

# Storm Barra

Tuesday 7 and Wednesday 8 December 2021

Second named storm of the 2021/2022 season. Named by Met Éireann on Sunday 5 December 2021 Date issued: Thursday 1 September 2022

Storm Barra brought widespread severe and damaging winds across Ireland on Tuesday 7 and Wednesday 8 December 2021, with Met Éireann issuing red, orange and yellow level wind warnings. An active cold front associated with the storm also brought widespread heavy rain, preceded by snow in places. The storm centre tracked directly over the country between Galway and Louth in an east-northeast direction on Tuesday 7, bringing violent storm force 11 winds, with gusts of up to 135 km/h (73 knots) and mean wind speeds of up to 104 km/h (56 knots). A 2-minute mean wind speed of 111 km/h (60 knots) was reported on the morning of Tuesday 7 at Sherkin Island, Co Cork. Five counties reached red wind warning levels, with a further two counties reaching orange wind warning levels and a further six counties reaching yellow wind warning levels. There were no national wind records broken during Storm Barra, but the widespread nature of the storm and its longevity were notable and unusual. It was the strongest windstorm to affect Ireland since Strom Ellen in August 2020.Storm Barra began as a weak low-pressure system on the



Figure 1. Analysis Chart closest to hour (18 UTC) on Tuesday 7, when the highest sustained wind speed was reported (104 km/h at Mace Head, Co Galway)

southern side of the North Atlantic jet stream off the east coast of Canada on Sunday 5 December. The low-pressure underwent explosive cyclogenesis on Monday 6 December and the early hours of Tuesday 7 December as it crossed to the northern side of the jet stream in the mid-Atlantic and engaged with the left exit region of a powerful jet streak. It deepened by 55 hPa in 24 hours, easily reaching the criteria for a bomb cyclone (a drop of 24 hPa or more in 24 hours). The storm reached its maximum intensity just before reaching the west coast of Ireland. It then disengaged with the jet stream and slowed down as it came up against a blocking high pressure system over Scandinavia. It slowly weakened as it tracked across the country on Tuesday 7. The winds close to the centre of the storm were relatively weak, which meant many places experienced a lull in the strong winds as the centre passed over the country, with the winds strengthening again from a different direction once the storm centre passed by.

Storm Barra brought widespread damage and disruption with coastal flooding in a number of locations, due to a combination of spring tides, storm surge, high waves and onshore wind flow. The longevity of the storm meant that many places received strong winds from the storm over a two-day period in the cyclonic flow, with the South, Southwest and West worst affected. In the Northwest of the country, Malin head, Co Donegal recorded its highest sustained wind speed of 95 km/h (50 knots) from an easterly direction at 10am Tuesday 7 before Storm Barra made landfall, while Finner, Co Donegal recorded its highest sustained wind speed of 75 km/h (42 knots) from a west north-westerly direction at 8am Wednesday 8. In the East, Casement, Co Dublin recorded its highest sustained wind speed of 67 km/h (36 knots) from a south-southeast direction at 9am Tuesday 7 as the active cold front passed over, while Dublin Airport, Co Dublin recorded its highest sustained wind speed of 65 km/h (35 knots) the following day at 12pm Wednesday 8 from a westerly direction. Mace Head, Co Galway experienced gusts of over 89 km/k (48 knots) lasting for at least 28 hours.

![](_page_1_Picture_1.jpeg)

Figure 2 and 3. EUMETSAT Visible Satellite images closest to hour (1200 UTC) of the lowest mean sea level pressure 957.2 hPa at Mace Head, Co Galway on Tue 7 Dec 2021

![](_page_1_Figure_3.jpeg)

Figure 4. On Tue 7 Dec 2021 in the hour ending 03 UTC 7.2 mm of rain fell at Valentia Observatory, Co Kerry

![](_page_1_Figure_5.jpeg)

Figure 5. On Tue 7 Dec 2021 in the hour ending 09 UTC 6.3 mm of rain fell at Knock Airport, Co Mayo

### **Atmospheric Pressure**

While rapidly intensifying over the Atlantic Storm Barra deepened by 55 hPa in 24 hours. The minimum mean sea level pressure (MSLP) observed in Ireland during Storm Barra was at Mace Head, Co Galway with 957.2 hPa on Tuesday 7. A pressure drop of approximately 50 hPa occurred at Mace Head, Co Galway over a 16-hour period between 20:15 on Monday 6 and 12:15 on Tuesday 7, when the low-pressure centre made landfall in Galway.

![](_page_2_Figure_2.jpeg)

Barra station mean Sea Level Pressure

Figure 6. Atmospheric pressure (before correction to MSLP is made) recorded at Mace Head, Co Galway on Tuesday 7 December 2021

### Impacts

- **Power Outages**: ESB Power Check showed 49,000 customers without power at 12:45 pm on Tuesday 7. On the morning of Wednesday 8, ESB Power Check revealed more than 59,000 customers were without power.
- **Flooding**: Some flooding in Cork, Kerry, Waterford and Dublin overnight of Monday 6 and during the day on Tuesday 7.
- Travel: Some air travel flights cancelled and delays experienced. Ferry cancellations reported. Bus services in red warning counties suspended on Tuesday 7. On the morning of Wednesday 8 bus services country-wide faced delays due to falling debris. Irish Rail remained open on Tuesday 7 but at reduced speeds with suspended rail services for a short time between Dalkey and Dun Laoghaire, Co Dublin. On Wednesday 8 storm damage on the Howth Dart line suspended rail services to the north side of Dublin.
- **Services**: On Tuesday 7 HSE services closed and appointments cancelled. Covid 19 vaccination centres closed in status red and orange counties. Ambulance services restricted due to debris on the roads.
- Schools & Crèches: On Tuesday 7, most schools and colleges shut in status red & orange counties. Creches shut country wide. On Wednesday 8, schools in 12 counties remained closed.

# Table 1. Observations at SYNOPTIC STATIONS

The following table contains wind speeds and rainfall observations for the SYNOPTIC stations for 3 days, Monday 6-December-2021 and Wednesday 8 December-2021. Some of the observations have weather warning thresholds and these are highlighted. See the weather warnings page on <u>www.met.ie.</u>

Station loca- tion	Sustained (10-min mean)	Date highest	Wind Direction	Gust (3-sec	Date Highest Gust	Wind Direction	Daily Rain	Total Rain (mm)
	wind Speed	mean	sustained	mean) Wind Speed		Gust	(mm)	
Mace Head** Co Galway	<b>104 km/h</b> Violent Storm Force (56 knots or 64 mph)	Tue 7 Dec 2021 16UTC	310° (NW)	<b>133 km/h</b> (72 knots or 83 mph)	Tue 7 Dec 2021 1622 UTC	310° (NW)	<b>22.4</b> Tue 7 Dec 2021	26.6
Sherkin Is- land Co Cork	<b>100 km/h</b> Storm Force (54 knots or 62 mph)	Tue 7 Dec 2021 09UTC	240° (WSW)	<b>135 km/h</b> (73 knots or 84 mph)	Tue 7 Dec 2021 1158 UTC	250° (WSW)	<b>11.6</b> Tue 7 Dec 2021	15.7
Malin Head* Co Donegal	93 km/h Storm Force (50 knots or 58 mph)	Tue 7 Dec 2021 10UTC	100° (E)	<b>119 km/h</b> (64 knots or 74 mph)	Tue 7 Dec 2021 0926 UTC	100° (E)	<b>15.1</b> Tue 7 Dec 2021	29.4
Valentia Observatory Co Kerry	<b>89 km/h</b> Storm Force (48 knots or 55 mph)	Tue 7 Dec 2021 10UTC	250° (WSW)	<b>130 km/h</b> (70 knots or 81 mph)	Tue 7 Dec 2021 1025 UTC	250° (WSW)	<b>29.4</b> Tue 7 Dec 2021	42.9
Roches Point Co Cork	<b>89 km/h</b> Storm Force (48 knots or 55 mph)	Tue 7 Dec 2021 08UTC	200° (SSW)	<b>120 km/h</b> (65 knots or 75 mph)	Tue 7 Dec 2021 1020 UTC	230° (SW)	<b>16.8</b> Tue 7 Dec 2021	22.3
Newport Co Mayo	<b>81 km/h</b> Strong Gale Force (44 knots or 51 mph)	Wed 8 Dec 2021 00UTC	300° (WNW)	<b>120 km/h</b> (65 knots or 75 mph)	Tue 7 Dec 2021 2338 UTC	290° (WNW)	<b>31.0</b> Tue 7 Dec 2021	38.1
Finner Co Donegal	<b>78 km/h</b> Strong Gale Force (42 knots or 48 mph)	Wed 8 Dec 2021 08UTC	300° (WNW)	<b>111 km/h</b> (60 knots or 69 mph)	Wed 8 Dec 2021 0236 UTC	320° (NW)	<b>21.2</b> Tue 7 Dec 2021	46.2
Shannon Airport Co Clare	<b>76 km/h</b> Strong Gale Force (41 knots or 47 mph)	Tue 7 Dec 2021 18UTC	290° (WNW)	<b>113 km/h</b> (61 knots or 70 mph)	Tue 7 Dec 2021 1652 UTC	290° (WNW)	<b>18.4</b> Tue 7 Dec 2021	27.9
Cork Airport Co Cork	<b>72 km/h</b> Gale Force 8 (39 knots or 45 mph)	Tue 7 Dec 2021 11UTC	220° (SW)	<b>119 km/h</b> (64 knots or 74 mph)	Tue 7 Dec 2021 1235 UTC	240° (WSW)	<b>21.3</b> Tue 7 Dec 2021	26.1
Knock Air- port Co Mayo	<b>72 km/h</b> Gale Force 8 (39 knots or 45 mph)	Tue 7 Dec 2021 20UTC	310° (NW)	<b>106 km/h</b> (57 knots or 66 mph)	Tue 7 Dec 2021 1928 UTC and Wed 8 Dec 2021 0034 UTC	310° (NW) and 300° (NW)	<b>22.8</b> Tue 7 Dec 2021	31.4
Belmullet Co Mayo	<b>69 km/h</b> Gale Force 8 (37 knots or 43	Tue 7 Dec 2021 22UTC	320° (NW)	<b>102 km/h</b> (55 knots or 63 mph)	Wed 8 Dec 2021 0016 UTC and Tue 7 Dec	330° (NNW) and 320°	<b>16.8</b> Tue 7 Dec 2021	19.4
Casement Aerodrome Co Dublin	<b>69 km/h</b> Gale Force 8 (37 knots or 43 mph)	Wed 8 Dec 2021 03UTC	260° (W)	<b>102 km/h</b> (55 knots or 63 mph)	Wed 8 Dec 2021 1345 UTC	260° (W)	<b>13.8</b> Tue 7 Dec 2021	23.8
Dublin Air- port Co Dublin	65 km/h Gale Force 8 (35 knots or 40 mph)	Wed 8 Dec 2021 12UTC	280° (W)	<b>93 km/h</b> (50 knots or 58 mph)	Wed 8 Dec 2021 1145 UTC	280° (W)	<b>10.8</b> Tue 7 Dec 2021	21.7

\*Caution: Malin Head wind speeds are observed (using an anemometer) at a non-standard height of 23m while all others are at 10m. This will cause Malin Head's wind speeds to be higher in a strong air flow.\*\* Caution: Mace Head anemometer is situated above exposed rock at the coast line.

Station loca- tion	Sustained (10-min mean)	Date highest	Wind Direction	Gust (3-sec	Date Highest Gust	Wind Direction	Daily Rain	Total Rain
	Wind Speed	mean	Highest	mean)		Highest	(mm)	(mm)
Oak Park	63 km/h	Tue 7 Dec	190° (S)	89 km/h	Tue 7 Dec 2021	180° (S)	18.0	21.2
Co Carlow	Gale Force 8	2021	150 (5)	(48 knots or	1225 UTC and	and 280°	Tue 7 Dec	21.2
	(34 knots or 39 mph)	13UTC		55 mph)	Wed 8 Dec	(S)	2021	
					2021 0322 UTC			
Gurteen	63 km/h	Tue 7 Dec	270° (W)	87 km/h	Tue 7 Dec 2021	270° (W)	14.9	19.6
Co Tipperary	Gale Force 8	2021		(47 knots or	1831 UTC		Tue 7 Dec	
	(34 knots or 39 mph)	18UTC		54 mph)			2021	
Claremorris	61 km/h	Tue 7 Dec	300°	96 km/h	Wed 8 Dec	300°	14.6	17.5
Co Mayo	Near Gale	2021	(WNW)	(52 knots or	2021 0228 UTC	(WNW)	Tue 7 Dec	
A • 1	(33 knots or 38 mph)	21010	200%	60 mph)	T T D 2024	2001	2021	40.0
Athenry	61 km/h	Tue / Dec	290°	91 km/h	Tue / Dec 2021	290°	13.2 Tuo 7 Doo	18.9
CO Galway	(22 knots or 28 mph)	2021 17UTC	$(\mathbf{v}\mathbf{v}\mathbf{v}\mathbf{v}\mathbf{v})$	(49 KHOLS OF	1/30 010	$(\mathbf{v}\mathbf{v}\mathbf{v}\mathbf{v})$	1ue 7 Dec 2021	
lohnstown	59 km/h	Tue 7 Dec	230° (SW/)	102 km/b	Tue 7 Dec 2021	210°	11 2	20.2
Castle	Near Gale	2021	230 (300)	(55 knots or	1607 UTC	(SSW/)	Tue 7 Dec	20.2
Co Wexford	(32 knots or 37 mph)	15UTC		63 mph)	1007 010	(3311)	2021	
Moore Park	56 km/h	Tue 7 Dec	250°	98 km/h	Tue 7 Dec 2021	240°	28.1	35.8
Co Cork	Near Gale	2021	(WSW)	(53 knots or	1436 UTC	(WSW)	Tue 7 Dec	
	(30 knots or 35 mph)	14UTC		61 mph)			2021	
Mount Dillon	56 km/h	Wed 8	280° (W)	87 km/h	Wed 8 Dec	280° (W)	20.2	43.0
Co Roscom-	Near Gale	Dec 2021		(47 knots or	2021 0211 UTC		Tue 7 Dec	
mon	(30 knots or 35 mph)	02UTC		54 mph)			2021	
Dunsany	56 km/h	Wed 8	260° (W)	80 km/h	Tue 7 Dec 2021	190° (S)	14.3	26.6
Co Meath	Near Gale	Dec 2021		(43 knots or	1221 UTC		Tue 7 Dec	
	(30 knots or 35 mph)	01UTC	(0.0)	49 mph)		(200)	2021	
iviullingar	50 km/h	Tue / Dec	130° (SE)	91 km/h	Tue / Dec 2021	120° (ESE)	17.0 Tuo 7 Dec	35.8
co west-	(27 knots or 21 mph)			(49 knots or	0847 010		10e 7 Dec	
Ballybaico	18 km/h		130° (SE)	76 km/h	Tue 7 Dec 2021	130° (SE)	17.0	22.2
Co Cavan	Strong Breeze	2021	130 (32)	(41 knots or	0917 LITC	130 (32)	Tue 7 Dec	33.2
ce durun	(26 knots or 30 mph)	09UTC		47 mph)	001/010		2021	

## **Marine Impacts**

Buoy M2 (east coast/lrish sea) observed a maximum individual wave of 9.84 m, this equalled the record set there on 2 March 2018 during Storm Emma.

Buoy M2 has been observing individual waves since February 2011.

Buoy M3 (south west coast) observed 87 km/h (47 knots), where its previous record was 89 km/h (48 knots) on 9 December 2007.

No significant wave and maximum individual wave height extremes were surpassed at other buoys.

### Table 2. Buoy Observations - 7 December 2021

buoy	Max Mean Winds	Max Gust	Max Sig. Wave	Max Individual Wave
M2	<b>74 km/h</b> Gale Force 8	<b>102 km/h</b> 55 knots   63 mph	6.4 m	9.8 m
M3	<b>87 km/h</b> Strong Gale Force	<b>115 km/h</b> 62 knots   71 mph	12.6 m	19.9 m
M4	<b>72 km/h</b> Gale Force 8	<b>104 km/h</b> 56 knots   64 mph	10.4 m	16.7 m
M5	<b>65 km/h</b> Gale Force 8	<b>109 km/h</b> 59 knots   68 mph	9.2 m	14.2 m
M6	<b>74 km/h</b> Gale Force 8	<b>100 km/h</b> 54 knots   62 mph	8.4 m	13.0 m

![](_page_5_Figure_0.jpeg)

Figure 7 and 8. Wind warnings and advisories for Tuesday 7 December and Wednesday 8 December 2021. See the weather warnings page on www.met.ie

#### Climate projections for Ireland

Due to its geographic location along the Western edge of Europe, Ireland is affected by mid-latitude wind storms. Latest future projections indicate an overall decrease of 10% in the number of less severe storms affecting Ireland by the middle of the 21st century (Nolan and Flanagan, 2020).

These projections also show there will be an eastward extension of the more severe wind storms over Ireland. As our planet warms, so does our atmosphere. Warmer air has the ability to hold more moisture. In Ireland, we have seen an increase in average annual rainfall by about 6% over the last 30 years (compared to the previous 30 years).

Latest future climate projections for Ireland indicate a decrease in mean rainfall by mid-century; a decrease in mean annual and spring and summer rainfall (Nolan and Flanagan, 2020) while heavy rainfall events are expected to become more frequent. Rainfall is expected to become more variable, with projected increases in frequency of both heavy rainfall events and dry periods also. These projections are in line with those carried out previously (e.g. Nolan 2015, Nolan 2017).

These projections were downscaled from CMIP5 output of the EC-Earth global climate model (Hazeleger 2012).

#### References

Hazeleger, W, X Wang, C Severijns, S Stefanescu, R Bintanja, A Sterl, K Wyser, T Semmler, S Yang, B van den Hurk, T van Noije, E van der Linden, and K van den Wiel (2012), EC-Earth V2: description and validation of a new seamless Earth system prediction model. Climate Dynamics, 39, 2611-2629

Nolan P, 2015. Ensemble of Regional Climate Model Projections for Ireland. Environmental Protection Agency, Johnstown Castle, Ireland. Nolan P and McKinstry A

Nolan P, Flanagan J (2020). <u>Research 339: High-resolution Climate Projections for Ireland. A Multi-model Ensemble</u> <u>Approach</u>. EPA report 339

Nolan P, O'Sullivan J, and McGrath R (2017). Impacts of climate change on mid-twenty-first-century rainfall in Ireland: a high-resolution regional climate model ensemble approach. International Journal of Climatology

### Definitions

### Gust wind speeds are an average of 3-second wind speeds.

Sustained wind speeds are an average of 10-minute wind speeds. For observations of sustained wind speeds:

- Storm Force  $10 \ge 89$  km/h (48 knots)

- Violent Storm Force 11 ≥ 103 km/h (56 knots)
- Hurricane Force 12 ≥ 117 km/h (64 knots)