

A high-speed photograph of water splashing on a dark, wet surface, creating numerous droplets and ripples. The background is dark and out of focus, emphasizing the water's movement.

Surface Water Flood Forecasting and Guidance in the UK

Jon Millard, FFC Senior Hydrometeorologist

FLOODFORECASTINGCENTRE

a working partnership between



Environment
Agency



Met Office

Outline

- ➡ FFC role
- ➡ Resolution and Uncertainty
- ➡ Surface Water Flood Forecasting
- ➡ Future Developments
- ➡ Customer Communication



FFC Role

FFC main customers





- ➡ Category 1 and 2 responders
- ➡ Government (Defra, DCLG etc)
- ➡ Environment Agency, NRW
- ➡ SFFS for SEPA

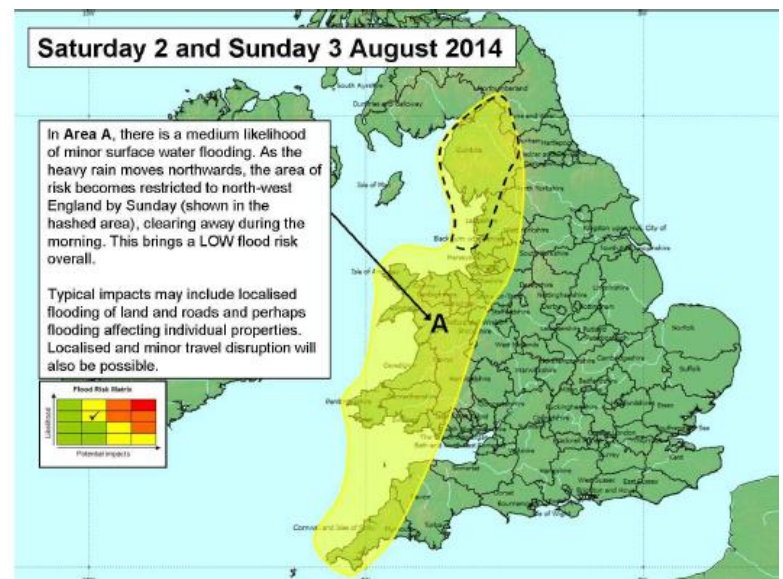
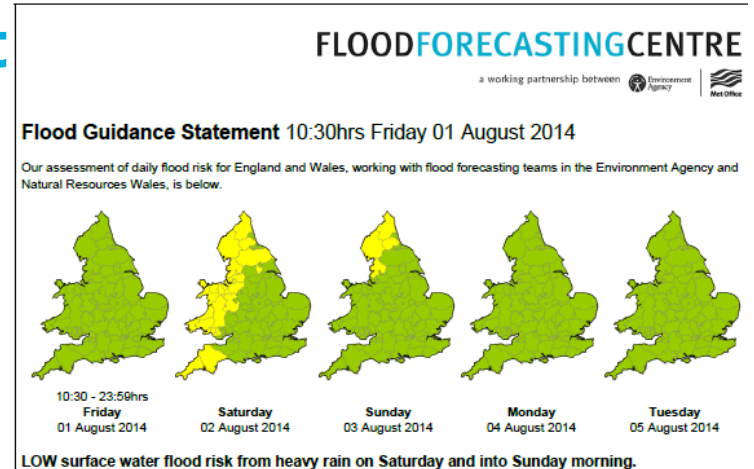


Flood Guidance Statement

- ➡ Daily assessment of flood risk from all sources for next 5 days
- ➡ County and Unitary Authorities
- ➡ Flood risk determined by FFC, EA local teams and MO meteorologists

Overall Flood Risk

HIGH	
MEDIUM	
LOW	
VERY LOW	

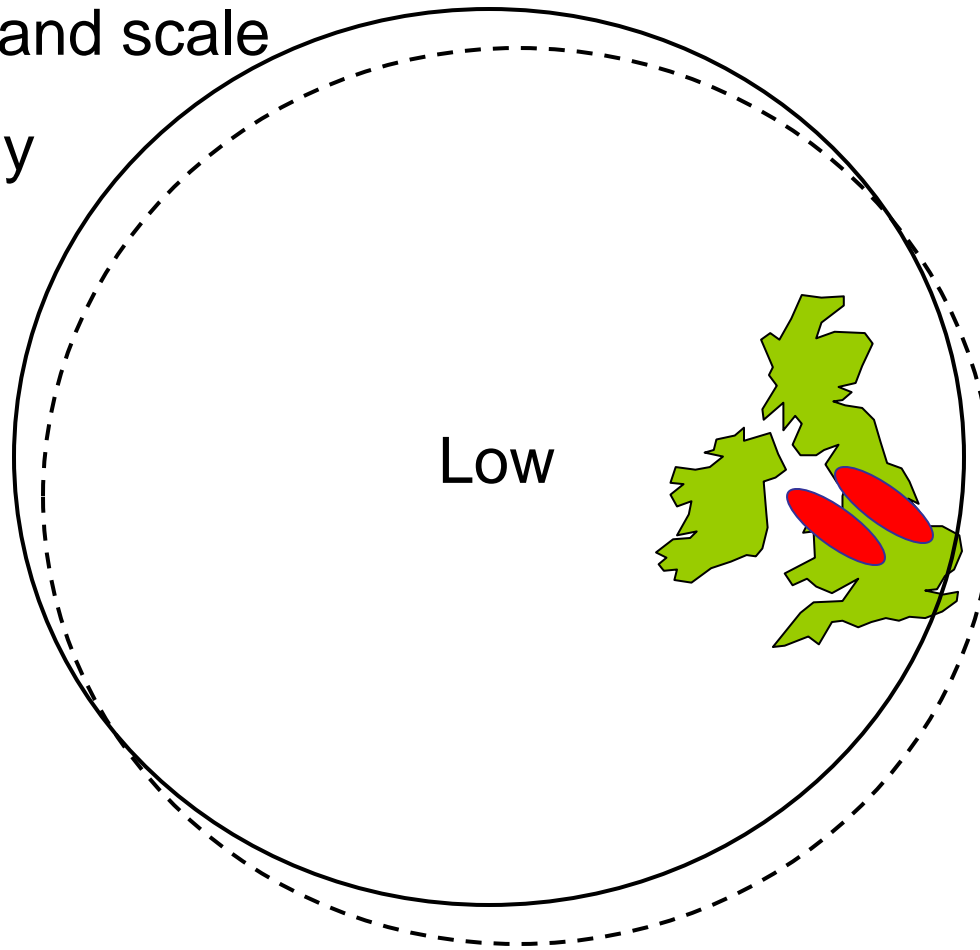




FFC Role

Take an FFC Tour for further information!

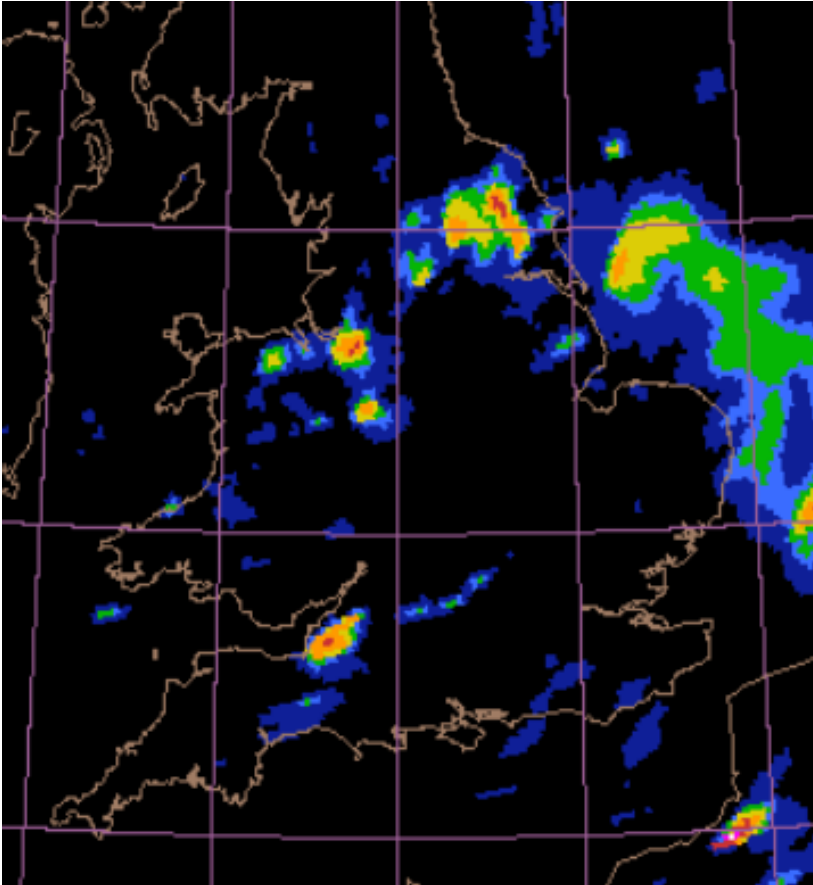
Predictability and scale
in meteorology



5% error over 1000 km = 100% error over 50 km



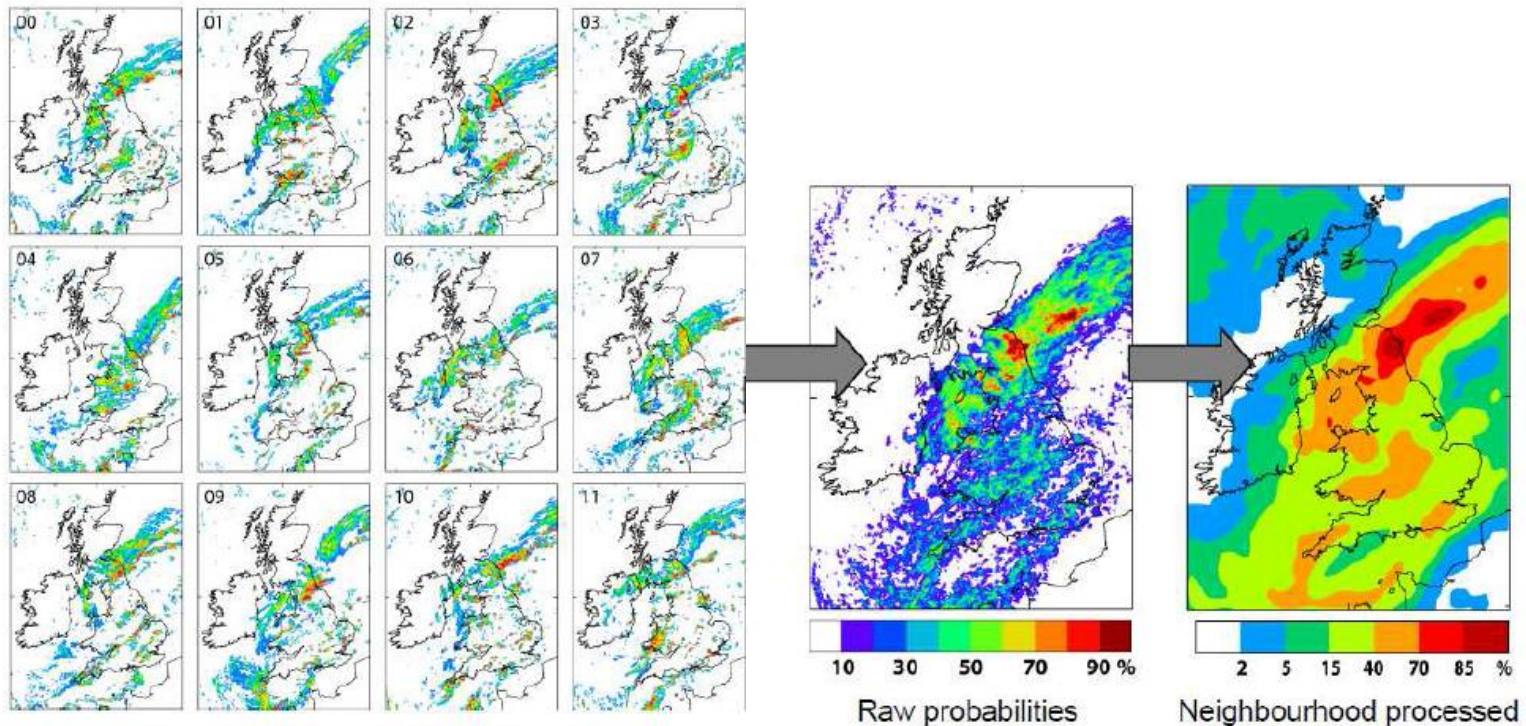
Probability Forecasts - Statistical Processing



In 2009, in order to get a more realistic forecast and a probability value from a 4 km deterministic forecast ‘Neighbourhood Processing’ and ‘Time Lagging’ were used.

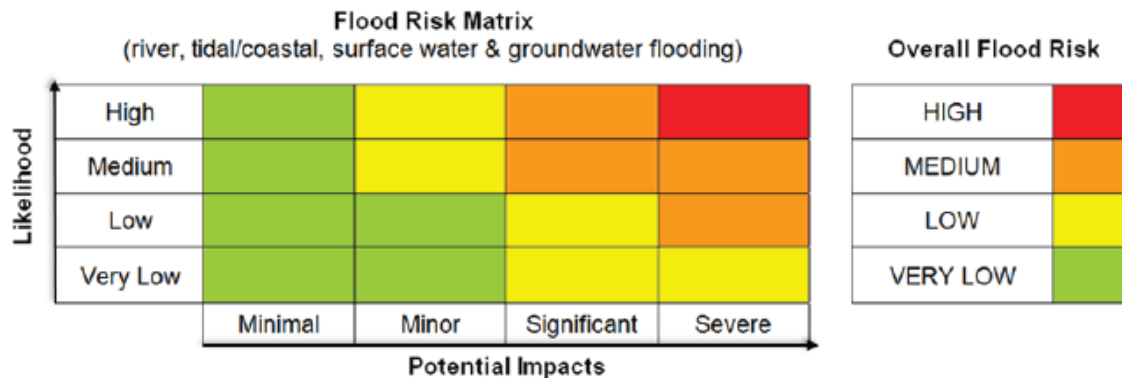
Probability Forecasts - Statistical Processing

Ensemble forecasts – 2.2 km physical modelling
Statistical model post processing
to produce smoothly-varying probabilities.



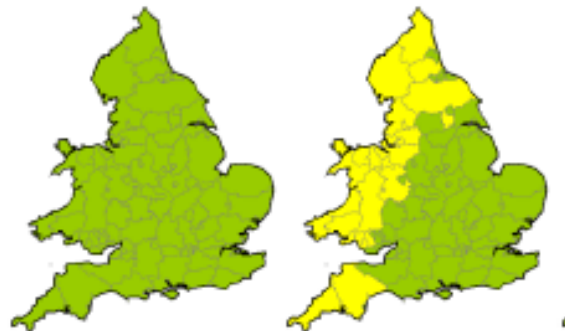
Example of MOGREPS-UK rainfall forecasts

Flood Risk Matrix



Flood Guidance Statement 10:3

Our assessment of daily flood risk for England and Wales, Natural Resources Wales, is below.

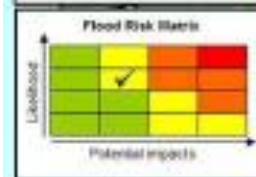


10:30 - 23:59hrs
Friday
01 August 2014

Saturday
02 August 2014

heavy rain moves northwards, the area of risk becomes restricted to north-west England by Sunday (shown in the hashed area), clearing away during the morning. This brings a LOW flood risk overall.

Typical impacts may include localised flooding of land and roads and perhaps flooding affecting individual properties. Localised and minor travel disruption will also be possible.



lay 3 August 2014



1st Generation - ERA Forecasting

Initial attempts to forecast SWF risk (2009/10)

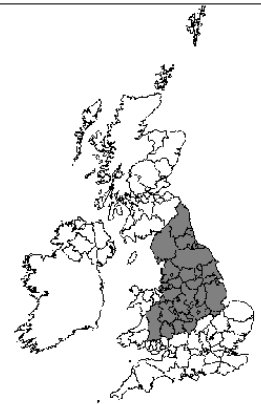
Based solely on forecast probability of 1 in 30 year rainfall depth-duration thresholds (roughly linked to drainage capacity in built-up areas)

The Extreme Rainfall Alerting (ERA) forecast service took no account of potential impacts or antecedent conditions

Extreme Rainfall Alert

An alert for the following regions:

- Blackburn with Darwen
- Blackpool
- Cheshire
- Cumbria
- Darlington
- Derby
- Derbyshire
- Durham
- E. Riding of Yorkshire
- Gtr Manchester
- Hallam
- Hatfield
- Herefordshire
- Kingston upon Hull
- Lancashire
- Leicester
- Leicestershire
- Lincolnshire
- Merseyside
- Middlesbrough
- N. Lincolnshire
- N. Yorkshire
- NE. Lincolnshire
- Northumberland
- Nottingham
- Nottinghamshire
- Peterborough
- Powys
- Redcar and Cleveland
- Rutland
- S. Yorkshire
- Shropshire
- Staffordshire
- Stockton-on-Tees
- Stoke-on-Trent
- Telford and Wrekin
- Tyne and Wear
- W. Midlands
- W. Yorkshire
- Warrington
- Warwickshire
- Worcestershire
- Wrexham
- York



Issued by the Flood Forecasting Centre at 12:03 on Friday, 15 February 2013
ERA reference number: 183

Extreme Rainfall Alert

Start of event: 12:00 on Thursday, 28 June 2012
End of event: 21:00 on Thursday, 28 June 2012

There is a 40% probability of rainfall amounts exceeding 50 millimetres in 6 hours
Event total accumulations of 70 millimetres are possible

**In some areas within those highlighted
extreme rainfall may lead to surface water flooding
Consider activating your emergency procedures**

All times are local

For enquiries regarding this alert please contact the Flood Forecasting Centre
Phone: 0300 123 4501 Email: FF.Enquiries@environment-agency.gov.uk
Visit www.metoffice.gov.uk for the National Severe Weather Warning Service
Visit www.environment-agency.gov.uk for river and sea flood warnings
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2nd Generation – SWFDST

Spreadsheet tool designed by Halcrow (now CH2M Hill) with the FFC in 2011 using data from previous SWF events, combining: UK4 FGERA data, meteorological hazard parameter (based on type of convective event) and an impact potential/urbanisation percentage.

	B	C	D	E	F	G	P	Q	R	S	T	U
1												
2												
3	Surface Water Decision Support Tool											
4												
5												
6												
7					Meteorological Hazard	Prob. Excd. 3Hr3d	Prob. Excd. 6Hr3d					
8	ID	County / Unitary Authority	Blue Square (%)	Blue Sq. Category	Weight Data	0.25 Score	Weight Data	0.375 Score	Weight Data	0.375 Score	Total weighted score	Risk Category
9												
10												
61	50	Kingston upon Hull	7.36	1	no rainfall	0	0	0	0	0	0.00	Very Low
62	51	E Riding of Yorkshire	2.20	1	no rainfall	0	0	0	0	0	0.00	Very Low
63	52	NE Lincolnshire	3.93	1	no rainfall	0	0	0	0	0	0.00	Very Low
64	53	N Lincolnshire	3.31	1	no rainfall	0	0	0	0	0	0.00	Very Low
65	54	York	2.21	1	no rainfall	0	0	0	0	0	0.00	Very Low
66	55	Derby	34.60	2	no rainfall	0	0	0	0	0	0.00	Very Low
67	56	Leicester	53.18	3	no rainfall	0	0	0	0	0	0.00	Very Low
68	57	Rutland	1.52	1	no rainfall	0	0	0	0	0	0.00	Very Low
69	58	Nottingham	36.19	2	no rainfall	0	0	0	0	0	0.00	Very Low
70	59	Herefordshire	12.96	1	no rainfall	0	0	0	0	0	0.00	Very Low
71	60	Telford and Wrekin	8.61	1	no rainfall	0	0	0	0	0	0.00	Very Low
72	61	Stoke-on-Trent	26.75	2	no rainfall	0	0	0	0	0	0.00	Very Low
73	62	Bath and NE Somerset	9.97	1	no rainfall	0	0	0	0	0	0.00	Very Low
74	63	Bristol	29.74	2	no rainfall	0	0	0	0	0	0.00	Very Low
75	64	N Somerset	5.63	1	no rainfall	0	0	0	0	0	0.00	Very Low
76	65	S Gloucestershire	5.96	1	no rainfall	0	0	0	0	0	0.00	Very Low
77	66	Plymouth	26.07	2	no rainfall	0	0	0	0	0	0.00	Very Low
78	67	Torbay	19.31	1	no rainfall	0	0	0	0	0	0.00	Very Low
79	68	Bournemouth	42.40	3	no rainfall	0	0	0	0	0	0.00	Very Low
80	69	Poole	21.41	2	no rainfall	0	0	0	0	0	0.00	Very Low

SWF Forecasting

SWFDST Upgrades

Winter 2011/12

Recalibrated with summer 2011 rainfall and impact data.

Winter 2012/13

Re-calibrated to use UKV data.
Added new SMD parameter.


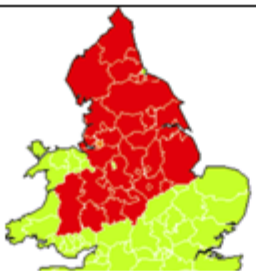
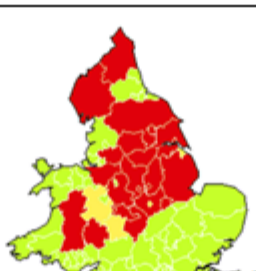
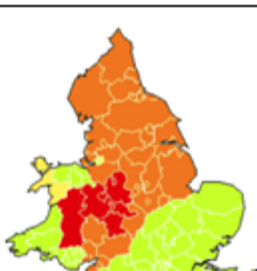
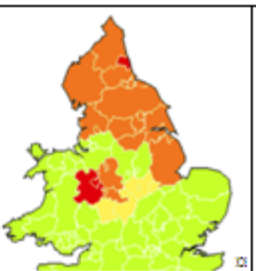
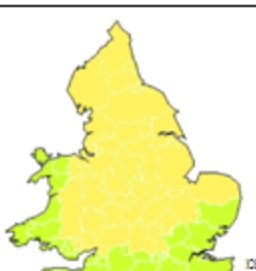


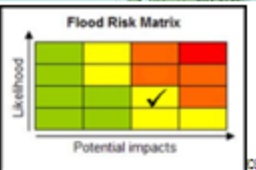
Changed to highest value (from 1, 3 and 6 hours) of 1 in 10 and also 1 in 30 year rainfall probability maxima.



Winter 2013/14

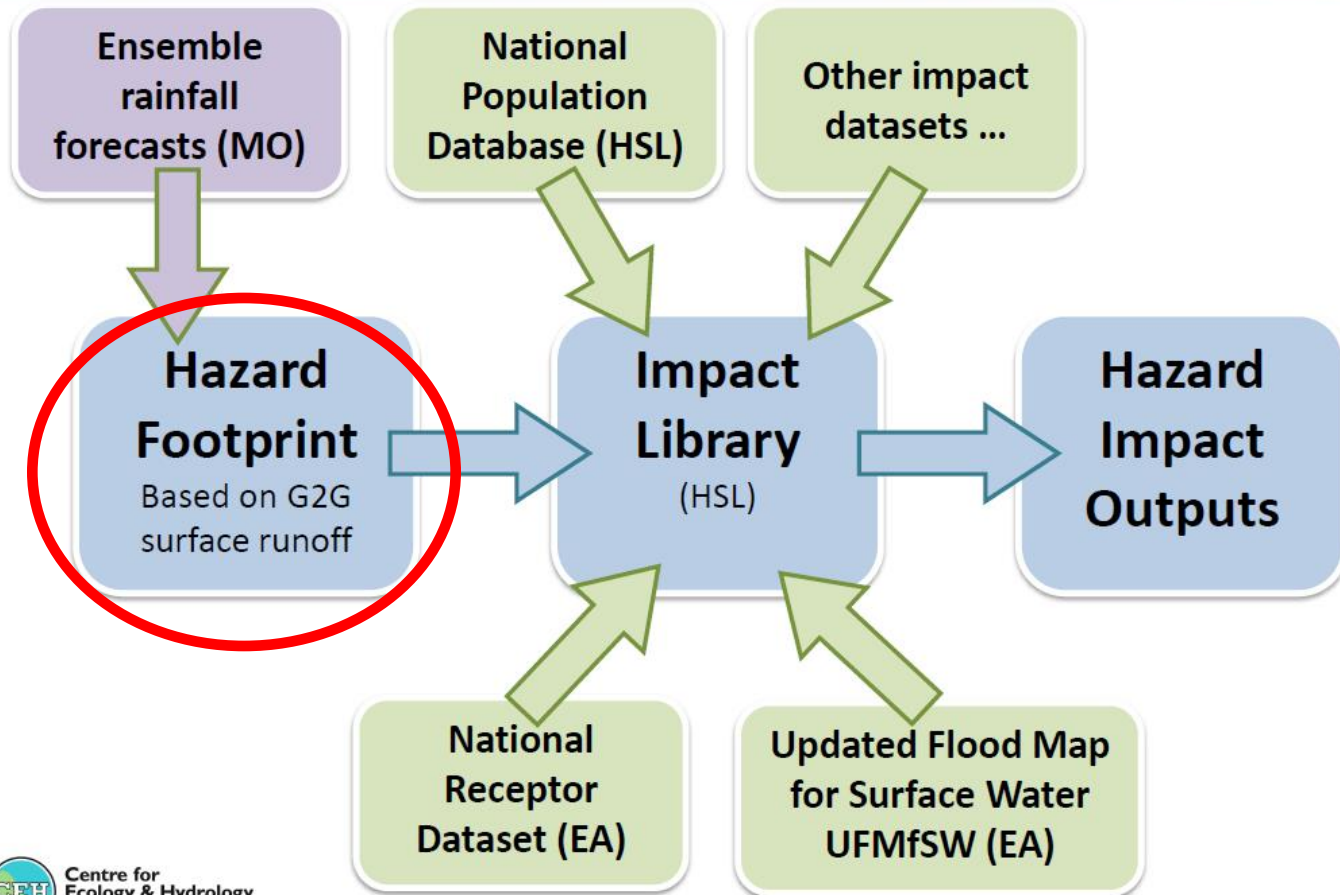
Upgraded to use MOGREPS-UK rainfall probability values

Case Study Results Comparisons

28-June-2012					
					
<p>ERA</p> <p>40%-Probability-of-50mm/6-hours</p> <p>Extreme Rainfall Alert</p> <p>FLOODFORECASTINGCENTRE</p>  <p>For enquiries regarding this alert please contact the Flood Forecasting Centre Phone: 0300 123 4567 E-mail: FFCC@environment-agency.gov.uk Visit: www.environment-agency.gov.uk For the National Citizen Weather Forecasting Service Visit: www.environment-agency.gov.uk For more and see flood warnings © Crown copyright Met Office</p>	<p>Initial-UK4-SWFDST</p> <p>Few-calibration-events</p>	<p>Updated-UK4-SWFDST</p> <p>More-calibration-events-from-summer-2011</p>	<p>UKV-SWFDST</p> <p>Input-data-changed</p> <p>Few-calibration-events</p>	<p>Actual-Impacts</p> <p>That-we-know-about-and-assuming-a-high-likelihood</p> <p>Sometimes-difficult-to-know-what-actually-happened</p>	<p>FGS-issued</p>  <p>Flood Risk Matrix</p> 

3rd Generation SWFDST – Hazard Impact Model

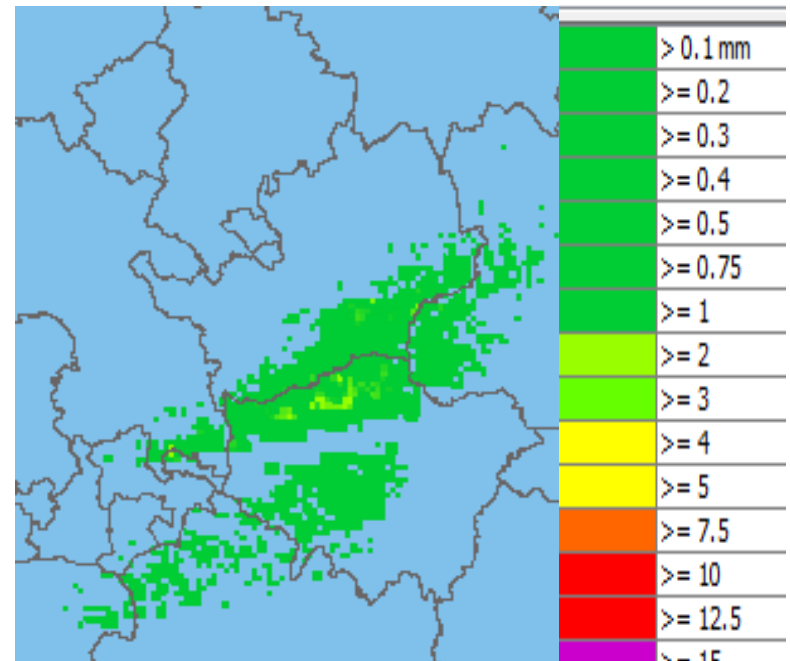
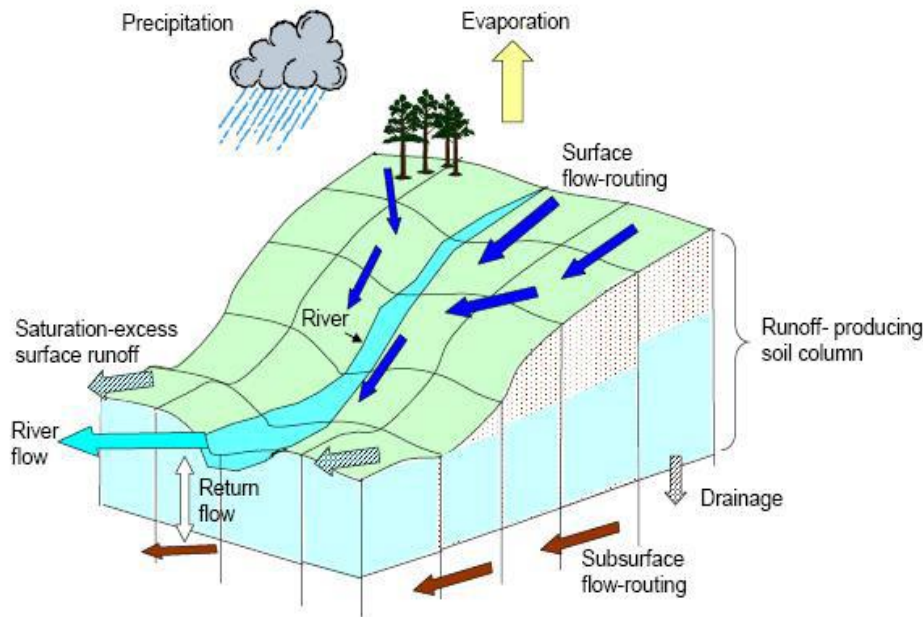
NHP SWF HIM approach



Future Developments

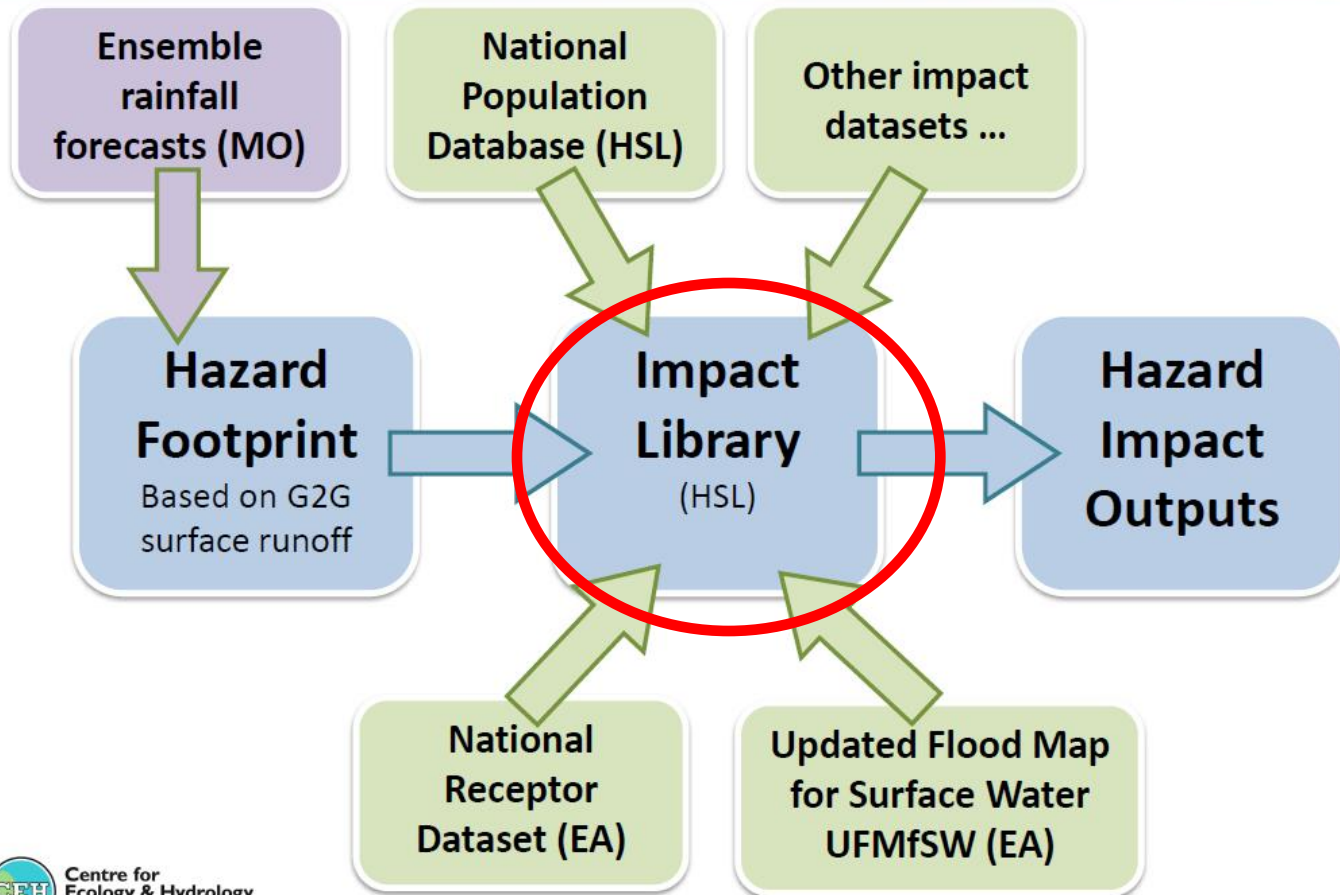
Hazard Modelling

- Hazard footprint defined using G2G (1km) surface runoff.
- G2G represents hydrological processes for a grid square (evaporation, infiltration, surface and sub-surface run-off generation)



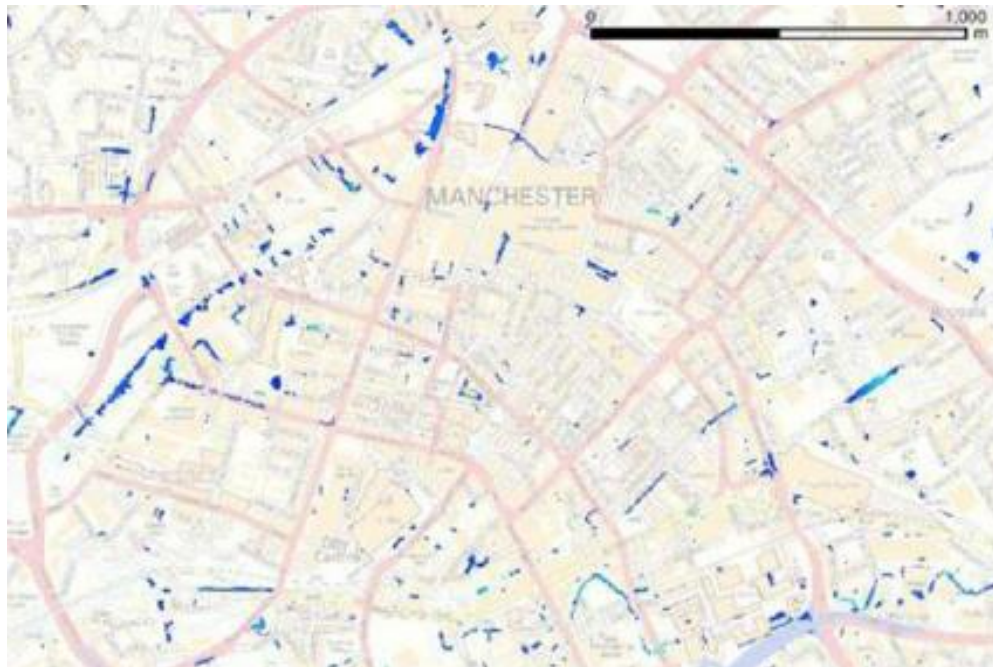
3rd Generation SWFDST – Hazard Impact Model

NHP SWF HIM approach



Impact Modelling

EA Updated Flood Map for Surface Water identifies areas expected to experience SWF from 9 idealised storms of: 1 in 30, 1 in 100 and 1 in 1000 year return periods and of 1, 3 or 6 hour durations, on a 2m grid across England and Wales.



Future Developments

Impact Modelling

Impacts are being calculated for each of the 3 hour storms from national database information. This will produce an **impact library** giving impact summary scores by type:

Criteria	Impact Statistic (per 1km cell)
Danger to Life	Count of people at risk
Potential Damage to Buildings	Count of residential properties at risk of being flooded Count of non-residential properties at risk of being flooded
Disruption of key sites/infrastructure	Count of key sites at risk of being flooded Count of infrastructure locations potentially inaccessible due to flood danger
Disruption of transport	Length of trunk road network affected by flooding Length of non-trunk A/B road network affected by flooding Length of railway network affected by flooding
Disruption of communities	Count of residential properties at risk of being flooded (redundant – captured within potential damage to buildings)

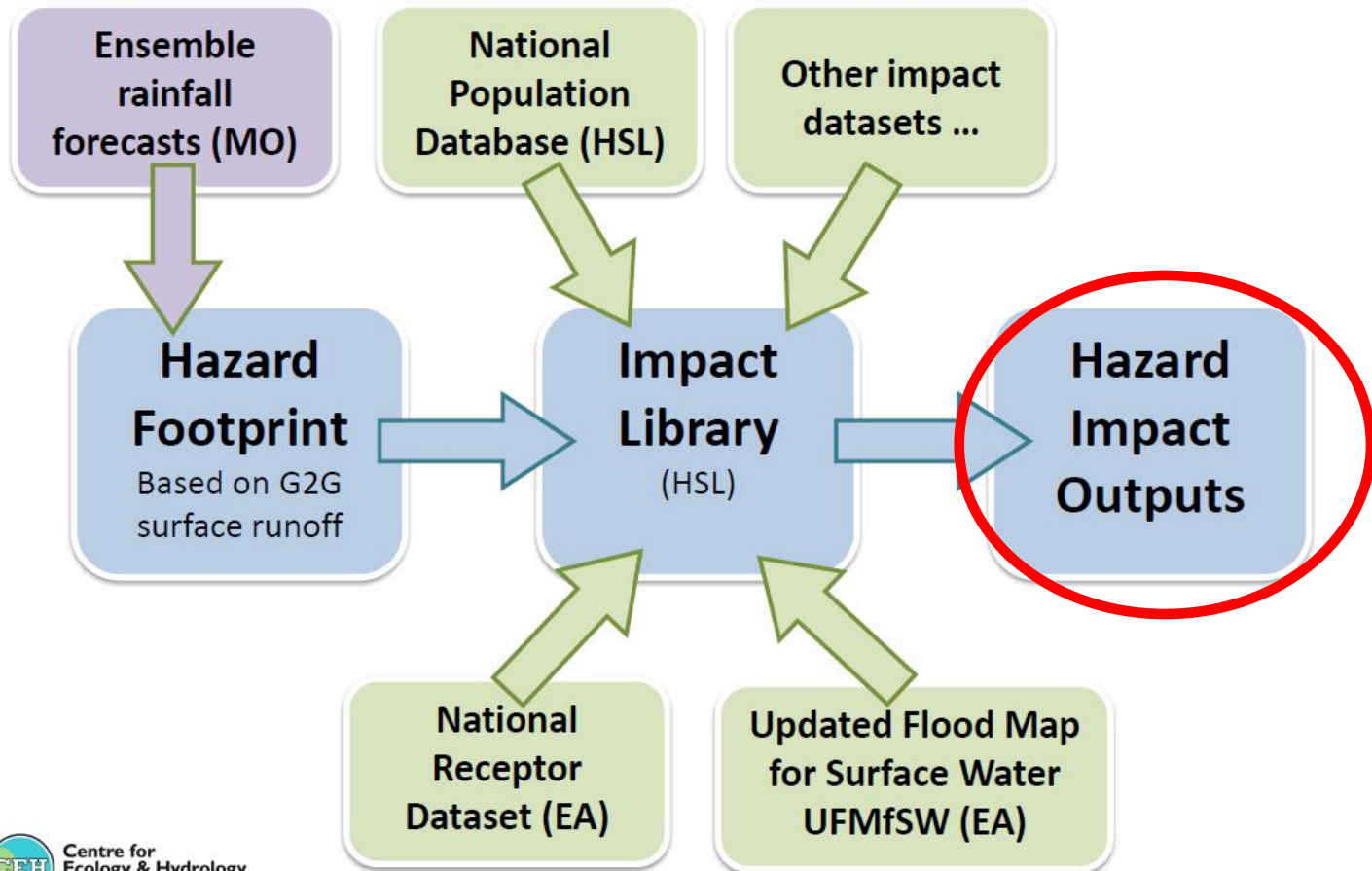
for the 3 return period scenarios on a 1 km grid for England and Wales. Classified from Minimal (1) to Severe (4).

Impact Modelling

Example impact output at 1km squares.

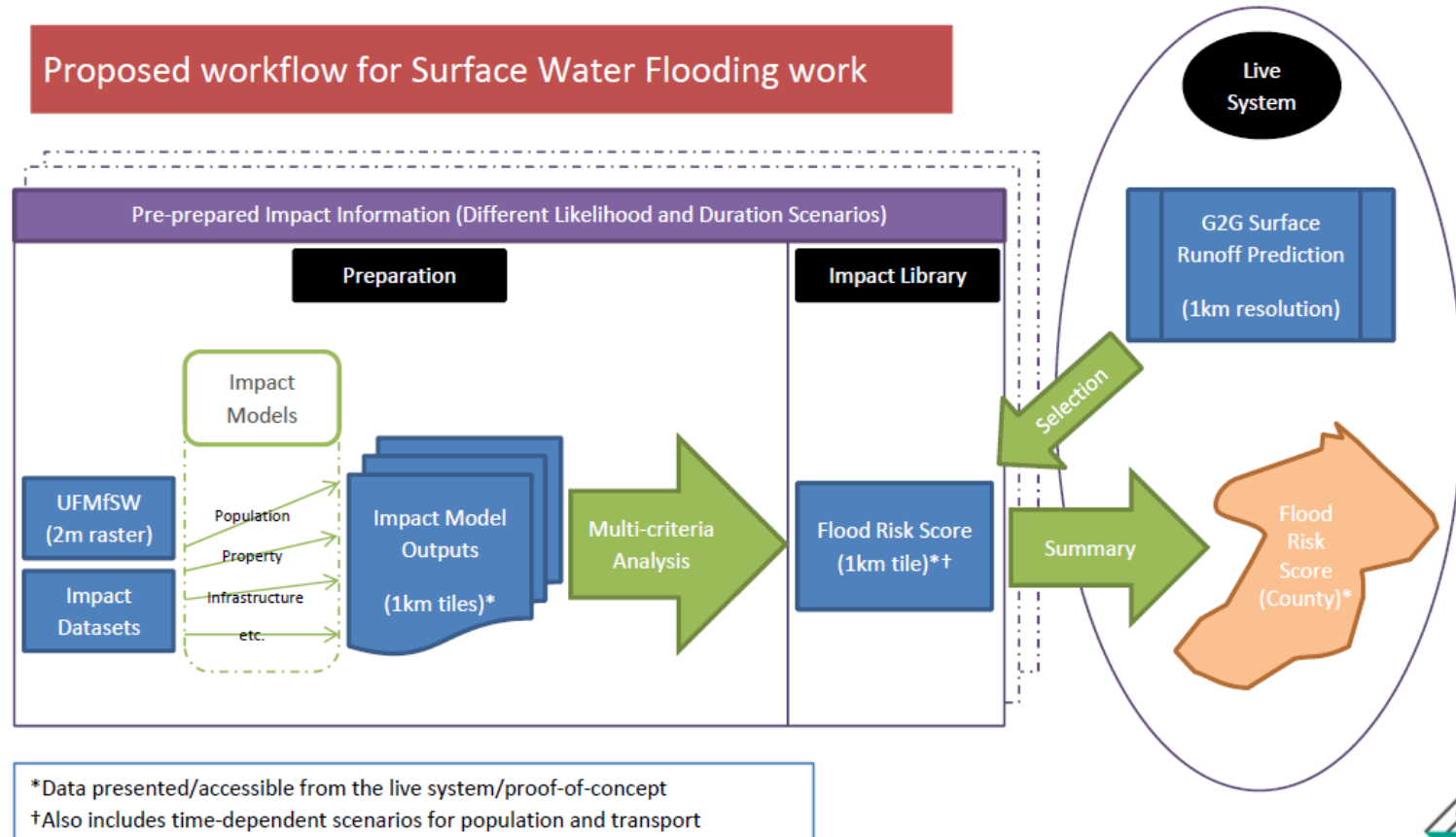
3rd Generation SWFDST – Hazard Impact Model

NHP SWF HIM approach



Future Developments

3rd Generation SWFDST – Hazard Impact Model



3rd Generation SWFDST – Hazard Impact Model

This procedure is undertaken for each ensemble member to produce an ensemble of impacts by county.

The likelihood of each impact category is then calculated to produce a surface water flood risk forecast aligned to the FGS matrix.

Impact	Maximum impact level				Overall
	Minimal	Minor	Significant	Severe	
No of ensembles	6	8	8	2	24
Likelihood (%)	24/24 x 100%= 100%	18/24 x 100% = 75%	10/24 x 100% = 41.7%	2/24 x 100% = 8.3%	
Likelihood	High	High	Medium	Very low	
Risk	Very low	Low	Medium	Low	



Managing Expectations



- ➡ Level of detail
- ➡ Understanding outputs
- ➡ Expert advice

A high-speed photograph of water splashing on a dark, wet surface, creating a dynamic and energetic background. The water droplets are frozen in time, showing the intricate patterns of the splash. The text "Thank You" is overlaid in a bold, blue font.

Thank You

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