WeatherNet Limited

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WeatherNet
Experts in Weather

LEGAL WEATHER REPORT
CLIENT: XXXXX
LOCATION: Middlesmoor (HG3 5ST)
DATE: 22nd July 2017

METEOROLOGICAL REPORT PREPARED BY

Dr Richard J. Wild
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LEGAL METEOROLOGICAL [illegible] PREPARED FOR AND INSTRUCTED BY

[illegible]XXXX XXXXXX
[illegible]X XXXX
XX X[illegible]XX XXXXX
[illegible]XXXXXXXX XXXXX
XXX XXX

Telephone: XXXXX XXXXXX
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Mobile: XXXXX XXXXXX
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Website: XXX.XXX.XXX
Your Reference: XXXXXX

Slipping incident at Middlesmoor (HG3 5ST) on 22nd July 2017
My Reference: XXXX (XX)
Date: 1st November 2017
“Bond Solon trained in the aspects of report writing and the Jackson Reforms”

Legal Report Front Cover

Meteorological Report of: Dr Richard Wild, WeatherNet Ltd
Specialist field: Forensic Meteorology
On behalf of: XXXXXXX XXXXXX (Client: XXXXX)

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METEOROLOGICAL REPORT FOR POSTCODE AREA HG3 5ST (MIDDLESMOOR) FOR THE 22ND JULY 2017 (CLIENT: XXXXX)

1. Introduction

1.01 The writer

I am Dr Richard John Wild. I am the Weather Services Commercial Manager and Forensic/Senior Meteorologist at WeatherNet Ltd. My specialist field is in forensic meteorology. My qualifications include a BSc (Hons) in Geography (2:1) (obtained June 1994) and a PhD investigating the spatial and temporal analysis of heavy snowfalls across Great Britain between the years 1861-1999 (obtained July 2005). WeatherNet Ltd is a private weather consultant and is solely responsible for the conclusions and opinion expressed in this report. WeatherNet [illegible] an Authorised Data user by agreement with the Meteorological Office, Exeter and its own private meteorological network across the United Kingdom. The meteorological data from the Met Office abides by the standards set by the World Meteorological Organisation, based in Geneva as the instruments at these meteorological stations, as well as the stations themselves are constantly checked for reliability.

1.02 Summary background of the case

I have been asked to provide a detailed meteorological report, giving an expert opinion based on the meteorological facts as to the probable meteorological conditions [illegible] above area on the date and time indicated. This meteorological report complies with civil and criminal procedures and the Jackson reforms. As far as I am aware, I have no connection with any of the parties involved in the incident.

1.03 Report prepared for XXXXXXX XXXXXX

1.04 Your reference XXXXX

1.05 My reference (XXXXX)

1.06 Place of incident Middlesmoor (HG3 5ST)

1.07 Date of incident 22nd July 2017

1.08 Time of incident 10:50 BST (09:50 GMT)

1.09 Summary of my conclusions

With these factors in mind, I conclude, based on my opinion, meteorological facts and data stated in this report that on the balance of probability that the best informed estimate showed that the 22nd July 2017 across the postcode HG3 5ST at the time of the incident was overcast with some moderate rain. The rainfall associated with this event would have resulted in the state of the ground to have been wet with standing water (puddles) to be present from early morning onwards on the 22nd.

Based on the precipitation radar only across the incident area, it appears that the highest hourly value on the 22nd July 2017 was 6.077mm (0801-0900 GMT (0901-1000 BST), while the 22nd as a whole saw 29.104mm. The highest 5 minute rainfall total over the incident day occurred between 0535-0540 GMT (0635-0640 BST) with 2.008mm. Based on the precipitation radar, it appears that rainfall started across the incident area just before midnight on the 21st and continued with only a few brief drier spells until ~1000 GMT (1100 BST). The precipitation that occurred during that morning period varied from light to heavy in intensity. All the hourly values and 5 minute values mentioned here in summary would be defined as heavy and as a rule of thumb the daily amount of precipitation that fell across the incident area would also be defined as heavy.

Based on the three nearest three weather stations that were operating (Pateley [illegible] Ravens Nest, Bainbridge and Leeming) close to the incident area, it appears that Pateley Bridge saw the highest daily precipitation amount of 45.2mm on the 22nd July, while the highest 4[illegible] precipitation total (21-22nd) was also 45.2mm from the same station. It appear[illegible] the high[illegible] value on the 22nd July 2017 was 16.6mm (0700-0800 GMT & 0800-0900 G[illegible]00-09[illegible] & 0900-1000 BST)) from Pateley Bridge, Ravens Nest. This amount of precipita[illegible]lling in 1 hour would be defined as heavy (precipitation amounts >=4mm per hour).

With reference to the sliding/fixed rainfall return perio[illegible] the postcode HG3 5ST (see Section 7 of the appendices); the precipitation data a[illegible]nts fro[illegible] rainfall radar show that a rainfall total of 6.077mm falling in 1 hour shows [illegible] perio[illegible] of less than twice a year, while 29.104mm falling in 24 hours; shows a return [illegible] less than twice a year. With respect to 29.934mm of precipitation falling ov[illegible] 48 hour [illegible]-22nd July), a return period of less than twice a year is also expected. Ra[illegible]ounts tha[illegible]ver a 3, 4 and 6 hourly periods just before the incident however sho[illegible]ed a [illegible] period o[illegible]once a year. Similar return values (~once a year and/or less than [illegible] year) [illegible] shown by the records of the three nearest weather stations close to the in[illegible]iden[illegible]

The only exception to these return v[illegible]of ~on[illegible] a year and/or less than twice a year is the precipitation amounts that fell at Pateley [illegible]. A rainfall total of 16.6mm falling in 1 hour showed a return period of b[illegible] 2-5 yea[illegible] while 33.2mm falling in 2 hours showed a return period of between 10-20 ye[illegible]rs. [illegible]fall total of 38.4mm falling in 3 hours showed a return period of between 10-20 years, w[illegible] 4[illegible]lling in 4 hours also showed a return period of between 10-20 years, w[illegible] finally [illegible]m[illegible] fall[illegible] in 6 hours showed a return period of between 5 and 10 years. All [illegible]ese return values [illegible]ased on these precipitation amounts falling at the incident postcode.

In reality, [illegible] precipi[illegible]ion amounts that occurred at the three nearest weather stations over the time of the incident did [illegible]t actually occur across the incident area itself as much lower rainfall totals occurred based on [illegible] precipitation radar. The rainfall reported at these weather stations may/may not have p[illegible]yed a part in this incident as these rainfall totals may fall into the same catchment area as the incident and/or higher rainfall totals from weather stations upstream of the incident and/or weather stations at higher altitudes receiving higher rainfall amounts than the incident height and cascading to lower elevations. A weather warning for rain was not in force for the incident area at the time of the incident.

It appears overall; even though the hourly/daily precipitation amounts mentioned would be defined as heavy; the hourly/daily precipitation amounts do not show a significant return for the incident postcode. The hourly precipitation amounts (1-6 hours) that occurred at Pateley Bridge on the 22nd July however being significantly higher in precipitation totals may have had some and/or significant influence in the incident/surrounding area.

Finally, flooding or standing water is also caused by a combination of other factors besides the total and rate of rainfall to occur across an incident area. Drainage systems, gullies, sewers, soil moisture, river levels, saturation levels of the ground, topography, rainfall catchment area, vegetation debris, rainfall that has fallen outside the incident area and then encroached the incident area due to run off will all/part play in any flooding episode. These however are outside my field of expertise, therefore unable to comment further on this incident relating to these other factors.

1.10 The parties involved

I have prepared this meteorological report for and on behalf of XXXXXXX XXXXXX.

1.11 Technical terms and explanations

If any technical terms are used within this meteorological report, then the explanatory notes section should be consulted in the appendices for further details.

2. The meteorological issues addressed and a statement of instructions

I have prepared this meteorological report for and on behalf of XXXXXXX XXXXXX, contained in their correspondence and instructions dated the [illegible] October 2017. The purpose of this meteorological report is to give an expert opinion based on the meteorological facts as to the probable meteorological conditions in the above area on the date and time indicated. The meteorological issues addressed (if available) included extracting meteorological data from professional ground based meteorological stations, synoptic meteorological charts, lightning maps, amateur meteorological stations, remote sensing data and rainfall radar imagery. This meteorological report complies with civil and criminal procedures and the Jackson reforms. This meteorological report has been produced without the benefit of a site visit or investigation to clarify some of the opinions expressed; however I have familiarised myself with the incident site through other information made available to me. This meteorological report has been prepared with the full recognition that it may be presented in court as evidence. It is also accepted that this report may be submitted by another expert to the court, separate to or form part of a report.

3. My investigation of the facts

3.01 Details of ground based hourly meteorological stations utilised

To establish what meteorological conditions occurred around the surrounding area of the time of the incident, I investigated which were the closest ground based hourly meteorological stations that were operating at the time. The closest ground based meteorological stations to the incident, at which hourly weather data were available to me, were Pateley Bridge, Ravens Nest (6.8 miles to the south-east), Bainbridge (14.5 miles to the north-west) and Leeming (16.5 miles to the north-east). This hourly meteorological data (manned and automatic ground based weather stations) should prove to be representative of the incident area.

3.02 Details of ground based daily meteorological stations utilised

To establish what meteorological conditions occurred around the surrounding area of the time of the incident, I investigated which were the closest ground based daily meteorological stations that were operating at the time. The closest ground based meteorological stations within 30km of the incident, at which daily weather data were available to me, were Pateley Bridge 2 (9.8km), Pateley Bridge Ravens Nest (10.9km), Bainbridge (23.3km) and Leeming (26.5km). This daily meteorological data (manned and automatic ground based weather stations) should prove to be representative of the incident area.

3.03 Details of daily rainfall stations utilised

To establish what precipitation conditions occurred around the surrounding area of the time of the incident, I investigated which were the closest daily rainfall stations that were operating at the time. The closest daily rainfall station to the incident at which daily rainfall data was available to me, was Scar House Resr (2.7 miles to the south-east). This daily rainfall data (manned and automatic daily rainfall stations) should prove to be representative of the incident area.

3.04 Remote sensed data (UKPP) utilised

To establish what weather conditions occurred across the incident postcode area itself at the time of the incident, I investigated (UKPP) remote sensed data (see Section 5 of the appendices).

3.05 Rainfall radar utilised

See Section 6 of the appendices.

3.06 Rainfall return periods for the postcode HG3 5ST

See Section 7 of the appendices.

3.07 Meteorological reports/documents enclosed

Hourly ground based meteorological reports from Pateley Bridge, Ravens Nest, Bainbridge and Leeming (see Section 2 of the appendices)
Daily ground based meteorological reports from Pateley Bridge 2, Pateley Bridge Ravens Nest, Bainbridge and Leeming (see Section 3 of the appendices)
Daily rainfall reports from Scar House Resr (see Section 4 of the appendices)
Rainfall return periods for the postcode HG3 5ST (See Section 7 of the appendices)

3.08 Anecdotal reports enclosed

No anecdotal reports were included in this meteorological report.

3.09 Sun and moon data

All times are universal.

On the 22nd July 2017: Sunrise: 04:04, Sunset: 20:23, Moonrise: 03:02, Moonset: 19:29, Phase of Moon: Waning Crescent (1%)

3.10 Interview and examination

None were conducted for this meteorological report.

3.11 Research papers

None were consulted for this meteorological report.

3.12 Measurement tests and experiments

None were conducted for this meteorological report.

4. My opinion, interpretation and conclusion

In addition to the hourly and daily meteorological data presented in the appendices within this meteorological report, I have also examined (but not included) other meteorological data based from other meteorological sources, for example examining synoptic meteorological charts, lightning maps and amateur meteorological stations (where available [illegible] incident date). Based upon data analysis, a study of the general meteorological situation and aspects of meteorological theory, my conclusions, interpretation, interpolation and opinion therefore are as follows based on the relevant data available to me within the given time frame to produce [illegible] report.

The 22nd July 2017 at 0000 GMT saw low pressure centred [illegible] southern Ireland, Spain and between Iceland and Greenland. High pressure was [illegible] between Norway and Iceland, southern France and SE Europe. A cold front affected many areas of England and Northern Ireland, while a warm front lay close to NW Scotland.

The 22nd July 2017 at 0950 GMT ([illegible] BST) across the Middlesmoor area saw moderate east to east-south-easterly winds in strength [illegible] Beaufort Scale 4). The highest gust that occurred within the incident area during that incident time [illegible] ~20mph. Other meteorological factors occurring over the incident time included temperatures of ~13°C, humidity values were ~95%, while visibility was moderate. The weather was overcast with moderate rain. The rainfall associated with this would have resulted in the state of the ground to have been wet with standing water (puddles) to be present.

Based on the precipitation radar only across the incident area, it appears that the highest hourly value on [illegible] was 6.077mm (0801-0900 GMT (0901-1000 BST)). This amount of precipitation falling in 1 hour would be defined as heavy (precipitation amounts >=4mm per hour). The second wettest hour was between 0701-0800 GMT (0801-0900 BST) with 5.960mm. This amount of precipitation falling in 1 hour would also be defined as heavy. Again based on the precipitation radar, the whole of the 22nd July 2017 saw 29.104mm. This daily precipitation amount is defined by the 24 hours (0000-2400 GMT) and as a rule of thumb this amount of precipitation falling in a day would be defined as heavy. The highest 5 minute rainfall totals over the incident day occurred between 0535-0540 GMT (0635-0640 BST) with 2.008mm, closely followed by 0730-0735 GMT (0830-0835 BST) with 1.950mm. Based on the precipitation radar, it appears that rainfall started across the incident area just before midnight on the 22nd and continued with only a few brief drier spells until ~1000 GMT (1100 BST). The precipitation that occurred during that morning period varied from light to heavy in intensity.

Based on the nearest three weather stations that were operating (Pateley Bridge Ravens Nest, Bainbridge and Lemming) close to the incident area, it appears that Pateley Bridge Ravens Nest saw 45.2mm of precipitation in total on the incident day, while Bainbridge saw 31.2mm and Leeming 16.2mm. These daily precipitation amounts are defined by the 24 hours (0000-2400 GMT) and as a rule of thumb the individual amounts of precipitation that occurred from all of the three weather stations falling in a day would be defined as heavy.

Based on the nearest three weather stations that were operating (Pateley Bridge Ravens Nest, Bainbridge and Lemming) close to the incident area, it appears that that the highest hourly precipitation value on the 22nd July 2017 was 16.6mm (0700-0800 GMT & 0800-0900 GMT (0800-0900 BST & 0900-1000 BST)) from Pateley Bridge, Ravens Nest. This amount of precipitation falling in 1 hour would be defined as heavy (precipitation amounts >=4mm per hour). The second wettest hour was reported at Bainbridge between 0900-1000 GMT (1000-11[illegible]T) with 11.8mm. This amount of precipitation falling in 1 hour would also be defined as hea[illegible].

With reference to the sliding/fixed rainfall return period data f[illegible] postcod[illegible] 5S[illegible] (see Section 7 of the appendices); the precipitation data amounts that have [illegible]btained [illegible] the following results based on the precipitation radar. A rainfall total of 6.077m[illegible]lling in 1 hour (between 0801-0900 GMT) shows a return period of less than twice a year. A[illegible]ll total of 11.164mm falling in 2 hours (between 0801-1000 GMT) shows a return[illegible] of ~tw[illegible] year. A rainfall total of 17.124mm falling in 3 hours (between 0701-1000 GMT[illegible]eturn period of ~once a year. A rainfall total of 20.335mm falling in 4 hours (between [illegible]01-100[illegible]T) shows a return period of ~once a year. A rainfall total of 25.142mm falling i[illegible] (betw[illegible] 0401-1000 GMT) shows a return period of ~once a year. With respect to 29.104mm[illegible] 24 hours (for the 22nd July); shows a return period of less than twice a year. [illegible] respect [illegible]934mm of precipitation falling over a 48 hour spell (21-22nd July), a return pe[illegible] than tw[illegible] is also expected.

By using the sliding/fixed rainfall return[illegible] data fo[illegible] postcode HG3 5ST (see Section 7 of the appendices); and using the precipit[illegible]tion [illegible]nts that actually occurred at the nearest three weather stations that were operatin[illegible]ateley [illegible] Ravens Nest, Bainbridge and Lemming) close to the incident area, the follow[illegible]sults a[illegible] as follows. With respect to 45.2mm falling in 24 hours at Pateley Bridge Ravens [illegible]hows a return period of ~once a year. The daily precipitation totals from Ba[illegible]ge (31.2m[illegible] and Leeming both show a return period of less than twice a year. With respect [illegible]2mm of precipitation falling over a 48 hour spell (21-22nd July) at Pateley Bridge, [illegible]ows a [illegible] period of less than twice a year. A rainfall total of 16.6mm falling[illegible] 1 hour [illegible]ase[illegible] on [illegible] highest hourly precipitation at Pateley Bridge) shows a return perio[illegible] of between 2-5 ye[illegible] rainfall total of 33.2mm falling in 2 hours (based on the hourly pr[illegible]cipitation a[illegible]nts be[illegible]en 0700-0900 GMT at Pateley Bridge) shows a return period of betwe[illegible] 10-2[illegible] rainfall total of 38.4mm falling in 3 hours (based on the hourly precipitati[illegible]s betw[illegible]n 0600-0900 GMT at Pateley Bridge) shows a return period of between 10-20 years. A r[illegible]nfall total of 41.0mm falling in 4 hours (based on the hourly precipitation amounts bet[illegible]een 0500-0900 GMT) shows a return period of between 10-20 years. A rainfall total of 4[illegible]m falling in 6 hours (based on the hourly precipitation amounts between 0400-1000 GMT at Pateley Bridge) shows a return period of between 5 and 10 years.

In reality, the actual precipitation amounts that occurred at Pateley Bridge Ravens Nest, Bainbridge and Leeming over the time of the incident shown in this report did not actually occur across the incident area itself as much lower rainfall totals occurred based on the precipitation radar. The actual precipitation amounts from these three rainfall stations and the rainfall return period based on the postcode HG3 5ST are shown here as a guide only and the rainfall reported at these weather stations may/may not have played a part in this incident as these rainfall totals may fall into the same catchment area as the incident and/or higher rainfall totals from weather stations upstream of the incident and/or weather stations at higher altitudes receiving higher rainfall amounts than the incident height and cascading to lower elevations. A weather warning for rain was not in force for the incident area at the time of the incident.

The rainfall return data shown here was obtained from The Flood Estimation Handbook (FEH) which was published in 2000. The two tables provided in Section 7 of the appendices show rainfall amounts in mm associated with given durations and return periods. A rainfall event with a return period of t years has a probability of 1 in t of being reached or exceeded in a given year. Calculations are made to a horizontal resolution of 1 km. The first and second tables provide figures for 'sliding' and 'fixed' durations respectively. The difference is that a sliding duration of 60 minutes represents an event of 60 minutes starting at any time whereas a fixed duration applies to an event of one hour starting at a clock hour. Similarly, a sliding duration of 24 ho[illegible]esents an event starting at any time, whereas a fixed duration of one day applies to an eve[illegible] of 2[illegible] hours starting at 09 UTC. For a given return period, the rainfall amounts corresponding [illegible] sliding d[illegible]rations are greater than those corresponding to fixed durations.

For return periods of five years or more, the results are based on a[illegible]ysis of annual maximum rainfalls. This technique is unsuited to shorter return periods, when al[illegible]lls above a threshold need to be considered. Accordingly, the Langbein formu[illegible]ich prov[illegible] a conversion from annual maximum to threshold techniques, has been used [illegible] su[illegible]ures for return periods up to and including two years.

The FEH only analysed data for durations between one [illegible]and [illegible] days, but with caution, the results can be extrapolated to 15 minutes. This [illegible] been don[illegible] first table (sliding durations), but not for the second table (fixed durations), b[illegible]uncertai[illegible] conversion factors.

Finally, flooding or standing water is als[illegible] by a c[illegible]ation of other factors besides the total and rate of rainfall to occur across an inc[illegible]dent [illegible] Drainage systems, gullies, sewers, soil moisture, river levels, saturation levels of the [illegible]d, topo[illegible], rainfall catchment area, vegetation debris, rainfall that has fallen outside the inci[illegible]a and [illegible]en encroached the incident area due to run off will all/part play in any flooding episode. [illegible] however are outside my field of expertise, therefore unable to comment further on [illegible]ncident re[illegible]g to these other factors.

With these factors in mind [illegible] on my opinion, meteorological facts and data stated in this report that [illegible] the ba[illegible] of p[illegible]ability that the best informed estimate showed that the 22nd July 2[illegible] across the pos[illegible] HG3 5ST at the time of the incident was overcast with some mo[illegible]erate rain. Th[illegible]rainfall [illegible]ociated with this event would have resulted in the state of the ground t[illegible] have [illegible] with standing water (puddles) to be present from early morning onwards o[illegible].

Based on the precipitation radar only across the incident area, it appears that the highest hourly value on the 22nd Ju[illegible]017 was 6.077mm (0801-0900 GMT (0901-1000 BST), while the 22nd as a whole saw 29.104mm. The highest 5 minute rainfall total over the incident day occurred between 0535-0540 GMT (0635-0640 BST) with 2.008mm. Based on the precipitation radar, it appears that rainfall started across the incident area just before midnight on the 21st and continued with only a few brief drier spells until ~1000 GMT (1100 BST). The precipitation that occurred during that morning period varied from light to heavy in intensity. All the hourly values and 5 minute values mentioned here in summary would be defined as heavy and as a rule of thumb the daily amount of precipitation that fell across the incident area would also be defined as heavy.

Based on the three nearest three weather stations that were operating (Pateley Bridge Ravens Nest, Bainbridge and Leeming) close to the incident area, it appears that Pateley Bridge saw the highest daily precipitation amount of 45.2mm on the 22nd July, while the highest 48 hour precipitation total (21-22nd) was also 45.2mm from the same station. It appears that the highest hourly value on the 22nd July 2017 was 16.6mm (0700-0800 GMT & 0800-0900 GMT (0800-0900 BST & 0900-1000 BST)) from Pateley Bridge, Ravens Nest. This amount of precipitation falling in 1 hour would be defined as heavy (precipitation amounts >=4mm per hour).

With reference to the sliding/fixed rainfall return period data for the postcode HG3 5ST (see Section 7 of the appendices); the precipitation data amounts from the rainfall radar show that a rainfall total of 6.077mm falling in 1 hour shows a return period of less than twice a year, while 29.104mm falling in 24 hours; shows a return period of less than twice a year. With respect to 29.934mm of precipitation falling over a 48 hour spell (21-22nd July), a return period of less than twice a year is also expected. Rainfall amounts that fell over the 1, 2, 3, 4 and 6 hourly periods just before the incident however showed a return period of ~once a year. Similar return values (~once a year and/or less than twice a year) were shown in the records of the three nearest weather stations close to the incident.

The only exception to these return values of ~once a year and/or less than twice a year is the precipitation amounts that fell at Pateley Bridge. A rainfall total of 16.6mm falling in 1 hour showed a return period of between 2-5 years, while [illegible]mm falling in 2 hours showed a return period of between 10-20 years. A rainfall total of 38.4mm falling in 3 hours showed a return period of between 10-20 years, while 41.0mm falling in 4 hours also showed a return period of between 10-20 years, while finally 43mm falling in 6 hours showed a return period of between 5 and 10 years. All these return values are based on these precipitation amounts falling at the incident postcode.

In reality, the actual precipitation amounts that occurred at the three nearest weather stations over the time of the incident did not actually occur across the incident area itself as much lower rainfall totals occurred based on the precipitation radar. The rainfall reported at these weather stations may/may not have played a part in this incident as these rainfall totals may fall into the same catchment area as the incident and higher rainfall totals from weather stations upstream of the incident and/or weather stations at higher altitudes receiving higher rainfall amounts than the incident height and cascading to lower elevations. A weather warning for rain was not in force for the incident area at the time of the incident.

It appears overall that although the hourly/daily precipitation amounts mentioned would be defined as heavy; the hourly/daily precipitation amounts do not show a significant return for the incident postcode. The hourly precipitation amounts (1-6 hours) that occurred at Pateley Bridge on the 22nd July however being significantly higher in precipitation totals may have had some and/or significant influence in the incident/surrounding area.

Finally, flooding or standing water is also caused by a combination of other factors besides the total and rate of rainfall to occur across an incident area. Drainage systems, gullies, sewers, soil moisture, river levels, saturation levels of the ground, topography, rainfall catchment area, vegetation debris, rainfall that has fallen outside the incident area and then encroached the incident area due to run off will all/part play in any flooding episode. These however are outside my field of expertise, therefore unable to comment further on this incident relating to these other factors.

5. Expert's declaration

I **Dr Richard J. Wild** declare that:

1. I understand that my duty in providing written meteorological reports and giving evidence is to help the Court, and that this duty overrides any obligation to XXXXXXX XXXXXX by whom I am engaged or the person who has paid or is liable to pay me. I confirm that I have complied and will continue to comply with my duty.
2. I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of the case.
3. I know of no conflict of interest of any kind, other than any which I have disclosed in my meteorological report.
4. I do not consider that any interest which I have disclosed affects my suitability as an expert witness on any issues on which I have given evidence.
5. I will advise XXXXXXX XXXXXX by whom I am instructed if, between the date of my meteorological report and the trial, there is any change in circumstances which affect my answers to points 3 and 4 above.
6. I have shown the sources of all information I have used.
7. I have exercised reasonable care and skill in order to be accurate and complete in preparing this meteorological report.
8. I have endeavoured to include in my meteorological report those matters, of which I have knowledge or of which I have been made aware, that might adversely affect the validity of my opinion. I have clearly stated any qualifications to my opinion.
9. I have not, without forming an independent view, included or excluded anything which has been suggested to me by others, including my instructing lawyers XXXXXXX XXXXXX.
10. I will notify XXXXXXX XXXXXX immediately and confirm in writing if, for any reason, my existing meteorological report requires correction or qualification.
11. I understand that;
    - 11.1 my meteorological report will form the evidence to be given under oath or affirmation;
    - 11.2 questions may be put to me in writing for the purposes of clarifying my meteorological report and my answers shall be treated as part of my meteorological report and covered by my statement of truth;
    - 11.3 the court may at any stage direct a discussion to take place between experts for the purpose of identifying and discussing the expert issues in the proceedings, where possible reaching an agreed opinion on those issues and identifying what action, if any, may be taken to resolve any of the outstanding issues between the parties;
    - 11.4 the court may direct that following a discussion between the experts that a statement should be prepared showing those issues which are agreed, and those issues which are not agreed, together with a summary of the reasons for disagreeing;
    - 11.5 I may be required to attend court to be cross-examined on my meteorological report by a cross-examiner assisted by an expert;
    - 11.6 I am likely to be the subject of public adverse criticism by the judge if the Court concludes that I have not taken reasonable care in trying to meet the standards set out above.
12. I have read Part 35 of the Civil Procedure Rules, the accompanying practice direction and the Guidance for the instruction of experts in civil claims and I have complied with their requirements.
13. I am aware of the practice direction on pre-action conduct. I have acted in accordance with the Code of Practice for Experts.

6. Statement of truth

I confirm that I have made clear which facts and matters referred to in this meteorological report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

7. Date and signature

Date: 1st November 2017

To: XXXXXXX XXXXXX
XXXX XXXX
XX XXXXX XXXXX
XXXXXXXXX XXXXX
XXX XXX

Signed:

Dr Richard J. Wild BSc (Hons) Ph[illegible]MetS [illegible] MAE MCSFS
Weather Services Commercial Manage[illegible]r Forensic Meteorologist, WeatherNet Ltd

Appendices

1. My experience and qualifications

I am the Weather Services Commercial Manager and Forensic/Senior Meteorologist at WeatherNet Ltd. WeatherNet Ltd is a subsidiary of Cunningham Lindsey Ltd, the UK's largest Claims and Incident Management Company. I have been employed by WeatherNet Ltd since the 10th July 1997. My qualifications include a BSc (Hons) in Geography (2:1) (obtained June 1994), while in July 1997, I obtained a City and Guilds certificate in Teaching (stage 1) in further and adult education. In July 2005, I obtained a PhD investigating the spatial and temporal analysis of heavy snowfalls across Great Britain between the years 1861-1999.

I am a Fellow of the Royal Meteorological Society (since October 1990), a Member of the National Geographic Society (since January 1993), a Member of the Association of British Climatologists (since January 1995) and a Fellow of the Royal Geographical Society (since January 2005). I have produced forty two research articles about snow/snowfalls/blizzards/weather in general in several academic publications (including the Journal of Meteorology and Weather) and two books since 1995. I have also made numerous talks at Universities/local clubs/written quotes for local/national radio, TV and newspapers. Finally, I have been credited on numerous films and TV programmes including Harry Potter and the Half-Blood Prince, Harry Potter and the Deathly Hallows: Part 1/2 and Britain's Worst Weather.

I am also a staff member of TORRO (Tornado and Storm Research Organisation (based at Oxford Brookes University)). My role is Research Head of Heavy Snowfalls which is a part of the Thunderstorm and Severe Weather Division and I have held this post since July 1998.

To date, I have prepared in excess of 1900 legal meteorological reports since the year 1997 and in the last five years, I have given evidence in court on five occasions (May 2012, September 2012, February 2013, July 2015 and May 2016).

I am (in association with WeatherNet Ltd) currently listed as an expert witness on several expert witness websites including www1.orcexperts.com, www.expertwitness.co.uk, www.expertsearch.co.uk, www.proexperts.co.uk, www.justicedirectory.co.uk, www.thelawpages.com, www.insurance-directories.com, www.yourexpertwitness.co.uk, www.witnessdirectory.com, www.thesolicitorsgroup.co.uk, www.publiclawtoday.co.uk, www.hgexperts.com and www.waterlowlegal.com. I have also (in association with WeatherNet Ltd) been on the Expert Witness Directory (www.legalhub.co.uk/legalhub/app/appinit) since January 2007 and the Law Society of Scotland (www.lawscot.org.uk) since November 2016. I have also obtained membership of the UK Register of Expert Witnesses (www.jspubs.com) since February 2007, the Association of Personal Injury Lawyers (www.apil.org.uk) since April 2007, the Academy of Experts (www.academy-experts.org) since June 2007, the Thomson Reuters Expert Witness Services (https://trexpertwitness.com/) since October 2007 and the Chartered Society of Forensic Sciences (www.csofs.org) since June 2009. Since July 2008, I have been trained by Bond Solon (www.bondsolon.com) in the aspects of report writing and also the Jackson Reforms since May 2013. Since September 2010, I have been included on the NPIA (National Policing Improvement Agency) Expert Advisers Database. This was transferred into the Serious Organised Crime Agency (SOCA) in April 2012 which then transferred again to the National Crime Agency (NCA) in October 2013 (www.nationalcrimeagency.gov.uk)).

2. Hourly meteorological report from ground based hourly meteorological stations for the 21-22nd July 2017

See enclosed inserted sheets.

3. Daily meteorological report from ground based daily meteorological stations for the 21-22nd July 2017

See enclosed inserted sheet.

4. Daily rainfall data from daily rainfall stations for the 21-23rd Ju[illegible]

Daily Rainfall Station	Rainfall 090[illegible]0900 GM[illegible]m)
Scar House Resr	21.6 (21st), [illegible]nd), 11.[illegible]

5. Remote sensed data (UKPP) for the 21-22nd July 2017

See enclosed inserted sheets.

6. Precipitation radar for the 21-22nd July 2017

See enclosed inserted sheets.

7. Rainfall return periods for postcode HG[illegible] 5ST

See enclosed inserted sheet.

8. Beaufort scale

See enclosed inserted sheet.

9. Explanatory notes

9.01 Gene[illegible]al

All mete[illegible]ologi[illegible] based readings presented in this report have been made using acknowled[illegible]mentat[illegible]n and in accordance with procedures laid down by the World Meteorological Organisation (WMO). All meteorological readings in this report have been subject to careful quality control [illegible]y WeatherNet Ltd. All times shown is Greenwich Mean Time (GMT) unless otherwise sta[illegible] These times will be 1-hour BEHIND clock time for the period late March-late October when British Summer Time (BST) is in operation in the United Kingdom.

9.02 The meteorological instrument enclosure

Most meteorological instruments at ground based meteorological stations are located in an enclosure, a flat area of ground approximately 10 metres by 7 metres covered by short grass and surrounded by fencing. The enclosure should be well away from trees or any other large obstructions. The distance of any object should be not less than twice the height of the object, and preferably four times the height.

9.03 Ground based meteorological stations

At most ground based meteorological stations; meteorological observations of the highest integrity are made by professional meteorological observers on a routine hourly basis throughout the 24-hour day, 365 days a year. Many meteorological parameters are monitored by automatic equipment (SAWS, SAMOS, CDL) and during periods when (some) ground based meteorological stations are unmanned, evaluations of certain meteorological parameters (present weather, visibility for example) may go unrecorded. Certain other ground based meteorological stations (i.e. Auxiliary Meteorological Stations (e.g. Coastguard Stations)) only make routine meteorological observations at certain fixed times of the day - often at 3-hourly intervals. At cooperating Climatological Stations, the meteorological observer normally makes only one routine meteorological observation per day at 0900 GMT. [illegible] meteorological observation represents the past 24 hour's e.g. maximum and minimum air temperatures, rainfall, state of ground, sunshine etc. Not all ground based meteorological stations [illegible] all meteorological parameters. They are manned by a large variety of persons [illegible] some [illegible] meteorological observer is available to monitor certain meteorological elements during the daytime, recording a very brief description in the form of a diary. At rainfall stations only, the previous days' 24-hour daily rainfall reading is taken at 0900 GMT.

9.04 Significant weather

Significant weather includes details of the occurrence of [illegible] ground (grass) frosts; gales; details of any heavy or continuous rain; fog; freezing rain; hail; sleet; lying snow; thunder, lightning; squalls and tornadoes to occur at the ground based meteorological station in the 24-hours ending midnight. 'None' means that none of these types of weather occurred. 'X' means that no meteorological observation of weather was made.

9.05 Rainfall

The enemies of rainfall measurement are [illegible] and in-splashing. Wind blows rain drops around a rain gauge and therefore the lower the rim (and [illegible]re the lighter the wind) the better. However, if the rim of the rain gauge is too close to the ground then in-splashing occurs. As a compromise, the standard rain gauge has its rim 30cm above the ground. The diameter is 5 inches (127mm) and rainfall can be measured to a resolution of [illegible]mm. [illegible] tipping bucket rain gauge perspective, this does not provide details of the timing of small amounts of rain. A tip of the rain gauge may be triggered in one hour when most of the rain fell in a previous hour. Rainfall (noted in millimetres and tenths), includes any solid precipitation such as snow or hail which is melted and measured in the same way as rain. There may also [illegible] to deposition of dew, hoar frost and rime ice on the collecting surface of the rain gauge. Small amounts of <0.05mm are usually recorded as 'trace'. In some instances, with automatic meteorological equipment, precipitation amounts less than 0.2mm (i.e. a few spots) will not be registered. Many rainfall stations in the UK are sited on Water Authority property, at reservoirs, sewage works and pumping stations. Daily rain gauges are normally read just once per day at 0900 GMT, the recorded value being a single measurement of the rainfall of the previous 24 hours. To convert rainfall in millimetres to inches, multiply by 25.4.

9.06 Intensity of rain

Rain (as opposed to rain showers) falls from dynamically produced stratiform (layered) cloud like stratus and nimbostratus in association with frontal zones. Slight rain is rain of low intensity; which usually consists of scattered large rain drops, or more numerous smaller rain drops. The rate of accumulation in a rain gauge is less than 0.5mm per hour. Moderate rain is rain falling fast enough to form puddles quickly, to make down pipes flow freely and to give some spray over hard surfaces. The rate of accumulation in a rain gauge is between 0.5mm and 4.0mm per hour. Heavy rain is sufficiently intense to produce a roaring noise on roofs, forms a misty spray of fine rain droplets by splashing on road surfaces etc. and accumulates in a rain gauge at a rate greater than 4.0mm per hour. Moderate and heavy rain is normally associated with layered cloud of great vertical depth, normally in associatio[illegible]rontal zones, or troughs of low pressure. Drizzle is precipitation where the rain droplet size i[illegible] very [illegible]mall [illegible] true drizzle droplets does not make a splash, or circular waves in a puddle. Drizzle is nor[illegible]ly associat[illegible]d with very low cloud of the type stratus, and is often experienced in fog, or [illegible] (cloud [illegible]gh ground). Freezing rain/drizzle is liquid water drops, with an air temperature [illegible]he zero [illegible]s mark (super-cooled water), which freeze on impact with a ground surface whose te[illegible]re is also below the zero Celsius mark. This form of precipitation produces a particularly hazardous [illegible]or foot and wheeled traffic. The ground effects of rain on a surface are determine[illegible] rate of [illegible]pact. In general terms, isolated periods of rain giving a 'trace' or 0.1mm of rainf[illegible] little more than dampen the ground, whereas 0.2mm falling in less than an hour wo[illegible] wet the [illegible]und, but without any puddle formation or puddles will form only slowly. Small puddle[illegible] form o[illegible] some previously dry metalled surfaces (tarmac/concrete) if 0.5mm falls in a relatively short [illegible]y, one hour. Clearly, the size of puddles at any one location/time is, in part, a prod[illegible]f local na[illegible]rtificial drainage characteristics. The above criteria based on the ground effects [illegible] amounts a[illegible]pproximate guide. The state of ground will depend on the intensity of rainfal[illegible] and th[illegible] evapora[illegible]on. Evaporation is very low in winter but averages about 3mm per day [illegible]er. Ra[illegible]all can also be described as continuous (rainfalls of one hour or more without a br[illegible]ak), [illegible]mittent (a period of less than one hour, or a longer period of rainfall with noticeable break[illegible]termitte[illegible] should not be confused with rain showers (the cloud type from which the precipitate fa[illegible]ifferent). With respect to the classification for showers, which are associated with convective cloud, [illegible]en of short duration and are characterised by rapid fluctuations of intensity. As a [illegible] rule, sho[illegible]rs are regarded as slight if the rate of accumulation is <2.0mm/hr, moderate 2.0 to [illegible].0m[illegible]eavy 10.0 to 50.0mm/hr and violent >50.0mm/hr.

9.07 Rainfall [illegible]uivalent

1mm of r[illegible]in measur[illegible] standard rain gauge is the equivalent of 1mm depth over an area of 1 square me[illegible] very roughly equal to 1mm. of rain. The range is from about 8 to 12 multiplied [illegible]quivalent [illegible] rainfall, depending on the water content of the snow.

9.08 Rainfall radar

The methods of collecting rainfall data from rainfall stations are explained in sections 7.5 and 7.6; however this section will explain rainfall accumulation from rainfall radar. Rainfall Radar (RAdio Detection And Ranging) is an echo-sounding system, which uses the same aerial for transmitting a signal and receiving the returned echo. Short pulses of electro-magnetic waves are transmitted in a narrow beam for a short time (typically 2 microseconds). When the beam hits a suitable target, some of the energy is reflected back to the radar, which 'listens' out for it for a much longer period (3300 microseconds in the case of Met Office radars) before transmitting a new pulse. The distance of the target from the transmitter can be worked out from the time taken by a pulse to travel there and back. Corrections have to be made to the raw data collected, including amendments for attenuation by intervening rain and range, elimination of ground clutter and the conversion of radar reflectivity to rainfall rate.

Each radar completes a series of scans about a vertical axis between four and six low-elevation angles every 5 minutes (typically between 0.5 and 4.0 degrees, depending on the height of surrounding hills). Each scan gives good, quantitative data that shows detailed distribution of precipitation intensities (1 and 2 km resolutions) out to a range of about 75 km and useful qualitative data that provides a good overall picture of the extent of precipitation at a national/regional scale (5 km resolution) to 255km.

Disadvantages of rainfall radar:
The radar rainfall display may not fully represent the rainfall observed at the ground due to:
• Permanent echoes (occultation) caused by hills or surface obstacles.
• Spurious echoes caused by ships, aircraft, sea waves, chaff in use on military exercises, technical problems or interference from other radars.
• Radar beam above the cloud at long ranges- difficulties in detecting low-level rain clouds.
• Evaporation of rainfall at lower levels beneath the beam giving an over-estimate of the actual rainfall.
• Orographic enhancement of rainfall at lower levels- light precipitation generated in layers of medium-level cloud can increase in intensity by sweeping up other small droplets as it falls through moist, cloudy layers at low levels.
• Bright Band Radar echoes from raindrops and snowflakes are calibrated to give correct intensities on the rainfall display. However, at the level where the temperature is near 0°C, melting snowflakes with large, reflective surfaces give strong echoes. These produce a false band of heavier rain, or bright band, on the radar picture.
• Anomalous propagation (anaprop) - radar beams travel in straight lines through a uniform medium but will be bent when passing through air of varying density. When a low-level temperature inversion exists, the radar beam is bent downwards and strong echoes are returned from the ground, in a manner akin to the formation of mirages.

Advantages of rainfall radar:
• Detailed, instantaneous and integrated rainfall rates
• Areal rainfall estimates over a wide area
• Information in near-real time
• Information in remote land areas and over adjacent seas
• Location of frontal and convective (shower) precipitation
• Monitoring movement and development of precipitation areas
• Short-range forecasts made by extrapolation
• Data can be assimilated into numerical weather prediction models

9.09 Temperature

To convert temperatures in Celsius (°C) to Fahrenheit (°F), multiply by 9, divide by 5 and then add 32. The main problem in measuring air temperature is shielding thermometers from radiation, mainly short wave radiation from the sun but also long wave radiation from the ground. Mainly, due to the effect of radiation, the air (or dry bulb) temperature varies markedly with height above the ground and the type of surface. Thermometers also need to be kept dry as evaporation produces cooling. The solutions to these problems are resolved by recording the temperature of the air (recorded in degrees and tenths, Celsius) by housing the thermometers in the shade, at a height of 1.25 metres above the ground (normally over short grass, except in a few cities where roof top sites are used) in a louvered white box called a Stevenson Screen. The Stevenson Screen protects the thermometers from radiation and precipitation while the louvres permit ventilation. Air temperature values below zero degrees Celsius are preceded by a minus sign, while recordings are made at each (notional) clock hour. In most modern day ground based meteorological stations, the thermometers are electrical resistance whereas in older ground based meteorological stations they are in the form of liquid in glass. Different thermometers are used for recording the maximum and minimum temperature. The highest and lowest air temperature recorded during the previous 24-hour period finalises at 0900 GMT. The wet bulb temperature records the temperature of a wet surface by means of a piece of muslin wrapped around the bulb of a thermometer and kept moist by capillary action from a reservoir of distilled water. The wet bulb thermometer indicates the 'temperature of evaporation' which is, in normal circumstances, lower than the air (dry bulb) temperature. The difference between the dry and wet bulb temperature is known as the wet bulb depression. From the dry and wet bulb readings, relative humidity and vapour pressure can be obtained. The maximum, minimum and wet bulb thermometers are housed in the Stevenson Screen as mentioned above. The dew point is the temperature to which air must be cooled before it becomes saturated with water vapour. It is so called because it is also the temperature to which a surface must be cooled before dew will be deposited. With reference to thermometers housed outside the Stevenson screen, the grass minimum temperature is recorded by a thermometer exposed to the air one or two inches above the ground. The bulb is in contact with the tips of the grass blades, and refers to the period ending at 0900 GMT on the date of entry. The concrete minimum temperature, like the grass minimum temperature, is recorded by a thermometer, but in this instance, the bulb is positioned in the centre of and just touching the slab and again refers to the period ending at 0900 GMT on the date of entry. Finally, soil temperatures are read at 0900 GMT in the morning at selected weather stations. Bent stem thermometers record the soil temperature at 5cm, 10cm and 20cm under a bare soil surface.

9.10 Sun

The total amount of sunshine (hours and tenths) recorded on the date of entry. Measurement of the duration of sunshine refers to so-called 'bright' sunshine. Since different meteorological instruments differ in their response characteristics to solar radiation, this term has lacked precise definition. However, The World Meteorological Organisation decided in 1962 to adopt the Campbell-Stokes Recorder, as used in the British Isles, as the standard meteorological instrument for recording sunshine amount.

9.11 Total cloud

Total cloud amounts are estimated as the fraction, in eighths (oktas), of the sky covered by cloud. At manned ground based meteorological stations, this is assessed by human observers. Some ground based automatic meteorological stations make this assessment from cloud recording equipment.

9.12 State of ground

At manned ground based meteorological stations, the state of ground refers to a bare patch of soil about 2m square and described accordingly. The state of ground includes descriptions such as dry, moist, wet, flooded, frozen, glazed, sand, ice, snow or dust covered.

9.13 Snow

Snow is much more difficult to measure than rain because the snowflakes blow around, rather than into, a rain gauge. The snow that does enter the gauge blocks it and prevents the normal operation of the rain gauge. Nevertheless, the aim is to record the amount of water substance that falls as snow. At manned ground based meteorological stations this is achieved by melting the snow and recording the amount of water as 'rain'. Automatic rain gauges do not work well at temperatures below freezing point. Any solid precipitation that falls collects in the rain gauge and no precipitation is registered. When the temperature rises above freezing, the snow melts and the rain gauge starts registering, even though the current weather may be dry. Daily rainfall amounts are quality controlled to overcome this deficiency and estimates of the correct daily rainfall are made. For hourly rainfall, it is very likely that original and erroneous data remain on the computer archive. There is a close relationship between the intensity of snowfall and visibility. Thus if it is known that poor visibility is due to falling snow, the intensity of the precipitation can be inferred from the following table.

Visibility	Description of snowfall intensity	Equivalent rainfall intensity
5km	Slight snow	0.2mm/hr
2km	Slight /moderate snow	0.5mm/hr
1km	Moderate snow	1.0mm/hr
250m	Moderate/heavy snow	4.0mm/hr
110m	Heavy snow	10.0mm/hr

Dry snowflakes result in visibilities of about half of those given above. Visibility in wet snow is somewhat better, as wet snowflakes collapse to a smaller volume and become translucent. Blowing snow (most likely when the snow is dry and powdery) gives very low visibilities.

9.14 Snow depth

At manned ground based meteorological stations, snow depth is measured with a ruler at three different locations and the average is then taken. The area chosen for these measurements should be as close as possible to the rain gauge and not affected by drifting or scoured by the wind. Some automatic ground based meteorological stations measure snow depth by an optical technique.

9.15 Wind

Wind direction is measured in degrees from north (360 degrees of a circle) and relates to the direction from which the wind is blowing from. The quoted figures represent the wind direction averaged over the hour ending at the time of entry. A direction reported as 360 degrees represents a wind from due north (a northerly wind); 090 degrees is from due east (an easterly wind) etc. Wind speeds are recorded in knots (where 1 knot = 1.1515 mph), and they refer to the average speed (which includes all gusts and all lulls) during the hour ending at the time of entry. The mean wind speed refers to the highest mean wind at 10m above ground in an open level situation measured in the 10 minutes immediately preceding each hour. The maximum gust speed is also recorded in knots; the highest value (even if only of momentary duration) attained during the hour ending at the time of entry. The maximum wind gust refers to the highest 3-5 second gust at 10m above ground level by an anemometer. Gale force gusts are gusts >=39 mph. A gust is a rapid, but momentary increase in the speed of the wind, relative to the mean wind speed at the time. Equally, a lull is a momentary decrease below the mean wind speed. Wind speed generally increases with height according to a power law equation, i.e. speed at height H = speed recorded at 10 metres x Pow ((Height H in metres/10 metres), p) where the power p takes a value between 0.067 and 0.29 depending upon local terrain roughness and whether it is mean or gust speed under consideration. Beaufort Force = Pow(Pow(“Wind Speed (mph)” / 1.87), 2), 1/3). Beaufort Forces apply only to mean wind speeds and must not be used in reference to gusts.

9.16 Glossary

Astronomical dawn and dusk - Morning astronomical twilight begins (astronomical dawn) and evening astronomical twilight ends (astronomical dusk) when the geometric centre of the Sun reaches 18° below the horizon. In the period of astronomical twilight (when the sun is between 12° and 18° below the horizon), away from urban light pollution, moonlight, auroras and other sources of light, the sky is darker enough for nearly all astronomical observations. Astronomers can easily make observations of point sources such as stars both during and after astronomical twilight in the evening and both before and during astronomical twilight in the morning. Some critical observations; however such as viewing nebulae and galaxies require observations beyond the limit of astronomical twilight. Theoretically, the faintest stars detectable by the naked eye (those of approximately the sixth magnitude) will become visible in the evening at astronomical dusk and become invisible at astronomical dawn. In certain places, astronomical twilight may be almost indistinguishable from night. In the evening, even when astronomical twilight has yet to end and in the morning when astronomical twilight has already begun, most casual observers would consider the entire sky fully dark.

Black ice - is a thin coating of ice on a ground surface, formed when moisture from either natural or unnatural sources (for example, rain, freezing rain or drizzle, surface run-off, etc.) becomes present on exposed objects with a surface temperature below or at freezing (0ºC). It is near transparent due to the fact it is only a thin accumulation of ice, making it much harder to see in comparison to snow, frozen slush or thicker ice layers. The ‘black’ term comes from the fact that when the ice or ‘glaze’ forms on a road surface, the black tarmac underneath can be seen clearly through it presenting a distinct risk of pedestrians and automobiles.

Civil twilight - is defined to begin at sunset and ends when the geometric centre of the sun is 6º below the horizon. This is the limit at which twilight illumination is sufficient, under good weather conditions, for terrestrial objects to be clearly distinguished. At the end of evening civil twilight, the horizon is clearly defined and the brightest stars are visible under good atmospheric conditions in the absence of moonlight or other illumination.

Cloud Cover – The total cloud amount or cloud cover is the fraction of the celestial dome covered by all clouds visible. The assessment of the total amount of cloud, therefore, consists in the weather observer estimating how much of the total apparent area of the sky is covered with cloud. The international unit for reporting the cloud amount is the 'okta' or eighth of the sky, with 0 oktas equating to a clear sky and 8 oktas equating to an overcast sky.

Cold Front – A frontal system whose movement is such that the colder air mass is replacing the warmer air mass. The passage of the cold front is marked at the surface by a rise in pressure, a fall of temperature and dew-point and a veer of wind direction.

Condensation – In meteorology, the formation of liquid water from water vapour. Since the capacity of air to hold water in the form of vapour decreases with temperature, cooling of air is the normal method by which first saturation, then condensation, is produced. Such cooling is effected by three main processes:

- (i) the expansion of ascending air,
- (ii) mixing with air at lower temperature,
- (iii) contact with earth's surface at lower temperature.

The water vapour condenses as cloud in (i), as fog or cloud in (ii), and as dew or hoar frost in (iii).

Dew – Condensation of water vapour on a surface whose temperature is reduced by radiational cooling to below the dew-point of the air in contact with it. Of the two recognized processes of dew formation the more common occurs in conditions of calm (wind at two metres height less than one knot) when water vapour diffuses from the soil upwards to the exposed cooling surface in contact with it (e.g. grass) and there condenses. The second of the processes is one of 'dewfall' when, in conditions of light wind, downward turbulent transfer of water vapour from the atmosphere to the cooled surface occurs.

Dew-Point – The dew-point of a moist air sample is that temperature to which the air must be cooled in order that it shall be saturated with respect to water at its existing pressure and humidity mixing ratio. Dew-point may be measured indirectly from wet- and dry-bulb temperature readings with the aid of humidity tables or directly with a 'dew-point hygrometer'.

Freezing drizzle, freezing fog, freezing rain – Supercooled water drops of drizzle (or fog or rain) which freeze on impact with the ground to form glazed frost or, in the case of smaller droplets which comprise of fog to form rime.

Freezing-point – The constant temperature at which the solid and liquid forms of a given pure substance are in equilibrium at standard atmospheric pressure. For pure-water substance the temperature is 0°C and is termed the 'ice-point' or 'freezing-point'. In practice, a cooling liquid may not freeze at the freezing-point due to a pressure variation from standard atmospheric pressure, or the presence of impurities, or the phenomenon supercooling.

Frost – Frost occurs when the temperature of the air in contact with the ground or at screen level (about four feet), is below the freezing-point of water ('ground frost' or 'air frost', respectively). The term is also used of the icy deposits which may form on the ground and on objects in such temperature conditions.

Frost Hollow – A local hollow-shaped region in which, in suitable conditions, cold air accumulates by night due to a katabatic air flow (see katabatic wind definition). Such regions are subject to a greater incidence of frosts and to more severe frosts, than are the surrounding areas of non-concave shape.

Funnel cloud - Is a funnel-shaped cloud of condensed water droplets, associated with a rotating column of wind and extending from the base of a cloud (usually a cumulonimbus or towering cumulus cloud) but not reaching the ground or a water surface. A funnel cloud is usually visible as a cone-shaped or needle like protuberance from the main cloud base. Funnel clouds form most frequently in association with supercell thunderstorms. If a funnel cloud touches the ground it becomes a tornado. Most tornadoes begin as funnel clouds, but many funnel clouds do not make ground contact and so do not become tornadoes.

Glazed Frost – A coat of ice, generally smooth and clear, formed by the falling of rain or drizzle (or sleet) on a surface whose temperature is below freezing-point: It may also form due to a sudden onset of warm, moist air following a severe frost, by the condensation and freezing of water on surfaces at temperatures still below freezing-point.
Grass Minimum Temperature – The minimum temperature indicated by a thermometer freely exposed in an open situation at night with its bulb in contact with the tips of the grass blades on an area covered with short turf.

Ground Frost – The term in forecasts signifies a grass minimum temperature below 0°C (32°F).

Gust front - is a leading edge/boundary (squall line) that separates cold downdraft (outflow (winds that flow outwards from a thunderstorm)) of an organised line of thunderstorms from warm, humid surface (environmental) air. Its passage at the surface resembles the passage of a cold front. This squall line is marked by upward motion along it and downward motion behind it. It is normally followed by a surge of gusty winds on or near the ground. A gust front is often associated with an atmospheric pressure rise, wind shift, an air temperature drop and sometime heavy precipitation.

Hoar/Grass Frost – This is a series of interlocked ice crystals that develop on surfaces during cold, typically clear nights where the exposed surface is chilled below the dew point of the surrounding air and the surface itself is colder than 0°C. Similarly, where air cooled by ground-level radiation loss travels downhill to form pockets of cold air in depressions, valleys and frost hollows, hoar frost can form even where the air temperature at the ground is above freezing.

Humidity – This is the term used to describe the amount of water vapour in the air and can indicate the likelihood of precipitation, dew or fog. A device used to measure humidity is called a hygrometer. At an official weather station, humidity is recorded by a wet bulb and dry bulb thermometer. The difference between the two temperature readings allows the observer to calculate the dew point and also the humidity in a percentage form.

Katabatic wind – On a 'radiation night' of clear skies and low pressure gradient, terrestrial radiation from the earth's surface causes a layer of cold air to form near the ground, with an associated inversion of temperature. If the ground is sloping, the air close to the ground is colder than air at the same level but at some horizontal distance. Downslope gravitational flow of the colder, denser air beneath the warmer, lighter air results and comprises the 'katabatic wind'.

Nautical dawn and dusk – Morning nautical twilight begins (nautical dawn) and evening nautical twilight ends (nautical dusk) when the geometric centre of the sun reaches 12° below the horizon. Nautical twilight (when the sun is between 6° and 12° below the horizon), artificial lighting must be used to see terrestrial objects clearly. Before nautical dawn and after nautical dusk, sailors cannot navigate via the horizon at sea. Under good atmospheric conditions with the absence of other illumination, during nautical twilight, the human eye may distinguish general outlines of ground objects but cannot participate in detailed outdoor operations.

Occlusion – A front which develops during the later stages of the life-cycle of a frontal depression. The term arises from the associated occluding (shutting off) of the warm air from the earth's surface.

Okta – Unit, equal to area of one eighth of the sky, used in specifying cloud amount.

Sensible and Latent Heat (Hidden Heat) – In meteorology, latent heat flux is the flux of heat from the Earth's surface to the atmosphere that is associated with evaporation or transpiration of water at the surface and subsequent condensation of water vapor in the troposphere. It is an important component of Earth's surface energy budget.

Sleet – Precipitation of snow and rain together or of snow melting as it falls.

Squall - is a sudden, sharp increase in wind speed which is usually associated with active weather, such as rain showers, thunderstorms, or heavy snow. Squalls refer to an increase in the sustained winds over a short time interval, as there may be higher gusts during a squall event. They usually occur in a region of strong mid-level height falls, mid-level tropospheric cooling, which force strong localised upward motions at the leading edge of the region of cooling, which then enhances local downward motions just in its wake.

Straight-line winds - are very strong winds that can produce damage, demonstrating a lack of a rotational damage pattern. Such rotational damage patterns are associated with cyclonic storms including tornadoes and tropical cyclones. Straight-line winds are common with the gust front of a thunderstorm or originate with a downburst from a thunderstorm. These events can cause considerable damage, even in the absence of a tornado. The winds can reach 80mph (130km/h) or more and can last for periods of twenty minutes or longer.

Synoptic Meteorological Charts – This is a weather chart that reflects the state of the atmosphere over a geographical area at a certain time based on information gathered from weather stations at surface level. The chart is created by plotting or tracing the values of relevant quantities (including sea level pressure, temperatures, etc.) and [illegible] the presence or potential development of weather fronts and systems.

Thaw – The transition by melting from snow or ice to water. The term is especially used to indicate the end of a spell of frost, which in the British Isles in winter is generally associated with the displacement of a stagnant or continental air mass by one of maritime origin.

Tornado – is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud. Tornadoes come in many shapes and sizes, but they are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust. Most tornadoes have wind speeds less than 110 mph (177km/h), are about 250 feet (76m) across, and travel a few miles before dissipating.

Trough - A non frontal line on a synoptic chart usually associated with an organised band of generally cloudy, showery weather.

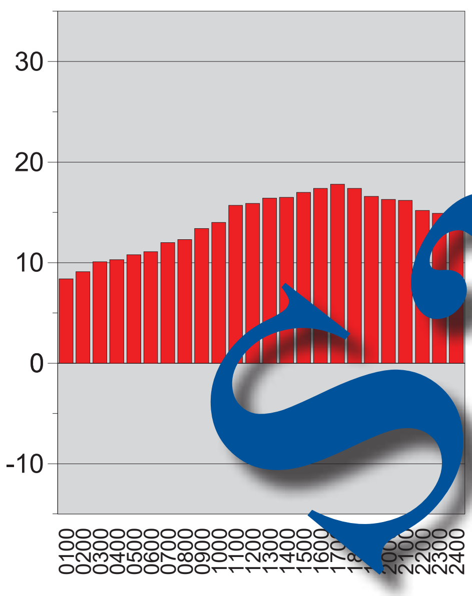
Visibility – Meteorological visibility is defined as the greatest distance at which a black object of suitable distance can be seen and recognised against the horizon sky. The simplest determinations of daylight visibility have, for many years, been deduced by how well a series of objects or lights of known distance can be seen from a certain point of a meteorological station. The estimated distance is then noted in the records. More recently; however, automated weather systems including a "forward scatter sensor" have been used, particularly at airports. This instrument produces pulsed flashes of light, some of which is scattered at an angle towards a nearby detector. Visibility is then estimated from the intensity of the scattered light. The sensors report a visibility based on one minute samples averaged over the past ten minutes leading up to each observation.

Warm Front – A frontal system whose movement is such that the warmer air mass is replacing a colder air mass. The passage of a warm front is marked at the surface by a rise in temperature and dew-point, a veer of wind direction and a steadying of pressure.

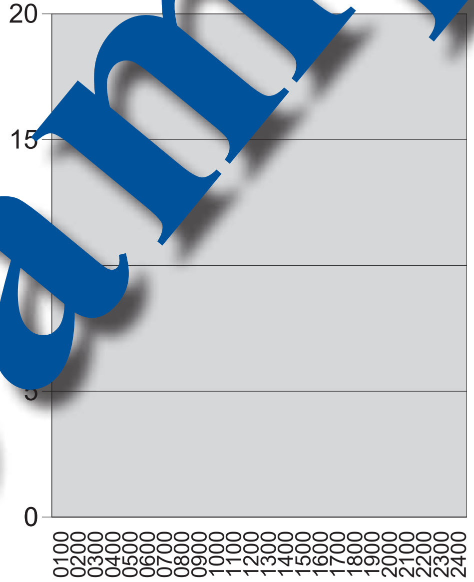
Weather at Pateley Bridge, Ravens Nest (259m ASL) 6.8 miles SE of HG3 5ST (210m ASL)
Friday 21 July 2017 (Appendix 2)

GMT	Air Temp	Humidity	Rain	Visibility	Sun	Cloud Cover	Wind From	Mean Wind	Max Gust	Weather
0100	8.4°C	92.8%	0.0mm							No data
0200	9.1°C	91.6%	0.0mm							No data
0300	10.1°C	89.8%	0.0mm							No data
0400	10.3°C	90.4%	0.0mm							No data
0500	10.8°C	90.5%	0.0mm							No data
0600	11.1°C	92.3%	0.0mm							No data
0700	12.0°C	93%	0.0mm							No data
0800	12.3°C	94.2%	0.0mm							No data
0900	13.4°C	94.9%	0.0mm							No data
1000	14.0°C	90.7%	0.0mm							No data
1100	15.7°C	84%	0.0mm							No data
1200	15.9°C	79.2%	0.0mm							No data
1300	16.4°C	73.8%	0.0mm							No data
1400	16.5°C	72.8%	0.0mm							No data
1500	17.0°C	68.7%	0.0mm							No data
1600	17.4°C	66.5%	0.0mm							No data
1700	17.8°C	64.9%	0.0mm							No data
1800	17.4°C	66.5%	0.0mm							No data
1900	16.6°C	70%	0.0mm							No data
2000	16.3°C	69.5%	0.0mm							No data
2100	16.2°C	63.7%	0.0mm							No data
2200	15.2°C	72.6%	0.0mm							No data
2300	14.9°C	85%	0.0mm							No data
2400	14.6°C	86.1%	0.0mm							No data
Totals			0.0mm							

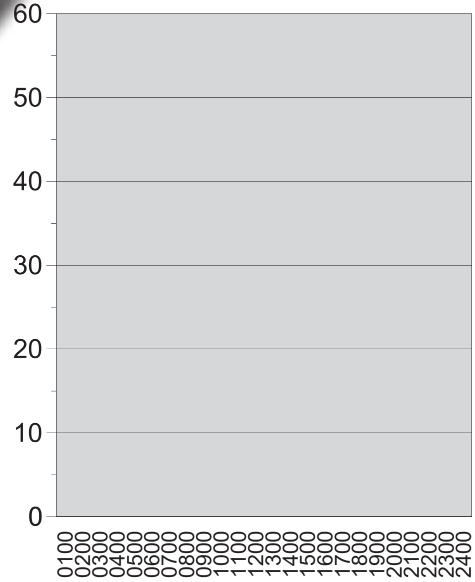
Air Temperature (°C)



(mm)



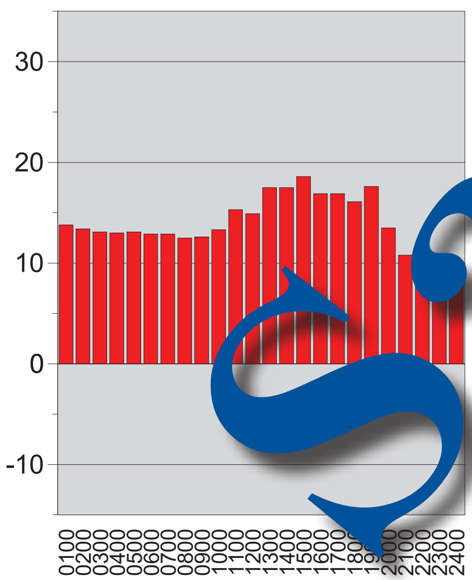
Mean Wind & Gust (kt)



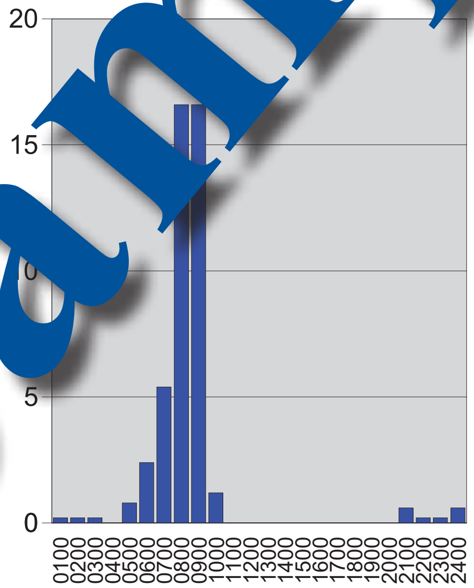
Weather at Pateley Bridge, Ravens Nest (259m ASL) 6.8 miles SE of HG3 5ST (210m ASL)
Saturday 22 July 2017 (Appendix 2)

GMT	Air Temp	Humidity	Rain	Visibility	Sun	Cloud Cover	Wind From	Mean Wind	Max Gust	Weather
0100	13.8°C	90.1%	0.2mm							No data
0200	13.4°C	93.1%	0.2mm							No data
0300	13.1°C	96.8%	0.2mm							No data
0400	13.0°C	98.1%	0.0mm							No data
0500	13.1°C	98.7%	0.8mm							No data
0600	12.9°C	98.7%	2.4mm							No data
0700	12.9°C	98.1%	5.4mm							No data
0800	12.5°C	98%	16.6mm							No data
0900	12.6°C	98.7%	16.6mm							No data
1000	13.3°C	99.4%	1.2mm							No data
1100	15.3°C	86.7%	0.0mm							No data
1200	14.9°C	87.3%	0.0mm							No data
1300	17.5°C	74.4%	0.0mm							No data
1400	17.5°C	60.6%	0.0mm							No data
1500	18.6°C	57.7%	0.0mm							No data
1600	16.9°C	64.7%	0.0mm							No data
1700	16.9°C	64.7%	0.0mm							No data
1800	16.1°C	70.4%	0.0mm							No data
1900	17.6°C	64%	0.0mm							No data
2000	13.5°C	79.9%	0.0mm							No data
2100	10.8°C	93.5%	0.6mm							No data
2200	10.5°C	94.8%	0.2mm							No data
2300	10.4°C	94.2%	0.2mm							No data
2400	10.2°C	95.4%	0.6mm							No data
Totals			45.2mm							

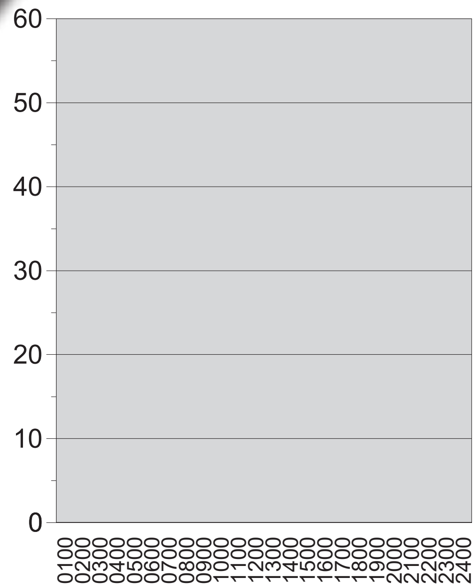
Air Temperature (°C)



Rain (mm)



Mean Wind & Gust (kt)



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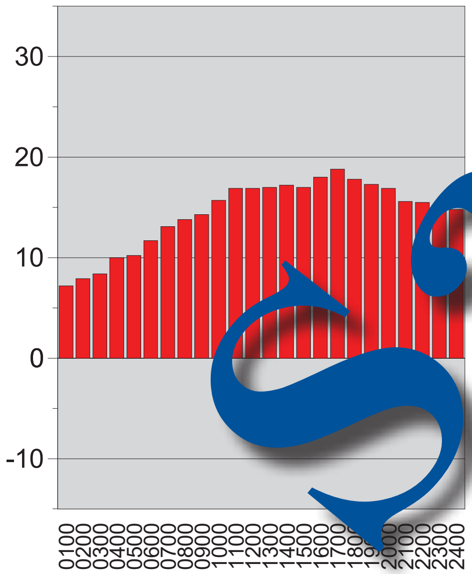
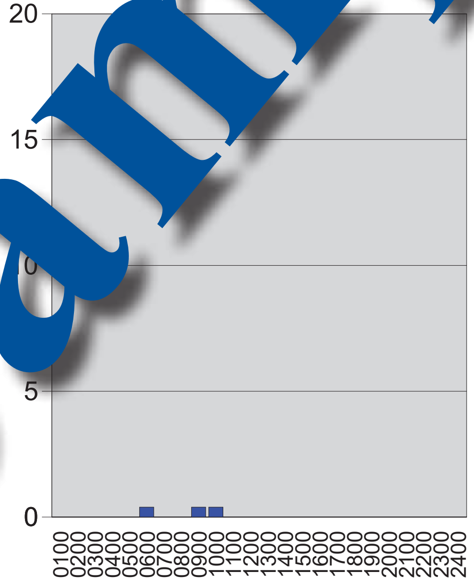
Weather at Bainbridge (210m ASL) 14.5 miles NW of HG3 5ST (210m ASL)
Friday 21 July 2017 (Appendix 2)

GMT	Air Temp	Humidity	Rain	Visibility	Sun	Cloud Cover	Wind From	Mean Wind	Max Gust	Weather
0100	7.2°C	96.6%	0.0mm							No data
0200	7.9°C	98%	0.0mm							No data
0300	8.4°C	98%	0.0mm							No data
0400	10.0°C	92.2%	0.0mm							No data
0500	10.2°C	91.6%	0.0mm							No data
0600	11.7°C	91.7%	0.4mm							No data
0700	13.1°C	88.8%	0.0mm							No data
0800	13.8°C	85.4%	0.0mm							No data
0900	14.3°C	86.6%	0.4mm							No data
1000	15.7°C	86.2%	0.4mm							No data
1100	16.9°C	78.8%	0.0mm							No data
1200	16.9°C	77.3%	0.0mm							No data
1300	17.0°C	71.9%	0.0mm							No data
1400	17.2°C	71%	0.0mm							No data
1500	17.0°C	70.1%	0.0mm							No data
1600	18.0°C	66.7%	0.0mm							No data
1700	18.8°C	60.9%	0.0mm							No data
1800	17.8°C	63.2%	0.0mm							No data
1900	17.3°C	67.8%	0.0mm							No data
2000	16.9°C	67.3%	0.0mm							No data
2100	15.6°C	78.1%	0.0mm							No data
2200	15.5°C	77.6%	0.0mm							No data
2300	15.2°C	82.8%	0.0mm							No data
2400	14.8°C	85.6%	0.0mm							No data
Totals			1.2mm							

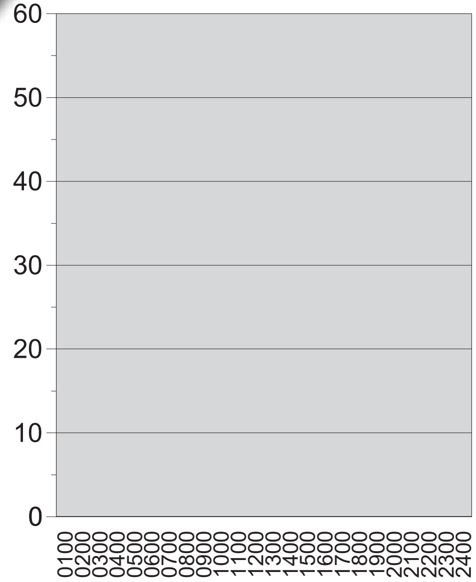
Air Temperature (°C)



Ra… (mm)



Mean Wind & Gust (kt)



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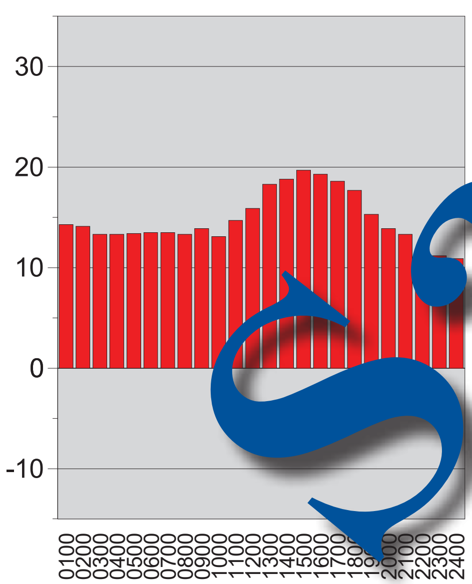
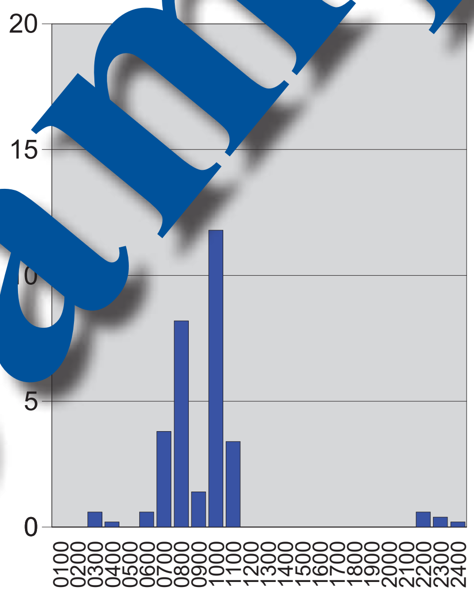
Weather at Bainbridge (210m ASL) 14.5 miles NW of HG3 5ST (210m ASL)
Saturday 22 July 2017 (Appendix 2)

GMT	Air Temp	Humidity	Rain	Visibility	Sun	Cloud Cover	Wind From	Mean Wind	Max Gust	Weather
0100	14.3°C	87.8%	0.0mm							No data
0200	14.1°C	88.3%	0.0mm							No data
0300	13.3°C	93.7%	0.6mm							No data
0400	13.3°C	96.2%	0.2mm							No data
0500	13.4°C	95.5%	0.0mm							No data
0600	13.5°C	95.5%	0.6mm							No data
0700	13.5°C	97.4%	3.8mm							No data
0800	13.3°C	96.2%	8.2mm							No data
0900	13.9°C	97.4%	1.4mm							No data
1000	13.1°C	94.9%	11.8mm							No data
1100	14.7°C	93.1%	3.4mm							No data
1200	15.9°C	86.2%	0.0mm							No data
1300	18.3°C	79%	0.0mm							No data
1400	18.8°C	67.3%	0.0mm							No data
1500	19.7°C	64.5%	0.0mm							No data
1600	19.3°C	57.1%	0.0mm							No data
1700	18.6°C	51.1%	0.0mm							No data
1800	17.7°C	57.9%	0.0mm							No data
1900	15.3°C	74%	0.0mm							No data
2000	13.9°C	82.1%	0.0mm							No data
2100	13.3°C	88.3%	0.0mm							No data
2200	11.5°C	88.1%	0.6mm							No data
2300	11.2°C	94.2%	0.4mm							No data
2400	10.9°C	94.2%	0.2mm							No data
Totals			31.2mm							

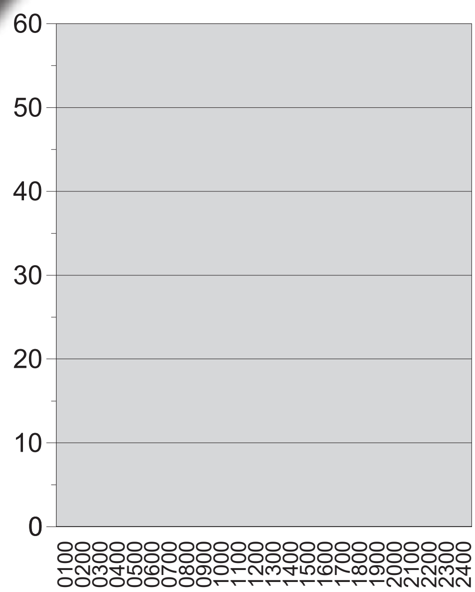
Air Temperature (°C)



(mm)



Mean Wind & Gust (kt)



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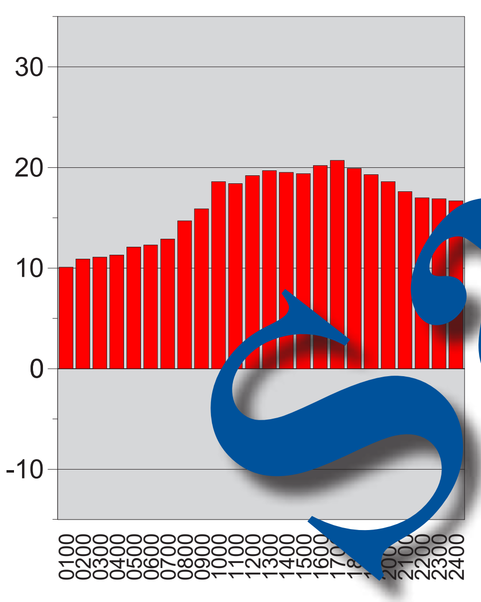
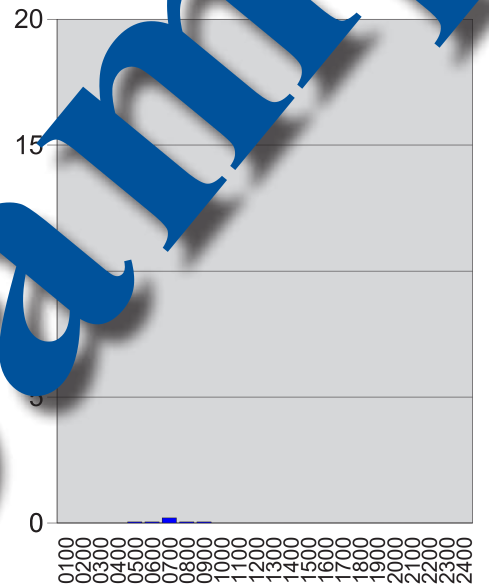
Weather at Leeming (33m ASL) 16.5 miles NE of HG3 5ST (210m ASL)
Friday 21 July 2017 (Appendix 2)

GMT	Air Temp	Humidity	Rain	Visibility	Sun	Cloud Cover	Wind From	Mean Wind	Max Gust	Weather
0100	10.1°C	85.6%	0.0mm	35km	0hr	75%	150°	5kt	9kt	None
0200	10.9°C	83.4%	0.0mm	35km	0hr	87.5%	140°	5kt	9kt	None
0300	11.1°C	84%	0.0mm	30km	0hr	87.5%	130°	6kt	11kt	None
0400	11.3°C	85.8%	0.0mm	35km	0hr	100%	150°	6kt	11kt	None
0500	12.1°C	81.3%	0.05mm	35km	0hr	87.5%	140°	8kt	13kt	Rain
0600	12.3°C	84.7%	0.05mm	23km	0hr	87.5%	150°	10kt	17kt	Rain
0700	12.9°C	89.4%	0.2mm	20km	0.2hr	62.5%	140°	10kt	16kt	Drizzle
0800	14.7°C	81.7%	0.05mm	25km	0.2hr	62.5%	150°	13kt	22kt	Slight intermittent rain
0900	15.9°C	77.2%	0.05mm	20km	0.2hr	87.5%	150°	13kt	22kt	Ground moist. Rain
1000	18.6°C	64.6%	0.0mm	30km	0.5hr	87.5%	160°	17kt	25kt	None
1100	18.4°C	63.3%	0.0mm	30km	0.1hr	87.5%	150°	15kt	25kt	None
1200	19.2°C	58.7%	0.0mm	40km	0.1hr	87.5%	150°	17kt	27kt	Ground moist
1300	19.7°C	56.9%	0.0mm	30km	0.1hr	87.5%	160°	17kt	25kt	None
1400	19.5°C	57.6%	0.0mm	35km	0hr	87.5%	150°	14kt	[illegible]	None
1500	19.4°C	56.8%	0.0mm	40km	0hr	87.5%	140°	11kt	19kt	Ground moist
1600	20.2°C	58.9%	0.0mm	30km	0hr	87.5%	120°	8kt	14kt	None
1700	20.7°C	52.4%	0.0mm	40km	0.3hr	87.5%	[illegible]	10kt	[illegible]	None
1800	19.9°C	60.4%	0.0mm	30km	0.4hr	50%	[illegible]	12kt	[illegible]	None
1900	19.3°C	63.1%	0.0mm	22km	0.1hr	75%	120°	[illegible]	17kt	None
2000	18.6°C	67.2%	0.0mm	22km	0hr	87.5%	110°	[illegible]	16kt	None
2100	17.6°C	69.7%	0.0mm	18km	0hr	62.5%	120°	10kt	[illegible]	None
2200	17.0°C	72.4%	0.0mm	20km	0hr	87.5%	[illegible]	11kt	19kt	None
2300	16.9°C	73.4%	0.0mm	19km	0hr	87.5%	[illegible]	12kt	21kt	None
2400	16.7°C	72.4%	0.0mm	18km	0hr	100%	130°	[illegible]	22kt	None
Totals			0.4mm		2.2hr					

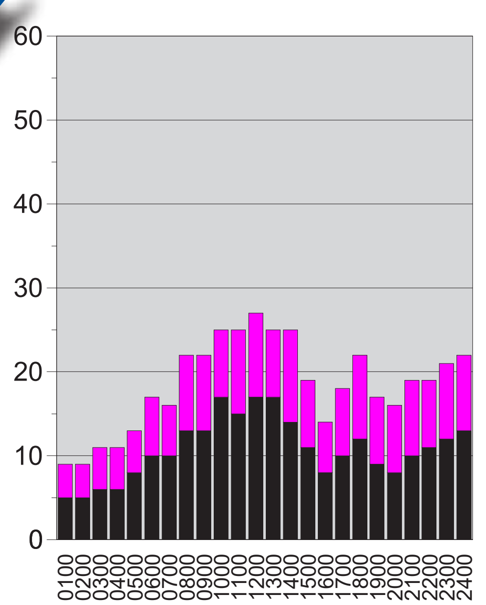
Air Temperature (°C)



Rainfall (mm)



Mean Wind & Gust (kt)



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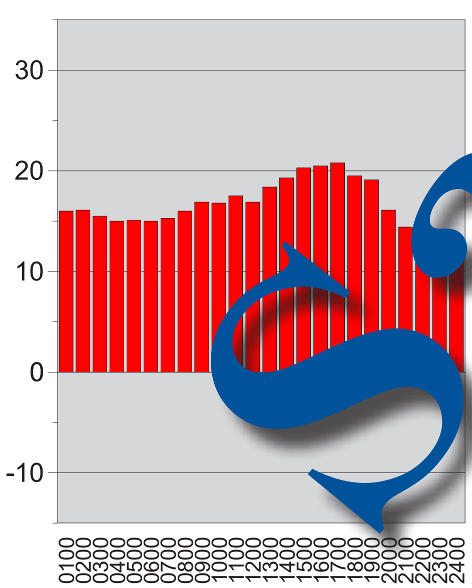
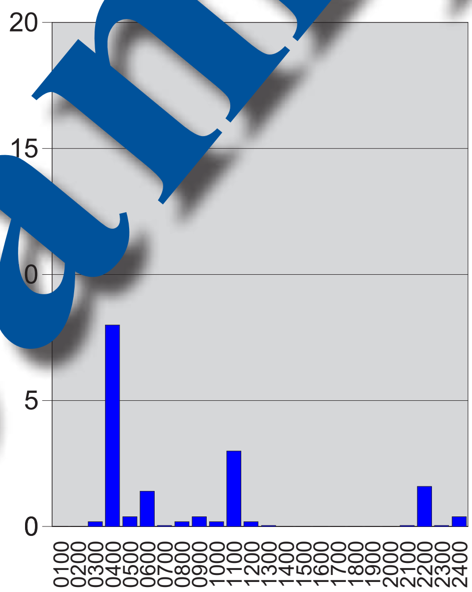
Weather at Leeming (33m ASL) 16.5 miles NE of HG3 5ST (210m ASL)
Saturday 22 July 2017 (Appendix 2)

GMT	Air Temp	Humidity	Rain	Visibility	Sun	Cloud Cover	Wind From	Mean Wind	Max Gust	Weather
0100	16.0°C	75.7%	0.0mm	18km	0hr	100%	120°	11kt	21kt	None
0200	16.1°C	78.7%	0.0mm	16km	0hr	75%	110°	10kt	19kt	None
0300	15.5°C	89%	0.2mm	10km	0hr	75%	120°	6kt	12kt	Slight rain
0400	15.0°C	96.2%	8.0mm	7km	0hr	62.5%	120°	4kt	9kt	Moderate rain
0500	15.1°C	95.6%	0.4mm	7km	0hr	87.5%	120°	3kt	6kt	Moderate rain
0600	15.0°C	95.6%	1.4mm	7km	0hr	75%	100°	4kt	9kt	Heavy rain
0700	15.3°C	94.4%	0.05mm	8km	0hr	37.5%	080°	3kt	6kt	Rain
0800	16.0°C	92.6%	0.2mm	6km	0hr	62.5%	080°	6kt	11kt	Moderate rain showers
0900	16.9°C	84.1%	0.4mm	21km	0hr	87.5%	100°	8kt	16kt	Rain
1000	16.8°C	85.8%	0.2mm	12km	0hr	75%	100°	7kt	13kt	Moderate rain showers
1100	17.5°C	87.5%	3.0mm	30km	0.2hr	50%	140°	6kt	11kt	Rain
1200	16.9°C	80.9%	0.2mm	40km	0.1hr	62.5%	180°	9kt	15kt	Ground moist. Moderate rain showers
1300	18.4°C	73.6%	0.05mm	40km	0.2hr	87.5%	160°	8kt	14kt	Rain
1400	19.3°C	60.3%	0.0mm	40km	0.7hr	25%	210°	9kt	16kt	None
1500	20.3°C	49.2%	0.0mm	35km	0.6hr	62.5%	[illegible]	7kt	[illegible]	Ground dry
1600	20.5°C	52%	0.0mm	50km	0.6hr	37.5%	[illegible]	8kt	[illegible]	[illegible]
1700	20.8°C	49%	0.0mm	45km	0.9hr	25%	210°	[illegible]	12kt	None
1800	19.5°C	51%	0.0mm	35km	0.7hr	62.5%	210°	[illegible]	7kt	None
1900	19.1°C	58.6%	0.0mm	40km	0.5hr	87.5%	240°	[illegible]	[illegible]	None
2000	16.1°C	69%	0.0mm	50km	0.3hr	87.5%	[illegible]	12kt	[illegible]	None
2100	14.4°C	74.4%	0.05mm	16km	0hr	87.5%	[illegible]	13kt	22kt	Moderate rain showers
2200	12.2°C	89.4%	1.6mm	14km	0hr	100%	230°	[illegible]	11kt	Moderate rain
2300	12.3°C	91.8%	0.05mm	35km	0hr	[illegible]	110°	[illegible]	9kt	Slight rain & drizzle
2400	11.8°C	94.2%	0.4mm	20km	0hr	[illegible]	[illegible]	1kt	2kt	Moderate rain showers
Totals			16.2mm		4.8hr					

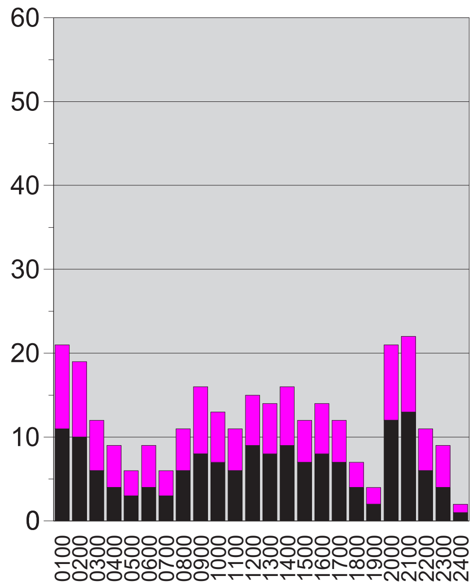
Air Temperature (°C)



Rainfall (mm)



Mean Wind & Gust (kt)



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Weather for 30km around HG3 5ST
21/07/2017 - 23/07/2017 (Appendix 3)

Fri 21 Jul 2017	Grass	Min T	Max T	Rain	Sun	Wind	Mx Gust	from	Significant Weather
Pateley Bridge 2 @9.8km		7.5°C	19.5°C		0.3hr	14mph	25mph	135°	N/A
Pateley Bridge, Ravens Nest @10.9km		7.0°C	18.9°C	0.0mm					N/A
Bainbridge @23.3km	4.5°C	6.8°C	19.0°C	1.2mm					N/A
Leeming @26.5km	5.8°C	8.5°C	20.9°C	0.4mm	2.2hr	20mph	31mph	150°	None

Sat 22 Jul 2017	Grass	Min T	Max T	Rain	Sun	Wind	Mx Gust	from	Significant Weather
Pateley Bridge 2 @9.8km		13.2°C	20.6°C		4.5hr	15mph	26mph	113°	N/A
Pateley Bridge, Ravens Nest @10.9km		12.9°C	19.1°C	45.2mm					16.6mm rain in 1 hour from 0800
Bainbridge @23.3km	12.9°C	13.2°C	19.8°C	31.2mm					11.8mm rain in 1 hour from 0900
Leeming @26.5km	14.5°C	15.0°C	20.9°C	16.2mm	4.9hr	15mph	[illegible]	150°	8mm rain in 1 hour from 0300

Sun 23 Jul 2017	Grass	Min T	Max T	Rain	Sun	Wind	Mx Gust	from	Significant Weather
Pateley Bridge 2 @9.8km		8.8°C	19.5°C	1.1mm	[illegible]	14mph	[illegible]	315°	N/A
Pateley Bridge, Ravens Nest @10.9km		7.0°C	19.7°C	8.8mm					N/A
Bainbridge @23.3km	5.4°C	7.6°C	17.8°C	7.8mm					N/A
Leeming @26.5km	6.5°C	8.7°C	19.8°C	11.5mm	[illegible]	[illegible]	29mph	360°	Fog

Sample

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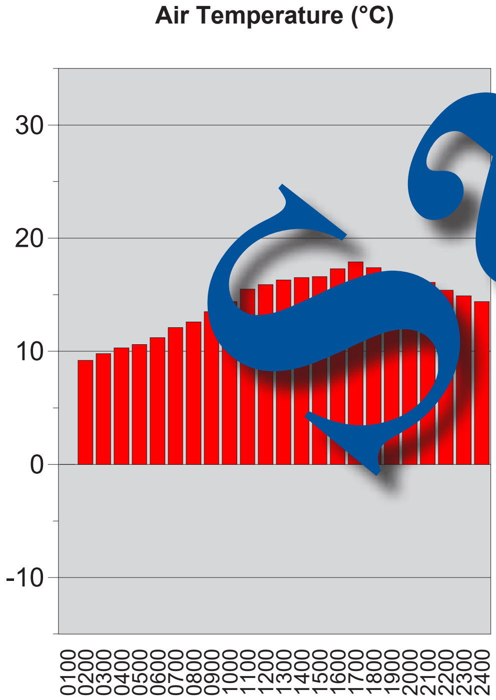
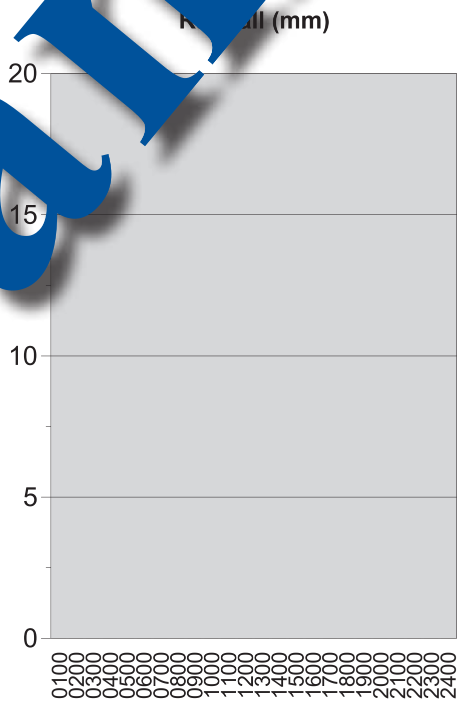
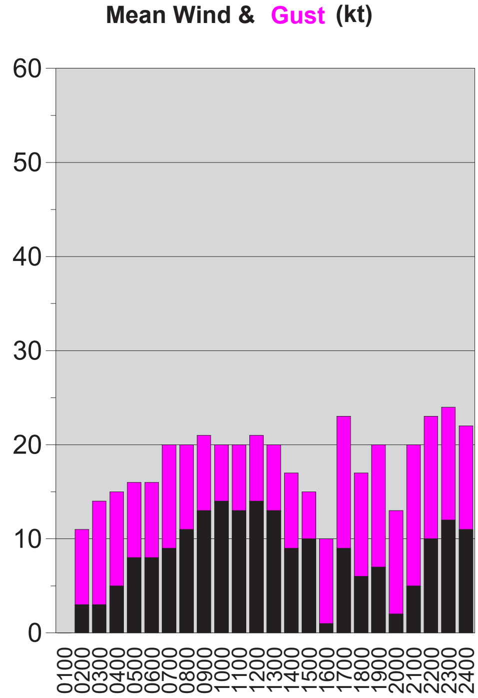
UKPP Weather Report for HG3 5ST
Friday 21 July 2017 (Appendix 5)

GMT	Air Temp	Humidity	Rain*	Visibility	Cloud Cover	Wind From	Mean Wind	Max Gust**	Weather Notes
0100									
0200	9.2°C	90.1%		18,952m	100.0%	129°	3kt	11kt	Nautical Dawn at 0159
0300	9.8°C	90.5%		7,686m	100.0%	124°	3kt	14kt	Moon Rise at 0202
0400	10.3°C	90.2%		19,938m	98.8%	134°	5kt	15kt	Civil Dawn at 0312
0500	10.6°C	90.7%		16,840m	100.0%	133°	8kt	16kt	Sunrise at 0402
0600	11.2°C	91.6%		15,324m	98.8%	139°	8kt	16kt	
0700	12.1°C	92.2%		11,832m	92.5%	144°	9kt	20kt	
0800	12.6°C	91.5%		11,046m	91.2%	140°	11kt	20kt	
0900	13.5°C	91.3%		9,570m	98.8%	149°	13kt	21kt	
1000	14.4°C	89.0%		9,936m	98.8%	143°	14kt	20kt	
1100	15.5°C	84.2%		11,962m	98.8%	148°	13kt	20kt	
1200	15.9°C	81.0%		16,560m	97.5%	146°	14kt	21kt	
1300	16.3°C	76.0%		17,070m	97.5%	153°	13kt	20kt	
1400	16.5°C	73.5%		17,768m	98.8%	136°	[illegible]	17kt	
1500	16.6°C	71.9%		20,686m	98.8%	140°	10kt	[illegible]	
1600	17.3°C	68.4%		19,438m	98.8%	136°	1kt	[illegible]	
1700	17.9°C	64.6%		25,202m	97.5%	134°	9kt	[illegible]	
1800	17.4°C	65.1%		23,502m	83.8%	140°	[illegible]	17kt	
1900	16.9°C	67.4%		26,264m	93.8%	167°	7kt	20kt	Moon Set at 1831
2000	16.5°C	68.6%		30,036m	100.0%	[illegible]	2kt	[illegible]	
2100	16.1°C	68.2%		30,892m	97.5%	[illegible]	[illegible]	[illegible]	Sunset at 2024
2200	15.4°C	73.4%		16,392m	100.0%	111°	[illegible]	23kt	Civil Dusk at 2113
2300	14.9°C	82.2%		14,286m	[illegible]	[illegible]	[illegible]	24kt	Nautical Dusk at 2225
2400	14.4°C	87.0%		17,412m	[illegible]	[illegible]	11kt	[illegible]	
Totals									







*Rainfall & lightning is available from 26/02/2016; **Wind gusts are available from 13/04/2016

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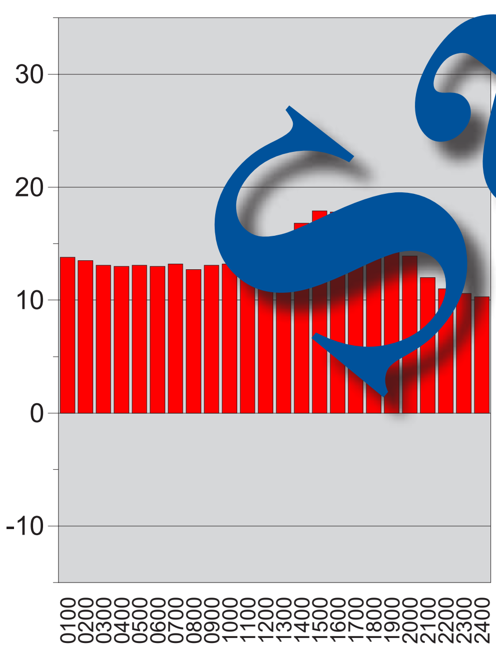
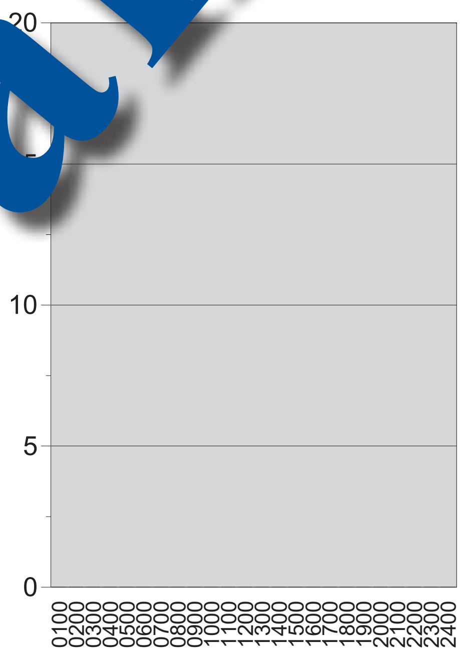
UKPP Weather Report for HG3 5ST
Saturday 22 July 2017 (Appendix 5)

GMT	Air Temp	Humidity	Rain*	Visibility	Cloud Cover	Wind From	Mean Wind	Max Gust**	Weather Notes
0100	13.8°C	90.7%		24,828m	100.0%	113°	12kt	24kt	
0200	13.5°C	92.6%		82m	100.0%	125°	7kt	17kt	Thick fog
0300	13.1°C	95.3%		23,122m	100.0%	126°	7kt	22kt	Nautical Dawn at 0202
0400	13.0°C	97.0%		12,768m	100.0%	131°	5kt	17kt	Civil Dawn at 0314. Moon Rise at 0301
0500	13.1°C	97.5%		7,134m	100.0%	112°	8kt	19kt	Sunrise at 0403
0600	13.0°C	97.6%		3,308m	100.0%	109°	9kt	18kt	
0700	13.2°C	97.1%		8,914m	100.0%	097°	5kt	15kt	
0800	12.7°C	97.4%		4,660m	100.0%	108°	6kt	12kt	
0900	13.1°C	96.1%		3,396m	98.8%	073°	9kt	16kt	Heavy rain
1000	13.2°C	95.7%		7,622m	100.0%	117°	12kt	18kt	Heavy rain
1100	14.8°C	87.2%		15,118m	97.5%	146°	6kt	12kt	
1200	15.1°C	87.8%		16,368m	100.0%	243°	8kt	13kt	
1300	15.7°C	84.5%		19,478m	97.5%	212°	8kt	10kt	
1400	16.8°C	70.3%		20,966m	75.0%	224°	4kt	4kt	
1500	17.9°C	62.2%		25,230m	73.8%	128°	4kt	[illegible]	
1600	17.8°C	57.7%		28,060m	85.0%	218°	9kt	10kt	
1700	18.3°C	56.0%		22,718m	82.5%	217°	4kt	7kt	
1800	16.8°C	63.7%		22,534m	76.2%	247°	1kt	8kt	
1900	16.4°C	67.4%		21,768m	96.3%	255°	1kt	7kt	
2000	13.9°C	79.8%		18,846m	100.0%	112°	4kt	5kt	Moon Set at 1929
2100	12.0°C	89.0%		19,744m	100.0%	156°	9kt	14kt	Sunset at 2023
2200	11.0°C	91.4%		5,350m	100.0%	[illegible]	3kt	8kt	Civil Dusk at 2111
2300	10.6°C	93.8%		21,756m	100.0%	[illegible]	4kt	[illegible]	Nautical Dusk at 2222
2400	10.3°C	95.3%		6,078m	100.0%	028°	1kt	2kt	
Totals									

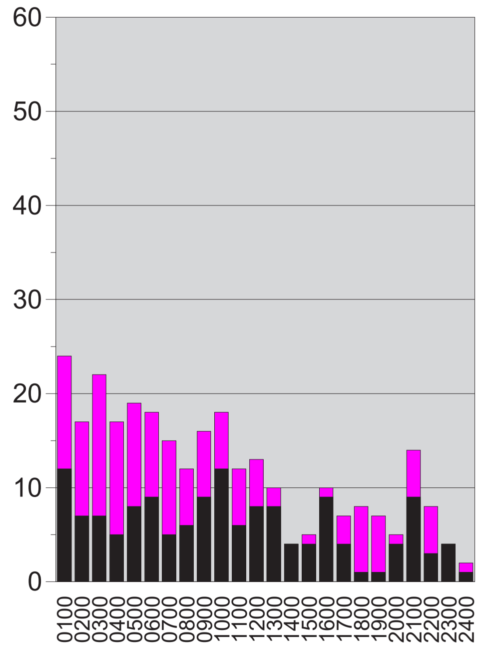
Air Temperature (°C)



Rainfall (mm)



Mean Wind & Gust (kt)



*Rainfall & lightning is available from 26/02/2016; **Wind gusts are available from 13/04/2016

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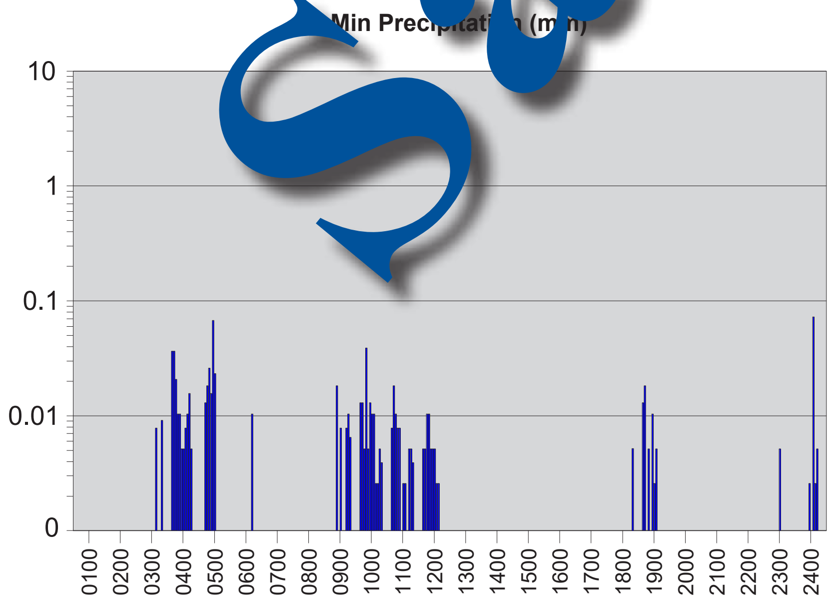
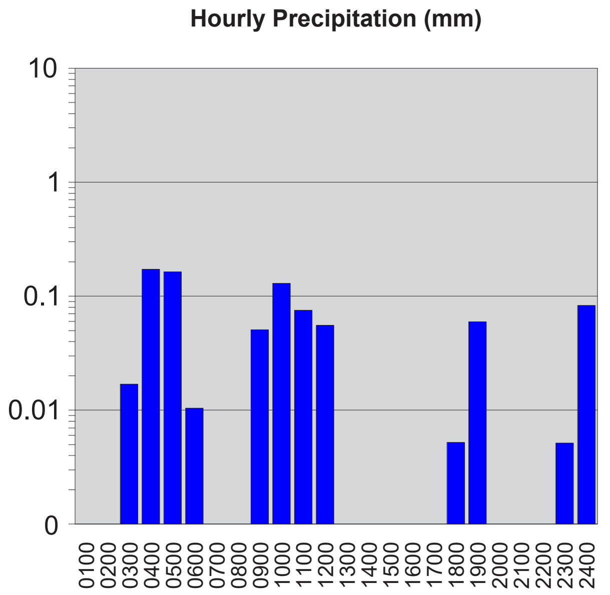
Radar Precipitation Report for HG3 5ST
Friday 21 July 2017 (Appendix 6)

GMT	05	10	15	20	25	30	35	40	45	50	55	60	Hourly Total* (mm)
	Precipitation (mm) for 5 minutes ending												
0001-0100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0101-0200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0201-0300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.009	0.017
0301-0400	0.037	0.037	0.021	0.010	0.010	0.005	0.005	0.008	0.010	0.016	0.005	0.000	0.173
0401-0500	0.000	0.013	0.018	0.026	0.016	0.068	0.023	0.000	0.000	0.000	0.000	0.000	0.164
0501-0600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.010
0601-0700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0701-0800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0801-0900	0.000	0.000	0.000	0.000	0.018	0.000	0.008	0.000	[illegible]	[illegible]	0.010	0.007	0.051
0901-1000	0.013	0.013	0.005	0.039	0.005	0.013	0.010	0.010	[illegible]	0.003	0.005	0.004	0.130
1001-1100	0.008	0.018	0.010	0.008	0.008	0.000	0.003	[illegible]	[illegible]	0.005	0.005	0.004	0.076
1101-1200	0.005	0.005	0.010	0.010	0.005	0.005	0.005	[illegible]	0.003	[illegible]	0.000	0.000	0.056
1201-1300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.000	0.000	0.000
1301-1400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.000	0.000	0.000
1401-1500	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000
1501-1600	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000
1601-1700	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.000	0.000	0.000	0.000	0.000
1701-1800	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	[illegible]	0.000	0.000	0.000	0.005	0.005
1801-1900	0.013	0.018	0.000	0.005	0.000	[illegible]	0.003	[illegible]	0.000	0.000	0.000	0.000	0.060
1901-2000	0.000	0.000	0.000	0.000	[illegible]	0.000	[illegible]	0.000	0.000	0.000	0.000	0.000	0.000
2001-2100	0.000	0.000	0.000	0.000	[illegible]	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000	0.000
2101-2200	0.000	0.000	0.000	0.000	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2201-2300	0.000	0.000	0.000	0.000	[illegible]	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.005
2301-2400	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.073	0.003	0.005	0.000	0.000	0.083
0001 - 2400 Total (mm)													0.830





*NB:The 12 5-minute precipitation totals may not exactly match the hourly total. The latter are calculated using a more precise 'trapezium' rule.

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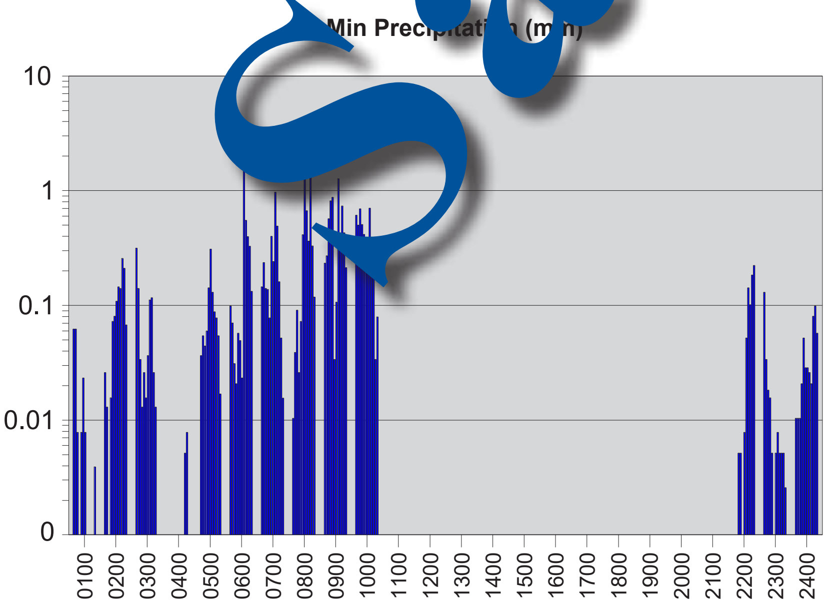
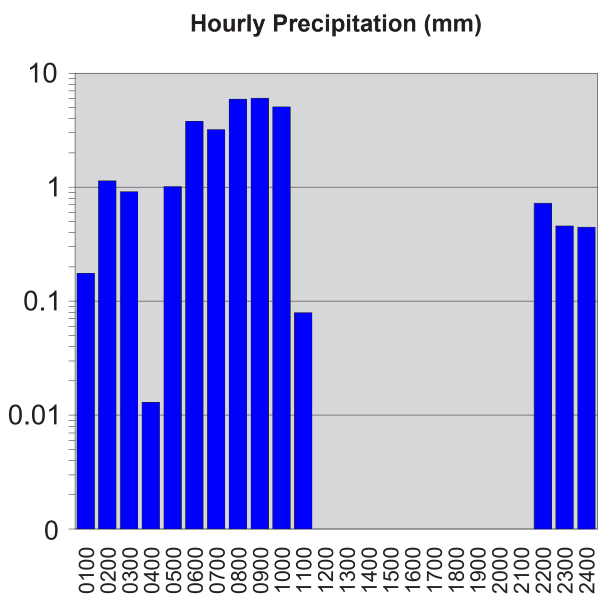
Radar Precipitation Report for HG3 5ST
Saturday 22 July 2017 (Appendix 6)

GMT	05	10	15	20	25	30	35	40	45	50	55	60	Hourly Total* (mm)
	------------------------------ Precipitation (mm) for 5 minutes ending ------------------------------												
0001-0100	0.063	0.063	0.008	0.000	0.008	0.023	0.008	0.000	0.000	0.000	0.000	0.004	0.176
0101-0200	0.026	0.013	0.000	0.016	0.073	0.081	0.109	0.146	0.141	0.258	0.211	0.068	1.145
0201-0300	0.318	0.141	0.034	0.013	0.026	0.016	0.037	0.112	0.117	0.026	0.013	0.000	0.919
0301-0400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.008	0.000	0.013
0401-0500	0.000	0.037	0.055	0.044	0.060	0.143	0.310	0.130	0.089	0.078	0.055	0.017	1.017
0501-0600	0.099	0.070	0.031	0.021	0.057	0.050	0.023	2.008	0.555	0.398	0.328	0.133	3.790
0601-0700	0.146	0.237	0.141	0.138	0.078	0.401	0.242	0.974	0.492	0.162	0.052	0.016	3.211
0701-0800	0.010	0.039	0.091	0.026	0.073	0.414	1.950	0.672	0.365	1.854	0.331	0.119	5.960
0801-0900	0.234	0.271	0.570	0.818	0.880	0.034	0.107	1.279	[illegible]	[illegible]	0.432	0.214	6.077
0901-1000	0.615	0.503	0.698	0.508	0.417	0.365	0.352	0.706	[illegible]	0.299	0.034	0.079	5.087
1001-1100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	[illegible]	0.000	0.000	0.000	0.079
1101-1200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	[illegible]	0.000	0.000	0.000
1201-1300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.000	0.000	0.000
1301-1400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.000	0.000	0.000
1401-1500	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000
1501-1600	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000
1601-1700	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.000	0.000	0.000	0.000	0.000
1701-1800	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	[illegible]	0.000	0.000	0.000	0.000	0.000
1801-1900	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	[illegible]	0.000	0.000	0.000	0.000	0.000
1901-2000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	0.000	0.000	0.000	0.000	0.000	0.000
2001-2100	0.000	0.000	0.000	0.000	[illegible]	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000	0.000
2101-2200	0.000	0.000	0.000	0.005	[illegible]	[illegible]	0.008	0.052	0.143	0.102	0.185	0.224	0.724
2201-2300	0.130	0.034	0.018	0.016	[illegible]	0.000	0.005	0.008	0.005	0.005	0.005	0.003	0.458
2301-2400	0.010	0.010	0.010	0.021	0.052	[illegible]	0.029	0.026	0.021	0.081	0.099	0.057	0.448
0001 - 2400 Total (mm)													29.104





*NB:The 12 5-minute precipitation totals may not exactly match the hourly total. The latter are calculated using a more precise 'trapezium' rule.

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Rainfall Return periods for Middlesmoor, North Yorkshire (HG3 5ST) (Appendix 7)

Rainfall (mm) for range of return periods X durations

	Return period (years)													
Sliding Duration	**Twice a Year**	**1**	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**	**1000**	**2000**	**5000**	**10000**
15 mins	[illegible]	[illegible]	7.9	10.3	13.1	16.7	22.6	28.5	35.8	48.4	60.8	76.4	103.3	129.7
30 mins	[illegible]	[illegible]	10.6	13.6	17.2	21.6	28.9	36.0	44.7	59.6	74.0	91.9	122.5	152.2
60 mins	[illegible]	11.6	14.2	18.1	22.6	28.0	36.9	45.4	55.8	73.3	90.1	110.7	145.3	178.5
2 hrs	[illegible]	15.7	19.1	24.0	29.6	36.2	47.1	57.3	69.7	90.2	109.6	133.2	172.3	209.4
3 hrs	[illegible]	[illegible]	22.7	28.3	34.7	42.2	54.3	65.7	79.3	101.8	122.9	148.4	190.4	229.9
4 hrs	17.8	[illegible]	[illegible]	31.8	38.8	47.0	60.1	72.3	87.0	110.9	133.3	160.3	204.3	245.6
6 hrs	21.4	[illegible]	[illegible]	37.5	45.4	54.6	69.3	82.9	99.0	125.3	149.6	178.6	225.8	269.6
8 hrs	24.4	29.0	[illegible]	42.2	50.8	60.8	76.7	91.3	108.6	136.5	162.3	192.9	242.3	288.1
12 hrs	29.4	[illegible]	41.0	[illegible]	59.6	70.8	88.5	104.7	123.7	154.1	182.0	214.9	267.8	316.2
18 hrs	35.1	[illegible]	48.4	[illegible]	69.2	81.7	101.3	119.0	139.7	172.6	202.6	237.7	293.6	344.5
24 hrs	39.9	46.5	[illegible]	65.1	77.0	90.5	111.5	130.4	152.4	187.1	218.6	255.3	313.4	366.1
36 hrs	47.6	55.3	[illegible]	[illegible]	[illegible]	104.5	127.7	148.3	172.2	209.6	243.3	282.3	343.7	398.8
48 hrs	54.0	62.4	[illegible]	[illegible]	[illegible]	115.7	140.5	162.5	187.7	227.2	262.5	303.2	366.9	423.8
72 hrs	63.0	72.3	83.0	[illegible]	[illegible]	130.5	157.0	180.4	207.1	248.5	285.2	327.4	392.7	450.7
96 hrs	70.3	80.3	91.8	[illegible]	[illegible]	[illegible]	169.9	194.3	222.1	264.9	302.6	345.7	412.2	470.9
144 hrs	82.0	93.1	105.7	122.4	[illegible]	[illegible]	189.9	215.7	245.0	289.7	328.8	373.2	441.3	500.9
192 hrs	91.5	103.4	116.8	134.6	153.6	[illegible]	[illegible]	232.4	262.6	308.7	348.8	394.1	463.1	523.3

Rainfall (mm) for range of return periods X durations

	Return period (years)													
Fixed Duration	**Twice a Year**	**1**	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**	**1000**	**2000**	**5000**	**10000**
1 hr	8.1	10.0	12.3	15.6	19.5	24.1	[illegible]	39.1	[illegible]	63.2	77.6	95.4	125.2	153.9
2 hrs	12.0	14.6	17.7	22.2	27.4	33.6	[illegible]	[illegible]	[illegible]	83.5	101.5	123.3	159.5	193.9
3 hrs	14.8	17.9	21.6	26.9	33.0	40.2	[illegible]	[illegible]	[illegible]	97.0	117.1	141.3	181.3	218.9
4 hrs	17.3	20.7	24.9	30.9	37.7	45.6	58.4	[illegible]	[illegible]	107.7	129.5	155.6	198.4	238.4
6 hrs	21.0	25.1	29.9	36.8	44.6	53.6	68.0	[illegible]	97.1	122.8	146.6	175.1	221.4	264.3
8 hrs	24.2	28.7	34.2	41.8	50.3	60.2	76.0	[illegible]	107.5	135.2	160.7	191.0	239.9	285.2
12 hrs	29.4	34.7	41.0	49.8	59.6	70.8	88.5	104.7	123.7	154.1	182.0	214.9	267.8	316.2
18 hrs	35.1	41.2	48.4	58.2	69.2	81.7	101.3	119.0	139.7	172.6	202.6	237.7	293.6	344.5
1 day	34.4	40.1	46.9	56.1	66.4	78.0	96.1	112.4	131.3	161.3	188.4	220.1	270.2	315.6
2 days	48.7	56.2	64.9	76.8	89.8	104.3	126.6	146.4	169.1	204.7	236.5	273.2	330.5	381.8
3 days	58.9	67.6	77.6	91.1	105.7	122.0	146.7	168.6	193.6	232.3	266.6	306.0	367.0	421.3
4 days	67.0	76.5	87.4	102.0	117.8	135.3	161.8	185.0	211.5	252.2	288.2	329.2	392.6	448.5
6 days	79.6	90.4	102.6	118.9	136.3	155.5	184.4	209.4	237.8	281.3	319.3	362.4	428.4	486.3
8 days	90.6	102.3	115.6	133.3	152.1	172.7	203.5	230.1	260.0	305.7	345.4	390.2	458.6	518.1

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Beaufort Scale (Appendix 8)

1 mph = 0.868 Knots

Beaufort Force	Description	Mean Speed (mph)	Lower Limit (mph)	Upper L[illegible] (mph)	Specification on Land	As Used at Sea: State of Sea	As Used at Sea: Specififcation at Sea	Height of Waves (ft)
0	Calm	0	0	[illegible]	Ca[illegible]; smoke rises vertically	Calm	Sea like a mirror	0
1	Light Air	2	[illegible]	[illegible]	Direction of wind shown by smoke drift but not by wind vanes	Calm	Ripples with the appearance of scales are formed, without foam crests	0.3
2	Light Breeze	5	4	[illegible]	Win[illegible] on face; leaves rustle	Smooth	Small wavelets, still short but more pronounced; crests have a glassy appearance and do not break	0.6
3	Gentle Breeze	10	8	12	[illegible]ves [illegible] twigs in constant [illegible]tion; [illegible] extends [illegible]ht flag	Smooth	Large wavelets; crests begin to break; foam is of glassy appearance; scattered white horses	2
4	Moderate Breeze	15	13	18	Dust [illegible]se paper [illegible] small branc[illegible] moved	Slight	Small waves; becoming longer; fairly frequent white horses	3
5	Fresh Breeze	21	18	24	Small trees in [illegible]egin to crested wavel[illegible]orm on [illegible]	Moderate	Moderate waves with more pronounced long form; many white horses; chance of some spray	7
6	Strong Breeze	27	24	31	Large branches in m[illegible]whistlin[illegible] heard in telegraph wir[illegible]	[illegible]ough	Large waves begin to form; white foam crests are more extensive everywhere; probably some spray	10
7	Near Gale	35	31	38	Whole trees in motion; inconvenience felt when walki[illegible] against the wind	Ver[illegible]h	Sea heaps up and white foam from breaking waves begins to be [illegible]lown in streaks along the direction of the wind	13
8	Gale	42	39	46	Twigs break off trees; difficult to wal[illegible] against wind	[illegible]h	[illegible]oderatel[illegible] waves of greater length; edges of crests begin to [illegible]reak in[illegible]drift; foam blown along the direction of the wind	18
9	Strong Gale	50	47	54	Slight structural damage to chimne[illegible] pots, aerials & roof slates	Very [illegible]	High [illegible]s; dense streaks of foam along the direction of the wind; cre[illegible] waves topple, tumble and roll over; spray may affect [illegible]y	23
10	Storm	59	55	63	Trees uprooted; considerable structural damage	Very High	Ve[illegible]y high [illegible]s with [illegible]g overhanging crests; foam patches blown in dense [illegible] strea[illegible]eavy “tumbling” of sea; visibility affected	30
11	Violent Storm	68	64	72	Widespread structural damage	Phenomenal	Exceptiona[illegible]high waves (ships sometimes lost to view behind the waves); every[illegible] the edges of the wave crests are blown into froth	38
12	Hurricane	-	73	-	Devastation	Phenomenal	Air is filled with foam and spray; sea completely white with driving spray; visibility very seriously affected	47