

Local Government Response to Winter Flooding 2015/2016

Brendan McGrath

Chief Executive

Galway City Council

Chair Environment, Climate Change and
Emergency Management Committee of CCMA

Date: 03rd Nov. 2016

Cork Flooding



Kinsale



Lahinch



Lahinch Promenade



Road Damage



Local Government Response to Winter Flooding 2015/2016

Date: 03rd Nov. 2016

Coastal Waves



Co Clare Coast



Coastal Waves



Adaptation to Impacts of Climate Change

- Potential impacts include:
 - Sea level rise
 - More intense storms and rainfall events
 - Greater probability of river and coastal flooding
 - Reduced water quality
 - Summertime water shortages (in East)
 - Changes in distribution of plant and animal species
 - Effects on fisheries

OPW CFRAMs

- Programme nearing completion
- 29 Flood Risk Management Plans to be finalised by end-2016
- First tranche currently at public consultation phase
- Outline proposals for dealing with flood risk in 300 areas
- Once plans finalised, a list of priority schemes will be advanced to detailed design and construction
- Impact on City and County Development Plans
- OPW Inter-Departmental Flood Policy Coordination Group



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Tipperary



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November 2015

- October 2015: relatively dry
- November 2015: wet, rainfall averaging 130%-190% across Met Eireann weather stations
- Storm Abigail: passed North of Ireland on 12th & 13th Nov. 2015
- Storm Barney: 16th -18th Nov. 2015
 - Wind gust at Shannon Airport on 17th Nov. (127km/h) – highest Nov. gust in all recordings
- Storm Clodagh: End of Nov. 2015
- 14 days in Nov. recorded max. wind gusts >50knots (93km/h)
- Third warmest Nov. since 1900
- Parts of Midlands, West and Northern areas recorded twice average Nov. average rainfall

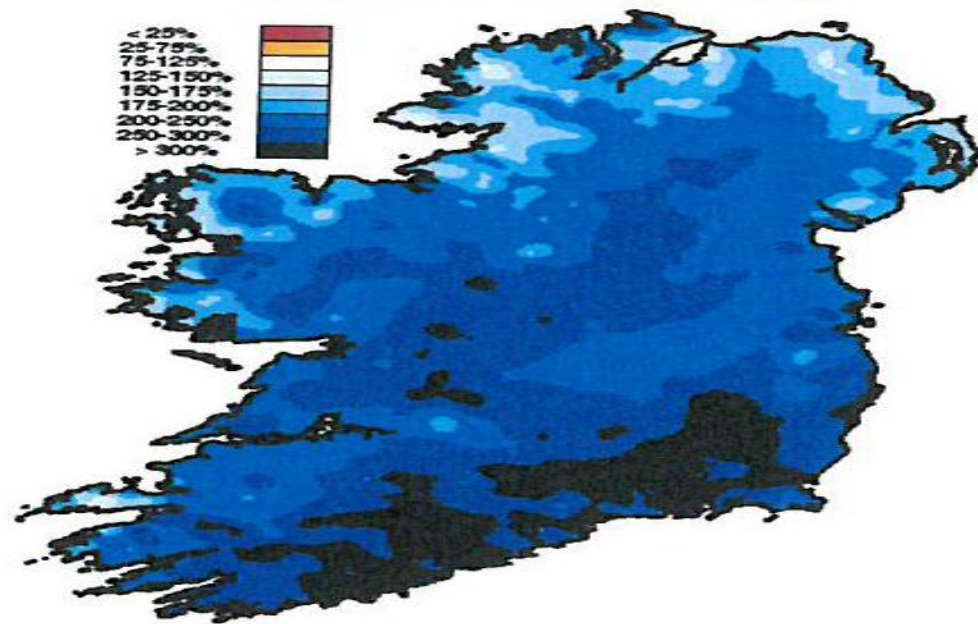
Shannon Airport



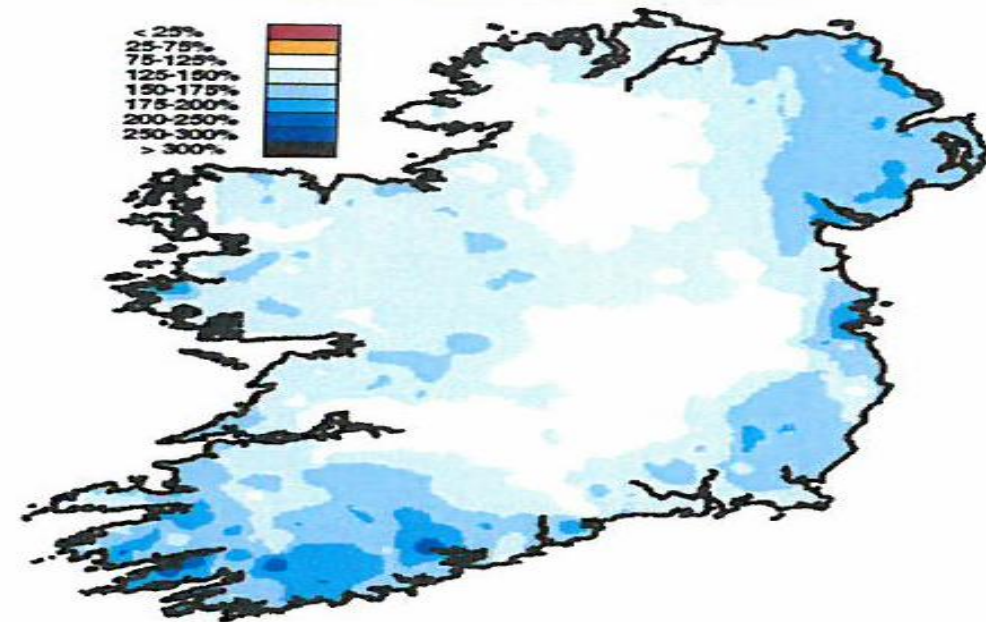
Poolbeg



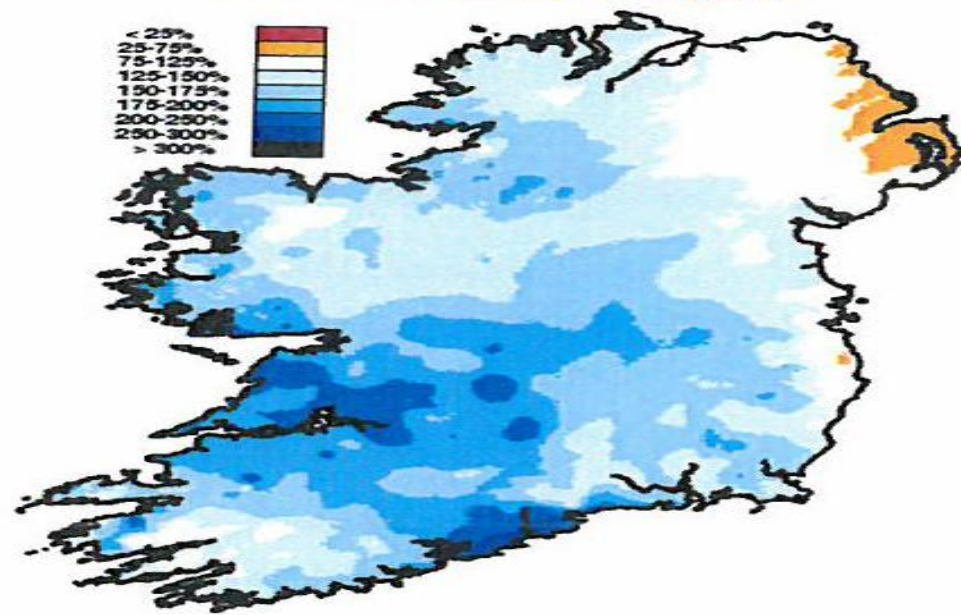
Rainfall % of Normal December 2015



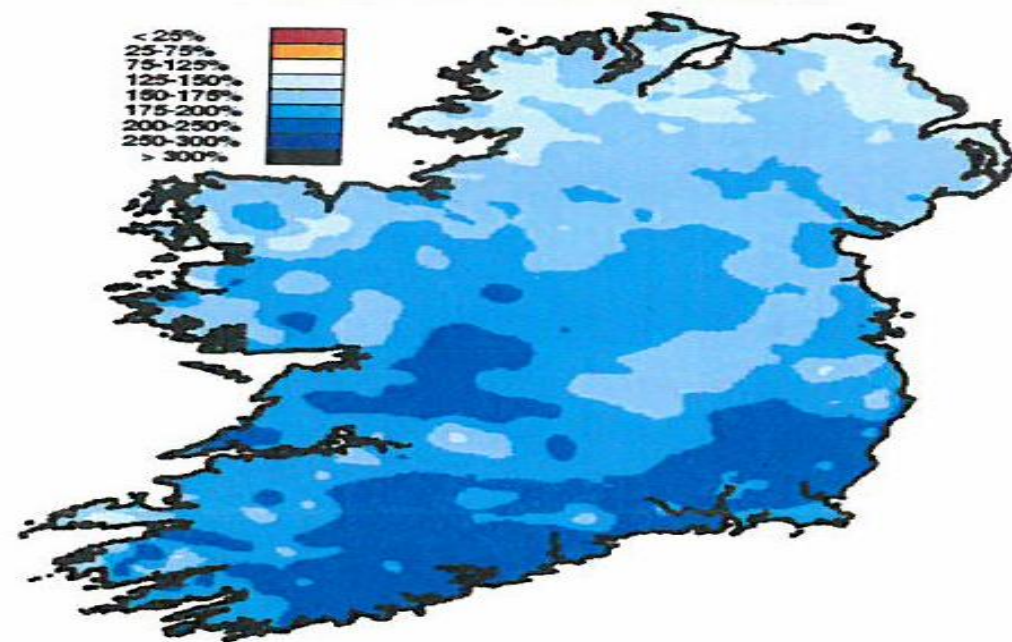
Rainfall % of Normal January 2016



Rainfall % of Normal February 2016



Rainfall % of Normal Winter 2016



December 2015

- Wettest Dec. in a time series since 1850
- Greatest anomalies in South and South West
- Storm Desmond: affected Ireland and UK from 04th – 06th Dec. 2015
- National Coordination Group: met 03rd Dec. 2015 due to early forecast and notification
- Red Status Rainfall Alert issued by Met Eireann on 04th Dec. 2015
- Prolonged intense rain in Connaught and Donegal (lasting up to 36hrs. in places)
- Storm tracked to North of Scotland: brought a mild, moist air-mass which resulted in storm being slow moving
- Also badly affected: Scotland and NW England

Force of the Rain





Waterford

December 2015 (continued)

- Rainfall continued at typical levels for next 6 days
- 12th Dec. 2015: further heavy rain, widespread across the country
- Normal rainfall to 20th Dec. 2015
- Storm Eva: 23rd Dec. 2015 (largely wind)
- Significant daily rain from 21st – 26th Dec. with approx. 25mm p/day South/South West
- Storm Frank: resulted in more heavy rain 28th – 30th Dec. 2015
- First half of Dec.: heaviest rain in West and NW
- Second half of Dec.: South and SW suffered heaviest falls
- 5 weather stations in Cork and Kerry broke previous record monthly accumulation of 790mm (new record 943mm)

Donegal



December 2015 (continued)

- Highest daily accumulation of rainfall in Ireland: Keenagh Beg, Co. Mayo (165mm)
- Leenae, Galway: recorded highest 48hr total of 259mm (highest on record in Irish digital database)
- Dec. 2015: exceptionally warm (Phoenix Park, Dublin recorded warmest Dec. in series back to 1855)
- Wind:
 - Storm Frank (30th Dec. 2015) had strongest winds of all (10min. mean sustained winds of 55knots – 102km/h)
 - Storm Eva gust of 73knots (135km/h) at Belmullet
- Dec. 2015: Dull in South and SW (Sherkin Island recorded total of 2.8hrs. Sunshine for an entire month – a record low)

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Broadhaven Co Mayo



Fallen Trees



January 2016

- Some rain gauges across Ireland (including Cork and Dublin) reported wettest January in 20-40 years
- Half of total rain for the month fell on 2 days (05th & 09th January)
- Spell of colder and generally dryer weather took hold middle of month due to northerly airflow
- Strongest January storm: Storm Gertrude on 29th January 2016
 - Mean (sustained) winds of 53 knots (98km/h) with a gust of 70 knots (130km/h) recorded at Malin Head
- Temperatures were closer to average but generally 1-2degrees Celsius above average

Enniscorthy underwater



Lahinch Co Clare



Salthill Car park



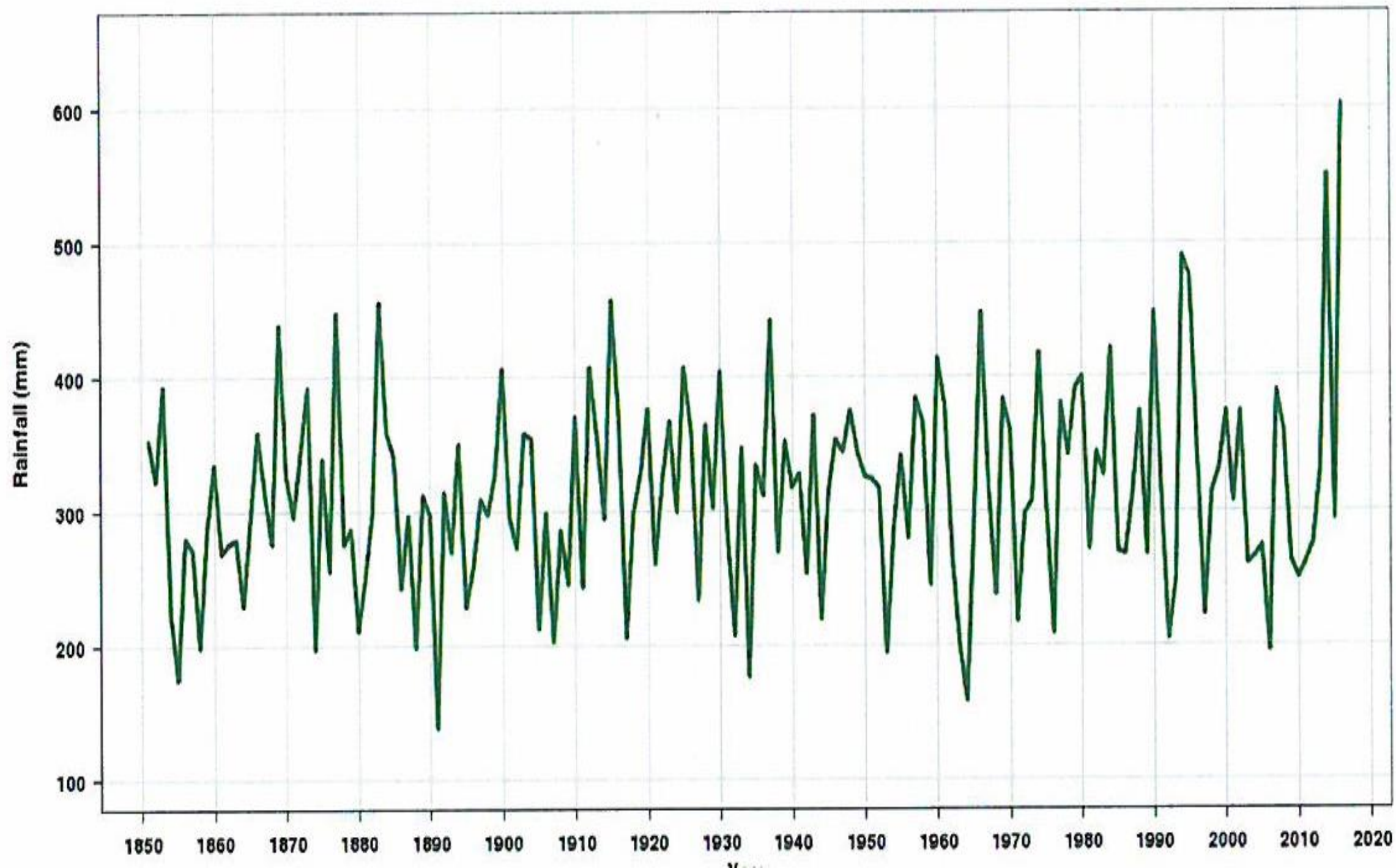
February 2016

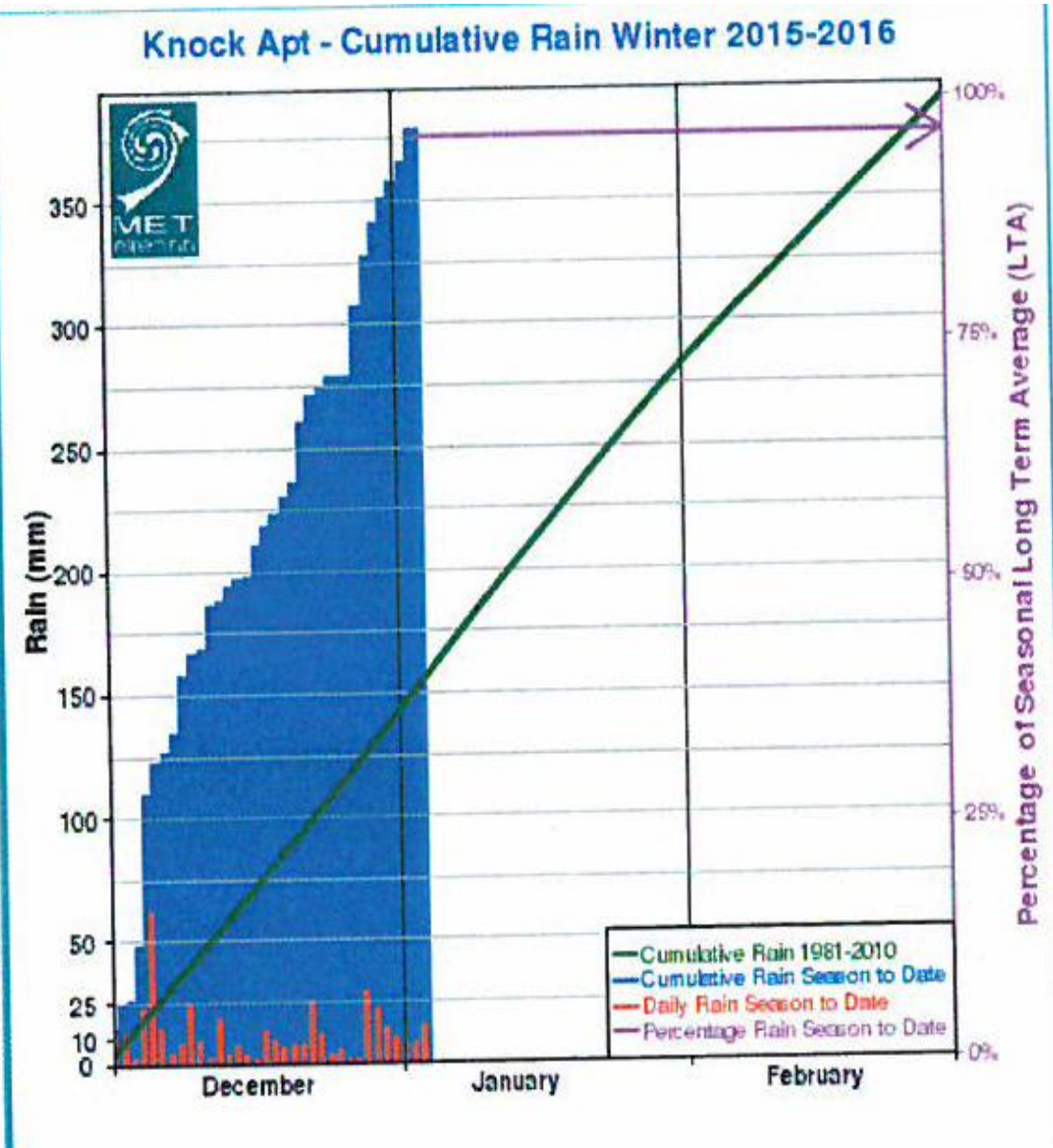
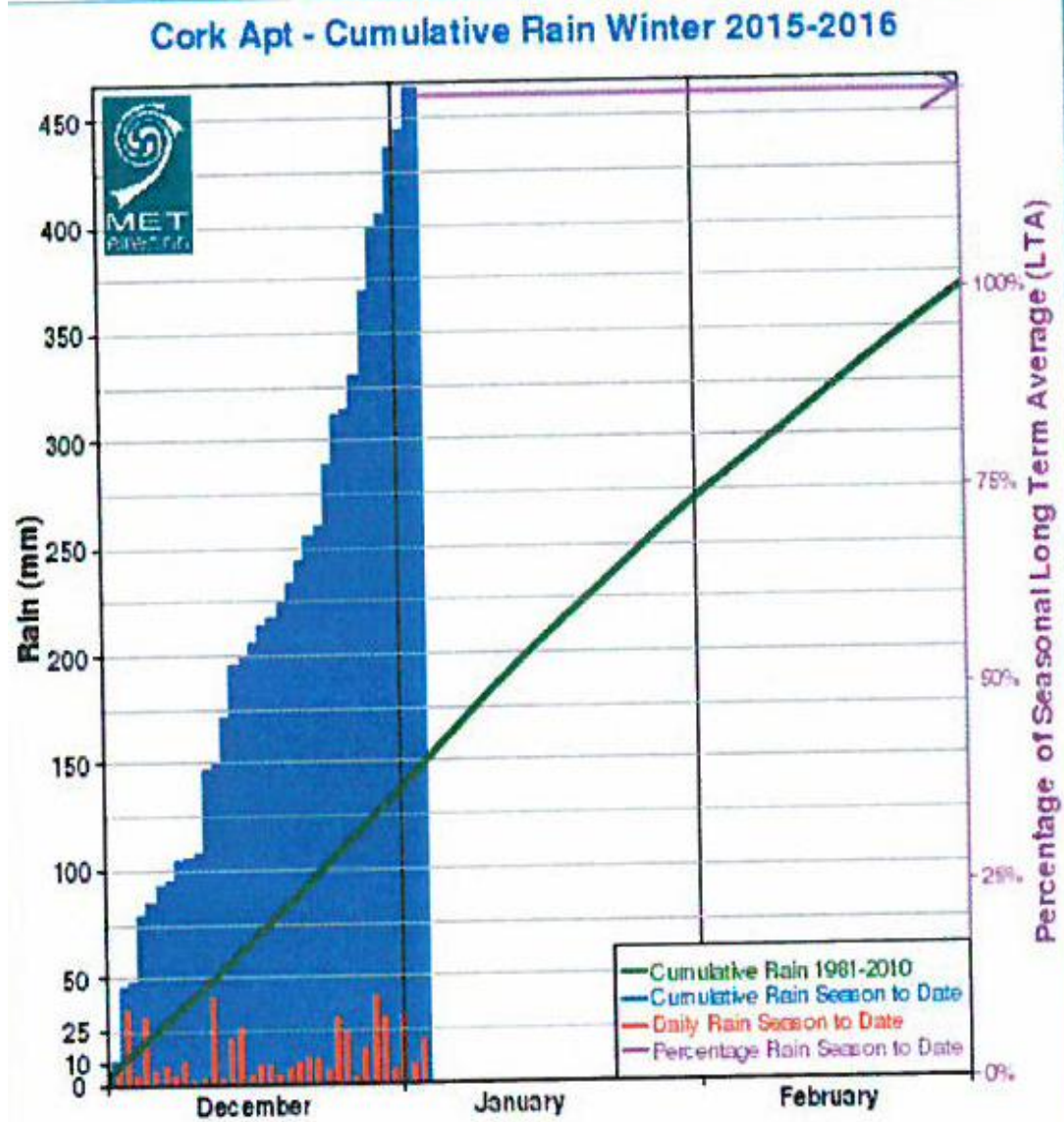
- First half of Feb. 2016: unsettled
- Storm Henry: missed Ireland and clipped North of Scotland (1st-2nd Feb.)
- Storm Immogen: most significant Feb. storm (07th Feb. 2016)
 - 10min (mean) sustained winds of 54knots (100km/h) with gusts of 73knots (135km/h) at Sherkin Island
 - Immogen passed to South of Ireland
- Mid Feb.: generally colder, dryer and sunnier
- SW Ireland: recorded highest rainfall anomalies of the month
 - Some locations recorded 2x their long-term average
 - Carron (Clare) recorded 265mm (223% of average)
 - Ballymacoda (Cork) recorded 186.9mm (253% of average)

Stormy periods over Winter 2015

- Data examined no. of days in each of the last 31 winters when storm force winds were recorded.
- Winter 2015/2016 was not exceptional
- On average 4 stormy winters would occur each decade
- Winter 2015/2016 while notably stormy was not as stormy as the winter of 2013/2014
- Winter 2015/2016 was wettest winter ever recorded in Ireland
- Rainfall totals at 189% of normal

Name	Max Gust (Knots)	Location	Date
Abigail	65	Belmullet (Mayo)	12-Nov
Barney	69	Shannon Airport (Clare)	17-Nov
Clodagh	65	Finner (Donegal)	29-Nov
Desmond	64	Mace Head (Galway)	04-Dec
Eva	73	Belmullet (Mayo)	23-Dec
Frank	72	Sherkin Island (Cork)	30-Dec
Gertrude	70	Malin Head (Donegal)	29-Jan
Henry	70	Malin Head (Donegal)	01-Feb
Mogén	73	Sherkin Island (Cork)	08-Feb



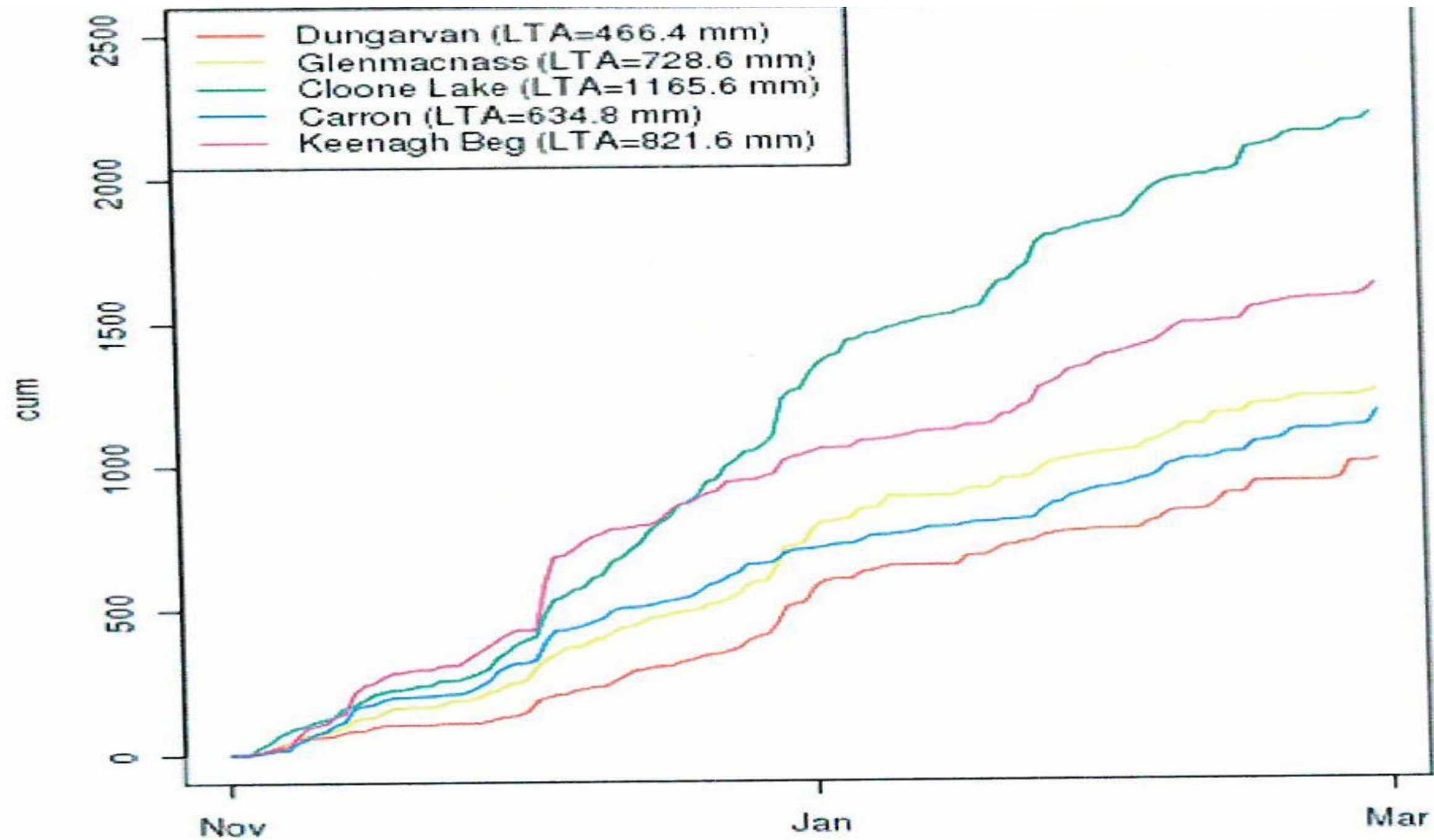


Blue: Accumulated Rainfall 12th Dec. 2015-14th Jan. 2016

Green: Expected rain over average winter

In both cases Dec. rainfall = 2-3x average per month

In Cork: by 04th Jan. 2016 average accumulation exceeded for 3 months (Nov-Jan)



Hydrological Background

- Flooding of three types:
 - Pluvial (from intense and prolonged rainfall)
 - Fluvial (resulting from swollen rivers overtopping their banks)
 - Groundwater sources (flooding persists long after floods receding elsewhere)
- Wettest counties during Dec. 2015: included Cork, Carlow, Westmeath, Mayo, Cavan, Dublin, Wexford, Galway and Roscommon (240%-300% of long-term average rainfall)
- Of six storms (Abbigal-Frank) the most significant for flooding were Abbigal, Desmond and Frank
- Largest flood events occurred between 06th–13th Dec. 2015
- In other areas, largest flood events occurred between 29th Dec. 2015 - 05th Jan. 2016

Hydrological Background (continued)

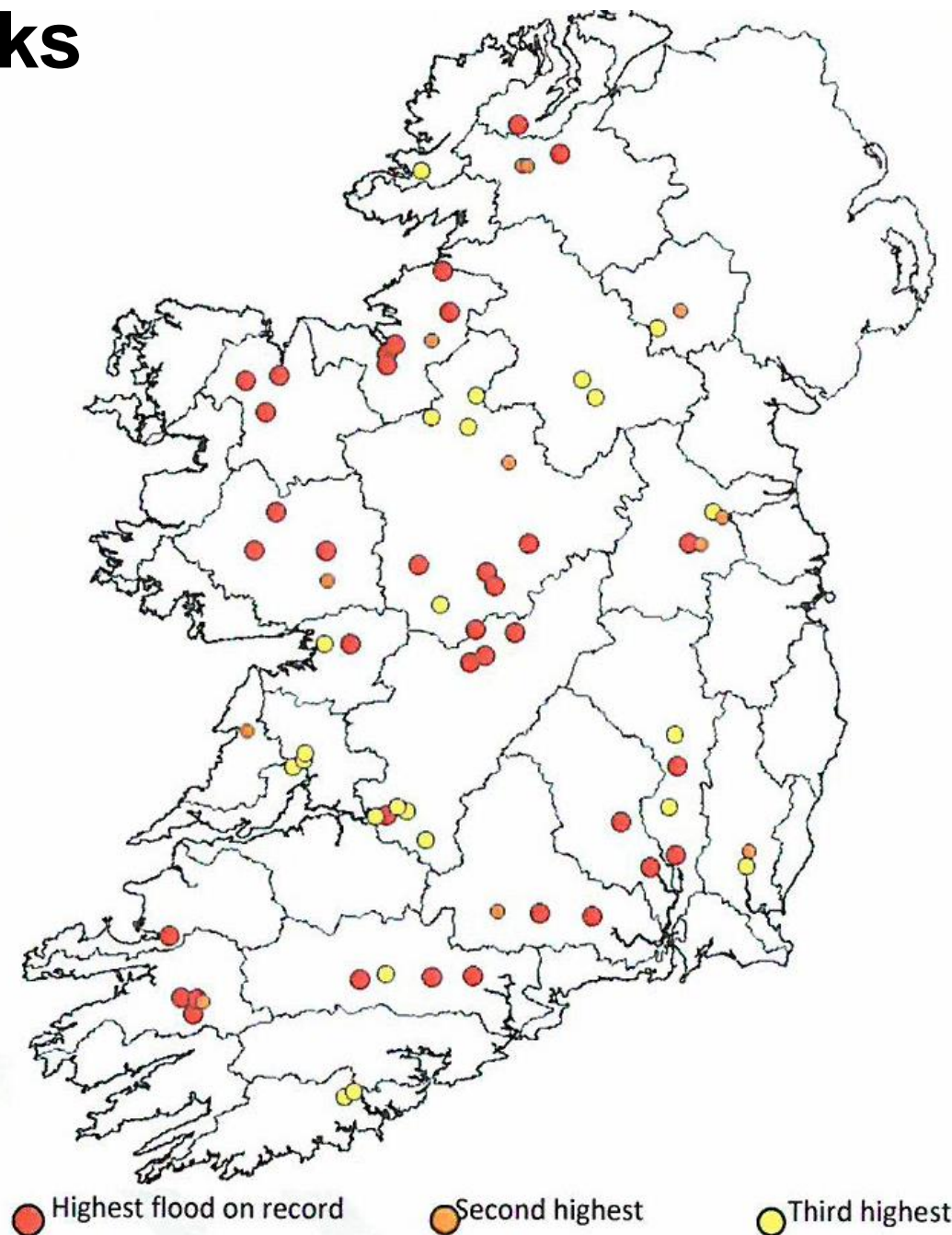
- Many OPW surface water gauging stations registered highest levels on record during this period
- Winter floods 2015/2016 believed by many to be worse than record
- OPW examined 75 water level gauges due to spatial distribution and quality of data
- First flood events of winter were witnessed on 15th Nov. in NW
- The last peaks occurred on 05th Jan. 2016 along middle and lower Shannon
- Shannon reached its highest recorded levels at Hudson Bay, Athlone, Shannonbridge on 05th Jan. 2016 and at Meelick Weir on 04th Jan. 2016
- Country was in a state of sustained flood emergency for two months

Spatial distribution of flood peaks in Winter 2015 / 2016....

- The floods of winter 2015 / 2016 were widespread with very few counties experiencing no flood even

Flood Peaks

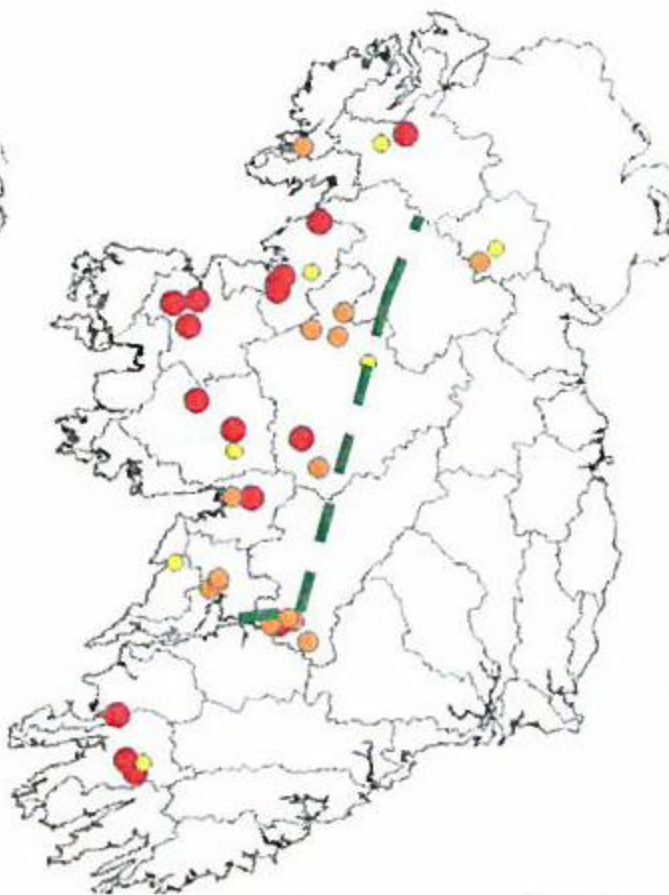
- Storm Abbigail (12th Nov): concentration in NW – mainly Donegal & Sligo
- Storm Desmond (04th–05th Dec): concentration to west of Shannon
- Storm Frank (29th – 30th Dec.): concentration South-SE Shannon (Nore, Suir, Barrow & Slaney worst affected)



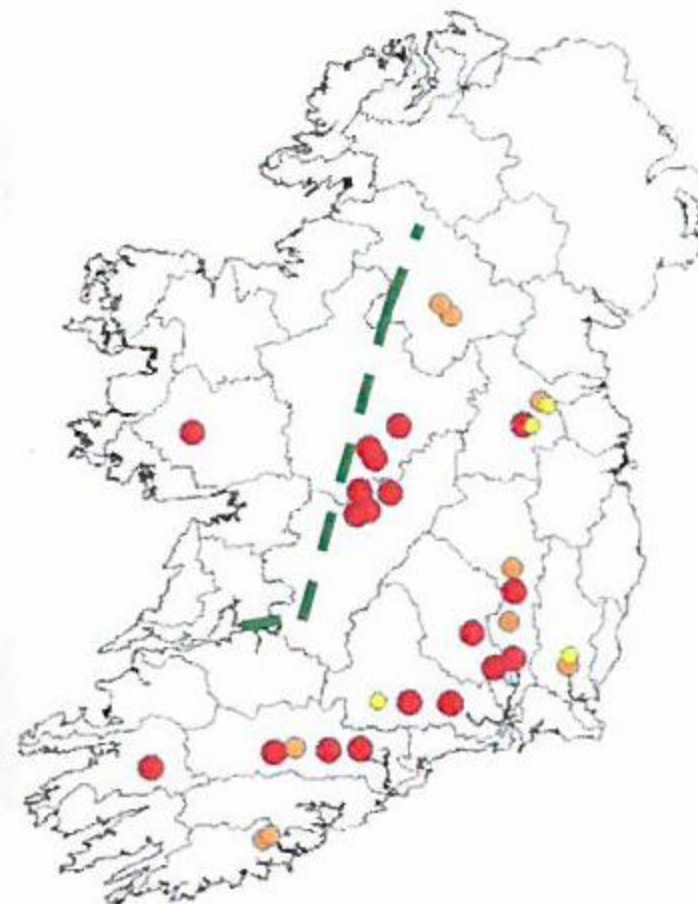
Flood Peaks



(a) Storm Abigail



(b) Storm Desmond



(c) Storm Frank

Legend:



Highest flood on record



Second highest



Third highest



Lower Shannon



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Locations Flooded

- Following table shows locations flooded and dates of first reporting
- Some towns affected by flooding on two occasions (e.g. Bandon 05th Dec. 2015 & 03rd Jan. 2016)
- Other locations experienced sustained flooding, starting in early Dec. 2015 and persisting into early Jan. 2016 including:
 - Athlone, Shannonbridge, Portumna, Castleconnell, Montpelier, Springfield & Annacotty
 - Flood levels in these areas remained high through Dec. 2015 into Jan. 2016

Location of Flooding	County	Date of Initial Reports of Flooding
Bandon	Cork	05/12/2015 and 30/12/2015
Athlone	Westmeath	05/12/2015
Crossmolina	Mayo	05/12/2015
Castlefinn	Donegal	05/12/2015
Ballybofey	Donegal	05/12/2015
Ballinasloe	Galway	05/12/2015 and 05/01/2016
Claregalway	Galway	05/12/2015
Portumna	Galway	05/12/2015
Ennis	Clare	05/12/2015
Feakle	Clare	05/12/2015
Killarney	Kerry	05/12/2015
Athleague	Roscommon	06/12/2015
Craughwell	Galway	06/12/2015
Galway City	Galway	06/12/2015 and 02/01/2016
Foxford	Mayo	07/12/2015
Monaghan	Monaghan	07/12/2015
Montpelier	Limerick	09/12/2015 and 05/01/2016
Castleconnell	Limerick	09/12/2015
Annacotty	Limerick	13/12/2015
Corbally	Limerick	13/12/2015
Shannonbridge	Offaly	15/12/2015
Carrick-on-Shannon	Leitrim	16/12/2015
Springfield	Clare	28/12/2015
Dundalk	Louth	28/12/2015
Graiguenamanagh	Kilkenny	29/12/2015
Thomastown	Kilkenny	29/12/2015
Inistioge	Kilkenny	29/12/2015
Clonmel	Tipperary	29/12/2015

Location of Flooding	County	Date of Initial Reports of Flooding
Fermoy	Cork	30/12/2015
Mallow	Cork	30/12/2015
Enniscorthy	Wexford	30/12/2015
Cavan	Cavan	28/12/2015

- Approx. 550 homes were flooded during winter 2015/2016
- A coordinated response saved a great many more homes and businesses from being flooded during these events

Aerial Footage



Aerial View of Athlone



Kilkenny Businesses Destroyed



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Flooding from Groundwater Sources

- Typically caused by cumulative flow or groundwater recharge
- Impacted by lack of adequate drainage
- Most susceptible region in Ireland is Gort Lowlands, South Galway
- During intense/prolonged rainfall, underground flow paths are unable to drain
- Available sub-surface storage rapidly reaches capacity
- Surface flooding occurs in tourloughs
- Flooding of 2009 worst on record until surpassed by 2015/2016
- Rain gauges at Gort recorded 297mm of rain in Nov. 2015 & 430mm in Dec. 2015

Flooding from Groundwater Sources (contd.)

- This represents increases of 203% & 288% respectively compared to long-term monthly averages
- 2009 event in South Galway was caused by a single large rainfall event
- 2015/2016 was caused by three smaller even resulting in 26% more rain than 2009
- Consequently impact in 2015/2016 was greater
- Worst affected areas include Kiltartan, Blackrock Tourlough (mostly river fed and groundwater drained) and Loughcoy Tourlough
- Groundwater flooding also occurred in Co. Roscommon and Co. Longford

Ground
water
Flooding



Impact on Householders and Properties affected

Local Authority	Residential Dwellings					Business affected
	Evac since 3 Dec	Evac now returned	Damaged but habitable	Inaccessable (not flooded)	Under threat of flooding	
Carlow	5	3	37	0	3	12
Cavan	5	0	12	112	14	6
Clare	9	0	13	17	6	12
Cork City	0	0	0	12	0	5
Cork County	38	22	155	101	134	135
Donegal	34	24	22	175	0	31
Dublin City	0	0	0	0	0	0
Dun Laoghaire	0	0	0	0	0	0
Fingal	0	0	0	0	0	0
Galway City	0	0	0	0	0	0
Galway County	70	20	30	80	35	42
Kerry	17	15	48	506	27	24
Kildare	3	2	4	0	500	3
Laois	5	3	7	13	0	0
Leitrim	3	0	5	136	42	31
Limerick	4	1	12	9	24	4
Louth	3	0	15	13	16	57
Longford	5	4	0	45	5	2
Mayo	90	70	25	765	139	81
Monaghan						
Offaly	45	5	3	45	38	5
Roscommon	46	8	45	209	144	38
Sligo	10	0	32	5	10	4
Tipperary	46	26	25	34	362	17
Waterford	5	5	18	20	0	8
Westmeath	79	41	2	64	130	1
Wexford	67	44	13	32	50	68
Wicklow	12	2	20	0	35	1
	601	295	543	2393	1714	587



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Framework for Emergency Management: Mitigation and Preparedness Measures for Severe Weather

- Responsibility assigned for various kinds of emergencies to 3 Principal Response Agencies:
 - I. An Garda Siochana
 - II. Health Service Executive
 - III. Local Authorities
- Framework for MEM: developed in 2005. Adopted by Gov. 2006
- Sets out common arrangements and structures for frontline public sector emergency management in Ireland
- Based on internationally recognised systems approach
- Proposes an iterative cycle of continuous activity through 5 stages of MEM



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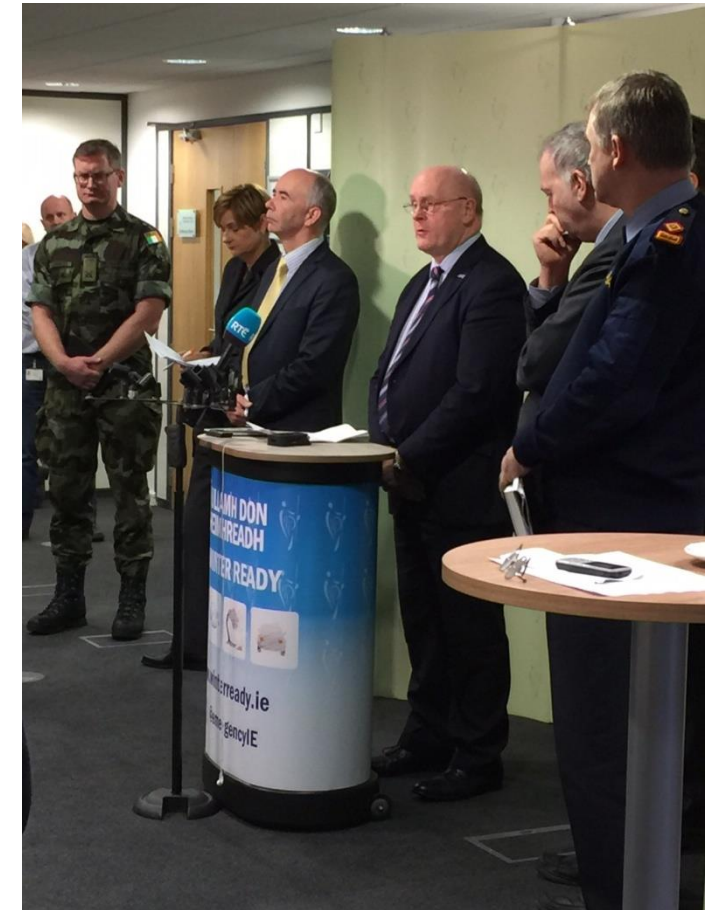
Framework for Emergency Management: Mitigation and Preparedness Measures for Severe Weather (contd.)

- Proposes an iterative cycle of continuous activity through 5 stages of MEM
 - I. Hazard Identification/Risk Assessment
 - II. Mitigation
 - III. Preparedness
 - IV. Response
 - V. Recovery/Review
- Framework adopts an all-hazards approach to MEM/informed by best international practice, customised to suit Irish conditions

Framework for Emergency Management: Mitigation and Preparedness Measures for Severe Weather (contd.)

- Establishes working relationships between the elements which make up frontline emergency response
- Two-year development programme 2006-2008 and further learning from severe weather episodes 2009,2010,2011 and winter 2013/2014
- Review reports prepared to further strengthen response capability

National Response



National Level Response to Flooding

- Alert to Dept. HPCL&G by Met Eireann to Storm Desmond (and subsequent storms)
- National Co-ordination Group on response to severe weather emergencies was convened on 03rd Dec. 2015
- Convened daily from 07th Dec. 2015 to 13th Jan. 2016, including throughout Christmas and New Year
- Daily press briefings
- Copernicus Activation

HOUSEHOLDS



Local Authority Preparedness

- All Local Authorities have participated in a series of MEM development programmes
- All LA's involved in managing severe weather emergencies over last decade
- Local Authorities work with other agencies and also work to regional programmes of training and exercises based on Regional Risk Assessments
- Met Eireann provide all LA's with weather alerts in times of severe weather

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Homes under Threat



Flood Rescue



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Local Authority Preparedness (continued)

- LA's place general operations staff and engineering staff on standby and respond as necessary
- As events unfold, response can be escalated (if required) to Regional Level
- Where situations further escalate to an exceptional extent, a whole government approach may be initiated to support Local and Regional response
- No MEM was declared. Severe weather emergency protocols are part of the Major Emergency Plans of the PRA's
- The Government has also established a taskforce on emergency planning (chaired by Minister for Defence)



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Laois

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Laois



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Farm animal Rescue



Local Level Response to Flooding

- LA's designated as Lead Agency to responding to severe weather
- LA response informed by *Guide to Severe Weather Events 2010*
- LA's have severe weather sub-plans based on this guidance material
- As lead agency, LA's carried out a number of functions during the response stage and continue to deal with recovery issues in conjunction with other responsible agencies

Loss of homes and Vehicles



Local Level Response to Flooding (continued)

- LA role included:
 - Coordinating and inter-agency response
 - Continuously monitoring forecasts/alerts/warnings to scale appropriate response measures
 - Operating flood defences and deploying sand bag defences
 - Clearing debris and fallen trees
 - Flood rescue and pumping water (Fire Service)
 - Public communication including text alert, extensive use of social media, real-time website updating, regular press briefings and use of all local media including local radio
 - Emergency housing
 - Deployment of Civil Defence
 - Transportation issues (e.g. closing/opening roads)
 - Transportation of families



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Local Level Response to Flooding (continued)

- Monitor weather forecasts
- Action alerts from Met Eireann
- Convene severe weather assessments
- Scale response as appropriate
- Ramp-up preparedness
- Activate inter-agency structures
- Inter-Local Authority Collaborative Response
- Monitor OPW EFAS Flood Alerts
- CFRAMS
- Minor flood relief works



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Stranded Animals



Local Level Response to Flooding (continued)

- Activate Crisis Management Teams
- Liaise with Defence Forces, Coast Guard, Mountain Rescue and Red Cross
- Certification of Red Cross assistance scheme
- Assisting DAFFM with emergency farm assistance
- Assisting Irish Water through SLA (boil water notices, flooded treatment plants etc.)
- Assisting business community with clean-up's and disposal of damaged goods
- Planning for establishment of reception centres in the event of evacuation of residents



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Local Level Response to Flooding (continued)

- 24/7 Operation
- Staff resilience
- Link with ESB
- Clear watercourses and water outlets – environmental clean-up's
- Remove fallen trees
- Temporary road repairs
- Response delivered over an extended period under difficult conditions
- LA response favourably commented on by public representatives across all political parties and in the Oireachtas

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Local Level Response to Flooding (continued)

- Timely and detailed reporting by LA's to national coordinating group
- LA's gave invaluable insight to conditions and activities at local level
- Information flow appreciated at Government level
- An Taoiseach and Government Ministers briefed at regular intervals
- Liaison and cooperation with Dept. Social Protection in implementing Humanitarian Assistance Scheme
- Assisting with access to schools/return to school after Christmas break
- Cooperating with HSE in relation to access to premises, transport of key staff etc.
- Cooperating with local communities/community resilience



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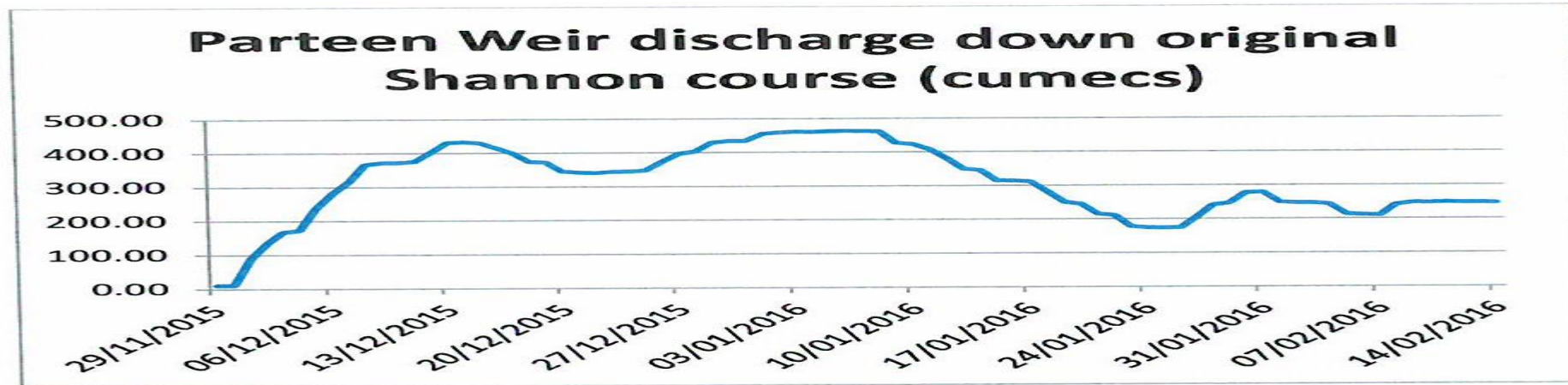
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ESB

- Prior to Winter 2015, ESB met with all LA's to explain ESB operations on rivers
- Also established good basis and contact for liaison in the event of floods
- Daily contact between ESB staff and various LA's along rivers (and also with Rivers Agency NI)
- Close coordination helped LA's to respond in a timely manner
- Dams on Shannon at Ardnacrussha, on the Lee at Inishcarra, on the Errin at Ballyshannon and at Poulaphouca on River Liffey were very closely monitored with ongoing joint consultation with joint LA's

Parteen Weir Discharge



Hazard Identification





Inniscarra



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Local Level / Civil Defence Response to Flooding

- Providing transport for health care workers, community welfare officers, postal deliveries and enabling children to attend school
- Provided throughout entire period of Dec. 2015 & Jan. 2016
- Civil Defence operation continued into early months of Summer in Counties Galway and Roscommon where householders remained cut-off from villages and towns



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Impact on Transport

- Transport normally affected by severe weather events
- All state bodies have emergency plans and procedures in place
- Road and rail impacted
- Air and ferries primarily impacted by high winds
- Limited impact on motorway network
- Significant number of national and regional routes affected
- Severe impact on local roads
- Impact on rail network (Wicklow-Greystones and on Galway, Sligo, Mayo and Ennis lines)

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Waterford

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Damage Assessment

- LA's requested by Dept. to compile initial estimates of damage to public infrastructure
- Damage of estimates to also include cost of response and clean-up
- Above compiled in Jan. 2016 whilst flooding was ongoing to assist with planning of immediate recovery methods
- Direct liaison between Dept. and all LA's
- Full extent of damage could not be ascertained for extended periods in certain areas (months) where flooding persisted
- Further appraisal of capital and infrastructural damage undertaken when flooding receded
- Cost of damage to roads has been the most significant element

MUD AND DEBRIS



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Damage Assessment (continued)

- LA's incurred significant additional/unbudgeted exceptional costs
- Costs related to emergency staff costs, emergency materials and equipment, hire of plant and necessary urgent works
- €18 million made available to assist LA's with meeting exceptional costs
- Claims received from 28 LA's
- Some recoupment's provided in Dec. 2015
- €106 million allocated by Government to assist in repair of storm and flood damage to transport infrastructure
- Indications to LA's that funding would be made available in 2 tranches
- €85 million announced in grant allocations to commence repairs on regional and local roads

Road Damage



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EMBANKMENTS AND STRUCTURES



EMBANKMENTS AND STRUCTURES



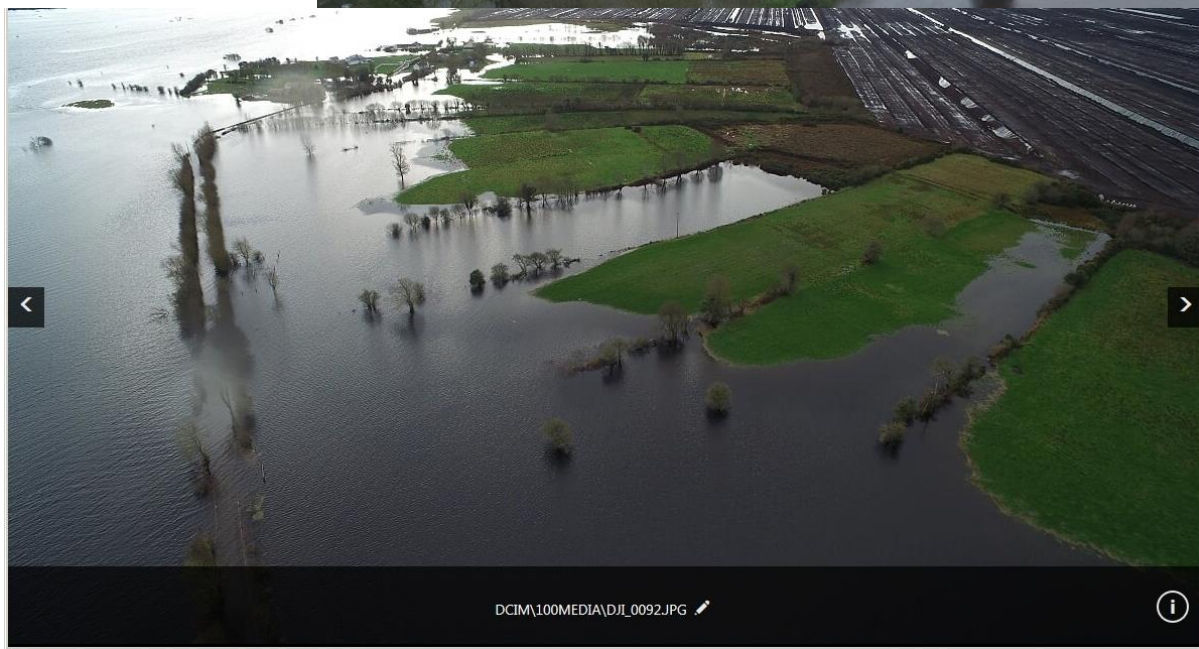
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Funding to be Drawn Down in 2016

- Top-up funding of €9 million allocated in May 2016
- €8 million allocated to TII for works on damaged national roads
- €8 million allocated to Irish Rail for repairs to rail network

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Choppy Seas

