangeitho and Ciliau Aeron, where tributaries of the River Aeron generate a more extensive floodplain which impacts areas such as Tal-sarn and Llanllyr. An NRW fluvial flood defence is present in Aberaeron along the left bank of the river, providing less than a 1 in 100-year standard of protection to a small residential development located behind the defences. However, this area is not classified as a TAN-15 Defended Zone.

The River Teifi flows in a westerly direction from its source at Llyn Teifi, north Ceredigion, and flows in a general south westerly direction, discharging into the sea at Cardigan Bay. The River Teifi generates a boundary between Ceredigion and its neighbouring county of Carmarthenshire. Main tributaries of the River Teifi in Ceredigion are the River Ceri, River Clettwr and River Cledlyn. Fluvial flood risk along the tributaries of the River Teifi are confined, and FMfP Flood Zone 2 and 3 remain within close proximity to the watercourse.

NRW fluvial flood defences are located in the lower reaches of the River Mwldan which converges with the River Teifi in Cardigan. These fluvial flood defences provide a minimum standard protection of 1 in 100 years. As a result of their presence, the areas located behind these defences are classified as TAN-15 Defended Zones.

The River Arth is sourced to the west of Crynfryn and flows in a general westerly direction before discharging into the sea at Aberarth. FMfP Zone 2 and 3 are present in the upper reaches of the River Arth and are confined to the watercourse. Between Dyffryn Arth and Pennant FMfP Zones 2 and 3 are more extensive where the Afon Bran converges with the River Arth, extending approximately 200m from the watercourse. In the downstream reaches of the River Arth, FMfP Zone 2 and 3 are confined to the watercourse from Pennant. There are no NRW fluvial flood defences located along the River Arth.

The River Clarach is sourced to the east of Pen-Rhiw-Newydd and flows in a general westerly direction via Clarach before discharging into the sea. The main tributary of the River Clarach is Bowstreet Brook which flows in a general south westerly direction from Bow Street before converging with the River Clarach. FMfP Flood Zone 2 and 3 are fairly confined to the watercourse in the upper reaches of the River Clarach. To the south of Bow Street where the Afon Peithyll and Bowstreet Brook converge with the River Clarach FMfP Flood Map Zone 2 and 3 are extensive and spread approximately 100m from the watercourse. The FMfP Flood Zones are present from this location until the river discharges into the sea. No NRW fluvial defences are present along the River Clarach or its tributaries.

The National Flood Asset Database (NFAD)[1] records flood infrastructure in Wales, including embankments, walls, flood gates, culverts, and debris screens. All RMA in Wales are encouraged to enter onto NFAD details of all assets that they are aware of, including privately owned assets. The NFAD is regularly updated to improve the accuracy of the data. However, at the moment NRW highlight the following issues with the database:

1 https://naturalresources.wales/flooding/managing-flood-risk/find-flood-defence-structures-near-you-the-national-flood-asset-database/?lang=en

- some of the data may be inaccurate, out-of-date or missing
- some of the underground assets might not be known or recorded accurately
- information for Ceredigion is not shown
- Property Flood Resilience (PFR) schemes are not included

Fluvial Flood Risk & TAN-15

Due to the nature of the topography in Ceredigion, floodplains are wide and flatter in the lower reaches, allowing water to cover larger areas. As a result, FMfP Flood Zone 2 and 3 are generally more extensive in the downstream reaches. Settlement areas such as Aberystwyth and Cardigan are partially located in FMfP Flood Zone 3. Elsewhere floodplains that are fairly confined and remain within close proximity to the watercourse, as shown by the FMfP Flood Zone 2 and 3 extents.

In upland areas, such as the Cambrian Mountains, there is very little fluvial risk present, due to the valley like characteristics. Consequently, the majority of these upland areas are located within FMfP Flood Zone 1.

Flood Defences found along the River Leri, River Ystwyth, River Aeron, River Mwldan and River Rheidol are maintained by NRW. As a result of these flood defences, parts of the fluvial floodplain are categorised as a TAN-15 Defended Zone. Therefore, all forms of development are possible subject to satisfying the requirements of the Justification Tests. The flood defences have a minimum 1% AEP event standard of protection.

New highly vulnerable development within undefended areas of FMfP Flood Zone 3 not possible, as FMfP Flood Zone 3 is not suitable for highly vulnerable development. Less Vulnerable development shall only be possible subject to the stringent Justification Tests outlined in TAN-15. Development in these areas shall be subject to site specific assessment and detailed flood modelling shall be required. Due to the lack of protection from NRW flood defences, any proposed development in an undefended area is likely to require flood mitigation considerations and may be more challenging to meet TAN-15 requirements.

1.3 Tidal

Cardigan Bay is a potential source of tidal flooding to areas near to tidal rivers in Ceredigion. Tidal flooding is most likely to occur during storm surge conditions that is characterised by wind-driven waves and low atmospheric pressure in high spring tides. In areas protected from flooding by sea defences, tidal flooding can occur as a result of a breach in the defences, failure of a mechanical barrier or overtopping of defences.

The NRW FMfP – Sea, shown in Appendix B.2, identifies that the River Dovey, River Rheidol, River Teifi, and River Aeron are tidally influenced rivers within Ceredigion; therefore, areas within the lower reaches are the main locations at risk of tidal flooding. For example, in the lower reaches of the River Dovey (within the Ceredigion boundary) the settlement of Borth is located in Flood Zone 3. Smaller settlements further inland including Llancynfelyn and Eglwys Fach are also located in Flood Zone 3. Areas of Borth are protected by tidal flood defences stretching from Ynyslas to Borth. The areas behind these defences are within a TAN15 defended zone meaning that the area has a minimum standard of protection of a 1 in 200 year flood event from the sea.

A number of other tidal defences are found along the left bank of the River Dovey in the form of embankments, stretching from the western parts of Borth to Eglwys Fach. These defences have a standard of protection less than a 1 in 200 year event as the areas behind are not classified as a TAN15 defended zone.

Areas of Aberystwyth which surround the marina are located in Flood Zone 3 as a result of wave overtopping and flooding from the tidally influenced River Rheidol. Flood Zone 3 is also found to the west of the urban centre of Aberystwyth in Glanyrafon as a result of the tidally influenced river. Combined fluvial and tidal defences are found on the River Rheidol close to the marina, although the area behind does not form a TAN15 defended zone.

Areas of Flood Zone 3 are found in the north west of Aberarth as a result of the tidal influence of the River Arth. There are no NRW flood defences present in this area.

Large areas of Aberaeron are located in Flood Zone 3, due to wave overtopping and the tidal influence of the River Aeron. The eastern area of Aberaeron is covered by a TAN15 Defended Zone. This usually means that the area is protected from a minimum event of a 1 in 200 year tidal flood event. NRW mapping does not show any NRW flood defenced in this area, although there does appear to be a flood wall in the area, as such the reason for the TAN15 Defended Zone is unclear.

Aberporth Bay and the immediate surrounds are located in Flood Zone 3, likely due to wave overtopping. There are no NRW flood defences in this area and flood risk remains largely contained in Aberporth Bay.

Extensive areas of Cardigan are located in Flood Zone 3 due to the tidal influence on the River Teifi. There are no tidal NRW flood defences or tidal TAN15 defenced zones within Cardigan.

Tides may affect flooding much further inland during extreme events, especially if sea levels rise as predicted in the future.

Tidal Flood Risk & TAN-15

Flood defences found along the tidal rivers in Ceredigion and around its coastline are maintained by NRW. As a result of these flood defences, parts of Cardigan, Aberystwyth, Aberaeron, and Borth, are categorised as a TAN-15 Defended Zones. Therefore, all forms of development are possible if requirements of the Justification Test can be satisfied.

Undefended areas within the county are unlikely to allow highly vulnerable development to be permitted. In these areas at risk, it is likely that the application of climate change results in a large tidal flood extent with significant depths of flooding. This increase in flood risk may make it difficult to meet the requirements of the acceptability criteria of TAN-15.

Less vulnerable development should only be considered in FMfP Flood Zone 3 subject to the application of the Justification Test and acceptability of consequences. It is likely that flood mitigation measures will be required for developments in these areas. Development in these areas shall be subject to site specific assessment and detailed modelling shall be required. Opportunities for highly vulnerable development should be located in areas outside of FMfP Flood Zone 3.

1.3.1 Coastal Erosion

To understand coastal erosion within Ceredigion, NRW's Coastal Erosion shapefile from the FMfP was used. The shapefile splits erosion timescales in the following categories:

- short-term (2005-2025)
- medium-term (2025-2055)
- long-term (2055-2105)

As planning tends to look at longer lifetimes of development e.g. 75 to 100 years the long term erosion rates are the focus of this section. Long term erosion rates are largely varied across the coastline of Ceredigion with rates varying between less than 20m to over 50m between 2055 and 2105. There are also several areas which are classified as 'negligible risk' or 'the causes of cliff instability are unclear'.

The highest erosion rates in Ceredigion are seen on a small section of coast between Aberarth and south of Llannon where erosion rates exceed 50m a year. Elsewhere in the county erosion rates appear to be less severe; for example, Aberporth is considered to see erosion rates of less than 20m between (2055-2105). Similar erosion rates are seen in the bay at New Quay with the exception of the headland which experiences slightly higher erosion rates of less than 50m.

Erosion rates in Aberaeron are recorded as the 'causes of cliff instability are complex' with no specific erosion rates given. Information on the Ceredigion website[2] provides further information on the wave conditions the settlement is exposed too:

2 https://www.ceredigion.gov.uk/resident/news/2020/views-sought-on-aberaeron-coastal-defence-scheme/

"*Aberaeron is exposed to a wide range of wave conditions from the North-West and South-Westerly directions; with storm waves entering through the harbour entrance causing overtopping of the harbour walls and in extreme conditions overtopping the inner secondary wall*. "

The Welsh Government have provided funding to Ceredigion to design a scheme that will help to mitigate flooding in Aberaeron by providing some protection against storms in the hope of mitigating flooding and coastal erosion.

To the south of the main settlement of Aberystwyth, erosion rates are classified as 'causes of cliff instability are complex' with no specific erosion rates given. However, wave overtopping has been known to occur in Aberystwyth[3] which is likely to have an impact. Erosion rates on the coast of the main settlement of Aberystwyth are identified as negligible and to the north of the settlement as less 20m a year.

In the main settlement of Borth, erosion rates are recorded as not being applicable. To the north of the main settlement of Borth between Ynyslas and the mouth of the River Dovey erosion rates are classed as less than 50m of erosion between 2055 and 2105. Between the mouth of the River Dovey and Eglwys Fachit is noted that coastal erosion is not the main risk in the area.

Information on Shoreline Management Plans and Catchment Flood Management Plans for Ceredigion can be found in Section 3.4.1 and 3.6 of the main report.

1.4 Surface water and smaller watercourses

Maps showing the extent of the flood outlines for the surface water in Carmarthenshire are provided in Appendix B.2.

The NRW FMfP – Surface Water and Small Watercourses shows surface water flooding is predicted to follow topographical flow paths of existing watercourses or dry valleys.

Along the River Teifi, River Aeron, Rheidol, Ystwyth, and north of Borth near to the River Dovey, significant surface water paths are evident which characterise the floodplains and tributaries to these watercourses.

Bronant and Swyddffynnon are two areas that appear to be at greatest risk of surface water and small watercourse flooding, with areas located in FMfP Flood Zone 3. As these areas are quite rural in nature, surface water flood risk is directed away from existing development.

Aberystwyth (River Rheidol) and north of Felinfach (River Aeron) are more developed areas at risk of surface water flooding, with Aberystwyth being one of the key settlements within Ceredigion. FMfP Flood Zone 3 covers large areas of these settlements, with predominantly commercial / industrial development being at risk of surface water flooding, as well as road infrastructure.

The Cambrian Mountains are located within the north east of Ceredigion and as a result of the upland characteristics, surface water flood risk is extensive within this area; however, poses a low risk to development in surrounding valley developments.

Surface water flow paths within urban areas are shaped by urban infrastructure and topographic depressions. Surface water is channelled by the roads around the settlements, pooling in areas of wide open spaces and topographic depressions.

Disposal of surface water runoff is a key consideration, whether a development site falls within a flood risk area or not. Intense development within a catchment could result in increased runoff which if not appropriately managed could result in increased flooding within and downstream of the study area.

New developments can also increase pressure on sewer systems and urban drainage. It is therefore important to manage the impact of developments in a sustainable manner. Whilst all proposed surface water drainage schemes for more than 1 dwelling or where construction area is of 100m^2 shall be required to comply with the Statutory Standards for SuDS in Wales and the discharge hierarchy, it is unlikely that any proposed development site shall be

3 https://www.ceredigion.gov.uk/resident/news/2021/storm-barra-ceredigion-flood-warnings/

permitted to discharge surface water into the public sewerage system, even where priority levels 1-3 (rainwater harvesting, infiltration, and discharge to a waterbody) are not viable.

Surface Water Flood Risk & TAN-15

All development types are permissible in FMfP Flood Zone 2 and 3 provided that the acceptability criteria in TAN-15 can be met. Development in these areas shall be subject to site specific assessment which should consider flow pathways, potential ground levelling for topographic depressions and how SuDS can be used to manage surface water flows across a development site. Developers should consult the LLFA/SAB for any specific knowledge related to surface water and small watercourse flooding at a proposed development site. Where there is localised surface water flooding, developments should be located outside of FMfP Zones 2 and 3 where possible.

1.5 Groundwater flood risk

The bedrock geology across Ceredigion is predominantly comprised of Mudstone, Siltstone, and Sandstone. Mudstone tends to have low porosity and permeability whilst sandstone is regarded as more permeable and allows for the storage and movement of groundwater. As a result, upward percolation of groundwater and subsequent flooding should be considered in these areas.

Areas of superficial deposits across Ceredigion are limited and predominantly present around Main Rivers of the county such as the River Teifi, River Aeron, and River Dovey. Superficial deposits are largely Alluvium which is comprised of Clay, Silt, and Sand. There are also records of Till which is deemed to be generally permeable. In the north of the county along the River Dovey estuary, Peat is present. The variation of superficial deposits across the county suggests that groundwater flooding could present a localised risk to some areas. Maps showing the indicative groundwater flood depths in Ceredigion are provided in Appendix B.2. The map also assesses the risk of groundwater emergence and not of resulting groundwater flooding. For groundwater flooding to occur it is often necessary for groundwater to have nowhere to go without ponding and flooding an area first.

The majority of Ceredigion is shown to have groundwater levels that are at least 5m below the ground surface or lower. In the north, near to the River Dovey and River Rheidol, localised areas have groundwater levels that are either at or very near (within 0.025m) of the ground surface. The River Aeron has very high groundwater levels between Llangeitho and Llanerchaeron, where there is an extensive area shown to have groundwater levels either at or very near (within 0.025m) of the ground surface. Within the south of Ceredigion, groundwater levels are most extensive along the River Teifi, with locations between Tregaron and Lampeter displaying groundwater levels of at most 5m below ground surface, and a large proportion of this area being recorded as either at or very near (within 0.025m) of the ground surface. In the downstream reaches of the River Teifi, between Lampeter and Cardigan, groundwater levels are predominantly between 0.5m and 5m below the ground surface. Its tributaries in the lower reaches are shown to have much higher levels of groundwater.

Cardigan is the main settlement with Ceredigion where groundwater depths are closest to the surface. Groundwater levels are shown to be predominantly at least 0.5m from the ground surface; however, there are localised areas within the settlement, and surrounding areas, which are shown to have groundwater levels between 0.025m and 0.5m below ground surface, with some small, restricted areas having high groundwater levels which are either at or very near (0.025m) to the ground surface. A high-risk groundwater zone does not automatically preclude the use of infiltration techniques for Sustainable Drainage Solutions (SuDS), although they are less likely to be suitable. A site-specific assessment of the potential for infiltration techniques shall always be required by the SAB.

Groundwater Flood Risk & TAN-15

TAN-15 does not specific any requirements for groundwater flood risk, other than the risk of groundwater flooding should be considered as part of an FCA. However, it would be advisable to locate developments away from areas where groundwater is less than 0.025m below the ground surface without further groundwater monitoring and detailed assessment being undertaken.

1.6 Sewer flooding

DCWW is responsible for sewer infrastructure across the study area and recording sewer flooding incidents.

DCWW have provided detail of historical incidents and active risk areas. Historical flooding incidents are recorded relating to public foul, combined, or surface water sewers. These records display the number of properties that experience internal and/or external flooding. A summary of the spatial distribution of historical sewer flooding incidents by electoral ward is summarised in Table 2-1. Wards recorded as having 'no data' are not listed in Table **1**-**2**. This data shows that the ward with the highest number of flood incidents is Aberteifi/Cardigan-Teifi.

DCWW are working to reduce the number of sewer flood incidents by investing in maintenance and improvements of the sewer network.

DCWW has not provided any information regarding the predicted flood risk from the sewerage network.

Table 1-2 Sewer Flooding Incidents by Electoral Ward

Electoral Ward	Number of sewer flooding incidents
Aberteifi/Cardigan-Teifi	41
Borth	24
LlanbadarnFawr-Padarn	21
Llandyfriog	15
Llandysilio-gogo	13
Llanarth	12
Ceulanamaesmawr	11
CiliauAeron	10
Tirymynach	9
Aberporth	8
Aberteifi/Cardigan-Rhyd-y-Fuwch	6
Aberaeron	5
Aberystwyth Penparcau	5
Aberystwyth Rheidol	5
Pen-parc	4
Aberteifi/Cardigan-Mwldan	3
Llandysul Town	3
Faenor	2
Trefeurig	2
Beulah	1
Llanbadarn Fawr-Sulien	1
Llanfarian	1
Llangeitho	1
Llansantffraed	1

Llanwenog	1
New Quay	1

Flood Risk from Sewers & TAN-15

TAN-15 does not specify any requirements for sewer flood risk, other than that it should be considered as part of an FCA. The LLFA and DCWW should be consulted to provide specific advice on any known history of sewer flooding and any remedial action taken.

1.7 Flooding from artificial sources

Artificial sources of flooding include reservoirs within and upstream of the county which could pose a flood risk to Ceredigion. Maps showing the potential flood risk from reservoirs are provided in Appendix B.2. The reservoirs which pose a flood risk to the county are:

- Cwm Rheidol
- Dinas
- Llyn Conach
- Llyn Criag-y-Pistyll
- Llyn Egnant
- Llyn Frongoch
- Llyn Glandwgan
- Llyn Nant-y-Cagal
- Llyn Pendam
- Llygad Rheidol
- Llyn Rhosrhydd
- Llyn Syfydrin
- Llyn Teifi
- Llyn-y-Gwaith
- Llyn-yr-Oerfa
- Nant-y-Moch
- Pond-y-Gwaith

The NRW FMfP – Reservoir's mapping indicates that areas located within the Llyn Conch, Nant-y-Moch, Dinas and Cwm Rheidol extents – all located along the River Rheidol, are the areas most affected due to a reservoir breach or overtopping, which would greatly impact Aberystwyth.

The failure of a reservoir can cause catastrophic damage due to the sudden release of large volumes of water. Reservoirs in the UK have an excellent safety record, and NRW is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. It is assumed that these reservoirs are regularly inspected, and essential safety work is carried out. Therefore, these reservoirs present minimal risk.

TAN-15 highlights that any development in the inundation catchment of a reservoir may change a reservoir's risk category. Any potential implications for the reservoir owners or operators, such as allocating development in inundation areas, should be raised by the planning authorities openly and constructively.

1.8 Changes in understanding of flood risk

FCERM Capital Investment

NRW have appointed engineering consultants to develop a new Flood Risk Management Scheme for Cardigan, Ceredigion. The construction of the scheme is proposed for 2023-2025.

Future FMfP improvements

The locations listed below are covered by existing NRW flood models which are expected to be incorporated into the Flood Map for Planning through future routine updates. NRW have not provided an indication of the timescales for these updates.

- Aberystwyth
- Borth
- Capel Bangor
- Llandysul Pentre
- Lampeter
- Mwldan
- Parc Teifi
- Tal-sarn