Parson's Tunnel to Teignmouth

Update — Autumn 2022

Agenda

1. Project background
2. Recent progress
3. Potential way forwards
4. Next steps
5. Q&A

The images and information in this update were presented to the community in November 2022 in a series of events in Holcombe and Teignmouth. The speakers were senior sponsor Julie Gregory, programme engineering manager Emma Lewis, project manager Sarah Fraser and senior programme manager Ewen Morrison.

View from the cliffs towards Holcombe beach

View from Holcombe beach looking up at cliffs

View from sea wall looking towards Teignmouth

Slide 1 — Agenda. Julie Gregory: it is my role to ensure that the project delivers its benefits, which in this case is the resilient railway that we need for Devon and Cornwall and which we know many of you have been very supportive of in the past. I'll begin with a bit of scene setting, to remind us all what the project is for and why it's needed. Then we will talk a bit about our recent progress over the past couple of years as we've sought to revise our proposals. This forms a good background to our latest thinking on what a revised scheme might look like, which is the main theme of the presentation and then we will finish off with our thoughts about the next steps before we open up for some questions.

South West Rail Resilience Programme | Keeping the South West rail healthy

Iconic railway line

Aerial view of Holcombe, the railway line and the beach

GWR train on railway between Parson’s Tunnel and Teignmouth

Slide 2 — Project background — an iconic railway. Julie Gregory:
Here is a reminder about the train service in this part of the country, which is such an iconic journey for passengers with the coastal railway a unique experience. People love to use this part of the railway and we need to make sure that we can protect it for future generations especially making sure that we can continue to operate as the climate changes around us.

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Vital artery for the South West

View from the cliffs towards Holcombe beach

Slide 3 — Project background — a vital artery. Julie Gregory:

In addition to being a wonderful local rail journey, this stretch of track is also the main line taking services all the way to Penzance. There are 50 towns and cities in Devon and Cornwall beyond Teignmouth that are served solely by this rail link.

2014 slope failure

Above: The storm damage to the railway at Dawlish in 2014 and, right, just below Woodland Avenue, between Parson’s Tunnel and Teignmouth

Slide 4 — Project background — 2014 slope failure. Julie Gregory:

In 2014, alongside the more well-known washout along the coast at Dawlish, we had a significant slope failure on the stretch of track between Holcombe and Teignmouth below Woodland Avenue. This was a large failure, which would by itself have shut the main line for several weeks. There were also 18 smaller failures related to the stability of the cliffs as a result of the storms in this area Since 2014 there have been a number of instances of cliff instability along this stretch. Falls from the cliffs are a risk to the railway itself and also to trains, in the worst cases they can result in derailments and/or injuries to passengers and the clear up can often disrupt train services for significant periods of time.

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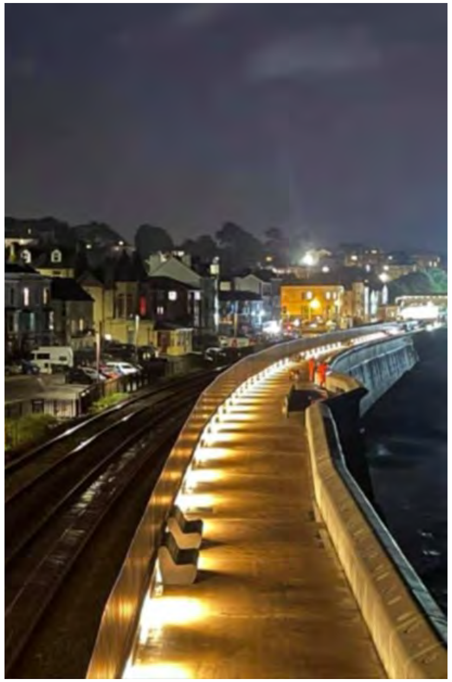
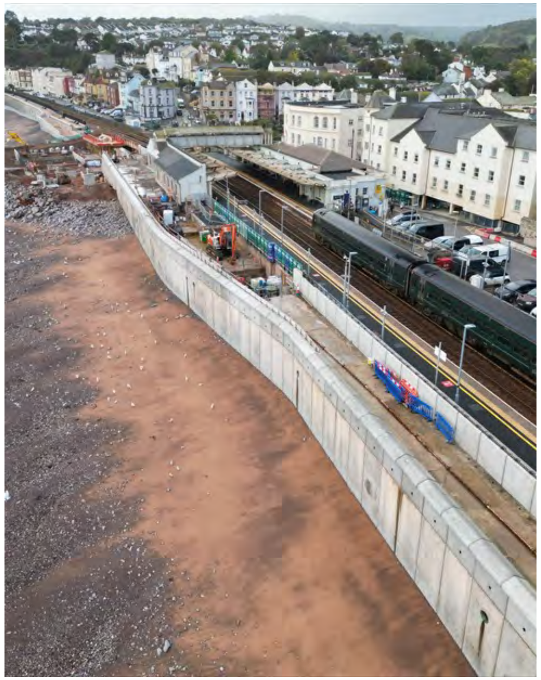
£150m investment so far





Slide 5 — Project background — other South West Rail Resilience Programme Projects. Julie Gregory:
£150m has been invested in the Programme so far; four other projects are either completed or under way; shown from left to right are the first phase of the new £80m sea wall at Dawlish, which was completed in 2020; the second phase of this wall, which is nearing completion; and a rockfall shelter under construction to the north of Parson's Tunnel. The final picture shows the area between Dawlish and Holcombe where design work is under way for a system of soil nails and mesh to protect the railway from the cliffs. The stretch of line between Parson's Tunnel to Teignmouth will be the last piece of the jigsaw puzzle.

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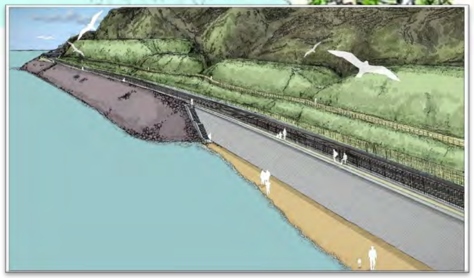
Top: Scope of the scheme between Teignmouth and Holcombe
Above: Realignment of railway proposed in 2020
Right: Artist's impression of the 2020 scheme



2020 Proposals

- Reclamation up to 40m from existing alignment
- Impact on Holcombe and Teignmouth beaches
- Marine and terrestrial environmental impact
- 10 year construction programme
- Very high capital cost
- 100 year resilience delivered in one go

- Environmental Impact ⬆
- Community Impact ⬆
- Cost/schedule ⬆
- Geotech resilience ✓
- Coastal resilience ✓

Slide 6 — Project Background — the scheme proposed in 2020. Julie Gregory:

We last came out to talk to you in 2020 and the scheme we presented then met with a mixed reception. Many of you recognise the need to protect the railway from the cliffs and there was significant local and regional buy-in to the requirement for a project to address those issues.

However, concerns were raised about the environmental impact of the proposals and there was significant local opposition to the potential impact on the beaches of Teignmouth and Holcombe. Questions were also asked about the justification for the scale of the scheme and the robustness of the data used.

As a result of these concerns, Network Rail undertook to look again at the proposals and consider whether something else could be done instead and resolved to look again at the data. We recognise that the immediate risks come from the cliffs in this location and currently not so much from the sea and therefore we decided to look at whether we could manage the cliffs without moving the railway or tackling the sea wall at this time. We really need to find out what's going on within the cliffs and the next slides explain what we've been doing over the past two years to progress towards this aim.

Ground investigation trials

Above: Drilling rig on site for ground investigation works. Top left: Core samples. Bottom left: Drilling equipment

Slide 7 — Ground Investigations. Emma Lewis:
The previous scheme moved the railway away from the risk and created space to build buttresses to support the cliffs. To be able to come up with solutions that leave the railway where it is, we need more data. This data will allow us to fully understand the differing cliff behaviours along the length, confirm the likelihood of different failure types and enable us to create targeted design solutions for each location. I will go through the works we are carrying out to gather this data.

It is usual for geotechnical schemes to gather data by taking samples from the ground and undertaking tests on the samples and then to make assumptions, based on this data, about the adjacent areas. This information is used in the analysis of the cliffs existing behaviour and potential failures and to inform any designs. It is impossible to get information on every part of the cliff but the more boreholes and testing you do, the fewer assumptions you need to make and the more refined and targeted your analysis and design can be.

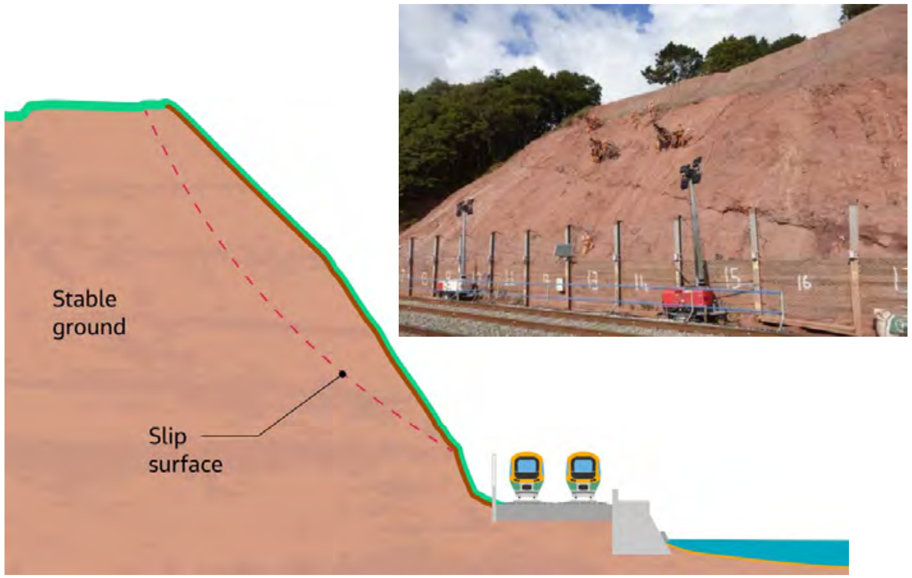
It is very difficult to extract samples from the cliffs at Teignmouth and Holcombe and this led to broad assumptions being made in the development of the previous scheme. The reason that it is hard to extract samples that can be tested is because the local rock comprises coarse pebbles / boulders with fine grained material bonding it together. As samples are removed from the rock, within a hollow tube, the twisting action can cause the finer material to crumble back to sand and you do not get a true representation of the rock properties. We have been trialling different techniques of extraction to obtain better data which will enable more refined analysis and design for localised cliff areas. We will use the techniques that worked best as we continue our investigations

Discontinuity investigations

- Rope access surveys
- Borehole techniques
  - Visual
  - Acoustic
  - Nuclear Magnetic Resonance
  - High Pressure Dilatometer

The graphic shows the slip surface/ discontinuity concept

Far right: Picture shows discontinuity line at the large failure below Woodland Avenue in 2014 following material removal



Slide 8 — Discontinuity investigations. Emma Lewis:

Being able to work out where — and if — larger cliff failures are likely to occur is critical to being able to create targeted solutions without creating space by moving the railway. It is therefore important that we understand the lines on the cliff where failures might occur. These are known as discontinuities.

Depending on the angle and direction of these lines, the failures can be onto or towards the railway creating the problems we are trying to tackle. Knowing where such surfaces are can enable us to put targeted measures in place to prevent the cliffs failing rather than having to make theoretical assumptions.

To identify these lines, we are surveying the cliffs in two different ways. One of these is to carry out detailed surveys using expert geologists to look closely at the rock formation on the surface of the cliffs. These will be carried out using rope access techniques to ensure that we cover as much of the cliff as possible.

The other method we are using is to examine the inside of the boreholes we create during the ground investigations. During our trials we tried several techniques to map the layers down the length of the borehole, which are up to 65 metres deep.

Not all the techniques proved successful. We have now identified what gives us the best chance of success to gather more data and this will be used in the new boreholes.

Groundwater and surface water data

- Catchments
- Gulleys
- Flow monitoring
- Borehole monitoring

Left: Water flowing in gulley between Parson's Tunnel and Teignmouth

Slide 9 — Groundwater and surface water investigations. Emma Lewis:

Historically, as we found in 2014 and other recent failure events, we have found that many of the failures we witness on these cliffs are influenced by water. The water affects the cliff either from within, as ground water, or running over the surface.

Therefore, the other big piece of information that we can gather from our boreholes, both existing and new, is the variation in the groundwater levels over time. This is important to know as the behaviour of the groundwater in combination with potential failure lines in the cliff can lead to instability. This is why extreme rainfall can trigger events such as landslips or rock falls in 2014.

Determining the behaviour of the groundwater is a key requirement to understanding the variability and sensitivity of the cliff to groundwater and whether managing it can reduce the risk of failures in the cliffs.

As well as looking at groundwater levels, we are also looking at the surface water flows and existing drainage systems to understand how they impact the surface of the cliffs and our railway.

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Landscape review

Slide 10 — Landscape review. Emma Lewis:

We have also considered how the cliffs look and the differences over this section. The green (right hatched) areas on the map, called embayments, are the shallower bowls in the cliff. These are likely to have been created by the action of water over time. Due to the shallower nature of these areas they do not have rockfall risks. The two blue areas (left hatched) are steep sided gullies which have been, and still are being, eroded by existing surface water flows. The orange areas (no hatching) are the remaining sections which generally are the steeper cliffs with the greater risks of rockfall. Generating this summary of the topography has been useful to understand the different cliff layouts and enables us to have a clear overview which supports the targeted approach.

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Risk review

Slide 11 — Risk review, Emma Lewis:

Beyond the landscape review we have also revisited our assessments of the risks, which we presented in 2020, for each of the cliff areas. As part of this revisit we have subdivided some of the original areas where we have variability of the risk within a section. The level of risk is not only about the potential instability of the cliff but also reflects the likelihood of this causing disruption to the railway. Over the next few months, we are extending our analysis of the risks to generate a decision-making tool to aid us with programming future works and prioritising where works need to be undertaken.

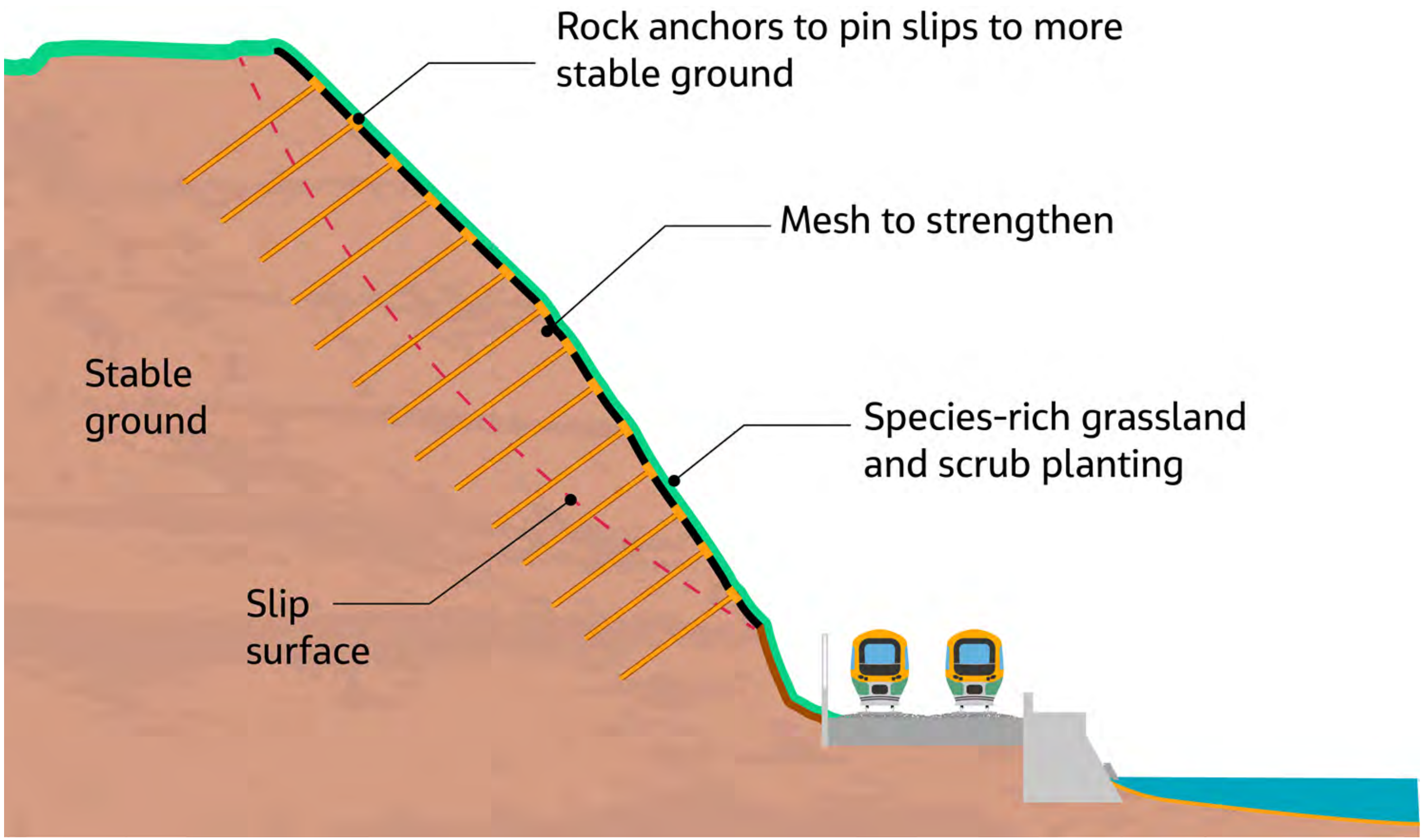
Geotechnical mitigation measures

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Amber	Green	Amber	Red	Green	Amber	Green	Red	Red	Red	Amber	Red	Red	Amber	Amber	Red
Cliff-based solutions	Soil nailing & meshing	Blue		Blue	Blue		Blue		Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	Toe debris barrier	Blue		Blue	Blue		Blue		Blue	Blue	Blue	Blue	Blue	Blue	Blue		Blue
	Heavy scaling / minor regrade			Blue	Blue												
	Ground anchors	Blue			Blue		Blue		Blue								
	Shotcrete/ structural facing											Blue					
Water management solutions	Deep cliff drainage			Blue	Blue					Blue	Blue	Blue	Blue	Blue	Blue		
	Drainage cascades		Blue			Blue		Blue		Blue		Blue					
	Debris flow / access culvert									Blue							
	Cliff toe drainage	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue			
	Track drainage	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue		

Slide 12 — Solutions summary. Sarah Fraser

This table summarises the different measures that we think may be needed in each of the areas along the cliffs. The red, amber and green boxes at the top of each column correspond to the different areas of the cliffs moving left to right from Teignmouth to Holcombe, and the toolbox of solutions we are looking at is described down the side. Where the box is coloured blue, we think that we may need that solution in that location and where it is white we do not believe it will be needed. The top half of the table has cliff-based measures which will be installed on the face or at the base of the cliffs and the bottom half of the table covers various kinds of water management. The next slides give you an idea of what one of the cliff-face measures, the rock anchors and meshing, might be like.

Soil nailing and meshing



Slide 13— Soil nailing and meshing. Sarah Fraser:

Here is the diagram we showed earlier about slip surfaces, now with the rock anchors and active meshing in place that can help to prevent movement along the discontinuity.

The mesh is a bit like chain-link fence and is pinned to the surface of the cliff to hold the rock in place. It needs to be tight to the cliff face to do its job. The rock anchors hold it in place and secure into the rock face beyond the unstable layer.

Often, but not always, the mesh is installed with a layer of matting made from plastic or natural fibre that is there to help prevent weathering of the face and encourage the regrowth of vegetation, which in itself can provide additional stability to the rock face.

What follows is a series of images to give you an idea of what this would look like in a specific place over time.

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Cliffs today

Photo of a section of cliffs in the Teignmouth area

Slide 14— Cliffs near Teignmouth. Sarah Fraser

Here is the area of the cliffs nearest Teignmouth as it currently looks today. Although there is existing netting, not all of it is actively pinned to the cliff surface and therefore we can address the risks better by upgrading it. Notice that there are barer patches and these relate to the steepness and shape of the surface, as well as to whether or not special matting has been installed. The first image may appear somewhat stark.

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Enabling works

Artist's impression to show what an area of the cliff may look like after preparation work for mesh installation

Slide 15— After devegetation. Sarah Fraser

The reason this looks so bare is because it shows the whole area prepared for installation with vegetation fully removed at once. In practice, we would probably proceed in smaller stages — however, we have done this to show that all of it does have to be stripped back at some point in order to allow the most effective installation of the mesh. The good news is it gets better over time.

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Rock anchors and active mesh installed

Artist's impression to show what an area of the cliff may look like directly after mesh installation

Slide 16— Newly installed mesh. Sarah Fraser

This slide shows the newly installed rock anchors and active meshing. The dark colour comes from the geotextile matting; this is dependent on the manufacturer and what we have shown is just an indication at this stage.

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One year later

Artist's impression to show what an area of the cliff may look like one year after mesh installation

Slide 17— Mesh after a year. Sarah Fraser:

Here we have an artist's impression of how the cliff might look a year after the mesh has been installed. The vegetation will have started to grow back almost immediately and the shorter, annual growth will already have returned after a single annual cycle.

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After several years

Artist's impression to show what an area of the cliff may look like several years after mesh installation

Slide 18 — Mesh after several years. Sarah Fraser:

Over a longer period of time, it is expected that the vegetation will return to very similar levels seen today; however, we will need to provide continuing maintenance to prevent the growth of larger trees that could disrupt the efficacy of the netting.

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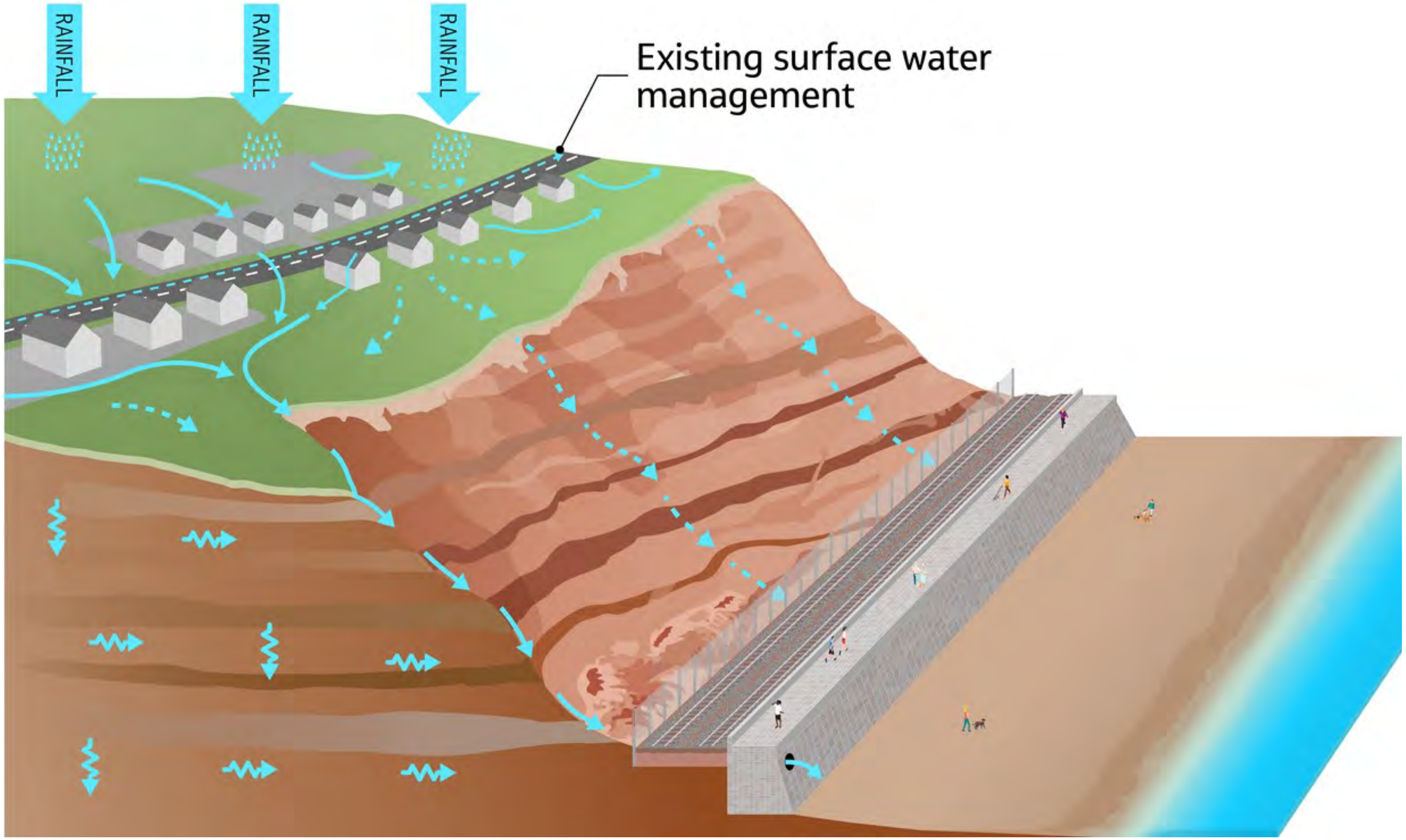
Water behaviour — unmitigated



Generic diagram to show how water moves through and over the cliffs; this does not depict a specific location

Slide 19 — water flows (unmitigated). Ewen Morrison:

This image shows you how water behaves as it makes its way across the landscape and down towards the sea. You can see from the blue arrows that the water travels both over the surface and also through the cliffs.

As rain falls onto the fields and residential areas at the top, it can either soak into the ground or find the easiest path across the surface, influenced always by gravity, towards the sea.

There are some existing drainage systems at track level, designed to capture surface run-off and groundwater, and these have outfalls onto the beach. However, at present, this system is insufficient to cope with the volume of water predicted during storm events.

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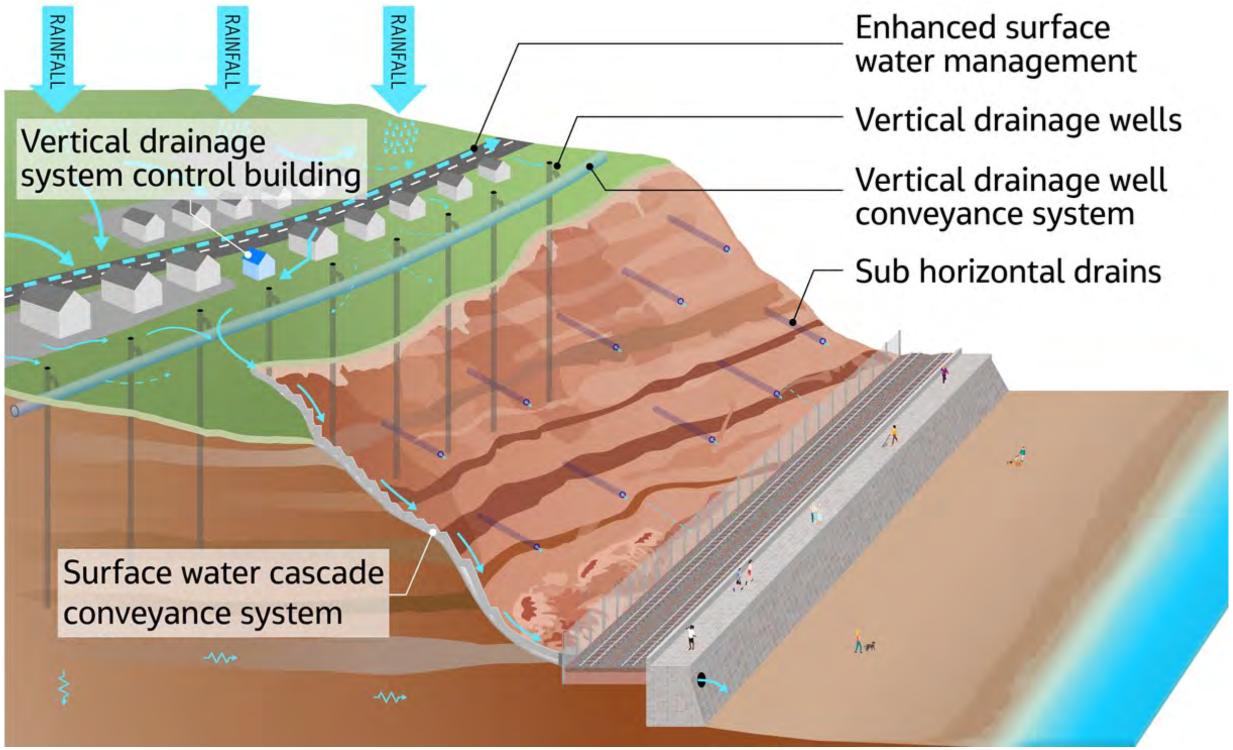
Managed water — ground wells and drains



Generic diagram to show how different water management mitigations may look installed on a cliff area; this does not depict a specific location

Slide 20 — Managing water flows. Ewen Morrison:

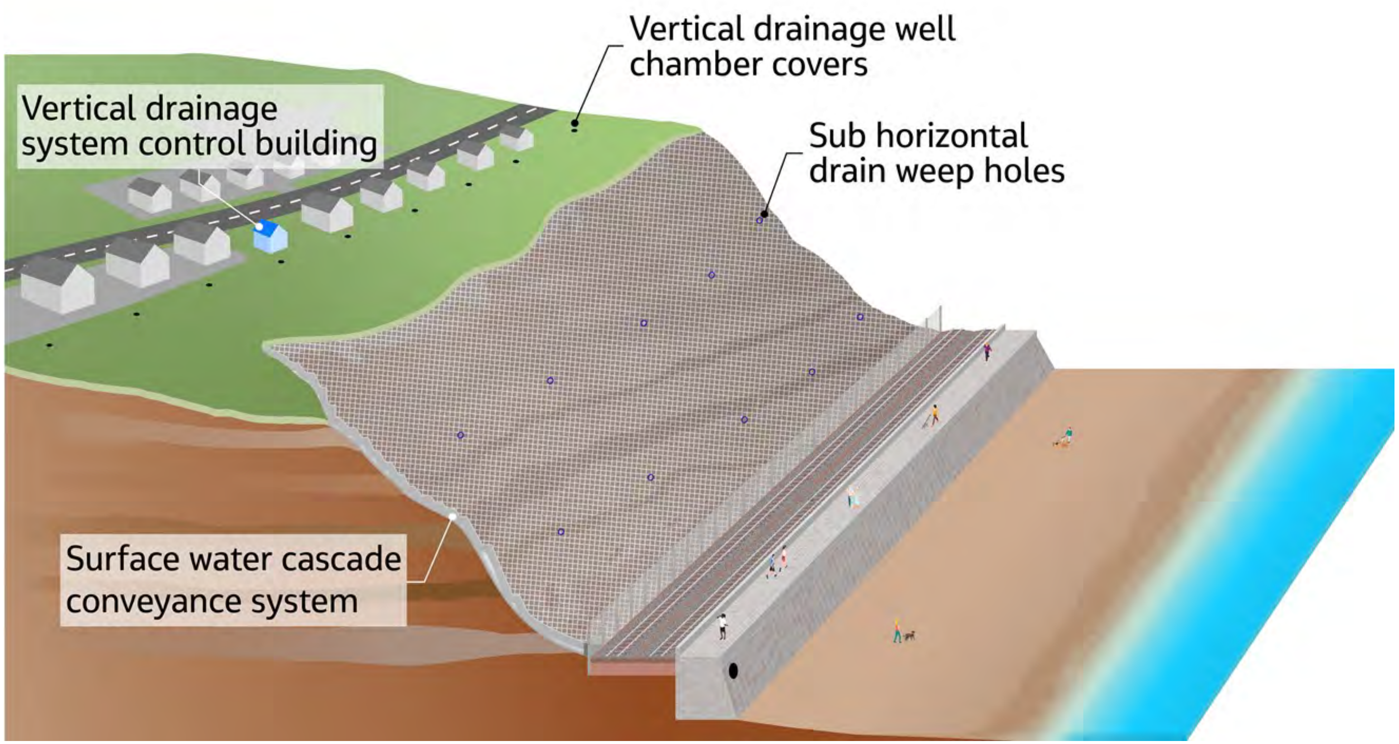
This slide shows some of the mechanisms that could be introduced to more effectively manage and control water movement through the cliffs.

At the top we have shown vertical drainage wells that would be used to extract groundwater and pump it away from the area. On the cliff face we have shown inclined drains that would drain the deeper sections of cliff and bring groundwater to the cliff face without destabilising the surrounding rock.

Depending on the results of our water investigations in the area, either or both of these mechanisms could be helpful as part of our project. We are at a very early stage with our thinking on these water management measures and we need to do further targeted investigations to establish whether it is viable in this area. If it is viable it could play a key role in enabling us to tackle the risks in the cliffs without moving the railway.

The other measure shown on this slide is the management of existing surface water that we see in areas such as gullies. This water would be managed through constructed routes such as pipes, cascades or culverts to control the flows down to track level drainage. This would reduce the erosive power of these streams.

Water management, plus nails, netting and catch fences



Generic diagram to show how different mitigations may look all installed together on a cliff area; this does not depict a specific location

Slide 21 — Managed water, plus nails, netting and catchfences. Ewen Morrison:

This image shows how we could use the measures we have already mentioned in combination to address different risks and protect the railway. You can see the water management is still in place along with mesh on the face and fencing at the toe of the cliff.

The water management is there to control the root cause of failures and that will reduce the tendency of large-scale weather events to trigger geological events. Residual failure risks are managed through the mesh system which holds the face of the cliff in place, while the fence at the bottom is an additional control measure to capture any remaining debris and prevent it reaching the railway. It is worth noting that the drainage well covers at the top and the inclined drains in the face are visually unintrusive.

I should note that we are at a very early stage with our thinking on these water management interventions in particular, and also with the project as a whole, and we do not have firm proposals at present.

Ground investigations, data crunching and risk analysis

Rope access survey work on local cliffs

- Groundwater monitoring
- Further boreholes
- Flow monitoring of surface water
- Rope access discontinuity surveys
- Quantitative risk assessment to compare areas of cliff and proposed interventions
- Refine and develop proposals through design and construction planning

Slide 22 — Next steps. Julie Gregory:

So, the main things that we need to do next are the things we've mentioned as we've been going along to increase our understanding of the data, the rock strata and the water behaviour in the cliffs.

This is going to involve plenty of site work as we create additional boreholes, install groundwater monitoring equipment, do our rope access surveys and monitor surface water flows.

We also need to refine our risk assessments to allow us to set priorities, quantify the impact of the measures we propose and define our construction programme. That will also require a lot of hard work to think about how we will access these very difficult sites and how we manage the construction work safely.

Finally, we need to analyse the data as it comes in and refine our proposals so that we have greater certainty and confidence and can outline a proposed scheme in detail.

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Further communication to come

- The purpose of today's session is to provide a progress update
- As proposals develop at a minimum we will provide further progress updates
- Progress for the scheme is subject to funding
- We may return to a more formal style of communication, for example if a Transport and Works Act Order is required
- We welcome your feedback on the format and content of this session

Slide 23— We're going to keep talking. Julie Gregory:

It is our intention to come back to you at that point with either another session like this or a more formal style of communication if it is determined that this is required to support the planning consents we may need. We are currently funded to do the investigation work I have just outlined and further progress on the scheme will need to be confirmed in due course. We are very glad we have been able to come out and update you as we know that our previous proposals were worrying for some in the community and we hope that you now have confidence we are seeking to move in a different direction.

Ways to keep in touch

Further information about all five projects in the South West Rail Resilience Programme is available at networkrail.co.uk/SouthWestRRP

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