



Rail Accident Investigation Branch

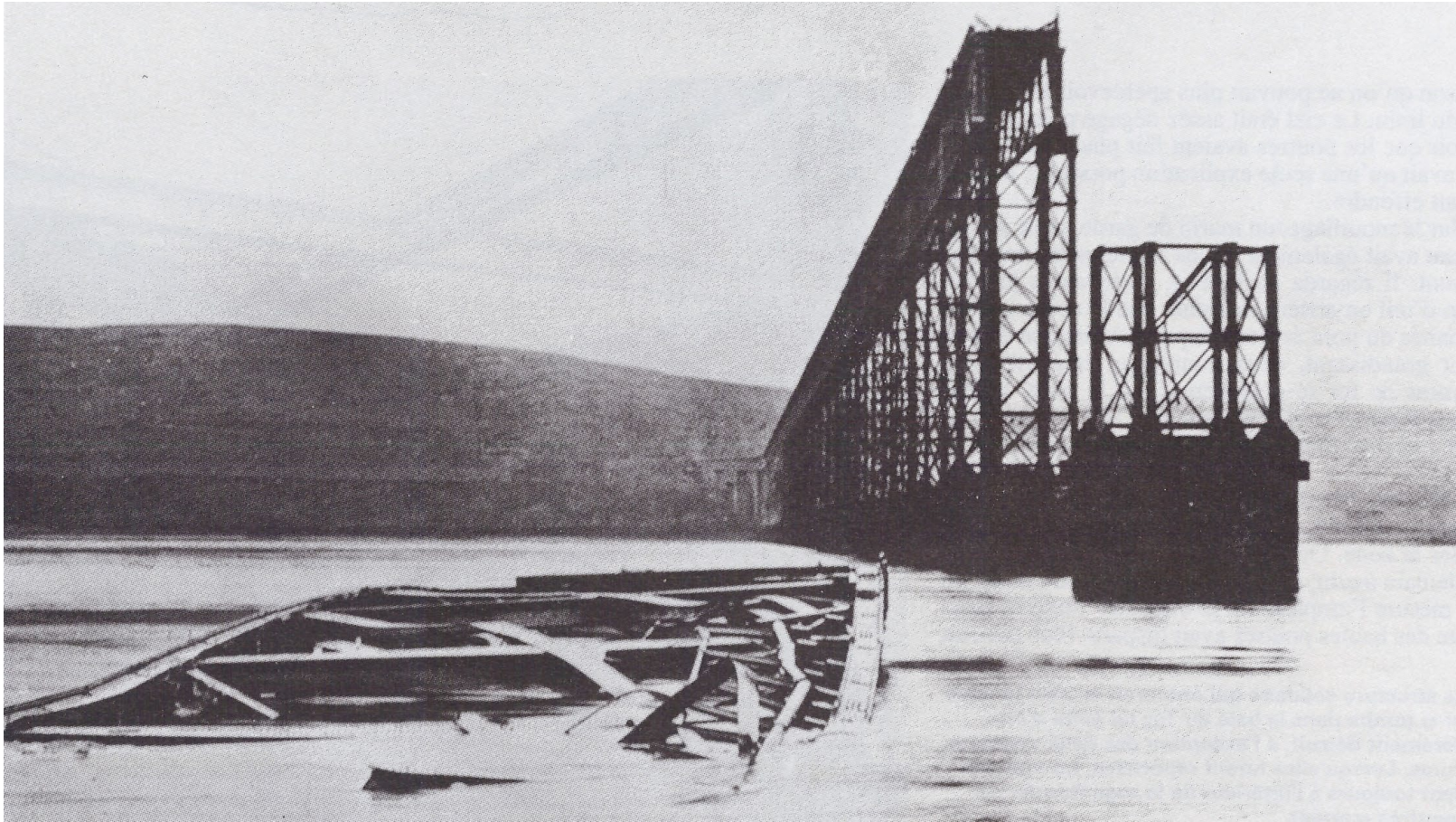
Weather investigation

Rail Accident Investigators Seminar

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Principal Inspector

15 November 2023

Weather – an old adversary



Tay bridge 1879 (Wikimedia commons)

What weather data is available?

Use and limitations

Modern data

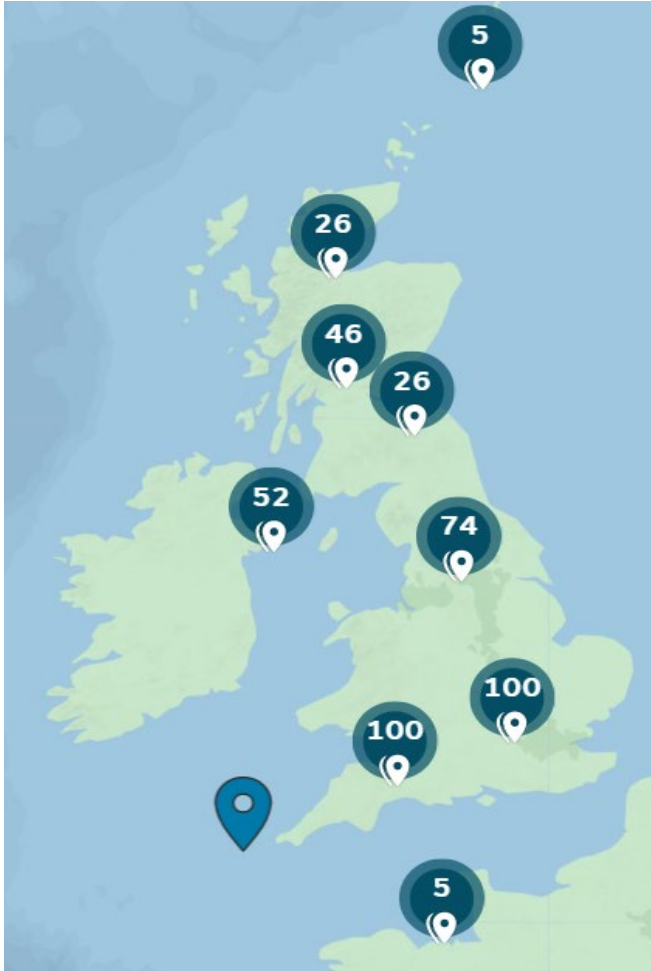


Data obtained can include

- air temperature/humidity
- wind speed/direction
- precipitation
- visibility
- dew point (calculated)

‘Met Office’ weather stations (Crown copyright)

Accessing public official weather station data



UK Met Office

- ~260 automated stations – report hourly
- ~140 manual stations – report less often
- daily data 09:00 hrs - 09:00 hrs **UTC**
- at least max/min temp & rainfall, often much more
- recent and, sometimes, **long term** data available from Met Office web site
(search for 'weather stations' on the Met Office web site)



SEPA

- ~267 automatic **rainfall gauges**
- hourly data
- data available from SEPA web site
(search for 'rainfall data' on SEPA web site)

What is actually measured



‘Official’ weather stations (Crown copyright)

Typical official requirements include

- Air temperature/humidity
 - ventilated shaded location
 - 1.25 - 2.0 m above ground
 - over grass/away from large paved areas
- Wind
 - 10 m above ground
 - open area (10 x obstruction height)
- Precipitation
 - open area (4 x obstruction height)

Investigator’s challenges

- **official stations rarely at incident location**
- **we may want something different**

Other weather stations

Other organisations

- Network Rail
- highways authorities
- hydro power...

Amateur weather stations

- immediate, free data, often near incident
- may not meet all 'official' requirements
nearby features - ground surface - height



(Images Wikimedia commons & Crown copyright)

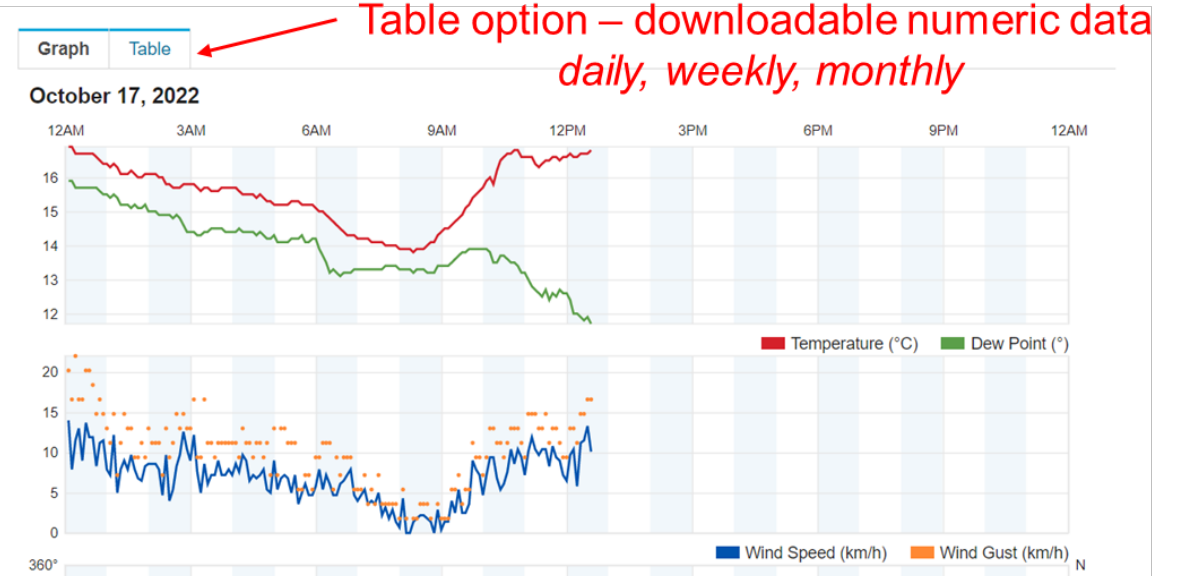
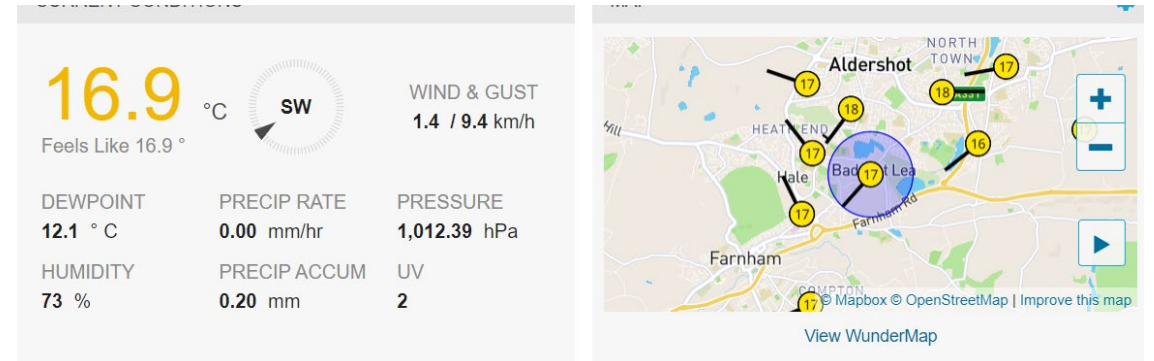
Accessing amateur data

<https://www.wunderground.com/wundermap> zoom/search on map to find location

Alternative: WOW on the Met Office website



Weather station locations
click on each to get its observations



Visual observation - witnesses

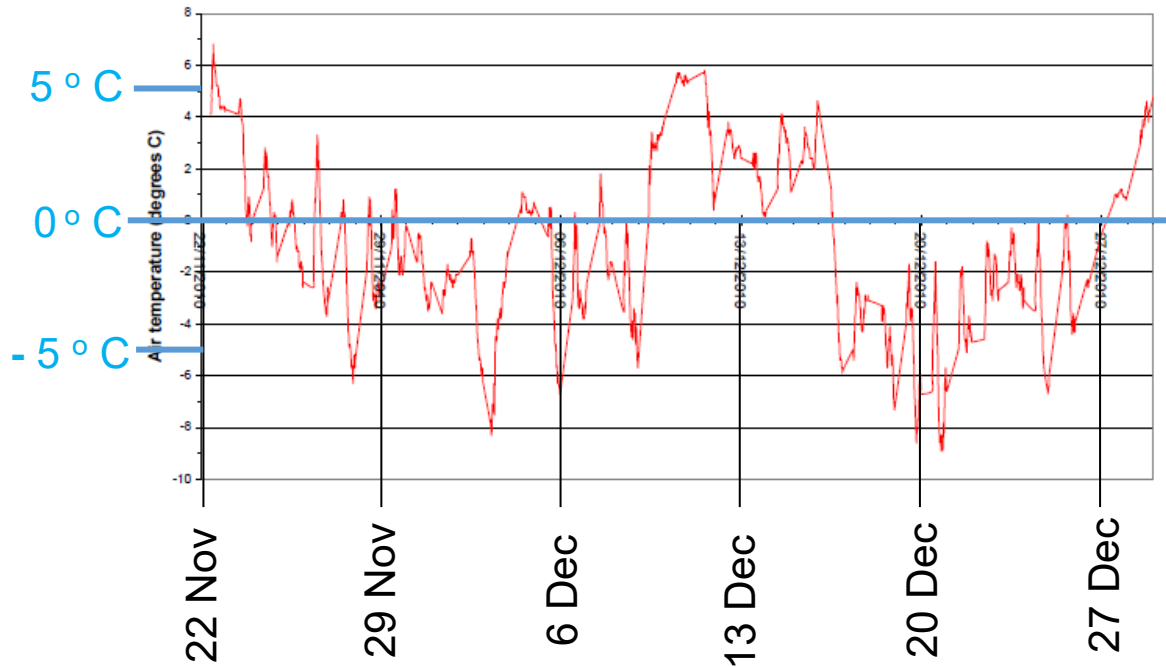


(Images NASA & Wikimedia commons)

What weather data is available?

Use and limitations

Temperature history



Summit tunnel

- sustained low/sub-zero
- rise through zero temperature



High temperature



Cummersdale

- Rail temperature
 - above air temperature (sun radiation)
 - depends on cloud cover during preceding hours

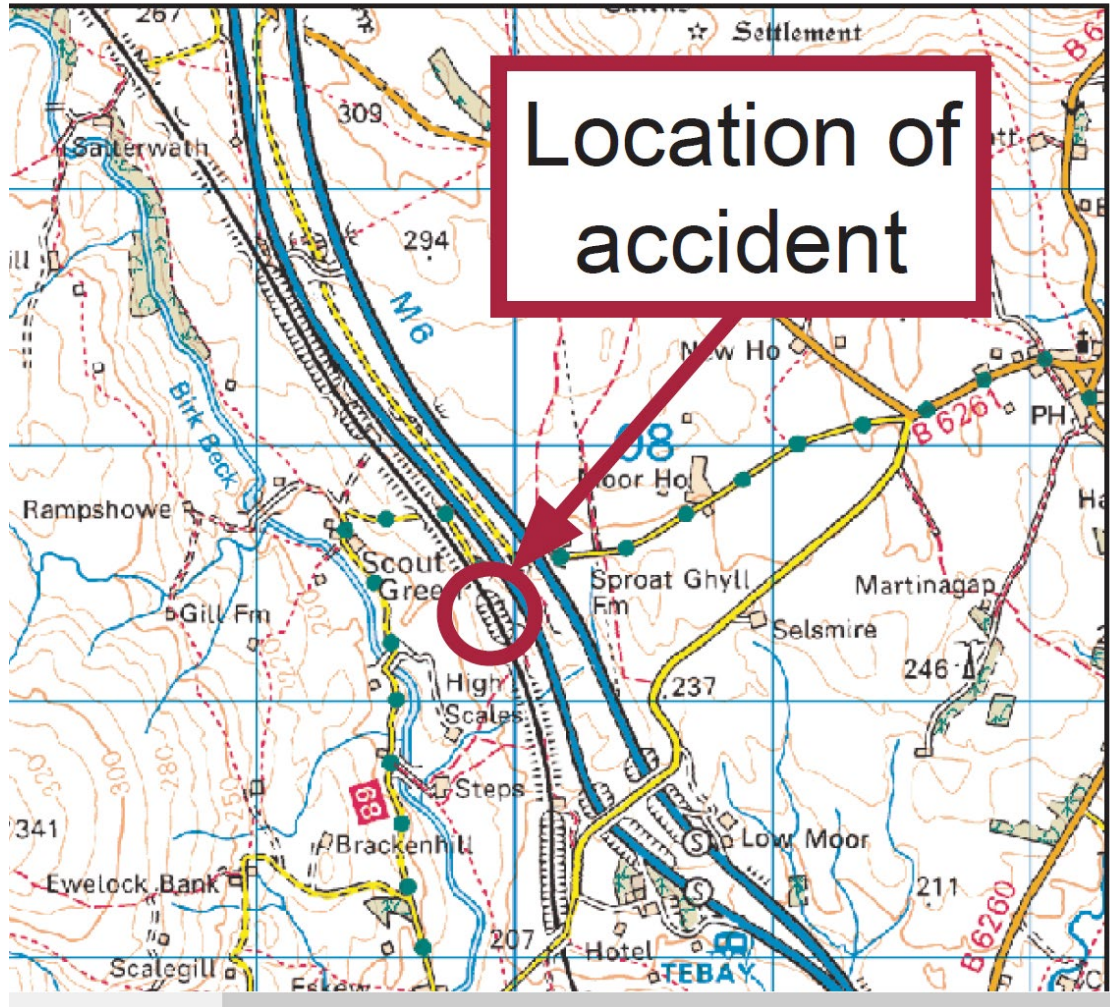
Wind speed & direction

Littleport

- direction & gust speed relevant
- observations 16 km, 31 km & 35 km away
- open countryside,
- 3 sec gust used
 - shorter not much faster
 - OLE inertia
- adjusted for OLE height above surrounding land



Wind - topography



Scout Green

- gust speed from Shap weather station
- only 6 km away
- topography effects – embankment, valley



Scout Green

Wind – unusual direction



Balderton

- collided with two trees, then one tree, then derailed on fourth tree, all within 7 miles (11 km)
- high winds but no mitigation relevant to accident scenario
 - average 39 mph (63 km/h)
 - gust 69 mph (111 km/h)
- northerly, rather than prevailing westerly, wind (Met Office report – thousands of trees felled)

Rain – sometimes rapid geographical variability



Baildon

- 17 mm rain in 30 minutes at weather station 1 mile west of washout
- no rain at two weather stations within a mile to the south

Carmont

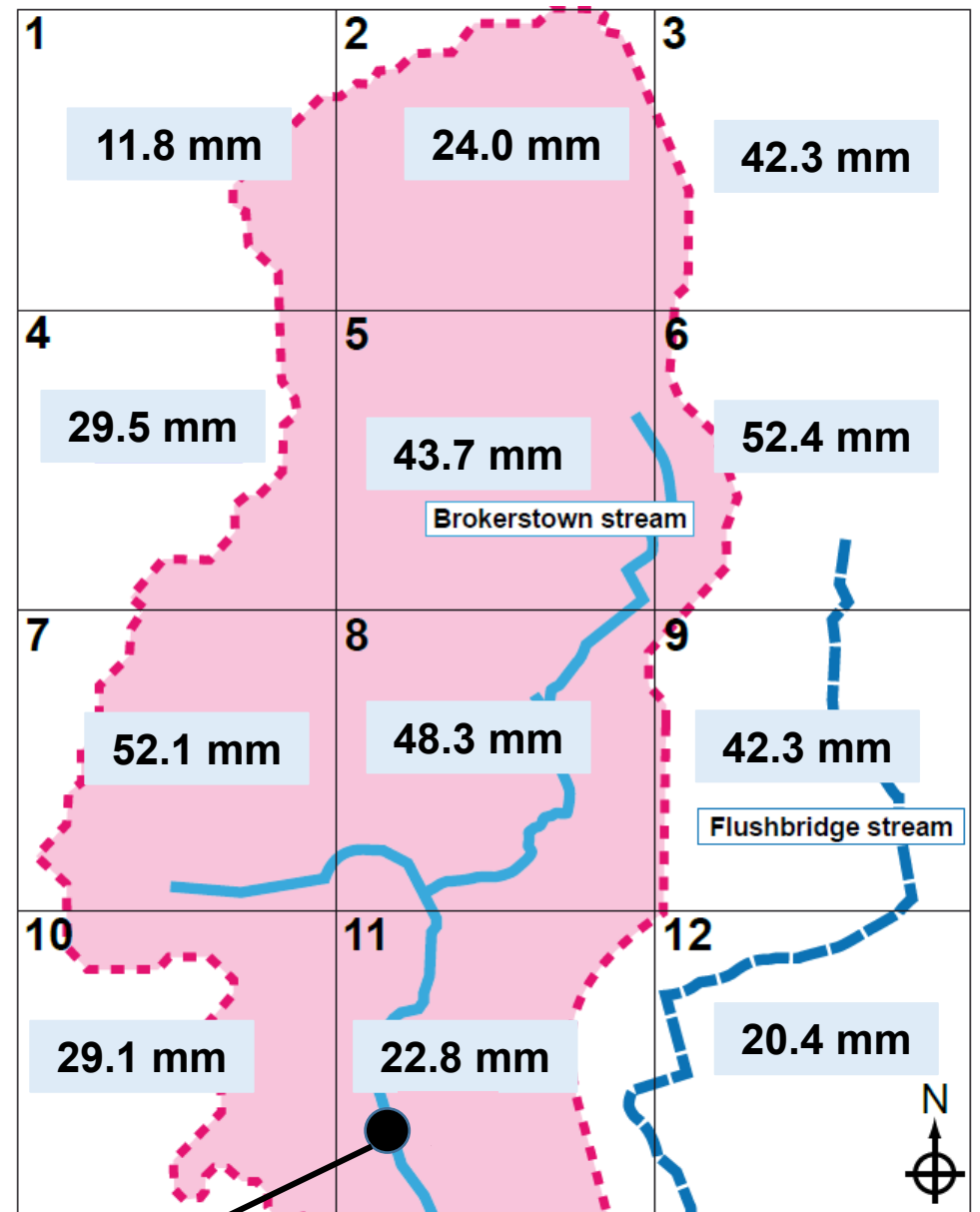
- 51.5 mm rain at accident site
- 79 mm at Cheyne, 4.6 km to north east

Rain – radar capability



Knockmore

Met Office or other specialist needed to obtain this data...at a cost!

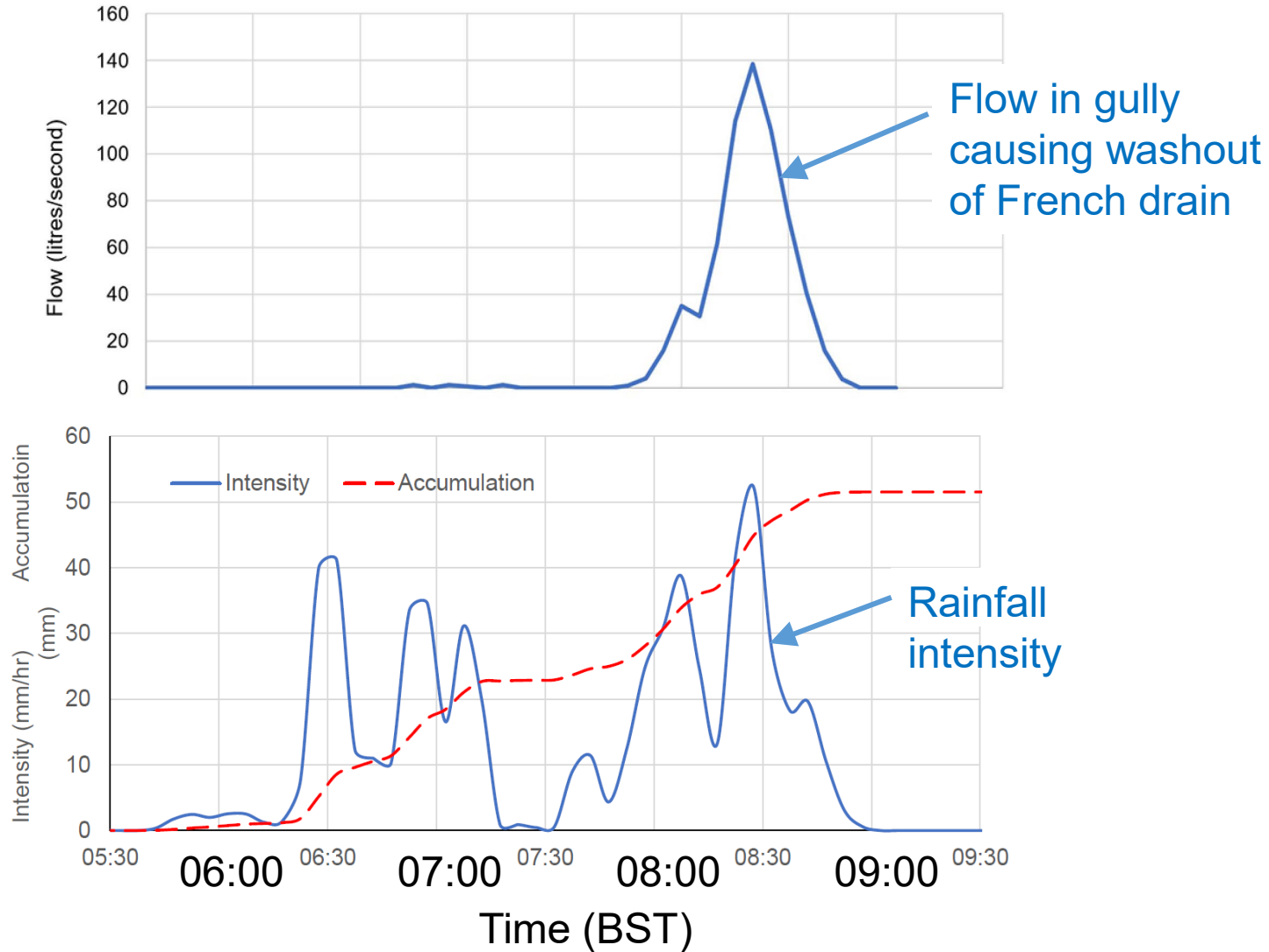


Rainfall in 1 km squares

Washout



Linking rainfall to consequence – the challenges



Incident site water flow not directly related to rainfall

- Some water soaks into ground
 - soil type
 - existing soil saturation
- Water must reach incident
 - over ground surface – time depends on surface type
 - through the ground – time depends on ground permeability
 - along drains & rivers

Linking rainfall to consequence – witness evidence



Downstream of embankment
CCTV images



Upstream of embankment

Deposits left on vegetation below, not above, water level

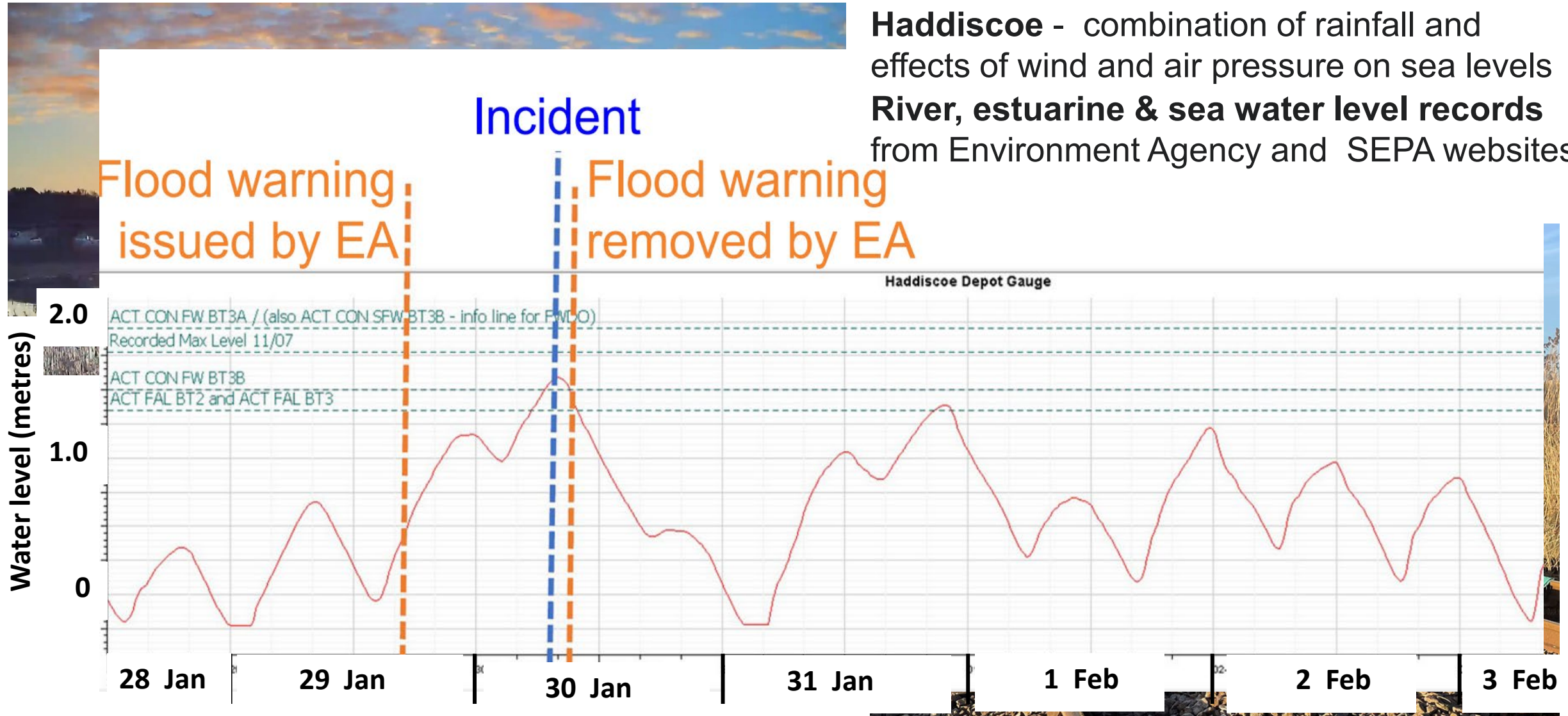
Rainfall – the importance of history



Bargoed

- preceding 24 hours
 - 40 mm rain
 - Return period < 1 year
- preceding five days
 - 125 mm rain
 - 1 in 7 year return period
- effect of previous rain seen on soil moisture maps

Linking weather to consequence – river/sea levels



Visibility



Tibberton

- CCTV provides direct evidence of conditions
- Pershore weather station - 10 miles (16 km) south - recorded fog

The challenge:

- visibility can change quickly and varies dramatically over short distances

Interaction between weather types



Loch Eilt

- Landslip triggered by snow melt
- Snow accumulation depends on
 - Ground/air temperature before & during snowfall
 - amount of snowfall
 - wind direction during snowfall
- Snow melt rate depends on
 - air temperature
 - cloud cover, shadow effects & slope/sun orientation
- Witness/CCTV evidence likely needed!

