

[Name withheld]  
via email

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Our Ref: RLTD 20/01/42 & EIR 7358

8<sup>th</sup> March 2011

Dear [name withheld],

### **EIR Request: Winter Resilience Review & Met Office**

I am writing to confirm that the Department has now completed its search for the information which you requested on 7<sup>th</sup> February 2011. Your request has been considered under the Environmental Information Regulations 2004.

You requested all emails and minutes or notes of meetings between the Winter Resilience Review ("the Review") and the Met Office in which the following matters were discussed:

- *What is meant by "a severe winter" when the Met Office experts were analysing the probability of such an event.*
- *The probability of severe winters and the calculation of their probability.*
- *The validity of making the assumption that severe winters are statistically independent.*

The following information has already been released and is available on the Review's website (<http://transportwinterresilience.independent.gov.uk/>).

- Initial evidence provided to the Review by the Met Office on 9<sup>th</sup> June 2010;
- Note of meeting held between the Review and the Met Office on 10<sup>th</sup> June 2010;
- Supplementary evidence provided to the Review by the Met Office on 18<sup>th</sup> June 2010.

The following information can be released under the EIR:

- A further meeting was held between the Review and the Met Office & Hadley Centre on 13<sup>th</sup> July 2010. This followed up the previous meeting of 10<sup>th</sup> June to and discussed the Review's emerging thinking on weather issues. The note of this meeting is attached at annex B of this letter.
- On the 16<sup>th</sup> July the Review requested comments from the Met Office on the draft chapter 'Weather forecasting and climate change' that was included in the Review's Interim Report. The Met Office responded on 21<sup>st</sup> July. The text of the

emails, and tracked changes suggested by the Met Office, are provided in Annex C to this letter.

I note that this information has already been released to you by the Met Office.

- Text of emails between the Winter Resilience Review and the Met Office are provided in Annex D.

No further information is held by the Department on the matters raised in your request.

In keeping with the spirit and effect of the Environmental Information Regulations 2004, all information is assumed to be releasable to the public unless exempt. The Department will, therefore, be simultaneously releasing to the public this information.

If you have any queries about this letter, please contact me. Please remember to quote the reference number above in any future communications.

Please see attached at Annex A details of DfT's complaints procedure and your right to complain to the Information Commissioner.

Yours sincerely,

***[name withheld]***

## **Your right to complain to the Department and the Information Commissioner**

You have the right to complain within 40 working days of the date of this letter about the way in which your request for information was handled and/or about the decision not to disclose all or part of the information requested. In addition a complaint can be made that DfT has not complied with its publication scheme. Any complaint should be made by writing to the Department's Information Rights Unit at:

Zone D/04  
Ashdown House  
Sedlescombe Road North  
Hastings  
East Sussex TN37 7GA  
E-mail: [FOI-Advice-Team-DFT@dft.gsi.gov.uk](mailto:FOI-Advice-Team-DFT@dft.gsi.gov.uk)

Your complaint will be acknowledged and you will be advised of a target date by which to expect a response. Initially your complaint will be re-considered by the official who dealt with your request for information. If, after careful consideration, that official decides that his/her decision was correct, your complaint will automatically be referred to a senior independent official who will conduct a further review. You will be advised of the outcome of your complaint and if a decision is taken to disclose information originally withheld this will be done as soon as possible.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at:

Information Commissioner's Office  
Wycliffe House  
Water Lane  
Wilmslow  
Cheshire  
SK9 5AF

**Winter Resilience Review Hearing: 11:00, Room 1/28a, 1st Floor, Great Minster House, 13<sup>th</sup> July 2010.**

Attending:	David Quarmby, CBE	Winter Resilience Review (WRR)
	Brian Smith	WRR
	Chris Green	WRR
	Phil Evans	Met Office (MO)
	Derrick Ryall	MO
	Chris Watts	WRR
	Lloyd Miles	WRR

**Met Office**

1. The meeting was convened to enable the Winter Review Panel to further consider the issues of severe winter weather following an initial meeting with the Met Office on 10<sup>th</sup> June 2010. The meeting discussed some of the long term implications for resources of changing weather patterns, and the issue of severe winter clustering.
2. A fundamental issue was the change in climate, with an increase in temperature but variations at local levels which was leading to extreme events. The next few decades would see rising temperatures, but with natural variations over days, weeks, months and up to decades. Weather patterns such as El Nino and the Pacific oscillations can cause lots of fluctuations in global weather, but key for the UK was the North Atlantic Oscillation which can have a range of natural variations over a period of years.
3. The main issue was understanding the connections between all the various weather systems. The Met Office believes that individual years are largely independent, but oscillations can be longer and can stay in place for several years. The Met Office then explained how last winter had become so severe, and the emerging pattern for next winter.
4. The Met Office were placing increasing emphasis on medium – term forecasts, which bridged the gap between weather and climate, but these were extremely difficult and had only been undertaken since 2005 for the 3 – 6 month range. A key issue was how these forecasts were communicated, and ensuring that they added value.
5. The meeting then discussed the issue of whether there would be more extreme events, the trend of recent mild winters and whether the level of snow precipitation would increase. The higher level of energy and moisture in the atmosphere could lead to more extreme events, but the level of snow was very difficult to predict, though there was some evidence to suggest the volume of snow would rise.
6. The Met Office advised that there could be fewer severe winters as global temperatures rise during this century, but over the 20 – 30 year timeframe they

will still occur. Evidence suggested that severe winters could be more extreme, and certainly no less extreme, but other events could still combine for a series of mild winters. One – off events, e.g. volcanoes, can also have an impact.

**Winter Resilience Review Team**  
**March 2011**

**Email from Winter Resilience Review to Met Office, 16<sup>th</sup> July 2010**

**Subject: Winter Resilience Review: text on weather and climate**

*Thanks for your and [name withheld] helpful evidence earlier in the week. Please find attached draft text from David Quarmby on weather and climate.*

*Could we please have your and [name withheld] views on the accuracy and terminology in this?*

**Email from Met Office to Winter Resilience Review, 21<sup>st</sup> July 2010**

**Subject: RE: Temperature charts**

*I've attached your extract with tracked changes. The relevant experts have made some changes on the climate statements. This does change the rationale for the second recommendation and I've made an amendment there also to reflect this. If you need to talk about this in further detail don't hesitate to call.*

**Weather Forecasting and Climate Change**

The role of weather forecasting services to inform and guide operational decisions about winter service by highway authorities, and decisions by salt producers, is set out in Chapter 2 above. This focusses on the "within day" and up to 5-day forecasts provided by the Met Office and private sector providers (predominately Meteo Group), often at a highly detailed geographical level, and with considerable attention by the providers to the precise information and forecasting needs of the client. These enable highway authorities or their contractors to make good decisions about the deployment of gritting vehicles, and to inform the public and stakeholders about action being taken and what they can expect over the subsequent few days.

Highway authorities and salt producers are generally well satisfied with these services from their weather forecast providers, citing them as accurate enough for their purpose and well-tailored to their needs. Both accuracy and levels of disaggregation have improved considerably in recent years, due both to technology and IT enhancements and to the spur of competition as alternatives to the Met Office as service providers have emerged.

In addition to the short-term 0-5 day forecast, the ideal requirement for winter service planning is also for

- 15-30 days forecast for resource planning, including salt restocking, labour scheduling and the possible deployment of other local authority staff to support winter resilience; and production planning for salt producers
- seasonal (ie up to 6 months ahead) and longer term forecasts to inform policy and strategic planning

Forecasting weather beyond 5 days is more problematical, due to the chaotic nature of the atmosphere and its weather systems and the particular position of the UK and Ireland off the north west coast of continental Europe and subject to the Atlantic weather systems. Forecasts become less skilful and the uncertainty increases the further into the future we go.

The Met Office Public Weather Service (PWS) provides regional forecasts for 5 days and UK outlook forecasts to 30 days that describe the main weather type and trends for the general public. The Met Office also offers a tailored rolling 30 day and seasonal forecast to organisations with operational and planning needs.

However, this is the period for which the word 'forecast' starts to mean something different: in common parlance, a forecast is a prediction that X or Y will happen – that the temperature will be - 2°C, or that there will be up to 15cms of snowfall.

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Beyond 5 days, we have to recognise that the techniques forecast risk rather than definitive events and are therefore expressed as probabilities – for example, that there is a 30% chance of snowfall, or a 60% chance of freezing temperatures<sup>1</sup>. We know that the general public – and the media they consume – can find the concept of probabilities difficult to handle or comprehend. But probabilistic predictions can be valuable to business and public organisations, as a basis for resourcing and planning decisions.

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The science of forecasting up to 30 days ahead and beyond has made great progress in recent years and will continue to develop; comparison of outturns against probabilistic predictions out to 30 days suggests that the information is of increasing value for winter service resourcing and planning.

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The Met Office has ceased publishing seasonal forecasts through the PWS, because – again – the nature of the weather and climate means that at these timescales it only makes sense to give probabilistic predictions rather than definitive forecasts, and this has proved difficult to communicate.

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Yet, as this Review makes clear, critical policy and strategic decisions would be enormously enhanced by even a probabilistic prediction about next winter's weather. Forecasting over this timescale and beyond takes us into the area of climate forecasting and the impact of climate change.

<sup>1</sup> "Ensemble" forecasting is the term used by weather forecasters for a technique which generates a large number of (say 50) predictions of future weather, using a carefully modelled set of slightly different starting points – reflecting that one of the uncertainties is an exact knowledge of weather detail at the current moment.

We have explored these issues in some depth with the climate research team at the Met Office Hadley Centre. The starting point is the slow but steady rise in average global temperatures. The consensus on the UK is that *on average* summers will become warmer, and winters will become warmer and wetter, though the next 10-15 years may be dominated by natural variability. When severe weather events happen they may be more extreme in terms of heat and rainfall.

Although the probability of severely cold winters in the UK is gradually declining, there is currently no evidence to suggest similar changes in extremes of snow, winds and storms in the UK.

We have also explored whether or not the occurrence of two successive severe winters influences the probability of a third in succession – in other words, is there any evidence of clustering?

There is some small influence from year to year, but these matters are still very uncertain and it would be safer to assume that there is statistical independence between one winter and the next.

In other words, we are advised to assume that the chance of a severe winter in 2010-11 is no greater (or less) than the current general probability of 1 in 20.

For the purpose of this report, the following summarises what we understand

- The probability of the next winter being severe is virtually unrelated to the fact of just having experienced two severe winters, and is still about 1 in 20
- The effect of climate change is to gradually but steadily reduce the probability of severe winters in the UK
- However, when severe winters come, they could still be extreme in terms of snowfall, wind and storms, though not necessarily in relation to temperature.

An important consequence of the declining occurrence of severe winters is the loss of knowledge and experience among planning and technical staff in local highway authorities, especially if the severe winters which do occur are more intensive.

All this, in our view, reinforces the need for comprehensive resilience planning, and for ensuring that the salt supply chain is resilient.

But we need to understand and accept that the chance of a severe winter is still relatively small and that there will be many years when some will question the degree of resources committed to winter resilience.

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extremes of rainfall, snow, wind and storms, and of heat – all of which have been manifest in the last decade.

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## RECOMMENDATION XX

We note and commend the generally high quality and accuracy of short term (0-5 days) weather forecasting now available to support the operational decisions of highway authorities and their contractors, and recommend that the weather forecasters continue to develop their capabilities both for 15-30 day forecasting to meet the resource planning needs of highway authorities, and for longer term seasonal forecasting

## RECOMMENDATION XX

Given that the probability of next winter being severe continues to be relatively small but that severe winters are still possible despite the warming trend, we recommend that winter resilience planning – and the securing of greater resilience in the supply of salt - should continue on the basis of dealing with winters of a severity similar to that of 2009-2010.

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**Email from Met Office to Winter Resilience Review, 11<sup>th</sup> June 2010**

**Subject: Supplementary information**

*The panel asked on Thursday for some supplementary information to be sent through regarding our services across the transport sector, their costs and climate predictions. I'll provide a full update to you on Monday but in the meantime you and the panel members may be interested in the following link to the UKCP09 Briefing report. It has a very useful summary at the beginning.*

[http://ukclimateprojections.defra.gov.uk/images/stories/briefing\\_pdfs/UKCP09\\_Briefing.pdf](http://ukclimateprojections.defra.gov.uk/images/stories/briefing_pdfs/UKCP09_Briefing.pdf)

**Email from Winter Resilience Review to Met Office, 17<sup>th</sup> June 2010**

**Subject: RE: Supplementary information**

*On the topic of climate predictions, David Quarmby wishes to have your advice on whether (or not) the probabilities of severe/mild winters are statistically independent. He has seen evidence suggesting the “clustering” of subsequent severe and mild winters annually (ie a series of mild winters followed by a succession of severe winters). The Met Office response at the hearing was that each winter is statistically independent (ie there's no such relationship) and that you would provide some further evidence to support that view.*

*Any further light you can shed on this issue would be particularly helpful.*

**Email from Met Office to Winter Resilience Review, 18<sup>th</sup> June 2010**

**Subject: RE: Supplementary information**

*I think the evidence of clustering you refer to [below] may relate to the potential impacts of the build up of wide-scale regimes (such as El Nino etc), which is a different issue than that of return periods and statistically independent occurrences and we will follow up on this as soon possible.*

**Email from Winter Resilience Review to Met Office, 3<sup>rd</sup> August 2010**

**Subject: Winter Resilience Review – query re winter weather patterns**

*Our Panel Chair David Quarmby has asked me to contact you with a further query on the issue of winter weather. The question is a follow up from his earlier query regarding the statistical independence of mild and severe winters each year.*

[Questions as below]

**Email from the Met Office to the Winter Resilience Review, 12<sup>th</sup> August 2010**

**Subject: RE: Winter Resilience Review – query re winter weather patterns**

*The statistical probability of past severe winters could be calculated directly from observations of past climate, although of course this would not indicate the probability of future severe winters in a changing climate. However, understanding and quantifying the causes of severe winters would require more detailed specific research in slower time. Perhaps you could let me know if there is any further time available and if this is something you would be interested in.*

**1. What is the statistical probability of severe winter weather occurring in January or February if the preceding December is severe? Is there any correlation between weather patterns in the winter months (i.e. if one winter month is severe, does that influence the severity of the following winter month)?**

*Severe winter weather in the UK is a result of a weakening of the Atlantic Jet Stream which causes more frequent than normal periods of easterly flow from cold continental regions such as Siberia.*

*There is some relationship between successive winter months. There are known mechanisms by which the weather in one month is related to the weather in the next.*

*For example, in recent winters a breakdown of the high altitude jet stream has been a precursor to prolonged severe weather over the UK. Another example is the El Nino effect in the tropical Pacific, which Met office scientists have demonstrated can force colder winter conditions over northern Europe.*

*Predictions months to a season ahead have lower skill than day to day weather forecasts, but have demonstrated some skill nevertheless. We use our knowledge of the processes described above to complement operational forecasts and continue to build improved seasonal forecast systems.*

**2. Are there key stages in the winter season when the bracket of possibilities tend to narrow to give a greater indication of the weather for January and February?**

*Weather forecasts attempt to quantify what the weather will be on a particular day at a particular place, and are normally confined to a few days ahead. A climate prediction looks at what the climate might be over a longer period ahead and looks at say the probability of a particular month being wetter or drier, or warmer or colder than average. It does not attempt to quantify exactly how much rainfall there will be or what the temperature will be.*

*The closer we get to January/February, the better is our knowledge of what the climate for January/February is likely to be (in much the same way as day to day weather forecasts tend to be better for shorter lead times). With a climate prediction for 1 or 2 months ahead this does not necessarily narrow the range of possibilities as the uncertainties may grow quite quickly. There are key indicators however that may help us to narrow the range, for example a sudden stratospheric warming is known to lead to jet stream changes, and the latter is known to affect winter severity (as explained above).*