

# Delivering the appropriate data for winter and flood resilience





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#### Content

Data collected/stored by forecast providers How data is used How forecast accuracy is currently measured/reported Winter Marginal Nights Trigger thresholds – are they appropriate? Heavy Rain Flooding thresholds High Winds **Diversions and Closures** 



# Data collected/stored by forecast providers

#### Minimum Forecast Road Temperatures Minimum Observed Road Temperatures

Other model data used as input Other site observations National/Global Observations Radar Satellite **Raw Road model output** Forecaster intervened output

Observations ()	stalled Table > B125	7 Chop Gate 🗸 🗸	Date 14/12/2021	< > LA		8		<b>B</b> =
Date/Time	Surface Condition	RST("C)	Deep Temp (*C)	Dew Point (°C)	Air Temp (°C)	Wind Speed (mph)	Wind Gust (mph)	Wind Direction
		Min: 2.6 Max: 11.0	Min: 5.4 Max: 6.4	Min: 2.5 Max: 4.6	Min: 5.5 Max: 8.1	Min: 1.6 Max: 7.6	Min: 4.5 Max: 19.0	
14-12-21 10:30 GM	T Moist	5.1	5.6	3.4	Min 5.5	3.1	10.5	
14-12-21 10:40 GM	T Moist	5.9	5.6	3.7	5.8	3.4	6.5	
14-12-21 10:50 GM	T Moist	6.3	5.5	4.0	6.3	3.1	7.8	
14-12-21 11:00 GM	T Moist	6.7	5.7	4.0	6.7	4.0	11.0	
14-12-21 11:10 GM	T Moist	6.5	5.6	3.9	6.8	5.6	12.3	
14-12-21 11:20 GM	T Moist	6.9	5.5	3.8	6.6	5.8	12.8	
14-12-21 11:30 GM	T Moist	7.8	5.7	4.0	6.9	4.3	11.2	
14-12-21 11:40 GM	T Moist	8.0	5.6	3.9	6.9	6.3	15.4	
14-12-21 11:50 GM	T Moist	8.1	5.7	3.8	6.9	7.4	14.3	
14-12-21 12:00 GM	T Moist	8.5	5.5	3.8	7.1	Max 7.6	17.4	
14-12-21 12:10 GM	T Moist	8.9	5.6	3.9	7.3	5.8	13.4	
14-12-21 12:20 GM	T Moist	8.6	5.7	3.9	7.0	7.4	15.9	
14-12-21 12:30 GM	T Moist	9.6	5.6	Max 4.6	7.6	4.7	15.7	
14-12-21 12:40 GM	T Moist	Max 11.0	5.6	4.3	Max 8.1	3.8	18.6	
14-12-21 12:50 GM	T Moist	10.2	5.6	4.3	7.6	6.3	16.1	





# Internal uses of this data

Daily forecast performance

Post event scenario verification

Model adjustments

Sensor performance anomalies

Forecaster added value

Model comparison/verification

	A	B	С	D	E	F
1	Site	Min Obs R	in Obs RST DTG (Localtim	Min Lunchtime FCST RST	Min Fcst (Midday)-Obs Delta	
2	A69 Brampton (Low Row)	-9.8	01/10/2022 14:00	8.1	17.9	
3	A66 Old Spittal Farm (KN3)	4.1	02/10/2022 04:00	5.1	1	
4	A701 Southerly Ridge	4.6	02/10/2022 06:50	5.2	0.6	
5	B1257 Chop Gate	4.7	02/10/2022 07:00	5.5	0.8	
6	A9 Dunkeld	4.8	02/10/2022 06:10	7.2	2.4	
7	A93 South Persie	5	02/10/2022 06:00	5.8	0.8	
8	A822 Amulree	5	02/10/2022 05:45	4.5	-0.5	
9	B6265 Grassington	5	02/10/2022 06:50	4.7	-0.3	
10	A92 Upper Victoria	5	02/10/2022 06:50	5.5	0.5	
11	A68 Soutra	5.1	02/10/2022 07:10	4.9	-0.2	
12	B6399 Berryfell	5.1	02/10/2022 06:40	5	-0.1	
13	Oakbank	5.2	02/10/2022 06:30	6.2	1	
14	A1 Stannington (AN2)	5.2	02/10/2022 07:00	5.7	0.5	
15	A90 Toll of Birness	5.2	02/10/2022 06:40	5.5	0.3	
16	A941 Cabrach	5.2	02/10/2022 06:30	5.9	0.7	
17	Balshando	5.3	02/10/2022 06:00	5.1	-0.2	
18	A9 Ord Ousdale	5.3	02/10/2022 05:50	5.5	0.2	
19	A907 Bogside	5.3	02/10/2022 07:00	5.8	0.5	
20	A66 North Bitts (KN3)	5.4	02/10/2022 07:10	6.3	0.9	
21	A66 Stainmore (KN3)	5.4	02/10/2022 07:20	6.1	0.7	



### Current external uses of the data

# KPI Reporting Post event analysis

Too	ols > Precip Analysis Tool > Issued: 05/09/22 16:28 > Swansea - All Areas > > Forecast > E E														
	Search	Radar (mm)				Forecast (mm)									
Ì	Location	Last 24h	13-14	14-15	15-16	16-17	17-18	18-19	19-07	07-19	Tue	Wed	Thu	Fri	Sat
	Area 1 North - Grid at No.400 Birchgrove-Llansamlet	35.0	0.0	0.0	0.5	0.1	1.8	1.0	8.5	6.3	10.3 💧	40.2 💧	11.0 💧	0.9 💧	0.2 💧
	Area 1 North - Grid Graig Y Pal, Glais	34.9					2.1	0.9	8.0	6.2	9.0 💧	36.6 💧	11.0 💧	0.9 💧	0.2 💧
	Area 1 North - Kingrosia Park - Grid, Clydach	32.2	0.0	0.0		0.1	2.4	0.6	7.7	5.9	7.9 💧	33.5 💧	10.9 👌	0.9 💧	0.2 💧
	Area 1 North - Llys Dol - Grid, Morriston	27.6	0.0	0.0	0.3	0.2	2.7	0.3	8.9	5.9	9.9 💧	42.3 💧	10.1 👌	0.9 💧	0.1 💧
	Area 1 West - A4118 Kittle Hill, Fairwood	27.9				1.3	2.7	0.3	9.4	5.9	9.2 <mark>(</mark>	53.1 💧	8.2 💧	1.2 💧	0.2 💧
	Area 1 West - Birchtree Close r/o Derwen Fawr Rd -Grid	32.2				1.4	1.5	0.6	11.2	5.9	10.1 💧	51.7 💧	7.6 💧	1.1 💧	0.1 💧
Ì	Area 1 West - Blackpill - Sketty - The Woodman - Grid	27.6	0.0	0.0	0.7	0.8	2.3	0.5	11.9	6.1	10.6 💧	55.1 💧	8.5 💧	1.1 👌	0.1 💧
	Area 1 West - Killay Square	34.5				3.4	2.7	0.8	10.1	5.6	9.3 💧	50.0 💧	7.1 💧	1.1 💧	0.2 💧
	Area 1 West - Southgate Road	25.0					1.7	0.4	10.1	6.2	8.9 💧	58.2 💧	13.3 💧	1.1 👌	0.1 💧
	Area 1 West - Top Llwyn Mawr Rd Tycoch	33.5	0.0	0.0	0.7	1.7	3.7	0.5	10.4	5.6	9.4 💧	49.0 💧	7.7 💧	1.1 💧	0.1 💧
Ì	Area 1 West - Ystrad Road Fforestfach - Grid	31.3	0.0	0.0	0.5	1.2	3.5	0.4	9.4	5.4	8.7 💧	46.1 💧	7.9 💧	1.0 💧	0.1 💧
	Area 2 North - Centroid, Pontarddulais	32.9				1.9	1.4	0.5	5.4	4.4	6.2 💧	35.8 💧	8.4 💧	0.9 💧	0.1 💧
	Area 2 North - Libanus Road Grid, Gorseinon	31.8				1.3	2.8	0.5	7.1		7.3 💧	44.0 💧	7.4 💧	1.0 💧	0.1 💧
	Area 2 North - Lon y Felin (R.Cathan) - Mawr	28.7	0.0	0.0	0.2	0.8	4.5	0.4	4.3	4.3	5.8 💧	28.2 💧	8.8 💧	0.8 💧	0.1 💧

Winter 2021-22 1<sup>st</sup> October – 30<sup>th</sup> April

#### Seasonal Statistics

INITIAL FOR	ECAST	FINAL FORE	CAST
Bias below 5C	F/F	Bias below 5C	F/F
-0.2	576	-0.2	590
RMSE below 5C	F/NF	RMSE below 5C	F/NF
1.2	181	1.1	173
% correct below 5C	NF/F	% correct below 5C	NF/F
89.8	97	90.6	83
GG % correct below 5C	NF/NF	GG % correct below 5C	NF/NF
96.2	1871	96.8	1875
False alarms	False alarm rate	False alarms	False alarm rate
181	6.6	173	6.4
Misses	Miss rate	Misses	Miss rate
97	3.6	83	3.1



### Relationships

### Domain, Route, Site Warmest to Coldest

Site (Warmest)

Route (Colder)

Domain (Coldest)





#### Site Specific Forecasts

Client 1170 North York	shire CC (V)	]		~						
Site List (overrides o	lient)									
Start dtg 2020-10-01	E	nd dtg 2021-04-30								
Forecast 1 offset 2h	ours	Forecast 2	offset 12hours							
Thresholds 5										
Select	Show nightly sta	ats 🗹 Show mor	Client 1170	North Yorkshire CC	(V)				~	
			Site List (ov	errides client)						
<u>Download</u> csv data			Start dtg 20	20-10-01	End dtg	2021-04	-30			
Seasonal St	atistics		Forecast 1	offset 2hours		Forecas	st 2 offset	12hours		
			Thresholds	5			,			
INITIAL FOR	ECAST	FINAL		otail 🗖 Shaw nie	abtly state 🗖	Chow m	onthly ato	to 🗖 Ch	ow accord atota	
- Bias below 5C	F/F	Bias below 5C		etali 🖬 Show hig	jilly stats 🖬	Show In	Unitily Sta		JW SEASON SIALS	
-0.1	679	-0.2	Select							
RMSE below 5C	F/NF	RMSE below 50								
1.3	115	1.2	Download c	sv data						
% correct below 5C	NF/F	% correct below								
01	62	91.5	54							
GG % correct below 5C		GG % correct below	50 NF/NF							
95.9	1107	96.4	1102							
False alarms	False alarm rate	False alarms	False alarm rate							
115	5.9	112	5.7							
Misses	Miss rate	Misses	Miss rate							
62	3.2	54	2.8							motdeel
										metaesi

#### Site Specific Forecasts

А	В	С	D	E	F	G	Н	1	J	К	L	М	N	0	Р	Q	R	S	т	U	V	W	Х	Υ	Z	AA	AB	AC
October	1304480					1304477					1304476				1	303472					1303457					1304474		
	init	final	obs	Err init	Err final	init	final o	bs	Err init	Err final	init	final	obs	Err init	Err final ini	t fir	nal	obs	Err init	Err final	init fi	nal ob	os	Err init	Err final	init f	inal	obs
01/10/2020	4.7	4.7	2.9	1.8	1.8	5.1	5.1	4.4	0.7	0.7	3	3	4	-1	-1	3.4	3.4				4.9	4.9	5	-0.1	-0.1	4.7	4.7	
02/10/2020	10	10	11.3	-1.3	-1.3	10.4	10.4	12	-1.6	-1.6	10.9	10.9	10.8	0.1	0.1	11	11				11.6	11.6	12.7	-1.1	-1.1	10.4	10.4	. 9
03/10/2020	7.4	7.9	7.6	-0.2	0.3	6.8	8.1	7.4	-0.6	0.7	7	8.1	7.9	-0.9	0.2	6.9	8				8.3	8.6	9.1	-0.8	-0.5	7.3	8.8	8
04/10/2020	8.3	8.3	9	-0.7	-0.7	8.2	8.8	9.4	-1.2	-0.6	9.2	9.2	9.8	-0.6	-0.6	9.5	9.7				9.7	10.1	9.9	-0.2	0.2	8.7	8.7	8
05/10/2020	6.9	6.9	5.9	1	. 1	7.7	7.7	7.9	-0.2	-0.2	9.7	9.7	8.8	0.9	0.9	8.4	8.4				8.7	8.7	8.8	-0.1	-0.1	9.8	9.8	. <u>e</u>
06/10/2020	5.2	5.6	6	-0.8	-0.4	7.1	7.4	8.1	-1	-0.7	6.5	7	6.6	-0.1	0.4	6.6	6.9				7.4	7.4	7.5	-0.1	-0.1	8.7	8.9	8
07/10/2020	6.5	6.5	7.1	-0.6	i -0.6	9.5	9.1	9.5	0	-0.4	8.1	8.1	8.9	-0.8	-0.8	8.2	8.2				8.9	8.9	9.5	-0.6	-0.6	7.3	7.3	. 8
08/10/2020	4.6	4.5	3.8	0.8	0.7	5.9	5.9	6	-0.1	-0.1	6	6	7.3	-1.3	-1.3	4.9	4.9				5.7	6	6.5	-0.8	-0.5	6.3	6.5	e
09/10/2020	2.1	2.1	1.4	0.7	0.7	4.6	4.1	4.5	0.1	-0.4	5	5	4.9	0.1	0.1	3.3	3.3				4.4	4.4	3.6	0.8	0.8	5.9	5.9	
10/10/2020	5.4	5.4	5.8	-0.4	-0.4	4.4	3.7	4.9	-0.5	-1.2	5	5	6.5	-1.5	-1.5	5	5				6.6	6.6	6.1	0.5	0.5	3.2	3.2	
11/10/2020	5	5	4.3	0.7	0.7	6.8	6.8	7.7	-0.9	-0.9	6.8	6.8	8	-1.2	-1.2	6.1	6.1				6.7	6.7	6.7	0	0	7.3	7.3	. 8
12/10/2020	5.7	4.6	5	0.7	-0.4	7.3	5.5	3.4	3.9	2.1	5.8	5.3	2.4	3.4	2.9	7.4	5.4				8.3	6.8	5.8	2.5	1	2.9	2.9	1
13/10/2020	6	6	6.5	-0.5	-0.5	5.5	5.5	4.9	0.6	0.6	4.9	4.9	5	-0.1	-0.1	5.2	5.2				6.4	6.4	5.6	0.8	0.8	6.1	6.1	. 6
14/10/2020	4.5	4.5	4.1	0.4	0.4	3.6	3.6	3.3	0.3	0.3	3.7	3.6	3.4	0.3	0.2	3.8	3.8				6.4	6.4	4.7	1.7	1.7	4	3.8	, e
15/10/2020	4.8	4.8	4.9	-0.1	-0.1	5.9	5.4	4.9	1	0.5	3.9	3.9	6	-2.1	-2.1	4.7	4.7				5.8	5.8	6.9	-1.1	-1.1	3.7	3.5	. 6
16/10/2020	6.8	6.9	6	0.8	0.9	5.1	6.8	7.5	-2.4	-0.7	4.9	6	7	-2.1	-1	6.9	7.2	7.1	-0.2	0.1	9.1	9.5	7.2	1.9	2.3	4.6	5.1	. 7
17/10/2020	6.6	6.6	6.5	0.1	0.1	7.4	7.4	5.6	1.8	1.8	7.6	7.6	4.6	3	3	7.8	7.8	5	2.8	2.8	7.9	7.9	6.9	1	1	7.3	7.1	. 6
18/10/2020	4.9	4.9	5.2	-0.3	-0.3	6.2	6.2	7.3	-1.1	-1.1	5.7	5.7	7.3	-1.6	-1.6	5.4	5.5	6.7	-1.3	-1.2	6	6	6.7	-0.7	-0.7	6.6	6.6	1
19/10/2020	7	7.5	6.9	0.1	0.6	9.8	9.8	9	0.8	0.8	8.5	8.5	8.3	0.2	0.2	8.9	9.1	8.9	) (	0.2	9.5	9.5	9.1	0.4	0.4	8.4	8.4	8
20/10/2020	9.4	10	9.4	C	0.6	11.3	11.3	12.3	-1	-1	10.1	11.1	10.5	-0.4	0.6	11.1	11.5	12	-0.9	-0.5	11.4	11.4	11.7	-0.3	-0.3	9.8	10.4	10
21/10/2020	6.1	6.1	6.4	-0.3	-0.3	6.8	6.8	8.1	-1.3	-1.3	8.5	8.5	8.2	0.3	0.3	7.2	7.2	7.2	2 0	0 0	6.8	6.8	8.1	-1.3	-1.3	8.1	8.1	. 8
22/10/2020	1.6	1.6	1.1	0.5	0.5	2.5	2.5	3.3	-0.8	-0.8	2.3	2.3	4.9	-2.6	-2.6	1.8	1.8	3.7	-1.9	-1.9	2.8	2.8	4	-1.2	-1.2	2.8	2.8	1
23/10/2020	2.5	2.5	1.2	1.3	1.3	4.1	4.1	3.5	0.6	0.6	3.8	3.8	3.8	0	0	3.9	3.9	3.6	i 0.3	0.3	4.1	4.1	4.3	-0.2	-0.2	5	5	4
24/10/2020	2.1	2.1	2.7	-0.6	-0.6	3.8	3.8	4	-0.2	-0.2	4	4	3.3	0.7	0.7	3.9	3.9	4.1	-0.2	-0.2	4.8	4.8	4.4	0.4	0.4	5	5	
25/10/2020	2	2	2.9	-0.9	-0.9	3.5	3.5	3	0.5	0.5	4	4	3.4	0.6	0.6	3.6	3.6	3.5	i 0.1	0.1	3.9	3.9	4.2	-0.3	-0.3	5.4	5.4	2
26/10/2020	2.6	2.6	2.4	0.2	0.2	3.8	3.8	3.5	0.3	0.3	3.6	3.6	3.8	-0.2	-0.2	3.8	3.8	3.6	i 0.2	0.2	4.1	4.1	4.4	-0.3	-0.3	5.4	5.4	
27/10/2020	3	3	1.9	1.1	1.1	4	4	2.6	1.4	1.4	4.1	4.1	3.5	0.6	0.6	4.1	4.1	3.7	0.4	0.4	4.3	4.3	4	0.3	0.3	5.5	5.5	
28/10/2020	2.3	2.3	1.6	0.7	0.7	4	4	3.5	0.5	0.5	3.8	3.5	4.1	-0.3	-0.6	4	4	3.5	i 0.5	0.5	4.6	4.6	4.9	-0.3	-0.3	5.3	5	4



#### Site Specific Forecasts





**Route Forecasts** 

Dynamic measurement unsuitable – hourly temporal forecast resolution : time/location of measurement

Spot measurement – possible at location of weather station

Important to have route forecast colder than any site along the route – safety issue





**Domain Forecast** 

Retrospective Thermal Map unsuitable – not based on raw data, includes bridge decks

Weather station observations unsuitable – not comparing apples with apples

**Important** to have domain forecast colder than any route forecast, site specific forecast/measurement





#### **Quick Recap**

Forecast accuracy is currently best measured by comparing site specific forecasts and observations from that site.

No perfect methodology exists for route and domain forecast accuracy measurement

Assumption therefore is that the accuracy of route and domain forecasts for any Forecast provider is as good as that for the site specific forecasting.

Provided the Warm - Cold - Coldest relationship exists



## Marginal Nights – Background Work

Sites where there are more forecast frosts than observed have best potential Ignore sites which you know are 'warm' - unrepresentative



Chart showing the number of marginal nights at each forecast site



# Marginal Nights – Background Work



2022-23

# Trend – By forecast site (associated Route or Domain) Use colder sites – closer to the route or domain forecast



42.85% of the forecasts where the forecast minimum was between +1 and 0 didn't go below +1



# Marginal Nights – Background Work

#### **Past Seasons**



2022-23 (42.85%)

metdesk

#### **Review of Trigger Thresholds**

Only applies for those with trigger thresholds above zero!

Use Marginal Night analysis Cold sites – closest profile to route or domain Those with lowest forecast error (RMSE)

Risk Profile – Cold Sites Compare nights below+1 and nights below 0 Missed Frosts– this is where the risk is





## **Risk Profile – Missed Frosts**

Client 1170 North Yorkshire CC (V)				~			
Site List (overrides client) 1304478	3 B1257 CI	HOP GA1					
Start dtg 2019-10-01	End dtg	2020-04-30		]			
Forecast 1 offset 2hours	1	Forecast 2 offse	t 12hour	S			
Thresholds 1	<b>—</b>						
Show Detail Show nightly stats Show monthly stats Show season stats Select							

Download csv data

#### Seasonal Statistics

INITIAL FOR	ECAST	FINAL FORE	CAST
Bias below 1C	F/F	Bias below 1C	F/F
-0.1	56	0	60
RMSE below 1C	F/NF	RMSE below 1C	F/NF
1.4	14	1.2	13
% correct below 1C	NF/F	% correct below 1C	NF/F
79.3	10	82.4	6
GG % correct below 1C	NF/NF	GG % correct below 1C	NF/NF
93.1	36	96.3	29
False alarms	False alarm rate	False alarms	False alarm rate
14	12.1	13	12
Misses	Miss rate	Misses	Miss rate
10	8.6	6	5.6

2019-20 Season Nights where forecast and Observations PS1 or below

6 nights where RSTs went Below zero when forecast to stay above

5.6% of all forecasts issued in range



# Look at Risk Scenarios (+1, 0.8, 0.5, 0.1)

Number of forecasts of >= PS1 that went below zero/stayed above then

Number of forecasts of <= PS0.5 that went below zero/stayed above If the numbers are similar then the data may support a reduction in trigger threshold

#### **Detail for February**

		13044	78 B12	257 CHOP G	ATE		NIGHTL	Y STATISTIC	s
FEDRUART	INIT	FINAL	OBS	ERR INIT	ERR FINAL	ME INIT	ME FINAL	RMSE INIT	RMSE FINAL
2020-02-01	0.9	1.4	2.4	-1.5	-1.0	-1.5	-1.0	1.5	1.0
2020-02-02	1.0	1.0	1.6	-0.6	-0.6	-0.6	-0.6	0.6	0.6
2020-02-03	-0.7	-0.7	-0.4	-0.3	-0.3	-0.3	-0.3	0.3	0.3
2020-02-04	-4.2	-4.2	-3.4	-0.8	-0.8	-0.8	-0.8	0.8	0.8
2020-02-05	-2.6	-2.6	-4.3	1.7	1.7	1.7	1.7	1.7	1.7
2020-02-06	-0.6	-3.1	-3.3	2.7	0.2	2.7	0.2	2.7	0.2
2020-02-07	0.3	0.3	1.5	-1.2	-1.2	-1.2	-1.2	1.2	1.2
2020-02-08	4.1	4.5	4.2	-0.1	0.3	-0.1	0.3	0.1	0.3
2020-02-09	-0.5	-0.5	0.4	-0.9	-0.9	-0.9	-0.9	0.9	0.9
2020-02-10	-0.8	-0.7	0.0	-0.8	-0.7	-0.8	-0.7	0.8	0.7
2020-02-11	-2.2	-2.2	-1.8	-0.4	-0.4	-0.4	-0.4	0.4	0.4
2020-02-12	-2.3	-1.4	-2.1	-0.2	0.7	-0.2	0.7	0.2	0.7
2020-02-13	0.1	0.1	1.2	-1.1	-1.1	-1.1	-1.1	1.1	1.1
2020-02-14	1.2	1.2	0.4	0.8	0.8	0.8	0.8	0.8	0.8
2020-02-15	4.0	4.0	4.1	-0.1	-0.1	-0.1	-0.1	0.1	0.1
2020-02-16	0.4	0.6	2.2	-1.8	-1.6	-1.8	-1.6	1.8	1.6
2020-02-17	-0.3	-0.3	0.3	-0.6	-0.6	-0.6	-0.6	0.6	0.6
2020-02-18	-1.7	-1.7	-1.9	0.2	0.2	0.2	0.2	0.2	0.2





# Risk / Reward Example – Single Domain Rutland – Uppingham

Threshold	False Alarm Rate %	Miss Rate %
+1	9.7	4.8
+0.8	10.2	5.1
+0.5	10.9	5.5
0	12.2	6.3

Change	+2.5% Potential Savings	+1.5% Increase in Miss Rates
Change	+2.5% Potential Savings	+1.5% Increase in Miss Rates



#### Risk / Reward Example – Multi Domain Nottinghamshire (4 domains)

Illustration showing change from +1 to 0 – 2022/23 Season

Domain	Reduction in False Alarms (Savings)	Increase in Miss Rates (Risk)
N+NW Notts (A631 Beckingham)	2%	2.8%
N Nottingham (A614 Burntstump)	3.2%	2.3%
SW Notts (A60 Costock)	4%	1.6%
E Notts (A614 Perlethorpe)	2.1%	2.1%



# Risk / Reward Example – Route Based Forecasting East Riding of Yorkshire (17 Routes)

#### Illustration showing change from +0.8 to +0.5 – 2022/23 Season

Route	Reduction in False Alarms (Savings)	Increase in Miss Rate (Risk)
BEV1 (A1023 Routh)	1.1%	0.2%
BEV2 (A1023 Routh)	1.1%	0.2%
BEV3 (A164 Cranswick)	1.4%	0.3%
BEV4 (B1230 High Hunsley)	1.3%	0.4%
CARN1,2 (A166 Garrowby)	0.6%	0.5%
CARN 3 (Octon)	1.6%	0.6%
CARN 4 (A164 Cranswick)	1.4%	0.3%
HEDON1,3 (B1242 Mappleton)	0.6%	0.1%
HEDON 2 (B1242 Withernsea)	0.9%	0.3%
MW1,2,3,4 (Asselby Main Street)	0.5%	0.9%
MW5 (A166 Garrowby)	0.6%	0.5%
MW6 (B1247 Pocklington)	1.5%	0.2%



# **Considerations/Implications**

- Monitoring/Alerting +1 and 0
- Reaction times
- Blanket application or by domain/route?
  - Domain and Route specific triggers?
- Other options
  - Route Based
  - Warm routes / Cold routes
  - Sub-routes





#### Rainfall

• Wealth of data available – EA, UKMO, UKCEH

- Adverse weather susceptibility study (forecast provider)
- Past event analysis
  - Outcomes surface flooding events
  - Rainfall amount gauges and calibrated radar

Search		Radar (mm)			Forecast (mm)									
Location	Last 24h	08-09	09-10	10-11	11-12	12-13	13-14	13-01	01-13	Fri	Sat	Sun	Mon	Tue
01 - A29 Northside (A597)	6.5	0.3	0.4	0.4	0.5	0.4	0.3	4.5	5.5	13.5 💧	5.2 <mark>(</mark>	0.0 💧	0.3 💧	0.3 💧
02 - A3 Derwent (Gote) (A5086)	12.1	0.8	0.6	0.6	0.5	0.4	1.0	4.6	6.1	14.5 💧	5.7 💧	0.0 💧	0.8 💧	0.3 💧
03 - A50 Ouse (B5291)	12.9	1.0	0.9	1.1	1.0	0.5	0.9	4.2	7.2	16.1 💧	6.1 💧	0.0 💧	1.5 💧	0.4 💧
04 - A49 Dubwath (B5291)	11.4	0.9	0.8	0.9	0.8	0.6	1.0	4.4	7.6	16.5 💧	5.9 <mark>(</mark>	0.0 💧	1.4 💧	0.4 💧
05 - A15 North Row (A591)	35.5	2.7	2.0	2.2	1.8	0.5	0.9	4.2	7.8	16.8 👌	6.1 💧	0.0 💧	1.6 💧	0.4 💧
06 - A9 Chapel (Bassenthwaite) (A591)	38.3	2.7	2.1	2.3	1.6	0.6	0.9	4.2	8.1	17.1 💧	6.1 💧	0.0 💧	1.6 💧	0.4 💧
07 - A13 Lair Beck (A591)	15.6	1.1	0.6	0.6	0.8	1.0	1.2	5.5	10.4	19.6 💧	5.2 💧	0.0 💧	1.1 💧	0.2 💧
08 - A34 Derwent (Keswick) (B5289)	6.0	0.5	0.2	0.2	0.2	1.1	1.1	5.5	10.7	20.1 💧	5.1 💧	0.0 💧	1.0 💧	0.2 💧
09 - A165 Pow (C2057)	5.4	0.5	0.2	0.2	0.2	1.2	1.1	5.6	10.8	20.3 💧	5.1 💧	0.0 💧	1.0 💧	0.2 💧
10 - A6 Greta (A5271)	16.4	1.2	0.6	0.8	0.7	1.1	1.1	5.6	10.7	20.0 💧	5.1 💧	0.0 💧	1.0 💧	0.2 💧
11 - A90 Townfield (B5322)	26.5	2.1	0.9	1.0	0.6	1.2	1.3	5.7	9.7	17.7 💧	5.1 💧	0.0 💧	1.1 💧	0.2 💧
12 - A19 Smaithwaite (A591)	21.8	0.9	0.2	0.6	0.3	1.3	1.1	7.3	11.9	21.1 💧	4.7 💧	0.0 💧	0.7 💧	0.2 💧
13 - A163 Grange (C2057)	29.4	1.8	1.0	1.3	0.6	1.2	0.9	7.8	13.5	24.7 💧	4.7 💧	0.0 💧	0.7 💧	0.3 💧
14 - A45 Strands (B5289)	12.3	0.4	0.2	0.3	0.5	1.4	1.0	9.1	15.1	27.6 💧	4.4 💧	0.0 💧	0.5 💧	0.3 💧



#### Rainfall

Historic radar dataHistoric soil moisture index data

Correlate with surface water flooding events
Develop trigger/alerts levels at asset level









### Rainfall Alert Thresholds Wet/Dry Soil

<u>Rainfall Hourly Values (mm) <mark>Dry</mark> Conditions (Dry = Soil Moisture Index Top 2 soil layers &lt;1)</u> Min Max Colour					l Hourly Values (n Max	nm) <mark>Wet</mark> Conditions (Wet = Soil Moisture Index Top 2 soil layers >1) Colour
-99	1.999	Green		-99	0.999	Green
2	4.999	Yellow		1	1.999	Yellow
5	9.999	Amber		2	2.999	Amber
10	999	Red		3	999	Red
<u>Rainfal</u>	l 12 Hourly Values	: (mm) <mark>Dry</mark> Conditions (Dry = Soil Moisture Index Top 2 soil layers <1)		<u>Rainfal</u>	I 12 Hourly Value	s (mm) <mark>Wet</mark> Conditions (Wet = Soil Moisture Index Top 2 soil layers >1)
Min	Max	Colour		Min	Max	Colour
-99	14.999	Green		-99	4.999	Green
15	19.999	Yellow		5	7.999	Yellow
20	24.999	Amber		8	12.999	Amber
25	999	Red		13	999	Red
<u>Rainfal</u>	I 24 Hourly Values	(mm) <mark>Dry</mark> Conditions (Dry = Soil Moisture Index Top 2 soil layers <1)		Rainfal	24 Hourly Value	s (mm) Wet Conditions (Wet = Soil Moisture Index Top 2 soil layers >1)
Min	Max	Colour		Min	Max	Colour
-99	29.999	Green		-99	9.999	Green
30	39.999	Yellow		10	14.999	Yellow
40	49.999	Amber		15	19.999	Amber
50	999	Red		20	999	Red



### Wind

#### Past diversions/closures

- Past events
- Historic wind speed/gust and direction data
- Design parameters

#### It's not just bridges!



Key: Wind Gust Alert Levels													
Green -	Gree	reen Wind											
Red Wind Gust Above 50m	Red	ed Wind											
N.B. The Wind Speed value shown is time.	the 'mean' w	ind speed for	ecast at and	l around each	forecast time	. The Maximu	um Gust valu	e is the maxin	num wind gu	st speed at a	nd around ea	ch forecas	
Lightning Risk Key 0 None 1 Small 2 Moderate 3 High/Strong													
iowal													
24 Hour Wind Forecast for Cowal	from Sund	av 24/09/2	3 12·00 to	Monday 25/	09/23 11:00								
				linoniday 20			1000						
Local Time	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	
Wind Speed (MPH)	16	17	16	14	13	16	24	28	29	24	17	15	
Wind Direction	SSE	SSE	SSE	s	SSE	SSE	S	S	S	SSW	SW	SW	
Maximum Gust (MPH)	32	34	33	28	25	32	47	55	58	48	33	31	
Wind Alert	Green	Green	Green	Green	Green	Green	Green	Red	Red	Green	Green	Green	
Lightning Risk	0	0	0	0	0	1	1	1	1	1	0	0	
Local Time	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	
Wind Speed (MPH)	16	16	17	19	19	20	17	14	14	17	20	19	
Wind Direction	SW	SSW	SSW	s	SSW	SW	SW	SSW	SSW	SSW	SSW	SSW	
Maximum Gust (MPH)	32	32	34	38	39	40	34	28	28	33	38	39	
Wind Alert	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
Lightning Risk	0	1	0	0	1	0	0	0	0	1	0	1	



# In summary

- Involve your forecast provider
- Making best use of data beyond the forecast
- Setting trigger thresholds
  - Winter All Year – Rainfall All Year - Wind
- Assessing the risk profile
   Domains
   Routes
   Site/Asset Locations





