The South West - Extreme weather resilience: 2012 and early 2013

Report: February 2014

Local Enterprise Partnership

CORNWALL & ISLES OF SCILLY
LOCAL ENTERPRISE PARTNERSHIP

HEART OF THE SOUTH WEST
Local Enterprise Partnership

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Devon County Council

Torbay Council
Cover photos:

Great West Mainline at Dawlish from above:
First Great Western

Flooding at Muchelney:
Somerset County Council

Road collapse, Seaton
Devon County Council

Closure of Great West Mainline, near Cowley Bridge
Devon County Council
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Introduction

The events of early 2014, not least the plight of flood hit communities on the Somerset Levels, have underlined yet again the severe impact that extreme weather has on community resilience, transport, local government and the economy of the South West Peninsula. The Peninsula is increasingly southern Britain’s front-line for extreme weather. Climate change projections warn that such events will occur more frequently up to 2050 and beyond.

Background

This report is the first detailed analysis of the wide-ranging impact that repeated severe weather events have across the Peninsula as a whole. Although the report touches on more recent events, its focus is the severe weather of 2012 and early 2013 because the evidence and understanding of the after effects are inevitably more complete.

The report is a deliberate and measured assessment of a series of events that wreaked much damage to the Peninsula’s infrastructure and economy. As such it represents a unique time capsule and serves as a siren warning of what these severe weather events can and will inflict.

The report makes a number of recommendations to Government and its agencies. It is to be hoped that Ministers and officials will heed the warnings contained here and act upon them.

In early 2013 Devon County Council produced a brief report investigating the impacts of the severe weather between July and December 2012 on the combined network of Trunk Roads, local highways and the rail network. The report brought together evidence on the damage and costs to the network and also wider impacts on properties and businesses across the county. In the context of the potential for further severe weather events occurring in future, the study outlined key recommendations for action.

Following this report a joint working group was established with Cornwall Council, Torbay Council, Plymouth City Council, Somerset County Council and the Heart of the South West Local Enterprise Partnership to discuss the possibility of coordinating a joint report covering the flooding and other severe weather impacts on the South West. This was agreed and each partner worked on a report or a set of data for their area. This report draws together this information in a coordinated manner.

During the course of the winter of 2013/14, the issue of extreme weather resilience has again been brought to the attention of communities, businesses, Local Authorities and policy makers as a result of further very heavy rainfall in December, January and February. This underlines that instances of extreme weather are likely to occur frequently and that urgent action is required to improve the resilience of the South West region.

South West: Extreme weather resilience report

This report brings together the findings from each of the upper tier Authority’s studies on the impacts of the recent severe weather events. It is split into sections which
consider the highways network, the rail network and wider impacts on properties, green infrastructure and the economy. The report concludes with key recommendations for interventions which are required.

In total, the severe weather experienced in 2012 and early 2013 caused an estimated £120.8m worth of damage across the South West, with the costs continuing to rise. Taking this into account, it is likely that the overall cost of the severe weather was in the region of £140m. The costs are broken down into topics as follows.

**Highway impacts**

In total, over £26m worth of damage was caused to the highway network adding to the already lengthy backlog of maintenance projects. Devon was the only Authority which received support from the Bellwin Fund, though this covered only approximately £3.1m, still leaving a funding gap across the South West of approximately £22.9m.

Most major Trunk Roads witnessed some form of delay or closure which significantly affected the connectivity of the South West. Local highways also bore severe impacts as a result of the weather with numerous communities being cut off. As an example Muchelney village in Somerset was cut off for 2 weeks. Subsequently, the village has also been cut off for approximately 6 weeks in late 2013 and early 2014.

**Rail impacts**

Arguably, the most severe disruption was caused to the rail network. The flooding of Cowley Bridge near Exeter led to the closure of the main line to London and Bristol severing the strategic rail connectivity of the South West, particularly Devon, Torbay, Plymouth and Cornwall. This had knock on effects for Taunton station which was the end of the line for many trains and was struggling to cope with the large increase in passengers and rail replacement bus services. Network Rail estimates that the financial costs of the flooding across the Western route are £15m for the repair and maintenance work and £12.2m in compensation payments to train operators.

Similar increases in passenger numbers were witnessed on the South West main line to London Waterloo which was less affected by the flooding. The only option for passengers travelling to and from London and the South East by rail was to use this line which again put pressure on the service, reiterating the need for further investment in this service.

More localised impacts were also witnessed on numerous branch lines such as that connecting Looe to the mainline which was closed for 4 separate days as a result of flooding. These lines are crucial links for many local economies across the region.

In 2013, Network Rail announced a series of ten schemes on the Western Route which would be delivered in order to improve operations and resilience. These schemes were to cost a total of £31.3m and included a number of projects which would provide particular benefits to the South West. One such scheme was an improvement programme in the Cowley Bridge area, just north of Exeter.

These improvements are strongly welcomed and are considered imperative to the resilience of the railway network in the South West. However, the reference to the provision of the funding for these schemes was omitted from the 2013 Autumn
More recently, particularly in February 2014, the fragility of the peninsular rail network has again been highlighted by the combined impact of heavy rain and high tides at Dawlish where part of the railway has been washed away and the seal wall breached. This effectively closes the Great West Mainline and severs western Devon, Plymouth, Torbay and Cornwall from the national rail network.

Impacts on properties

Properties in the South West were significantly affected by the extreme weather. Due to the negative impact of flooding on property insurance, it is recognised that many incidences of flooding would not have been reported. Even though this is the case it is estimated that there were 1,778 affected properties across Devon, Plymouth, Torbay, Somerset and Cornwall during July, November and December 2012. Coastal communities were also hit, especially in Cornwall where communities have been hit on numerous previous occasions.

A number of flood drop-in sessions were held across the region to allow individuals to report flood incidents and discuss issues with Council and Environment Agency representatives. These surgeries were vital in obtaining insights into the nature of the flooding, however they also acted to raise expectations in many communities, which in turn need to be met.

Impacts on green infrastructure

The region’s array of green infrastructure assets was also affected. The most notable impacts were to the South West Coast Path and the Grand Western Canal which suffered considerable damage. 36 sections of the South West Coast Path had to be closed, the repair for which had a combined bill of £0.6m. A serious breach of the Grand Western Canal near Halberton, in Devon, in effect led to the creation of two distinct waterways. Devon County Council budgeted £3m for works to the canal.

Further damage to a range of other assets in the region was recorded. All of these problems combined to further increase the burden on Local Authority budgets and act to degrade the assets in the South West which many businesses rely on.

Economic impacts

Though the Local Authorities bore significant costs in repairing highways, schools and housing, wider impacts were widely felt. Other infrastructure organisations such as communications, power and water companies were affected, with emergency repair work needed.

Businesses across the region also felt the effects with damage to buildings and stock. Agriculture was significantly affected with loss of crops and accessibility issues. Tourism was also affected through the summer season with reduced visitor numbers.

The lack of resilience of the transport network also hit confidence levels of businesses. This affected businesses currently in the South West looking to expand and also those looking for potential investment from outside the area.
This report only looks briefly at the wider economic impacts because an additional study was undertaken to gather further information. This study estimated losses of £8.5m for the businesses and their suppliers in five key sectors across the worst hit areas in Devon and Somerset. The biggest impacts were on a relatively small number of agriculture and tourism businesses that have been hit very hard. Wider surveys across the whole of the region and of a much larger sample of businesses would show much more significant economic costs. In addition, there would be further costs associated with the more recent extreme weather which has taken place in late 2013 and early 2014.

The full report on this further study can be found via the link: http://www.devonomics.info/documents/devon-somerset-flood-results-final-report

Cumulative impacts

The major concern for the South West was the cumulative impacts that each of these individual aspects had when combined. Though it is not possible to fully quantify, these numerous cumulative impacts will have acted to worsen the impacts of the severe weather. In November, widespread rail, strategic road and ferry service closures combined to effectively cut Cornwall off. The additional impacts on businesses, tourism and investment confidence levels will have been significant.

The future

The severe weather events witnessed in the South West during 2012/13 are not a one off and will continue to occur with increasing frequency. This has been demonstrated clearly through the significant rainfall which has taken place in December 2013 and early 2014. Indeed, Met Office records show that during January 2014, large parts of the region received more than twice the average rainfall for the month\(^1\). This suggests that such extreme weather will occur more frequently as is actually becoming the norm.

In order for the South West to cope with these events it needs to adapt. Key to this are the vital improvements needed to its transport networks.

The key interventions needed include:

- The urgent implementation of the £31.3m programme of schemes identified by Network Rail to improve resilience and operations on the Great Western and West of England Lines;

- Provide an appropriate solution to the Exeter Flood Relief Improvement Scheme at Cowley Bridge to provide appropriate flood relief whilst also improving the strategic rail connectivity of the South West;

- The provision of additional passing loops on the West of England Mainline (in the vicinity of Honiton) to provide an alternative diversionary route to the South West;

- Localised schemes on the trunk road network including improvements to the M5 and A303;

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The South West: Extreme Weather Resilience

- Ensure and improve dialogue between Government, Network Rail, the Environment Agency, the Highways Agency and Local Authorities, to prepare appropriate solutions to improve resilience, protect our infrastructure and tackle issues of strategic connectivity;

- Increased funding and support for Local Authority flood risk alleviation measures; and

- Revision of the Bellwin Fund criteria to ensure that funding is more widely available to respond to future events.

A small number of further interventions are included in the conclusion of the report.

In summary, the South West Peninsula is resilience weak with the resultant cost to the economy, and the public purse, high. It has been identified that the prime strategic intervention required is to improve the resilience of the Peninsula railway.
1. **Background and context**

1.1 The purpose of this report is to examine the impacts of the recent extreme weather events on the South West region, particularly the resilience of the transport network. The South West study region shown in Figure 1 includes Cornwall, Devon, Plymouth, Somerset and Torbay who all share a strategic transport network. Due to the linear nature of the region and the limited port and airport facilities, this shared network is essential to the region. Having a fully operational road and rail network is vital to support the growing economy of the South West and any events that threaten the resilience of this network will have significant impacts on the region.

![Figure 1 - The South West study area](image)

1.2 There are nearly 18,000 miles of roads across the South West along with a rail network that is supporting passenger numbers which have reached unprecedented levels. Numerous other vital services such as the Tamar Bridge and Torpoint Ferry operate to further provide essential connectivity. This combined network is vital to the region and essential for the effective functioning of its economy.

1.3 The economy of the South West is large but underperforming, with GVA per head remaining significantly lower than the national average (Table 1). The region has seen significant growth in the past and has shown strong potential for growth in the future therefore an improved and more resilient transport network is essential to unlocking this.
The South West: Extreme Weather Resilience

<table>
<thead>
<tr>
<th>Area</th>
<th>Total size of economy - GVA 2011</th>
<th>Total population – 2011 census</th>
<th>GVA per head of population - 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>South West - Somerset, Devon, Plymouth, Torbay and Cornwall</td>
<td>£36bn</td>
<td>2,198,190</td>
<td>£16,290</td>
</tr>
<tr>
<td>West of England – North Somerset, Bristol City, Bath and North East Somerset and South Gloucestershire</td>
<td>£26bn</td>
<td>1,069,583</td>
<td>£24,340</td>
</tr>
<tr>
<td>Urban South Wales - Monmouthshire, Newport, Cardiff, Vale of Glamorgan, Bridgend, Neath, Port Talbot and Swansea</td>
<td>£23bn</td>
<td>1,227,498</td>
<td>£18,468</td>
</tr>
<tr>
<td>Bournemouth, Dorset and Poole</td>
<td>£13bn</td>
<td>744,041</td>
<td>£17,949</td>
</tr>
<tr>
<td>UK GVA comparator</td>
<td>-</td>
<td>-</td>
<td>£21,368</td>
</tr>
</tbody>
</table>

NB: - Figures may not add exactly due to rounding.
- It should be noted that the figures here are aggregated. The economic output of individual Local Authority areas varies significantly across the region.

Table 1 - Economy of the South West in comparison to other regions

1.4 The main lines of the rail network link Penzance, Plymouth, Exeter and Taunton to London, Bristol and stations further north. Essential branch lines link the Torbay area, Barnstaple and smaller Cornish communities to the national network. Figure 2 shows the rail network and how closely it aligns with the strategic road network.

1.5 The strategic road network, also shown in Figure 2, is equally as crucial to the South West. Key routes connecting the region with other areas are limited with one motorway, the M5, and the A303, much of which is single-carriageway. The routes through the region are also limited to the A30, A38, A303 and A35 all of which have both dual and single carriageway sections.
The combined network of Trunk Roads, rail lines and local highways provides the strategic links through the region and with the rest of the country. The linear nature of the region, and its existing network, means that any conditions that jeopardise its smooth running will have significant impacts for the whole region.

Severe flooding events were experienced across the South West during much of 2012. Heavy monthly rainfall totals in April, June, July and August were nearly 50% higher than the UK average and much higher than previous year averages. These rainfall levels resulted in saturated ground conditions and swollen river levels by the autumn.

Rainfall levels in November and December were also considerably higher than previous years and the UK average, with monthly averages of 183mm and 257mm respectively. The nature of the rainfall however was very flashy with 6 day averages of 250mm (85mm in last 24 hours) and 80mm (50mm in last 24 hours) being recorded in November and December. This combined with the already saturated ground to result in severe flooding.

In November and December, the rainfall was very ‘flashy’ in nature. In the 24 hours prior to the 21st November flooding event the South West experienced unusually high levels of rainfall. Over 90mm of rain fell in some areas of Dartmoor, the South Hams and the south west of Cornwall with other areas receiving in excess of 50mm of rainfall.

In the 3 days prior to the flooding event on 18th, 19th and 20th December, areas of Exmoor, West Devon and Cornwall experienced rainfall in excess of 100mm. Other areas across the region were hit by rainfall of over 70mm. All

Source: Environment Agency (2012/13) Post Event Hydrological Review November and December
this combined with an already saturated ground to cause the flooding events on the 21st December.

1.11 The flooding has had a significant impact on the condition of the strategic and local transport infrastructure in the South West. These impacts had further cumulative impacts for communities, the economic performance of many areas and public sector budgets.

1.12 The financial implications are felt in terms of the increased maintenance burden which is placed on upper tier Authority revenue budgets in the short term, but also longer term when the legacy of the repairs become clearer. Furthermore there is a more wide-spread impact on the local economy both in the short term through operational issues, but perhaps more damagingly, in the longer term through a lack of strategic transport resilience and connectivity which will affect economic output and investment confidence.

1.13 The Bellwin Scheme does provide some level of emergency assistance to Local Authorities. The fund, which was set up in 1983, is activated when Local Authorities incur expenditure on safeguarding life or property, or on preventing suffering or severe inconvenience as a result of an emergency or disaster. Only certain events are eligible for funding and these would still require contributions from the Local Authority.

1.14 There are, however, limitations to the scheme when it is considered in relation to the flooding that occurred. The scheme only covers costs associated with the initial clearing up and temporary repairs. This unfortunately does not reflect the long term damage and maintenance backlog caused by the flooding.

1.15 Further conditions state that any work undertaken needs to be completed within two months of the event date. This however is almost impossible to achieve as much of the damage is not immediately apparent and it takes time to gather the information required to apply for funding. It is therefore unrealistic to expect works to be completed within the 2 month timescale outlined.

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3 Source: Bellwin scheme of emergency financial assistance to local authorities - Guidance notes for claims 2012-13
2. The report

2.1. In early 2013 Devon County Council produced a brief study investigating the impacts of the severe weather in 2012 and early 2013 on the combined network of Trunk Roads, County highways and the rail network. The study used data provided by County Council officers together with information from Network Rail and the Highways Agency. The report brought together evidence on the damage and costs to the network and also wider impacts on properties and businesses across the county. In the context of further severe weather events, the study outlined key recommendations for action and steps that needed to be taken to ensure the resilience of Devon’s network.

2.2. Following this report a joint meeting was organised with Cornwall Council, Torbay Council, Plymouth City Council, Somerset County Council, Dorset County Council and the Heart of the South West Local Enterprise Partnership to discuss the possibility of coordinating a joint report covering the flooding and other severe weather impacts on the South West. Each partner agreed on the approach as a way forward and worked on collating information for their respective area. The Cornwall and Isles of Scilly Local Enterprise Partnership has subsequently been involved in the research and the production of the report.

2.3. This report seeks to combine these responses into one that assesses the impacts on the South West from the severe weather experienced in 2012 and early 2013. The report will seek to gather information on the impacts on the highways network, the rail network and the wider impacts on properties and business within the region. The report will then look to the future and in the context of increased instances of extreme weather will conclude with the key areas of improvement needed to ensure that the impacts witnessed in the South West do not happen to the same extent again. Although the report covers 2012 and early 2013, it is recognised that significant weather events have also affected the region in late 2013 and early 2014, highlighting the re-occurring nature of extreme weather.

Other relevant reports

2.4. Other reports looking at the impact of the severe weather on the South West have been produced by a range of organisations.

2.5. *The South West Spine Report* makes the case for greater investment across the South West peninsula railway network. In the context of unprecedented passenger growth and the importance of the rail network to the South West, the report makes recommendations for key investment plans. The report stresses the fragility of the rail network against severe weather conditions, highlighting the events of late 2012/2013 as a key demonstration of this fact.4

2.6. The Institute of Civil Engineers produce a number of *State of the Nation* reports on various subjects in order to stimulate debate and highlight actions needed. The 2010 *South West Infrastructure Paper* assesses the state of the transport, energy and waste infrastructure provision. The paper

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reiterates the vital yet fragile nature of the South West's transport infrastructure stating how severe weather events have a disproportionate effect on the region.\textsuperscript{5}

2.7. The South West Chamber of Commerce (SWCOC) are also expressing concerns over the lack of investment in the South West transport network especially in the context of the disruptions caused by the flooding in 2012/13. Published statistics by HM Treasury\textsuperscript{6} show that the average public sector spend per head in the South West for transport in 2010/11 was £212. This was the lowest figure in the country and is just over 25\% of that spent per head in London, which amounted to £774 in the same period. The SWCOC are in the process of conducting a survey to capture views of businesses on increased investment in the South West's transport infrastructure.

\textsuperscript{5} Source: ICE (2010) The State of the Nation Briefing: South West Infrastructure
\textsuperscript{6} Source: Public Expenditure Statistical Analyses November 2012
3. Highway connectivity impacts

The South West picture

3.1. The extreme weather witnessed in the South West caused major disruption across the highway network with widespread closures to both major Trunk Roads and Local highway Networks.

3.2. Major Trunk Road closures across the region were enforced as a result of both flooding but also accidents caused by heavy rain, hail and snow. Table 2 outlines the locations were affected in late 2012 and early 2013, further information can be found in Appendix A.

<table>
<thead>
<tr>
<th>Road</th>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date</td>
<td>Date</td>
<td>Date</td>
</tr>
<tr>
<td></td>
<td>Time closed</td>
<td>Time closed</td>
<td>Time closed</td>
</tr>
<tr>
<td>M5 – EB and WB Jct 25 - 26</td>
<td>25th</td>
<td>23rd</td>
<td>25th</td>
</tr>
<tr>
<td>A35 – between Dorchester and Bridport</td>
<td></td>
<td>1 hour</td>
<td>2 hours 30</td>
</tr>
<tr>
<td>A38 – Glynn Valley EB and WB</td>
<td>9th</td>
<td>1 hour</td>
<td></td>
</tr>
<tr>
<td>A38 – Liskeard EB and WB</td>
<td>11th</td>
<td>2 hours 30</td>
<td></td>
</tr>
<tr>
<td>A38 – Plympton EB</td>
<td>22nd</td>
<td>3 hours 45</td>
<td></td>
</tr>
<tr>
<td>A38 – Smithaleigh EB 1 lane</td>
<td>22nd</td>
<td>5 hours</td>
<td></td>
</tr>
<tr>
<td>A38 – Plymouth Parkway EB</td>
<td></td>
<td>20 hours</td>
<td></td>
</tr>
<tr>
<td>A38 – Kennford WB</td>
<td></td>
<td>11 hours</td>
<td></td>
</tr>
<tr>
<td>A30 – EB Jct with A35 Honiton to Jct with A303 Upottery</td>
<td>21st</td>
<td>2 hours</td>
<td></td>
</tr>
<tr>
<td>A30 – EB and WB Jct with A35 Honiton to Jct with A303 Upottery</td>
<td>25th</td>
<td>3 hours</td>
<td></td>
</tr>
<tr>
<td>A303 – EB and WB between Jct with A30 Upottery and Jct with A358</td>
<td>25th</td>
<td>3 hours</td>
<td>18th</td>
</tr>
<tr>
<td></td>
<td>24 hours 30</td>
<td></td>
<td>4 hours</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8</td>
<td>40 hours 15</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2 - Closures of Trunk Roads due to severe weather conditions
EB – Eastbound          WB - Westbound
3.3. In total, there were 15 closures across a 3 month period totalling nearly 66 hours of closure. Noteworthy days include 25th November and 25th January in which 3 roads were closed. Further closures not outlined above occurred including the partial closure of the Tamar Bridge.

3.4. Many of these disruptions combined with other impacts on the rail network (chapter 5) and the closure of the Torpoint Ferry service. On the weekend of the 24th and 25th November these closures acted to effectively cut off Cornwall as all major routes into the county were closed.

3.5. These closures affected travel across the whole of the South West. In addition to the impacts outlined above there was a number of more localised highway connectivity impacts across the region which left many communities cut off. Many people chose to remain at home instead of attempting to travel. This had far reaching impacts especially for many businesses that were understaffed whilst also lacking custom that would have been generated.

Devon

3.6. The A361, a crucial link road to North Devon, was closed on numerous occasions during December, due to flooding and January as a result of heavy snow. Numerous smaller roads were also affected across Devon. On 12th July torrential downpours caused Old Beer Road in Seaton to drop by more than 3 feet making it unusable. The road has been closed indefinitely.

3.7. In addition three bridges were severely damaged or lost as a result of the severe weather. Alma Bridge (Sidmouth) which provides a crucial link on the South West Coast Path had to be closed as a result of continued deterioration caused by severe weather. Collards Bridge (near Barnstaple) and Waterstave Bridge (Bradninch), which is listed, were both washed away in December.

Somerset

3.8. The connectivity impacts that have afflicted communities, businesses and services in Somerset this winter (2013/14) and attracted national media attention, were all too evident as a result of the flooding from November 2012 to January 2013. Many of the areas flooded more than once leading to increased levels of disruption.

3.9. One particular issue was the impact that flooding had on routes close to the trunk road network. This caused subsequent problems with regional connectivity. The A358, linking the M5 at Taunton and the A303 at Ilminster, was closed with significant tail backs and blockages occurring. This also meant there was no access between the two Trunk Roads during this time. In addition, the M5 diversion route between Taunton and Wellington along the A38 was also closed due to flooding on a number of days, meaning there was no access beyond Taunton to the South West on the M5 or via the diversion during these times.

3.10. The A361 saw numerous closures, particularly between Burrowbridge and East Lyng. In total the closures lasted 60 days (although not consecutively) over the period from November to early February. The A39 was also closed on numerous occasions most frequently at Bilbrook and Carhampton which
was the only A road into Minehead. These all compounded to cause further problems for other communities across the area.

3.11. In addition, the rising of flood water on the Somerset Levels by up to 3m in places meant that villages such as Muchelney were cut off for 12 days between 22nd November 2012 to December 3rd 2012, a grim rehearsal for what followed 12 months later when the community was still cut off after six weeks at the time of finalising this report. 100 residents were left stranded and supplies needed to be delivered by boat. Other villages, including Moorland and Dulverton had access issues, though to a lesser extent. Examples of local highway flooding are shown in Figure 3.

3.12. In Torbay the Police and the Council were required to close a section of the Torquay Seafront at various times; there were 7 overtopping events which forced the closure of the Seafront between February 2012 and February 2013. Torrential rain led to the section between Belgrave Road and Wheatridge Lane being closed. This section of the A3022 is one of the two principal routes into Torbay and is likely to continue to be susceptible to severe weather conditions.

3.13. Further roads were also closed as in excess of 175 incidents of fallen trees caused problems across the area. These closures left a lengthy backlog of problems for the Council to deal with. Further problems have arisen from cliff falls across the area which are threatening the connectivity through damage to roads.

3.14. Simultaneous incidents on the A30 and A38 caused by severe wind and rainfall over the weekend of November 24th and 25th led to the closure of both roads. These combined with the partial closure of the Tamar Bridge
and lack of rail operations beyond Plymouth to effectively sever links into the county.

3.15. The delays and closures on Trunk Roads in Cornwall also combined with flooding impacts on a range of local roads. During the November event the B3253 collapsed onto the A387 at the junction of St.Martin’s Hill and Sandplace Road in south east Cornwall (near Looe). These effectively reduced two single carriageway roads to a single lane under traffic-light control. These issues are ongoing in early 2014.

3.16. In the December event major damage was also caused when sections of the B3247 between Hessenford and Seaton collapsed into the adjacent river, restricting access to the communities of Seaton and Downderry (south east Cornwall) to one lane under traffic light control.

3.17. Further notable closures included the:
- B3287 near Grampound;
- A39 at Kilkhampton;
- A374 at Torpoint; and
- Local road closures near Carnhell Green and Penryn;

3.18. These roads provide a crucial link to connect many of the functional economic communities within Cornwall. Numerous closures across the County left many communities cut off, especially in west Cornwall which was hit hard with widespread delays for many communities. Numerous road closures occurred in the centre of Newlyn where businesses have been repeatedly hit by bad weather.

Plymouth

3.19. In total 123 incidents of flooding on the highways in Plymouth were recorded in November and December 2012. 105 of these occurred between 21st and 24th November with the remaining 18 roads flooded on the 22nd December. The majority of these incidents were as a result of blocked drains or surcharges lifting manhole covers.

3.20. Of the closures, Gdynia Way (A374), a main dual carriageway route into Plymouth from the A38 and the east, was closed for a time on 3 days in November and again on 22nd December. This severely hampered the connectivity to parts of the city and added to the congestion of other parts of the city, whose roads were less affected.
4. Local highway maintenance impacts

The South West picture

4.1. Significant damage to the fabric and structure of the local highway network in the South West was caused in the second half of 2012 which had significant financial implications for Local Authorities. A number of the flooding events are avoidable if sufficient funds are available for preventative maintenance. This is particularly true of roadside flooding where blocked gullies which have not been cleared cause widespread problems.

4.2. Overall the impacts on condition of the highways in the South West were extensive. It is estimated that more than £26m worth of damage was caused to the network adding to the already lengthy backlog of maintenance projects with many made worst by the conditions.

4.3. Each Authority considered applying to the Bellwin fund for assistance. Devon County Council, however, was the only Authority eligible for Bellwin funding. This unlocked support in the region of £3.1m which still leaves a funding gap across the South West of approximately £22.9m.

Devon

4.4. Devon County Council spent approximately £12.2m on emergency highway reaction in relation to storm damage between April 2012 and the end of January 2013. November and December alone caused £3.6m and £3.7m worth of damage.

4.5. The storms of July, September, November and December were classified as ‘Bellwin events’. As a result financial assistance has been successfully applied for, totalling £3.1m. This however left a funding gap of £9.1m, which should be seen in the context of a legacy works of approximately £5m which still needs to be spent. Although the County welcomes the assistance offered by Bellwin, under the current ‘rules’ there are limitations:

- The scheme only covers costs associated with clearing up and temporary repairs;
- The scheme only applies to costs in excess of £1.7m;
- In order to comply with the conditions of the scheme, works have to be completed within two months of the event. This is almost impossible to achieve as much of the damage is not immediately apparent and is still being uncovered; and
- Only the July event was 100% reimbursable.

4.6. These highway costs should also be seen in the context of an existing highway maintenance backlog of £687m and a need to spend £62m per annum for the next 10 years just to maintain the current condition of the highway to pre 2012 standards.

4.7. Between July 2012 and January 2013 Devon County Council received approximately 65,000 calls from customers regarding highway issues. This

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7 Source: All figures Devon County Council, 2013
was nearly 50% up on the number of calls received over the same period in 2011 and early 2012 which totalled 44,000. This increase of 21,000 calls can be mostly attributed to the severe impacts of the flooding.

4.8. Significant drainage impairment has also occurred on the County highway network which has both cost implications and has inhibited the ability to carry out routine maintenance work. The current drainage legacy is estimated at £3m which has to be found from a £1.6m budget.

**Somerset**

4.9. In total Somerset County Council identified 78 maintenance schemes that are required as a result of the November and December flooding. In total the schemes would cost £1.8m to implement with the majority being spent in South Somerset (£1.5m).

4.10. The current terms and conditions of the Bellwin scheme mean that Somerset County Council was ineligible to access Bellwin funding for the weather events in 2012/13. One particular issue is the timeframe in which any funding needs to be spent. The issues arising from the flooding were not able to be fully investigated in the timeframe of the Bellwin fund, with many remaining underwater for considerable time preventing investigations. Somerset is therefore required to fund all the maintenance required without any further assistance.

4.11. Somerset County Council also recorded a significant increase in the number of enquiries received relating to highways issues; 927 enquiries were received between November 2012 and January 2013 compared to 242 for the same period the previous year. All five districts in Somerset were affected demonstrating the widespread nature of the flooding.

**Torbay**

4.12. The Torbay area, though not as severely affected as some other Local Authority areas, still bore costs from the flooding events. A number of flooding events of varying degrees have occurred since October 2012; including seafront overtopping, stream and watercourse flooding, tree falls and concerns over cliff movements. Further details of these impacts and related damage to properties in Torbay can be found in chapter 6. It is estimated that the costs from these impacts borne by the Local Authority was approximately £1.25m.

4.13. In addition, there is a backlog of maintenance schemes totalling £10.5m (483 sites) throughout the bay. The wet weather has accelerated the rate of failure of some of the Local Highway Network.

**Cornwall**

4.14. Estimates made by Cornwall Council state that approximately £7.8m will have been spent on the emergency highway and environment reaction caused by the flooding events in November and December which cost £3.8m and £4m respectively.

4.15. Notable examples include the collapse of the B3253 onto the A387 near Looe in November and the major damage to the B3247 near Hessenford
which collapsed into the adjacent river. The costs of works in these two cases alone are approximately £0.3m and £1.5m in repairs.

4.16. This again should be seen in the context of a £205m\(^a\) highway maintenance backlog and a need to spend £3m per annum just to maintain the current condition of the highway. If the network was to receive the much needed improvements and investment then an additional £10.5m per year is needed.

4.17. The number of potholes recorded has increased extensively as a result of the bad weather. Cases reported increased from 3000 in 2004/05 to nearly 8400 in 11/12. Costs for these to be filled have been estimated at around £37m annually.

4.18. Cornwall Council also decided against pursuing any additional funding from the Bellwin fund. Concerns were also raised about the criteria and the limitations of the timescales imposed.

**Plymouth**

4.19. During the months of November and December 2012 Plymouth City Council received 518 pothole reports by members of the public which represents 35% of the total number of reports from April 2012. 182 of these were reported in the last 7 days of December. Compare this to the average rate of 8-10 reports per day and there was a 260% increase in the last 7 days of December. This clearly shows the impacts that the severe weather had on the maintenance of the local highways network.

4.20. The immediate costs of temporarily repairing the potholes have been estimated to be in the region of £0.25m. A best estimate as to overall damage to the network and the expected longer term repair costs is in the order of £2-3m.

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\(^a\) Source: Cornwall Council 2013
5. **Railway Impacts**

5.1. The linear nature of the South West rail network makes it highly vulnerable to weather related disruptions. This was demonstrated clearly during the extreme weather conditions at the end of 2012 and early 2013, when flooding at Cowley Bridge closed the Great West Mainline for 15 days which meant that, for many trains, Taunton became the end of the line. In total over 2000\(^9\) trains were directly affected. Services were either delayed or cancelled and significant damage to the signalling equipment caused further delays for more than 6 weeks.

5.2. Figure 4 summarises the main closures of the rail network\(^{10}\) as a result of the severe weather.

![Figure 4 – Plan showing the rail closures that occurred in November and December 2012](© Crown copyright. All rights reserved. 100019783. 2013)

5.3. It should be noted that the extreme weather in early 2014 has caused further disruption on the Great West Mainline, particularly at Dawlish. Closures in February have resulted from a breach of the sea wall and the washing away of part of the track bed. The impacts of these closures have not been assessed however they go to show the fragility of the network in the area.

5.4. In 2012/13, the most significant flooding occurred at Cowley Bridge, near Exeter, where river water flowed across and along the line washing away track and ballast on multiple occasions during November and December. Network Rail estimates that the financial costs across the Western route of the flooding are £15m for the repair and maintenance work and £12.2m in compensation payments to train operators.

5.5. In addition to the direct costs, the closure also had wider impacts across the

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\(^9\) Source: Devon County Council, 2013  
\(^{10}\) Source: Network Rail, 2013
region. The closure of this section acted to effectively sever the First Great Western and Cross Country services to London, Bristol and the Midlands. Many passengers were either stranded in Exeter or had to take the alternative main line to London Waterloo which itself came under significant pressure.

5.6. Trains were not only prevented from leaving Exeter to destinations further north but were also prevented from arriving into Exeter, and therefore to destinations further down the line such as Torbay, Plymouth and Cornwall. This had indirect consequences for Taunton station which was the end of the line for many trains and was struggling to cope with the large increase in passengers and rail replacement services.

5.7. Similar increases in passenger numbers were also witnessed on the South West Main Line to London Waterloo which was less affected than the Great West Main Line to London Paddington. Many passengers expecting to use the main line to London Paddington were required to change plans, instead using the London Waterloo line. This again put pressure on the service reiterating the need for investment in this line.

5.8. Local branch lines across the region were also affected. Services to Barnstaple were cancelled and delayed due to the Cowley Bridge flooding, and planned maintenance of the line was not completed. In total the line was closed for 22 days during November and December. Numerous other services in Cornwall were also disrupted as a result of flooding, with 4 separate day closures of the Looe branch line, 1 in October and November and 2 in December, causing usage to fall by 46% in December 2012 compared to same period in 2011.

5.9. Table 3 below summarises the number of delays and cancellations between Taunton and Penzance on selected days in November and December 2012. Figure 5 shows the spread of problems across the two months.

<table>
<thead>
<tr>
<th>Date</th>
<th>Number of delays and cancellations</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 November</td>
<td>112</td>
</tr>
<tr>
<td>23 November</td>
<td>102</td>
</tr>
<tr>
<td>27 November</td>
<td>137</td>
</tr>
<tr>
<td>28 November</td>
<td>202</td>
</tr>
<tr>
<td>29 November</td>
<td>147</td>
</tr>
<tr>
<td>22 December</td>
<td>119</td>
</tr>
<tr>
<td>24 December</td>
<td>127</td>
</tr>
<tr>
<td>Total</td>
<td>846</td>
</tr>
</tbody>
</table>

Table 3 - The number of delays and cancellations between Taunton and Penzance on selected days in November and December 2012

Source: First Great Western, 2013
5.10. The specific costs of the weather events to the rail industry are not fully clear. However, Network Rail estimates that the financial costs of the flooding across the Western route are £15m for the repair and maintenance work and £12.2m in compensation payments to train operators. Estimated costs of the damage occurring in specific locations are shown in Table 4.

<table>
<thead>
<tr>
<th>Events</th>
<th>November</th>
<th>December</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowley Bridge</td>
<td>£2.2m</td>
<td>£0.7m</td>
<td>£2.9m</td>
</tr>
<tr>
<td>Whiteball Tunnel</td>
<td>£0.8m</td>
<td></td>
<td>£0.8m</td>
</tr>
<tr>
<td>Teignmouth Landslip</td>
<td>£1.2m</td>
<td></td>
<td>£1.2m</td>
</tr>
<tr>
<td>Blackboy Tunnel</td>
<td>£0.1m</td>
<td></td>
<td>£0.1m</td>
</tr>
<tr>
<td>Total</td>
<td>£4.3m</td>
<td>£0.7m</td>
<td>£5.0m</td>
</tr>
</tbody>
</table>

Table 4 - The approximate value of compensation costs to NR for specific sections of line in November and December 2012

5.11. Whilst not possible to fully quantify, it is likely that the cost to the economy across the peninsula is significant, both direct costs to businesses and indirect costs resulting from passenger delays. The significant negative media coverage will also have resulted in reduced confidence levels in relation to:

- Existing businesses in the South West;
- Prospective new businesses considering relocating to the peninsula;
- Future visitors and tourists; and
- The reputation of the region in general.

Source: Devon County Council, 2013
5.12. The effect of the disruption to rail freight traffic, and the potential loss of business confidence, is also a concern. With three new intermodal freight facilities planned in the peninsula - Truro and Plymouth (using existing facilities) and Cranbrook (near Exeter, where work has started on a new intermodal freight depot) - there is a need to secure the on-going commitment to these facilities by businesses.

5.13. To encourage future growth, potential users need to be confident that resilience problems have been resolved – not just reduced. A comprehensive and effective solution is urgently required.

5.14. In 2013, Network Rail announced a series of ten schemes on the Western Route which would be delivered in order to improve operations and resilience. These schemes were to cost a total of £31.3m and included a number of schemes which will provide particular benefits to the South West. These were:

- Cowley Bridge Junction;
- Whiteball Tunnel South (commenced);
- Athelney – Cogload;
- Hele and Bradninch;
- Exeter diversionary route (works at Honiton, Crewkerne, River Axe); and
- Catchment instrumentation and flood protection system.

5.15. These improvements are strongly welcomed and are considered imperative to the resilience of the railway network in the South West. However, the reference to the provision of the funding for these schemes was omitted from the 2013 Autumn Statement. As such, it is not currently clear whether the funding for these schemes will be secured. This creates significant uncertainty for the communities, businesses and Local Authorities in the South West. It is critical that the necessary funding is made available in a timely manner to ensure that these schemes can go ahead urgently.

5.16. A further detailed report on the need for greater investment in the South West peninsula railway has already been issued by Authorities in the South West.
6. Flooding impacts on properties

The South West

6.1. Properties across the South West were hit hard by the severe weather events that occurred in the second half of 2012. Due to the negative impact of flooding on property insurance, it is recognised that many incidences of flooding would not have been reported. However, an estimate as to the number of properties affected has been made and is shown below in Table 5.

<table>
<thead>
<tr>
<th>Month</th>
<th>Estimate number of properties affected in each Local Authority and estimated costs to implement recommended actions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Devon</td>
</tr>
<tr>
<td>July</td>
<td>237</td>
</tr>
<tr>
<td>November</td>
<td>466</td>
</tr>
<tr>
<td>December</td>
<td>327</td>
</tr>
</tbody>
</table>

NB: Figures quoted are rounded.

Table 5 - Number of known properties affected by flooding in 2012

6.2. Some communities were flooded several times. In some cases it was not possible to clean up fully after one flood before a further flood occurred. This has instigated a plethora of flood investigation initiatives. These included workshops and the preliminary investigation of remedial measures.

6.3. In total it was estimated that 1778 properties were affected. Several more properties were put at risk and numerous communities were cut off, some for consecutive days. Flood surgeries and quick win schemes have already been implemented and are a positive step forward; nevertheless they also serve to raise expectations which need to be managed carefully.

6.4. Flood investigation reports have also been produced by each Authority for the relevant flood events. Actions highlighted in these reports have an estimated cost which totals £54m worth of work, further increasing the strain on public sector budgets.

Devon

6.5. As part of the responsibility of Devon County Council a total of 23 joint County Council and Environment Agency flood drop-in events were conducted between July 2012 and early 2013 to allow individuals to report flood incidents and discuss issues with Council and Environment Agency representatives. These surgeries were organised in locations which have been worst affected by the weather to collect key information on the severity of damage and gather detailed concerns from residents. Large turnouts occurred in some of the worst affected communities such as Feniton, Cullompton and Stoke Canon. Across December and January nearly 500 questionnaires were completed and returned with many more residents attending the events themselves.
6.6. Devon County Council also has a statutory responsibility as a Lead Local Flood Authority to investigate flooding events in its area. The County Council has produced reports both for the summer and winter flooding events in 2012. These detailed reports capture the flooding incidents, key evidence and suggests recommendations for actions. These actions range from further investigations through to large scale flood defence schemes. Initial estimates of £31.5m have been cost against these actions.

6.7. Some initial projects which are currently underway or have been completed include:

- Undertaking key investigatory work at sites which witnessed high levels or flooding;
- A number of small scale ‘quick win’ works to address on-going flood risk where a clear solution can be implemented easily; and
- Prepared a bid for funding through the Government’s recently announced ‘Flood Resilience Community Pathfinder’ scheme.

6.8. Further work is taking place and larger projects, such as the £26m Exeter flood defence scheme that has been given the go ahead, will be coming on stream in the near future.

Somerset

6.9. In Somerset similar impacts were felt with numerous settlements being cut off or having limited access. The village of Muchelney, shown in Figure 6, suffered the worst of this, being cut off for approximately 12 days between 22\textsuperscript{nd} November and 3\textsuperscript{rd} December, during which time supplies had to be delivered by boat. Muchelney has subsequently been cut off for 6 weeks as a result of heavy rainfall in late 2013 and early 2014.

6.10. In total 463 properties were affected by the flooding across 157 settlements in Somerset. The worst hit villages were those of Gurney Slade and Cannington in which 36 and 21 properties were flooded respectively. The widespread nature of the flooding however was the major concern with so many settlements being affected.
6.11. The Environment Agency has also been holding flooding surgeries to discuss the issue of flooding with local people and how events can be managed or prevented in the future. In addition, a number of organisations, including the Somerset Drainage Board and the Environment Agency, have been working to identify ways in which the Somerset Levels can be managed to cope with incidents of significant rainfall.

Torbay

6.12. In Torbay, more than 40 properties suffered internal flooding as a result of the severe weather experienced in late 2012. In addition to the flooding there have been numerous issues regarding the stability of both inland and coastal cliffs. At Oddicombe Cliff in Torquay, as a result of significant cliff falls concerns were raised about the stability of properties in Redcliffe Road. Early in 2013, following further rock falls, one property collapsed. At another property structural damage has meant that residents have had to leave their home. Other significant locations where rockfalls have occurred include:

- Cliff to the rear of Meadfoot Sea Road;
- Cliff at Institute Beach;
- Quarry face at rear of Manscombe Close;
- Cliff at Hollicombe;
- Cliff at Paignton Harbour; and
- Cliff at Goodrington North.

6.13. The budget estimate for the stability works to those cliffs where funding has been secured is in the region of £0.5m.

6.14. Following a spell of easterly storm conditions in 2012 and again in February/March 2013 damage occurred to the sea walls at Livermead and
Meadfoot. At Livermead, the damage was so severe that a breach of the sea wall occurred on 1st April 2013. On 2nd April 2013 the wash out behind the sea wall caused the South West Water rising main (which transfers all of Torquay’s sewage to the sewage treatment works) to fail.

6.15. In addition, there was a significant risk of the high pressure gas main under Torbay Road failing and therefore sheet piles were installed overnight in order to alleviate this risk. As a consequence of this breach, the main coast road between Torquay and Brixham had to be closed for a period of three weeks whilst emergency works were carried out. This resulted in major disruption to businesses and road users due to the length of the traffic diversion route.

6.16. As part of the emergency repairs, further investigations into the revetment at the toe of the sea wall have identified significant damage which, if not repaired, would result in a serious risk of further breach failures occurring in the near future. Repairs to the entire length of the revetment to the sea wall will be undertaken as part of the emergency works. The overall cost of the repairs to the sea wall and the revetment is in the region of £0.75m excluding the cost of the repair works to the rising main.

Cornwall

6.17. Unlike 2010 when communities in a small area were flooded, the events in 2012 had an impact across Cornwall. In some cases private businesses and residences have been issued with very large bills as a result of flood water putting the drainage system under pressure. Furthermore, where culverts have been blocked by the vast amount of debris this has caused flooding issues to undermine private properties.

6.18. In total, more than 20 flood surgeries were held across Cornwall in the immediate aftermath of the November and December events to gather information on the physical and social impact of the floods. In more remote communities door-to-door visits were organised with the support of the voluntary and community sector to identify and help more vulnerable residents. In some cases immediate intervention has been required to ensure safety.

6.19. The Environment Agency took a range of calls relating to flooding across the Cornwall region. The floodline service took 262 calls in November and 205 calls in December. As part of this process a recorded message service is run to provide pre-recorded warning information to the public. This service took 560 calls in November and 594 in December. In total 1,621 calls were taken in relation to flooding events across Cornwall.

6.20. As a result of these floods, and the floods in 2010, more than 20 Town and Parish Councils are now being supported by the Council and the Cabinet Office to develop their own Community Resilience Plans. Additionally, the Cornwall Flood Forum has been established to help communities at risk from flooding to work together and share best practice.

6.21. The severe weather also combined with high tides in many coastal areas to cause tidal flooding. Notable impacts were witnessed in areas such as Looe and Mevagissy where numerous roads, businesses and properties were
flooded. Low lying coastal roads and farmland were also affected, further adding to the impacts bore by these branch line economies.

**Plymouth**

6.22. In total 55 properties across the Plymouth area were flooded. 33 were flooded between the 21\textsuperscript{st} and 24\textsuperscript{th} November with the remaining 22 properties being flooded on the 22\textsuperscript{nd} December.

6.23. On the 24\textsuperscript{th} November an entire traveller site in Ride had to be evacuated after floodwater inundated the site. In total, 11 children and 16 adults were rescued from the site by fire-fighters and were housed in temporary accommodation until water levels had receded.

6.24. Colebrook Village which lies on the outskirts of Plymouth also made headlines after it was flooded four times in 2012. Two of these floods occurred in two days during November and again on 22\textsuperscript{nd} December. This resulted in substantial damage to multiple properties in the village including the Colebrook Inn which had to remain closed until late January to make repairs, missing out on one of its busiest periods of the year.
7. Impacts on Green Infrastructure

7.1. The severe weather experienced had significant impacts on much of the region’s array of green infrastructure assets. The most notable impacts were to the South West Coast Path and the Grand Western Canal which suffered considerable damage. All of these problems combine to further increase the burden on Local Authority budgets and act to degrade the assets in the South West which many tourism businesses rely on.

South West Coast Path

7.2. The rainfall of 2012 resulted in an unprecedented number of cliff falls during the winter of 2012-13. Severe weather has resulted in 36 significant route closures or diversions along the whole South West Coast Path National Trail (SWCP). 22 of these were in Cornwall, 6 were in Dorset and 8 were in Devon of which one was in Exmoor and another in Plymouth (more details are included in Appendix 2). In addition there have been many small scale diversions, and numerous instances of surface damage.

7.3. Some repair work has already commenced but future work is subject to additional funding being secured. Overall, the bill for the damage has been estimated to be in excess of £0.6m. This should be seen in the context of an annual maintenance budget for the SWCP which has been reduced by 30% since 2010 and is currently approximately £0.5m. Though not possible to fully quantify, there were also additional costs in terms of staff time involved in maintaining closures and negotiating diversions.

7.4. Cornwall was the worst affected region with 22 closures along the route, unsurprising as half of the SWCP is located in Cornwall. The closures and related repair work are estimated to cost approximately £0.55m. This again should be seen in the context of Government’s allocated budget for Cornwall of £0.225m for 2013/14 which is 30% down on 2010 figures. It is worth noting that this is a revenue budget and therefore is only available for the day to day maintenance of the trail and not for capital works such as rerouting the path.

7.5. There are also impacts on the offering of the route as a tourist attraction. Though it not possible to directly quantify these effects, it is estimated that the SWCP annually attracts 6.2 million users (excluding local non-tourism use such as by dog walkers) who contribute £389m to the local economy and support 9000 jobs in the South West. As already outlined, the damage to the path meant that sections were diverted away from coast, which is the main draw for visitors using the path. The subsequent loss to the local economy will therefore continue as long as significant diversions exist, particularly where these are along roads.
Grand Western Canal

7.6. The extreme rainfall experienced during 20\textsuperscript{th} and 21\textsuperscript{st} November resulted in an unprecedented overnight rise in water levels in the Grand Western Canal. Despite efforts to isolate a section of the Canal, overtopping led to a major breach on the afternoon of 21\textsuperscript{st} November as shown in Figure 7.

![Figure 7 – Breach of Grand Western Canal](image)

7.7. This failure of the embankment means that in effect the Grand Western Canal became two distinct waterways. A diversionary route was implemented which took pedestrians and cyclists through the village of Halberton.

7.8. Devon County Council budgeted £3m for the repairs of this embankment and to upgrade the Canal’s water management systems.

Other Public Rights of Way

7.9. Other public rights of way were also affected across the region. Further costs were incurred to repair routes that were damaged.

7.10. In Devon, Rights of Way and off road cycle/ walking trail networks were badly affected. As well as significant closures on the SWCP and the Grand Western Canal public footpath (and part of the National Cycle Network), over £1m worth of damage was experienced on the network as a whole. This ranged from local community routes through to the regional walking networks and closures of the prestigious Exe Estuary Trail.

7.11. The Tarr Steps, a medieval bridge which is one of Exmoor’s most popular sites, was washed away by the floods. Repair work, which cost in the region
of £0.012m, has been completed though the wider economic impacts of lost tourism during its closure are harder to quantify.

7.12. In Cornwall, aside from the damage to the SWCP, other trails were affected by severe weather during November and December 2012. The collapse of watercourse banks alongside the Pentreath Trail caused £0.175m worth of damage. Further damage was felt in Newquay where beach access damage near Whipsiderry has cost £0.04m and surface damage to the Newquay bridleway has cost an additional £0.04m.

7.13. Significant damage to the network of footpaths in Plymouth also occurred. Ham Woods had £0.02m of path improvements washed away and different drainage solutions are being trialled at a cost of a further £0.015m.

7.14. Further drainage issues were highlighted across the wider Public Rights of Way network in Plymouth with run-off leaving the network into private land. Examples include Radford Woods where numerous requests were received from nearby land owners to carry out preventative work to ensure that aggregate and surface dressing remains on the network.
8. Economic impacts of the severe weather events

8.1. Despite the recent economic down-turn, the economy of the South West has shown strong long-term growth potential. This nevertheless is reliant on what is becoming an increasingly fragile transport network. The severe weather events of 2012/13 and 2013/14 have not only had significant impacts on the network itself but also on the wider economy of the region.

8.2. In 2012 and early 2013, businesses across the region felt both the effects of damage to buildings, stock and also reduced custom. The economy of the South West is strongly reliant on the agricultural and tourism sectors which are generally focused in the less affluent areas of the region along with in many of the peripheral or branchline economies. These locations and sectors are disproportionately affected by the severe weather and the impacts that it has on the transport network.

8.3. Farming has been significantly affected with several thousand hectares of farm land having been inundated with floodwater. Business continuity issues for farmers have included problems accessing land, inability to plant crops for next summer, animals needing to be re-housed, loss of top soil and road access issues.

8.4. Many farm businesses have had to incur costs to purchase more feed and sell animals on an unplanned basis due to flooded sheds and feed stores. Poor harvests and a lack of winter feed for livestock combined with increased prices for imported feed. These added costs came at a time when the industry was already being stretched. This was no more apparent than in Holsworthy, Devon, where in April 2013, up to 400 dairy farmers met in protest of poor milk prices, high fuel prices and the lack of support being offered to the industry.

8.5. There is also an opportunity to lengthen the agri-food supply chain and add value to the product which already represents a significant percentage the regions GVA. There is a need, therefore, to ‘future proof’ the sector in order to realise its potential to add value to the economy of SW and the UK PLC.

8.6. The 2012 summer tourist season was also poor with weather discouraging many visitors. Impacts on some of the region’s assets such as the South West Coast Path, which, in 2011 alone, attracted an estimated 6.2 million visits leading to a direct spend of £388.6m, would have added to these problems.

8.7. There were also widespread problems with insurance claims with a number of businesses reportedly having difficulties with their claims. Similarly, a significant issue has been raised for smaller businesses in terms of insurance protection from the impacts of flooding.
8.8. All of these impacts will have combined to reduce confidence for businesses in the South West and also the investment opportunities available in the South West, all compounding to lead to longer term issues.

8.9. A further piece of work commissioned by Devon County Council, Somerset County Council and the Heart of the South West Local Enterprise Partnership looked directly at the economic impact on the businesses in the worst hit areas in 2012 and 2013.

8.10. A survey which targeted 600 businesses in the worst affected areas was conducted and found that in Devon and Somerset estimated losses to businesses totalled £7.5m. Losses rose to £8.5m when losses to the suppliers of these businesses and loss to trade were taken into account. The biggest impacts were on a relatively small number of agriculture and tourism businesses that have been hit very hard. The figure of £8.5m only relates to the impact on the businesses surveyed and their wider supply chain. As such, the actual cost to businesses across the region would be far more significant if a full survey were to be undertaken.

8.11. In addition, this figure does not include any assumptions regarding the cost of the most recent extreme weather which has taken place in late 2013 and early 2014. Impacts of recent weather events suggest that significant costs to businesses are likely to be an ongoing occurrence, year on year.

9. Cumulative impacts

9.1. The nature of the impacts of the severe weather events in 2012 and early 2013 combined to create cumulative impacts rather than the occurring as separate, discrete events. Appendix C shows the full extent of the problems experienced across the region as a result of the severe weather experienced in late 2012 and early 2013.

9.2. The multitude of closures to the transport network combined to cause widespread problems for the region. As shown in Appendix C, the linear nature of the network means that it is very fragile. Flooding around Exeter led to the closure of multiple rail lines which combined with both strategic and local road closures. This was no more apparent than on the weekend of 24th and 25th November when these effects combined with the partial closure of the Tamar Bridge and closure of the Torpoint Ferry to effectively cut Cornwall off.

9.3. The closures affected travel across the whole of the South West. This had obvious, direct impacts on those who did travel but it also had indirect impacts on those who decided against travelling. The news of widespread problems would have put many off attempting to travel. This had far reaching impacts especially for many businesses that were understaffed and lacking custom.

9.4. These impacts would act cumulatively with others borne by businesses. Significant damage was caused to the fabric of many business properties as a result of the severe weather. This added cost would obviously hit many businesses hard, coming at a time of reduced custom. Reduced investment confidence would also significantly add to the direct costs of the extreme weather.

9.5. The cumulative impacts are varied and it is not possible to capture or quantify all of them. It is however evident that the impacts of the severe weather should not be viewed in isolation rather they should be considered as a whole.
10. The future

10.1. All regions of the UK have experienced an increase in the contribution to winter rainfall from heavy precipitation events between 1961 and 2006. Whilst it is very difficult to determine whether a particular event is attributable to human impact on climate change, it has been demonstrated that the emissions of greenhouse gases by humans has contributed to an increased intensity of heavy rainfall events in the northern hemisphere over the second half of the 20th century.

10.2. Government’s own climate change predictions from the UK Climate Change Programme 2009 (UKCP09) starkly illustrate the changing weather patterns that are likely to be experienced in the UK as a whole and in the South West in particular.

10.3. These projections underline that the annual average temperature in the South West is likely to rise in the shorter term up to 2020 and also the longer term to 2080. This increase in temperature will enable more moisture to be stored in the atmosphere and hence increase the frequency and intensity of rainfall events, particularly in the winter months.

10.4. The Met Office issued a report on 3rd January 2013 predicting a more frequent incidence of “extreme rainfall” in the future than that experienced in the past. This follows widespread meteorological research indicating that climate change is likely to result in more extreme weather events, including extreme rainfall, occurring more frequently. This analysis demonstrates this by stating that for the Exeter area the current 1:100 year winter rainfall event will become a 1:35 year event by 2040.

10.5. The issue of climate change resilience and adaptation is being considered at a national level by DEFRA through the National Adaptation Programme and the Climate Change Risk Assessment. This assessment considers 100 impacts across eleven key sectors, on the basis of their likelihood of occurrence, the scale of their potential consequences and the urgency with which action may be needed to address them. A specific assessment for transport has identified some key potential impacts of climate change in future. Most notably, there are high confidence levels in the risks of flooding shown in table 6.

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2050</th>
<th>2080</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of road with a significant likelihood of flooding</td>
<td>12,000km</td>
<td>13,000km - 18,000 km</td>
<td>14,000 km - 19,000 km</td>
</tr>
<tr>
<td>Length of railway with a significant likelihood of flooding</td>
<td>2000km</td>
<td>2000km - 2900km</td>
<td>2300km - 3100km</td>
</tr>
</tbody>
</table>

Table 6 - Significant likelihood of future flooding on the road and rail networks

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13 UK Climate Impacts Programme (2009), The Climate of the UK and Recent Trends. Available online: http://ukclimateprojections.defra.gov.uk/content/view/830/500/
15 Source: Met Office, 2012
16 Climate Change Risk Assessment for the Transport Sector Jan 2012
10.6. Sea levels rising are also a concern for coastal communities especially in Cornwall. For example, in Newlyn levels have risen by 20cm since 1920, and are forecast to rise a further 13cm by 2020 and 29cm by 2050. Combine these predicted sea level rises with the increased rainfall and many coastal communities will become increasingly at risk.

10.7. It is therefore beyond doubt that the kind of weather events witnessed in 2012 and early 2013, and subsequently in late 2013 and early 2014, will occur more often and the South West needs to be able to withstand the implications of such weather events more robustly.
11. **Conclusion and actions**

11.1. The flood events of 2012 and early 2013 have had a significant impact on Local Authority budgets and the economic performance of the South West. Climate change projections underline that such events will occur more frequently in the period up to 2050 and beyond.

11.2. In total, the severe weather experienced caused an estimated £120.8m worth of damage across the South West, with the costs continuing to rise. These costs include:

<table>
<thead>
<tr>
<th>Area of damage</th>
<th>Financial cost of severe weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail: repair and maintenance</td>
<td>£15m (across Western route)</td>
</tr>
<tr>
<td>Rail: compensation pay-outs</td>
<td>£12.2m (across Western route)</td>
</tr>
<tr>
<td>Highways</td>
<td>£26m</td>
</tr>
<tr>
<td>LA interventions to protect properties</td>
<td>£54m</td>
</tr>
<tr>
<td>South West Coast Path</td>
<td>£0.6m</td>
</tr>
<tr>
<td>Grand Western Canal</td>
<td>£3m</td>
</tr>
<tr>
<td>Other PROW</td>
<td>£1.5m</td>
</tr>
<tr>
<td>Impact on specific businesses</td>
<td>£8.5m</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>£120.8m</strong></td>
</tr>
</tbody>
</table>

Table 7 - Summary of costs

11.3. It should be noted that the assessment undertaken to consider the impact on businesses was undertaken shortly after the floods in 2013. As such, further costs which have not been recorded are likely to have been incurred. Taking these costs into consideration, it is likely that the overall economic cost of the severe weather in late 2012 and early 2013 may have been approximately £140m.

11.4. In addition, in December 2013 and January 2014 there have been further instances of severe weather which have caused additional, significant disruption. Although the financial impact of these further weather events have not been assessed, such costs are likely to be significant.

11.5. As such, strategic infrastructure interventions are required to adapt to climate change and mitigate the associated transportation and economic risks in future. The strategic rail and highway interventions are vital to maintain connectivity for Devon, Somerset, Plymouth, Torbay and Cornwall. Interventions needed include:
11.6. **Strategic rail interventions:**

- The urgent implementation of the £31.3m programme of schemes identified by Network Rail to improve resilience and operations on the Great Western and West of England Lines;
- Provide an appropriate solution to the Exeter Flood Relief Improvement Scheme at Cowley Bridge to provide appropriate flood relief whilst also improving the strategic rail connectivity of the South West;
- The provision of additional passing loops on the West of England Mainline (in the vicinity of Honiton) to provide an alternative diversionary route to the South West;
- Improvements to Dawlish/ Teignmouth Seawall and action, including mitigating landslips;
- Improvements to other sites of potential repeated disruption on the Berks & Hants line including the Somerset Levels; and
- Improvements to support connectivity within Cornwall to sustain branch lines.

11.7. **Highway interventions:**

- Localised schemes on the trunk road network including improvements to the M5 and A303, including improvements to the A358 to avoid the two roads being cut off;
- Additional funding mechanisms to cover the emergency reaction in relation to permanent highway repair and the on-going, associated maintenance burden;
- Improved integration between rail, bus and road routes to support main centres but also rural and coastal communities;
- Management of bottlenecks (worsened by poor weather) linked to place focused growth; and
- A more flexible approach to securing emergency, central funding that allows for smaller sums to be accessed and over a longer timeframe, to ensure all associated damage is covered.

11.8. **Operational intervention:**

- To ensure and improve dialogue between Government, Network Rail, the Environment Agency, the Highways Agency and Local Authorities, to prepare appropriate solutions to improve resilience, protect our infrastructure and tackle issues of strategic connectivity.

11.9. **Community flood risk interventions:**

- Increased funding and support for Local Authority flood risk alleviation measures; and
- Further research into moorland and wetland management to support communities in the future.

11.10. **Bellwin Fund:**

- Revision of the Bellwin Fund criteria to ensure that funding is more widely available to respond to future events.
Appendix A: Trunk road closures

M5 closure due to severe weather:
- Nov 25\textsuperscript{th} - M5 Southbound Jct’s 25 – 26 closed for 1 hour;
- Jan 25\textsuperscript{th} - M5 Southbound Jct’s 25 – 26 closed for 1 hour.

A35 closure due to severe weather:
- Dec 23\textsuperscript{rd} - Dorchester to Bridport Road closed for approximately 1 hour;
- Jan 25\textsuperscript{th} - Dorchester to Bridport Road closed for approximately 2.5 hours.

A38 closure due to severe weather:
- Nov 9\textsuperscript{th} - A38 Glynn Valley EB & WB full closure for approx 2 hrs 30;
- Nov 11\textsuperscript{th} - A38 Liskeard EB & WB full closure for approx 3hrs 45;
- Nov 22\textsuperscript{nd} - A38 Plympton EB full closure for approx 5 hrs;
- Nov 22\textsuperscript{nd} - A38 Smithaleigh EB 1 lane closure for approx 20 hrs;
- Jan 22\textsuperscript{nd} - A38 Plymouth Parkway EB full closure for approx 11 hours;
- Jan 22\textsuperscript{nd} - A38 Kennford WB full closure for approx 1 hour;

A30 closure due to severe weather:
- A30 Okehampton due to a vehicle colliding with the central reservation after it aquaplaned;
- Nov 21\textsuperscript{st} - A30 Closed Eastbound from Jct with A35 Honiton to Jct with A303 Upottery for 2 hours;
- Nov 25\textsuperscript{th} - A30 closed in both directions from Jct with A35 Honiton - Jct with A303 Upottery for 3 hours;

A303 closure due to severe weather:
- Nov 25\textsuperscript{th} - A303 closed in both directions from Jct with A30 Upottery – Jct with A358 Southfields Rbt for 3 hours;
- Jan 18\textsuperscript{th} – A303 closed in both directions from Jct with A30 Upottery – Jct with A358 Southfields Rbt for 5 hours.
- Jan 25\textsuperscript{th} - A303 closed in both directions from Jct with A30 Upottery – Jct with A358 Southfields Rbt for 4 hours;
Appendix B: South West Coast Path closures

Short diversions are those up to a quarter of a mile longer than the original route.

1. Exmoor: Crock Point, near Woody Bay - short diversion
3. North Cornwall: Tintagel to Port Isaac - small diversion around a cliff fall
4. North Cornwall: Watergate Bay - Update: Path reopened
5. North Cornwall: Trevelgue Head, Newquay - Update: Path reopened
6. North Cornwall: Gannel Crossing, Newquay - 2 mile diversion on low tide route due to boardwalk being damaged.
7. West Cornwall: Kenidjack Valley - Update: Path reopened
8. West Cornwall: Porthchapel near Porthcurno - path collapsed near the bridge over the stream
9. South Cornwall: Cadgwith, the Lizard - Update: Path reopened
10. South Cornwall: South of Chynalls Point near Coverack - short diversion
11. South Cornwall: Porthallow, the Lizard - short diversion
12. South Cornwall: Porthoustock - short diversion
13. South Cornwall: Portscatho - short diversion
14. South Cornwall: Durgan - short diversion
15. South Cornwall: Porthluney Cove (Caerhayes) to Hemmick Beach - 1½ mile diversion
16. SE Cornwall: Par to Polkerris - 1 mile diversion
17. SE Cornwall: Lansallos (between Polruan & Polperro) - Update: Now reopened
18. SE Cornwall: Talland Bay to Looe - Update: Now reopened
19. SE Cornwall: Whitsand Bay - short diversion
20. SE Cornwall: Millendreath to Seaton (Monkey Sanctuary) - 1¼ mile diversion
21. SE Cornwall: Porthpean - short diversion
22. SE Cornwall: Portwrinkle - short diversion
23. SE Cornwall: Downderry - short diversion
24. Plymouth: Jenncliff to Bovisand - short diversion
25. South Devon: Wembury Point to Wembury Beach - Update: Now reopened
26. South Devon: River Erme to Ferncombe Point - Update: Reopened
27. South Devon: Thurlestone to Hope Cove - 1 mile diversion
28. South Devon: Lannacombe Cove - 2 mile diversion
29. South Devon: Kingswear - short diversion
30. East Devon: Seaton to Beer - 1 mile diversion
31. East Devon: Axmouth to Lyme Regis - Update: now reopened
32. West Dorset: Ridge Water near Golden Cap - Update: now reopened
33. West Dorset: Burton Bradstock - Update: path reopened on slightly different route
34. West Dorset: Abbotsbury to Ferrybridge - section open but very wet, muddy and hard going due to ground being waterlogged
35. Dorset: Portland, West Cliff - short diversion
36. Purbeck, Dorset: Kimmeridge to Chapman's Pool - 4 mile diversion
37. Dorset: South Beach, Studland, Purbeck - short diversion
Appendix C: Plan showing the combined impacts of the severe weather across the South West