STRONG REPORT

"Review of Winter Flooding"

(Northern Ireland) 2015-2016

Independent Review

W Alan Strong MBE CEng FICE
Chairman, Drainage Council NI

November 2016

The Report can be accessed on the Department for Infrastructure website at:
https://www.infrastructure-ni.gov.uk/publications/alan-strongs-report-review-winter-flooding-northern-ireland-2015-2016

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Flooding Review Content

EXECUTIVE SUMMARY

Purpose

The 'Review of Winter Flooding 2015-16' was commissioned by Michelle O'Neill MLA (Minister of the Department of Agriculture and Rural Development (DARD)) in March 2016, following a period of severe rain and subsequent flooding in the period from November 2015 to January 2016.

The purpose of the review was to enable DARD or its successor, to capture issues identified during the flooding experienced in parts of Northern Ireland in that flooding period. In essence, the Review will:

- Consider the causes of the flooding;
- Conduct a regional debrief into the multi-agency emergency response;
- Consider the current management and operating regime to control water levels for Lough Neagh; and
- Consider the issues faced by those affected by the flooding.

Context

The Review initially placed Winter Flooding in the wider contexts of the Global, European, National and Regional scenes. It made particular reference to high level drivers such as the UN Sustainable Development Goals, European Directives addressing Water and Flooding, and key UK Statements such as the Pitt Review (2009), the National Flood Resilience Review (2016) and the recently published Climate Change Risk Assessment (CCRA) Report 2017.
The Regional context was articulated through the NI Departmental plans on Flood Risk Management and the Long Term Water Strategy.

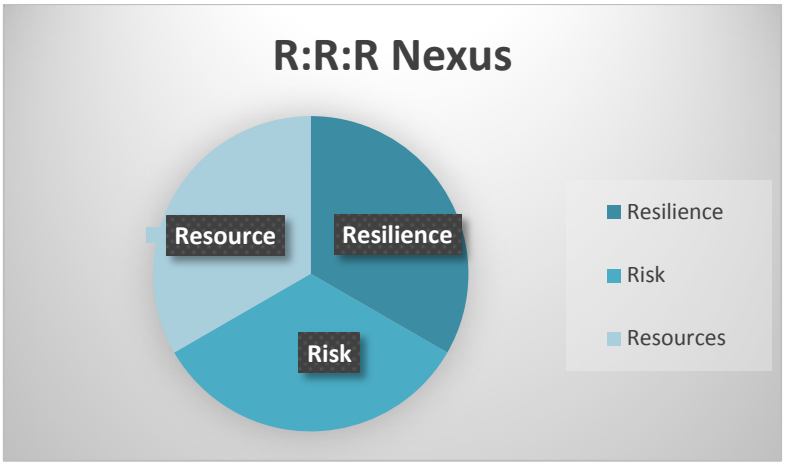
Appraisal Rationale

An early identification of the concept of 'linking the Resilience of a system with its Risk of survival, and how this relationship could be enhanced or reduced by application of Resources' was adopted, and this became an over-arching rationale for appraisal of Winter Flooding issues. This was referred to as the Resilience-Risk-Resource (R:R:R) Nexus.

The adopted descriptors were:

- Resilience: 'an ability to recover from or adjust easily to misfortune or change';
- Risk: 'probability of occurrence of an unwanted event multiplied by the consequence (loss) of the event; three types of loss are people, property and efficacy; and
- Resource: 'a stock or supply of money, materials, knowledge, staff, and other assets that can be drawn on by a person or organisation in order to function effectively'.

This Nexus, when all three elements are in balance, is shown diagrammatically as follows:



Flood Reviewing – 'Where we have come from'

A brief look back at the Performance and Efficiency Delivery Unit (PEDU) report from 2012, and earlier reports, allowed this Review to see what had been done by Government and specifically DARD and Rivers Agency following the 2 day storm period in Belfast in late June 2012. The development of flood warning and informing proposals, a scheme of individual property protection and the delivery of a large scale emergency planning exercise were significant outcomes.

Similarly, a review of the NIAO Report (2016), entitled 'The Rivers Agency: Flood Prevention and Management', identified that there was a high level of assurance that there had been significant improvements in the management of flood risk in recent years. Matters that were praised by NIAO included Rivers Agency's Flood Risk Management Strategy that was in line with the EU Floods Directive requirements, and its developed Strategic Flood Map and Detailed Flood Maps. Development of the business case for the £1 million Homeowner

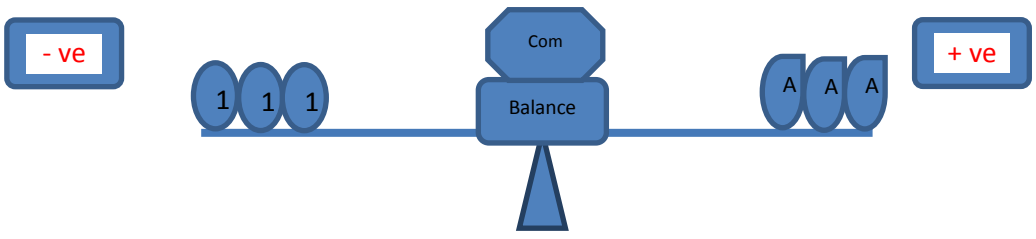
Flood Protection Grant Scheme, subsequently launched in January 2016, was aimed at residential properties located within high-risk flood areas. However, Rivers Agency was criticised for the majority of projects finished either late, over budget or both in the last five years, despite investing nearly £33 million in the construction of new flood defence assets. However, recommendations were acknowledged on how to improve this delivery and provide value for money.

Review Methodology

As this was an evidence-based study, there were a range of mechanisms adopted to obtain facts, secure comment and translate these into coherent and consolidated views. An initial capture of input from many of the Emergency Responders was obtained from both written comments and a large De-Briefing session; this identified a range of Key Issues.

The subsequent round of stakeholder engagements included meetings with over 45 Groups involving over 300 people, written input from over 50 correspondents; these views were representative of a broad range of interested parties covering farming, engineering, environment and governance.

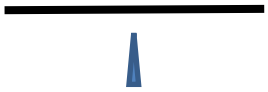
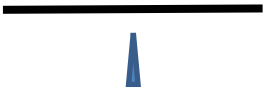
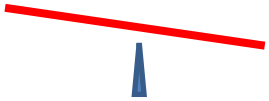
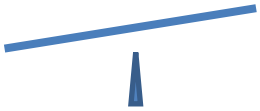
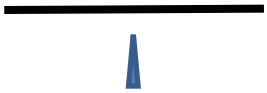
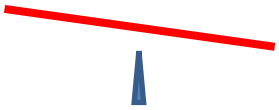
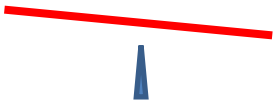
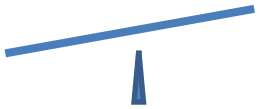
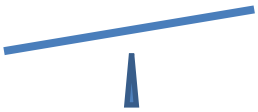
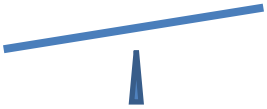
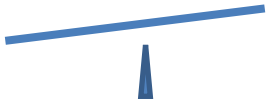
Views and comments were triangulated with literature; this also led to the identification of eleven discrete areas of investigation. In order to apply a systematic approach, these were each analysed against a Resilient Beam in which the positive impacts were set against negative influences in order to establish what was needed to obtain a balance – these balancing elements became the Balancing Actions, leading on to key Recommendations, while 'good practice' constituted the Commendations. Typically, this was shown as:



The Fulcrum of each beam was a statement of what was expected from that issue in the long-term.

Commentary on Resilient Issues

A detailed analysis, following the Methodology rigorously, produced the following Resilient Issue Beam configurations:

'Human Interaction'		
STAFF 	COMMUNICATIONS 	COMMUNITY NETWORKS 
'Science and Engineering'		
HYDRAULICS 	RIVERS and INFRASTRUCTURE 	WEATHER DATA 
'Governance'		
EMERGENCY PLANNING 		FLOOD ECONOMICS 
'Agriculture and Land'		
LAND USE 	CATCHMENTS 	FARMERS 

Each of the Issues had at least 15 items of stakeholder evidence which were interpreted into 4 or 5 positive and 4 or 5 negative impacts; this resulted in an overall configuration for each issue as shown above; it is noted that a Beam which is dominated by 'positive inputs' will lean to the right, coloured **Red** (e.g. Community Networks), while those with dominant negative inputs will lean to the left, coloured **Blue** (e.g. Hydraulics); hence those in a neutral position, coloured in **Black** (e.g. Staff), indicated balance during the Winter Flooding. Also each Issue was awarded at least one item of Commendation for 'evidence of good practice'

and a number of Recommendations for 'work that should be applied or investigated to provide greater balance'. These amounted to 50 Balancing Actions.

In summary, it is noted that three issues were in balance (in **Black**); three were positive (in **Red**), and five were negative (in **Blue**). This appraisal was influenced by a desire to identify the R:R:R Nexus and therefore to derive Headline Recommendations.

Headline Commendations

Five Commendations were each lauded in at least one or more of the Resilience Issues sections:

- **Comm1**: Distinct leadership, on the ground and in the media by Minister and Rivers Agency Chief Executive;
- **Comm2**: Notable support and guidance by the Ulster Farmers Union for its members across the province;
- **Comm3**: Strong resilience, in the face of adversity and medium to long-term disruption, by many in the rural community;
- **Comm4**: Vision to engage with Natural Flood Management Systems;
- **Comm5**: Sustained efforts by Emergency Planning Groups, Community Resilience Groups and Service providers over a 14 week period.

Headline Recommendations

The Review produced a 'One Concept and a 10 C-Plan' as follows:

One Concept and a 10 C-Plan:

One Concept or Overarching Approach of "**Resilience** links to **Risk** though the appropriate and sustained allocation of **Resource**" (R:R:R Nexus).

10 C-Plan, based on R:R:R Nexus Concept:

C1: Commission: Procurement of a Hydraulic Model of Lough Neagh flows, leading to *a review of the statutory water levels in Lough Neagh*;

C2: Crops: Increased research and development work, through DAERA, to examine *crop performance and potential for alternative land* uses in floodplains;

C3: Communications: Seek greater clarity in messages which deal with *'Flood Warning'*, '*Severity and frequency of floods'* and the '*Flooding Incident Line prompts*';

C4: Collaboration of Staff and Resources: Seek greater integration of multi-agency working including *innovative solutions for staff and resource shortages*, initially at Departmental level. Sharing of skills and responsibilities is highly desirable in an inter-departmental work area;

C5: Connection: with and support for farmers in areas of potential flooding to be enhanced through the investigation of a new *Farming Resilience Group (FRG) model,* ideally led by the agriculture industry;

C6: Civil Contingency Systems: review connections and develop a (more visible) suitable management organogram to facilitate the integration of departmental Major Emergency Response Plan(s), Emergency Planning Coordinating Officers and Community Resilience Groups, ensuring adequate policies and efficient delivery. Cross-border liaison is highly desirable, with due attention to checks across Preparedness, Co-ordination, Response, Communication and Recovery;

C7: Catchment Modelling: investigate and develop an *Integrated Catchment Wide Model (ICWM)* to simulate the activities of an entire catchment and interrogate possible new or additional uses/applications. The consolidated ICWM has the possibility to be re-used on several catchments, to bring integration across economic, environmental and social aspects and promote the use of Natural Flood Management techniques. Included may be a review of maintenance work programmes to ensure that key rivers and/or 'designated watercourses' continue to function effectively;

C8: Community Resilience Groups: enhancement of arguably the 'jewel in the crown' for survival of many aspects during extended flooding; greater support for the management, materials and sustainability is needed to ensure that the CRG network grows and matures as well as being an integral part of rural society;

C9: Connecting Resources requires a mature and broad interpretation of the role of Resources in the RRR Nexus, to include capital and operational funds, knowledge, research and experience-informed decisions as well as fit-for-purpose systems for Flood Risk Management. An increased need for Resources in the form of FUNDING will emerge; and

C10: Curricula of all education sectors (primary, secondary, tertiary) should include and be made aware of Emergency Planning, using Flood Risk Management and allied activities as key exemplars. Gaining **Public Confidence** is central to the acceptability of this Review and to an improved response to any further severe flooding.

It is finally recommended that the outputs of this Review, covered by the 10 C-Plan and the Balancing Actions in each Resilience Issue section, should be evaluated independently within a 2-year period, say December 2018. It should also be subject to the normal NI Assembly Ministerial and Committee scrutiny.

The Reviewer acknowledges the immense help and co-operation of many Stakeholders, Rivers Agency Staff and Ulster University colleagues.

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Key Stakeholders –'Who Spoke (or Wrote) up?'

RESILIENT ISSUE	STAKEHOLDERS									
Staff	RA HQ	RA Regions	Blue Lights	DfI Policy Section	UFU Erne	UFU U Bann	UFU L Bann	RCRG	SOLACE	
Communications	Minister O'Neill	DfI and DARD Press Offices	RA HQ	RCRG	Met Office	UFU	Fintona CRG	DAERA - Corp. Services	Academic (K Cronin)	Consumer Council
Community Networks	RA HQ Staff	RCRG	Emergency Planning Co-ordinators	Fintona CRG	Red Cross	Farmers	Politicians (U Bann)	CCG	Academic (K Cronin)	SOLACE
Emergency Planning	DfI	Emergency Planning Co-ordinators	SOLACE	RA HQ (J McKee)	Blue Lights (PSNI, NIAS, NIFRS)	Consumer Council	NI Water	DfI Corporate Services	Translink	Transport NI
Hydraulics	RA Regional Staff	RA HQ	Waterways Ireland	Toome Eel Fisheries	Civil Engineering Professionals	Edge Watersports	Movanagher Fish Farm	B McAfee (Aghadowey)	U Bann Councillors and Farmers	L. Neagh Group
Rivers Operation	Waterways Ireland	Linen Green Management	Kinnego Businesses	RA HQ	Toome Eel Fisheries	Edge Watersports	Movanagher Fish Farm	RA Coleraine Area	Loughs Agency	Farmers
Weather Data	Climate NI	Met Office	Academic (P Biglarbeigi)	RA HQ (J McKee)	NI Water	Movanagher Fish Farm	Translink	Transport NI	Belfast City Council	
Land Use	DAERA	UFU Erne	UFU U Bann + Crop Growers	UFU L Bann	CAFRE Research	Civil Engineering Professionals	CNCC	Blue-Green Cities Research	Sustainable Land Management	NIEA + NIEL
Farmers	UFU HQ	UFU Erne	UFU U Bann	UFU L Bann	DAERA	CAFRE	U Bann Councillors	DARD	Dairy Consultant	Individual Farmers
Catchments	Council for Nature Conservation and Countryside	NI Fresh Water Taskforce	NIEA	Civil Engineering Professionals	Climate NI	UFU	DAERA	CAFRE	Edge Watersports	Salmon Fisheries
Economics	RA HQ	Belfast City Council	Emergency Planning Coordinators	Red Cross	DARD/DAERA Corporate Services	DEFRA	Civil Contingency Group (CCG)	Dairy Consultant	Honourable The Irish Society	Retail Traders
Broader Issues	DEFRA	SEPA	Natural Resources Wales	EPG's	'Blue Lights' – NIFRS, PSNI, NIAS	DARD/DAERA Corporate Services	RA HQ Staff	Institution of Civil Engineers	Building Research Establishment	Local (NI) Councils

Facts - 'Say it in Numbers'

Did you know that:

A. In this evidence-based investigation, the Reviewer:

- Spoke with 300+ Stakeholders
- Hosted 110 Stakeholder-Issue Encounters
- Sought out and met 45 Stakeholder Groups
- Received 56 written submissions, comprising evidence or comments on substantive and relevant matters
- Largest meeting was with 24 farmers; smallest was two 'one-to-one's' and occurred with a Householder and an Environmentalist

B. The extent of winter Flooding is described by:

- More than 3,300 hectares of land were flooded, as determined by satellite imagery
- Farming costs for only re-seeding and/or loss of production was excessive, primarily in Lough Neagh and Lough Erne catchments
- 174 Domestic Properties suffered from flooding
- 176 properties were protected from flooding by the 'emergency response actions of the emergency services, drainage agencies and voluntary sector'
- 100's of homes were protected from flooding by existing flood defence structures
- 36 Commercial Properties were badly flooded
- 55+ roads were closed due to extreme flooding
- The Rail line between Belfast and Dublin was closed due to extreme flooding
- 15 consecutive School-days were lost in parts of the Erne and Neagh basins due to inability of School buses to drive on inundated roads
- Total cost to deal with Winter Flooding over the phases of Preparedness, Co-ordination, Response, Communication and Recovery was estimated at £12.6m
- Personal pain and stress cannot be accounted for in monetary terms
- Upper Lough Erne water levels were about 1m above prescribed upper limit and 140mm below 2009 peak levels

- Lough Neagh water levels were just over 1m above prescribed upper limit, and highest level since 1928

C. Extreme Weather Statistics:

- Winter Rainfall arose from 4 consecutive storms, from November 2015 to January 2016
- Rainfall in Northern Ireland in November and December was 164% and 193% respectively above the '30 year average'
- Met Office (Nov. 2015) predicted: "GB and NI to be affected by 3 months of storms as the biggest Super El Nino in 144 years was about to hit the UK", and this was a remarkably accurate prediction
- 2015/16 was the 'wettest winter on record for over 100 years', as recorded by the Met Office'
- The 'wettest December since records began 1838' 'as recorded by the Armagh Observatory'

D. 2015/16 Winter Storm details:

Storm Name	Date named	Date of impact on UK and/or Ireland
Abigail	10 November 2015	12 - 13 November 2015
Barney	16 November 2015	17 - 18 November 2015
Clodagh	28 November 2015	29 November 2015
Desmond	4 December 2015	5 - 6 December 2015
Eva	22 December 2015	24 December 2015
Frank	28 December 2015	29 - 30 December 2015
Gertrude	28 January 2016	29 January 2016
Henry	30 January 2016	1 - 2 February 2016
Imogen	7 February 2016	8 February 2016

E. Storm Names

- These were allocated alternatively by the UK Met Office and its Irish counterpart Met Eireann
- Names were female and male alternatively, and were decided after the public had made suggestions by email
- To be given a name, a storm must usually be a deep low forecast to require yellow, amber or red warnings with the potential to cause either medium or high impact. A yellow warning comes into place when you should 'be aware' of potential severe weather in the coming days. Amber means 'be prepared' and red means 'take action'
- The 2016/17 Meteorological Storm season commences on 31 October; designation of a storm will not just be based on wind speed. Met Office will now also include, as storm systems, weather which brings impact from rain and snow
- Agreed names for 2016/17 Floods, if required, are:
    - A - Angus
    - B - Barbara
    - C - Conor
    - D - Doris
    - E - Ewan
    - F - Fleur
    - G - Gabriel
    - H – Holly

1. INTRODUCTION – 'WHERE IS THE ACTION?'

1.1 General

The purpose of this Flooding Review Report is to enable DARD, or its successor, to capture issues identified during the flooding experienced in parts of Northern Ireland between November 2015 and January 2016. This brief is expanded upon on Section 1.8 and in Chapter 4.

The earth faces many variables and changes which have neither a rhythm nor an exact reason, other than that change has been observed and can be expected; rainwater, flooding and sunshine is seen as an example of this uncertainty. Scientists and Engineers would want to analyse these changes and inform society of the frequency and consequences of such dramatic changes, using a range of professional skills and predictive tools, and therein lays the challenge for those with responsibility for Flood Risk Management.

In this Flooding Review Report, the author did not have the luxury of all these specialist skills, but set out to gather evidence in a systematic manner from a range of stakeholders who had some direct involvement or influence with Winter Flooding 2015/16. While the brief did not require a deep appraisal on this multi-discipline study on Flooding, there was a considerable amount of evidence provided through the stakeholders, and this was corroborated or altered through examination of similar sources and in literature. This approach is described in the Methodology chapter as I set out to engage with a wide range of views, avoid 'author prejudice' and triangulate opinions and facts in such a way that the Report could bring increased clarity to the complexities and identify improvements which could **'improve flooding response'** and **'increase public confidence'**. Looking forward was therefore a key driver for this Report, using back-casting to develop fore-casting.

The concepts of **Triangulation** are explained in detail later, while the clarification of which matters needed more attention was scoped out by identification of 'those issues which needed attention in order to minimise further disruption or uncertainty if left unattended'; these critical matters were labelled as '**Resilient Issues'**, as each needed to maintain stability of its **Resilient Beam**.

This document sits in the context of previous flooding reviews, and in the more recent Nov. 2015 – Feb. 2016 flooding events. The significance of this series of events is captured in this quotation from the Environment Agency (UK):

> *"Storms Desmond, Eva and Frank disrupted communities across northern parts of the UK, with Desmond alone costing the UK more than £5bn." (EA 2016)*

There have been a series of compelling statements, strategies, reports and commentaries on 'the impact of flooding and how to alleviate it'; while these are helpful and informative, there is a risk of information over-load; therefore this report is not a chronological record of all that took place, nor is it an exhaustive examination of all the Policy material on Flood Risk Management, but it simply highlights a sample of key drivers which serve to set the scene and assist in the wider integrative analysis.

To begin with, I wish to set the wider Global, European, National and Regional context scene.

1.2 Global

- **The UN Sustainable Development Strategy**, as described in 'Our Common Future', known as the Brundtland Report (1987), was the work of the World Commission on Environment and Development for the U.N. General Assembly. It was designed to examine global environment and development to the year 2000 to re-assess critical problems, to formulate realistic proposals for solving them, and to raise the level of understanding and commitment to the issues of environment and development. The Report advocated the growth of economies based on policies that do not harm, and can even enhance, the environment. The commission recognises that the time has come for a marriage of economy and ecology, in order to ensure the growth of human progress through development without bankrupting the resources of future generations.

- **Sustainable Development Goals** (SDG) effectively brought clarity to the Brundtland Report by focusing on global needs and challenges across the triple bottom line of

Economic Stability, Environmental Enhancement and Social Inclusion. The SDG's (paraphrased below) cover 17 thematic goals, with associated key performance indicators.

UN Sustainable Development Goals (SDG) 2015	
1. End poverty in all its forms everywhere	2. End hunger, achieve food security , improved nutrition, promote sustainable agriculture
3. Ensure healthy lives and promote well-being for all at all ages	4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Achieve gender equality and empower all women and girls	6. Ensure availability and sustainable management of water and sanitation for all
7. Ensure access to affordable, reliable, sustainable and modern energy for all	8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	10. Reduce inequality within and among countries
11. Make cities and human settlements inclusive, safe, resilient and sustainable	12. Ensure sustainable consumption and production patterns
13. Take urgent action to combat climate change and its impacts	14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development	

It is argued that four of these SDG's (shown shaded above) relate to the concern over climatic change, food security and agriculture, water management and sustainable materials

consumption and protection. Hence the matter of Flood Risk Management plays a part in meeting or solving, in some way, these lofty international goals and aspirations.

1.3 European

In this Flood Risk Management context, there are many statements, white papers etc., but these two Directives are the most relevant:

- **European Water Framework Directive.** In the array of directives, strategies, statements, communications and papers of the European Union the Water Framework Directive (2000/60/EC) set out "To establish a Community Framework for the protection of inland surface waters, coastal waters and groundwater, in order to prevent and reduce pollution, promote sustainable water use, protect the aquatic environment, improve that status of aquatic ecosystems and mitigate the effects of floods and droughts". It had the key emphases of Catchment Management Planning, River Basin Modelling and the Cost of Compliance.

- **European Flood Directive.** The Directive (2007/60/EC[1]) is legislation on the assessment and management of flood risks. It prescribes a three-step procedure:
  a. Preliminary Flood Risk Assessment, to consider impacts on human health and life, the environment, cultural heritage and economic activity, with a legislative completion date of December 2011;
  b. Risk Assessment, used to identify the areas at significant risk which will then be modelled in order to produce flood hazard and risk maps, to be in place by December 2013 and include detail on the flood extent, depth and level for three risk scenarios (high, medium and low probability); and
  c. Flood Risk Management Plans, to indicate to policy makers, developers, and the public the nature of the risk and the measures proposed to manage these risks. Plans are to focus on prevention, protection and preparedness, and to take into account the relevant environmental objectives of the 'Water Framework Directive'.

1.4 National

- **The UK Pitt Review (2007**) by Sir Michael Pitt was hailed as 'one of the widest ranging policy reviews of our time'. Sir Michael Pitt called for urgent and fundamental changes in the way that Britain is adapting to the increased risk of flooding and called on the Government to set out publicly how it will make rapid progress, and be held to account, on improving the country's flood resilience. **Sir Michael, having received over 1,000 written submissions, consulted widely and visited communities to see for himself the extraordinary hardship so many families across the country faced, said:**
  a. "Research published as part of my report today shows that the risk of flooding continues to escalate; making the events that shattered so many communities last year an ever increasing threat;
  b. I urge the Government to show leadership and urgently set out the process and timescale for improving resilience in the UK. The recommendations in my report are realistic and affordable and should be made a priority. Waiting for another serious event is a dangerous 'strategy of luck'; we need to act now to protect our future;
  c. The Government should:
     i. Establish a Cabinet Committee dedicated to tackling the risk of flooding, bringing flooding in line with other major risks such as pandemic flu and terrorism;
     ii. Publish monthly summaries of progress during the recovery phase of major flooding events, including number of households still displaced;
     iii. Ensure proper resourcing of flood resilience measures, with above inflation increases every spending review;
     iv. Establish a National Resilience Forum to facilitate national level planning for flooding and other emergencies;
     v. Have pre-planned, rather than ad-hoc, financial arrangements in place for responding to the financial burden of exceptional emergencies;
     vi. Publish an action plan to implement the recommendations in this review, with regular progress updates".
  d. He had concerns about the quality and availability of flood risk information currently available to emergency responders and the public;

e. “We need to be more willing to tell people the truth about risk. The current lack of clarity and transparency has the potential to put not only people’s homes, but lives in jeopardy;

f. People purchasing a property in a flood risk area should be made aware of the potential for flooding so they can make informed choices, including on taking out insurance. While the current flood code system needs to be simplified, with earlier and more personalised warnings issued jointly by the Met Office and Environment Agency that say what they mean and give clear advice.”

- **The UK National Flood Resilience Review (2016)** was commissioned by Rt. Hon Ben Gummer (Minister for the Cabinet Office and Paymaster General) and Rt. Hon Andrea Leadsom (Secretary of State for Department of Environment, Food and Rural Affairs); it was researched and written by the National Flood Resilience Review Group, comprising representatives from nine Government Departments, and supported by several Expert Advisors. The extensive study was focused on three key elements:
    - Programme of work to improve understanding of the fluvial and coastal flood risk in England; this arose partly due to the concern of how weather has been traditionally expressed in terms of ‘rainfall return periods’ which was confusing; hence the testing of weather scenarios has led to Environment Agency Extreme Flood Outlines constituting a good representation of plausible severe fluvial and tidal flooding;
    - Using these Extreme Flood Outlines to test the resilience of key local infrastructure assets, such as energy, water, health, transport and telecommunications, on which services to our communities and businesses depend;
    - Focus on making this key infrastructure resilient to the level of flooding portrayed in the Extreme Flood Outlines; this examined the potential for industry to buy and use temporary defences to defend a significant proportion of key local infrastructure rapidly and effectively against extreme flood conditions before it is made as resilient as is feasible; work with the relevant utilities, regulators and government departments will develop and implement plans for temporary improvements to resilience in line with those already available in the electricity

supply industry. These plans will ensure that the utilities obtain stock-piles of temporary defences in advance, and have ready site-specific plans for deploying them where appropriate and possible, if and when serious floods occur this coming winter.

- **The Climate Change Risk Assessment (CCRA) Report 2017**, was published by the UK Committee on Climate Change in September 2016, and provides a balanced response to the risks of dangerous climate change, and is independent, evidence-based advice to the UK and Devolved Governments and Parliaments; there is a bespoke Northern Ireland report. Key comments from CCRA 2017 for Northern Ireland:
    - Climate change is happening now. Globally, 14 of the 15 hottest years on record have occurred since 2000;
    - Impacts of climate change are already being felt in the UK, and urgent action is required to address climate-related risks;
    - It sets out the most urgent risks and opportunities arising for the UK from climate change;
    - Report is the result of over three years of work involving hundreds of leading scientists and experts from the public and private sectors and civil society; risk assessment has been peer reviewed by UK and international specialists;
    - Changes to the UK climate are likely to include periods of too much or too little water, increasing average and extreme temperatures, and sea level rise;
    - Report concludes that the most urgent risks for the UK resulting from these changes are:
        - Flooding and coastal change risks to communities, businesses and infrastructure;
        - Risks to health, wellbeing and productivity from high temperatures;
        - Risk of shortages in the public water supply, and water for agriculture, energy generation and industry, with impacts on freshwater ecology;
        - Risks to natural capital, including terrestrial, coastal, marine and freshwater ecosystems, soils and biodiversity;
        - Risks to domestic and international food production and trade;

        - Risks of new and emerging pests and diseases, and invasive non-native species, affecting people, plants and animals;
    - Opportunities for the UK from climate change include:
        - UK agriculture and forestry may be able to increase production with warmer weather and longer growing seasons, if constraints such as water availability and soil fertility are managed;
        - There may be economic opportunities for UK businesses from an increase in global demand for adaptation-related goods and services, such as engineering and insurance.

- **National Needs Assessment (NNA) – A Vision for UK Infrastructure (October 2016)** by the Institution of Civil Engineers (ICE) made specific reference to Flood Management:
    - Main challenge for the sector is to devise optimal investment strategy for flood risk infrastructure; this is likely to take the form of an enhanced whole systems (EWS) approach comprised of a portfolio of structural and non-structural measures to maximally reduce risks;
    - More rounded approach taken to river basin management; e.g. allow certain rivers to flood to relieve downstream pressures and to the reconfiguration of urban areas, including the installation of green infrastructure to better manage runoff, rain water harvesting and sustainable urban drainage schemes;
    - Review of the responsibilities for flood risk management and a funding model that shifts the onus of paying for flood defences away from the public purse; possible move to the privatisation of flood defence infrastructure with a mechanism for revenue funding to a body which is incentivised and regulated, following the example of the privatisation of the water industry.

1.5 Regional

- **Northern Ireland Assembly 'Programme for Government (PfG)' (2016)** recommends a 'bottom-up approach' as it seeks inter-departmental responses to a number of outcomes. The Framework contains 14 strategic outcomes

which, taken together, set a clear direction of travel and enable continuous improvement on the essential components of societal wellbeing. They touch on every aspect of government, including the attainment of good health and education, economic success and confident and peaceful communities. In addition to merely fulfilling our statutory obligations, we will in future be able to target those things that make real improvements to the quality of life for the citizen. It is speculated that a joined-approach to address issues such as Flooding impact and Alleviation can contribute to some of the outcomes, especially when risk is reduced and resilience is increased.

- **'Building our Quality of life by ICE Northern Ireland Manifesto 2016',** is the most recent in a series of strategic documents issued by ICE NI, in which it highlights the key elements of infrastructure which need attention or are critical to 'quality of life'; it is based on the premise that 'we think differently about how we fund and procure projects, what areas are most in need and how we attract and develop our best people'. This Manifesto categorises its recommendations via Delivery, Resilience and Skills.

- **ICE State of the Nation Report 2014: Flood Management** section made the following comments:
  - ICE recognised that with the implementation of the Floods Directive and lessons learned from recent flooding events, there has been a significant change in the approach to flood risk management.
  - These advancements, including flood mapping and improved community engagement, have resulted in a more joined-up approach to the protection of people, property and vital infrastructure, as well as planning for, responding to, and recovering from flood events.
  - Recommendations included:
    - One government body should have overall authority for flooding;
    - Education for the public and business owners, along with timely flood warnings to allow them to defend their properties;
    - All development must be designed for extreme events when drainage infrastructure is overwhelmed.

- **Flood Risk Management Plans**
  - Flood Fisk Management Plans for Northern Ireland have been produced by DfI Rivers to comply with the requirements of the European Union Directive on managing flood risk (2007/60/EC) (Floods Directive) which was transposed to local legislation through The Water Environment (Floods Directive) Regulations (Northern Ireland) 2009;
  - The completed Plans were published in December 2015 in accordance with EU requirements. They highlight the flood hazards and risks, in the 20 most significant flood risk areas in Northern Ireland, from flooding from rivers, the sea, surface water and reservoirs. The Plans identify the flood risk management measures that are to be undertaken over the next 6 years, 2015- 2021, and set out how the relevant authorities will work together and with communities to reduce the flood risks;
  - As well as implementation of the measures over the current 6 year cycle, Plans are to be reviewed and so work will soon commence on the 2nd cycle Preliminary Flood Risk Assessment, an early stage in Plan development, which must be completed by December 2018.

- **Long Term Water Strategy**
  - 'Sustainable Water - A Long-Term Water Strategy for Northern Ireland (2015-2040)' was agreed by the Executive and published in March 2016. The Strategy sets out a range of initiatives to deliver the Executive's long-term goal of a sustainable water sector in Northern Ireland. It encourages a sustainable and integrated approach to managing all our water needs, focusing on Economic Development and Growth, Affordability, Environmental Improvement and Compliance, Flood Risk Management and Sustainable Service Delivery;
  - The Long-Term Water Strategy aims to:
    - create a more sustainable water sector where all water related activities can co-exist without compromising the environment or increasing flood risk;
    - consolidate and bring together all policies that affect the water sector;
    - progress delivery of difficult cross-cutting policies such as water efficiency, surface water management and water and sewerage funding and regulation;

- inform the development and delivery of the Executive's River Basin Management Plans, Flood Risk Management Plans and proposed Marine Plan;
- provide strategic direction and a framework for long-term investment plans to encourage the delivery of sustainable initiatives with longer pay back periods; and
- ensure existing water and sewerage infrastructure and investment proposals inform future planning decisions.

- **Flood Reviews – Northern Ireland.** Several reviews have been carried out by Government Agencies or Departments in the last decade, and these are summarised in Chapter 2 Flood Reviewing - 'Where we have come from'.

1.6 Winter Flooding (Nov 2015 – February 2016) Context

Widespread flooding occurred in several areas at various levels over the period from early December 2015 to early February 2016. Road networks and properties around Lough Erne, Lough Neagh, River Blackwater, River Finn, River Sillees and River Quiggery were affected and communities in Aughnacloy, Lisnaskea, Kesh, Omagh, Clady, Strabane, Dungannon, Fintona, Coalisland and Castlederg were impacted. Significant areas, circa 7,000 hectares (unconfirmed) of farmland, primarily in river floodplains, were inundated with fluvial water which had over-spilt from rivers. This extreme flooding was caused by three consecutive storms, Desmond, Eva and Frank.

1.7 Commentary

An appraisal of these statements, reports or commentaries from the four jurisdictions of Global, European, National and Regional identifies several common themes relating to Flood Risk Management, and also finds areas of governance which are of concern.

1.7.1 The **common areas of concern** are:

A. Identifying and expressing Risk in ways that both professionals, members of society and decision makers can understand and respond to;
B. Defining and changing the Resilience of many aspects of Flooding Infrastructure or Support Systems;

C. Describing types of Resource which are needed to deliver sufficient and efficient Flood Risk Management systems, in the broadest sense.

D. A desire to manage the (often unpredictable) variables of flood management so that there is confidence in the processes, high level and adequate support and mutual respect across all the key stakeholders.

1.7.2 **Three over-arching elements** emerge which need addressed and developed, with the test that they can be applied to many aspects of Flood Risk Management. They are:

- **Resilience:**

  'an ability to recover from or adjust easily to misfortune or change'

- **Risk:**

  'probability of occurrence of an unwanted event multiplied by the consequence (loss) of the event'; three types of loss are people, property and efficacy

- **Resource:**

  'a stock or supply of money, materials, staff, knowledge, skills and other assets that can be drawn on by a person or organisation in order to function effectively'

1.8 Flooding Review 2016 Explanation and Connectivity

This Review arose on the request of the DARD Minister, Michelle O'Neill MLA, and Officials and had the initial Purpose and Scope as follows:

- **Purpose:** The purpose of the review is to enable DARD to capture issues identified during the flooding experienced in parts of Northern Ireland between November 2015 and January 2016;
- **Scope:** The review will:
  - Consider the causes of the flooding;
  - Conduct a regional debrief into the multi-agency emergency response;
  - Consider the current management and operating regime to control water levels for Lough Neagh; and
  - Consider the issues faced by those affected by the flooding.

This initial brief, along with logistics and administration support, was expanded out for clarity by the Author in conjunction with the Minister and Officials, and this agreed Commission is detailed in Chapter 4 Methodology.

It became evident to the Reviewer that the need to triangulate the evidence of a disparate range of stakeholders required an appraisal of the context, literature and background to Flood Risk Management; hence the detail in this chapter was vital in identifying a structured systematic methodology and led to a holistic and integrative approach to the Review Report. The Methodology chapter takes this approach forward.

2. FLOOD REVIEWING – 'WHERE WE HAVE COME FROM'

There have been a number of Flood Reviews in recent years. It was not an objective of this Flooding Review (2015-16) to review all previous flooding commentaries and reviews.

However, it was considered valuable to reflect briefly on the more recent reviews, namely the Performance and Efficiency Delivery Unit (PEDU) Report (2012) and the Northern Ireland Audit Office Report (2016).

2.1 PEDU Reporting

Following the significant flooding that occurred in Belfast on the 27th and 28th June 2012 the Executive, at its meeting on 5 July 2012, agreed that the Performance and Efficiency Delivery Unit (PEDU) should be asked to review the response of the government agencies.

Approximately 1600 homes were flooded as a result of approximately 44mm of rain that fell in 3 hours in the evening of the 27th June.

The PEDU report made 12 recommendations, one of which related to the consideration of a number of recommendations arising from earlier reports. This brought the total number of recommendations to 31.

All 31 recommendations have now been addressed through the work of a number of Departments and organisations and these have, for the most part, provided a solid basis for the improvements in the emergency response to flooding, which has been evident in recent years. Notable recommendations that have realised positive benefits include:

- the development of flood warning and informing proposals for Northern Ireland;
- developing a scheme of individual property protection;
- delivery of a large scale emergency planning exercise, Eluvies 2, to clarify roles and responsibilities in relation to the emergency response to coastal flooding.

It is also worth noting that working through these recommendations has also improved the co-ordination between organisations and a better understanding of roles and capabilities.

The establishment of DARD, as the 'Lead Government Department (LGD) for the Co-ordination of the Emergency Response to Flooding', occurred in 2014. This was a further positive development to enable a more effective response to flooding by government. Key elements in delivering this new responsibility include planning for emergencies, co-ordination, communication and the provision of flood related expertise to other responding organisations.

The LGD responsibility by DARD passed to the Department for Infrastructure (DfI) in May 2016, as a result of the review of the NI Government Departments. All of the Drainage Organisations are now part of DfI, and this opportunity for enhanced co-operation fulfils a recommendation of the PEDU report that all the Flood Response Agencies should be within a single departmental ambit.

2.2 Northern Ireland Audit Office Reporting

This NIAO Report (2016) was entitled 'The Rivers Agency: Flood Prevention and Management' see: https://www.niauditoffice.gov.uk/publication/rivers-agency-flood-prevention-and-management.

A summary of the content is as follows:

2.2.1 The Northern Ireland Audit Office (NIAO) carried out a 'value for money' audit on Rivers Agency over the last 2 years.

2.2.2 The Comptroller and Auditor General from NIAO published the report on 13 September 2016.

2.2.3 The report provides a high level of assurance that there have been significant improvements in the management of flood risk in recent years; however, it does identify some areas where improvement is required.

2.2.4 Main Findings

- The Rivers Agency's Flood Risk Management Strategy is in line with the EU Floods Directive requirements, and the developed Strategic Flood Map and Detailed Flood Maps are fit for purpose.

- The Rivers Agency's flood maps are useful for development planning, promoting and designing resilience measures, and flood defence project prioritisation. The Rivers Agency has made these maps available to the public, allowing them to check if they are in a flood prone area. (https://mapping.infrastructure-ni.gov.uklFloodMapsNI/index.aspx)
- There are effective structures, guidance and protocols in place to allow stakeholders to collaborate during flooding incidents which are routinely tested to identify improvements. Improvements to the weather warning arrangements within Northern Ireland will mainly benefit river flood warning.
- The Flooding Incident Line continues to be improved but the call abandonment rate, which peaked in 2012 at 27 per cent, remained high at 16 per cent in 2015. There is therefore scope to improve the performance of the Flooding Incident Line.
- Each year the Rivers Agency commits around £80,000 to improve resilience to flooding, especially in areas subject to repetitive flooding. The Rivers Agency also developed the business case for the £1 million Homeowner Flood Protection Grant Scheme, launched in January 2016, aimed at residential properties located within high-risk flood areas unlikely to benefit from publicly funded flood solutions, within five years of their application.
- Over the last five years, the Rivers Agency has invested nearly £33 million in the construction of new flood defence assets. However, the majority of projects finished either late, over budget or both. Rivers Agency has made recommendations on how to improve their delivery and value for money. However, it will take a number of years to determine if these recommendations will reduce cost overruns and time delays.

3. REGIONAL REVIEW OF WINTER FLOODING DE-BRIEF (16 MARCH 2016) - 'WHAT THEY SAID FIRST'

This key De-Briefing session was held in Loughry College, Cookstown on Wednesday 16 March, 2016 at 9.30am – 4.30pm. The context of the day had been established though the submission of Feedback templates by all the key agencies and organisations which had been involved with the Winter Flooding.

Clarification: The record of this De-Briefing session was made by Kieran Brazier (DARD Civil Servant) and his staff, and is a fair record of a day of considerable interaction. It is written in the style to suit the dynamics of the day. Also it is noted that the Departmental labels were those in place on that day, but some have subsequently changed due to a re-alignment of the NI Executive Departments.

3.1 Attendance

Table 1	Table 2	Table 3	Table 4
Jonathan McKee	Eugene Cunningham (ABC B Council)	Joan McCaffrey (F&O Council)	Owen McGivern (RA HQ)
David Porter	Claire Carleton (BCC)	Juliet Coulter (M&EA B Council)	Sean O'Neill (RA HQ)
William Irwin (MLA)	Michael Patterson (BCC)	Kieran Connolly (L&C B Council)	Graeme Anderson (RA HQ)
Sydney Anderson (MLA)	Gillian Topping (ABC)	Ray Hall (MU Council)	Jim Martin (RA HQ)
Kieran Brazier (RA)	Liam Hannaway (NM&D D Council)	Mark Kelso (MU Council)	Jackie Gregg (DRD)
Alan Strong (Reviewer)	Davy Neill (BCC)	Perry Donaldson (A&N B Council)	Diane McKain & John Wylie (Met Office)
Table 5	**Table 6**	**Table 7**	**Table 8**
Tracey Teague (DARD Corporate)	Henry Robinson (Transport NI)	Lex McCoubrey (PSNI)	Barclay Bell (Ulster Farmers Union)
Moya Haughey (DARD)	Linda MacHugh (DRD)	Huw Morgan (MoD)	Kerry Daggett (BT)
Ronan Henry (DARD PO)	Eilis Ferguson (DRD)	Maurice Rafferty (NI Fire and Rescue)	Robert McKissick (NIE)
Lynda Lowe (DARD)	Andrew Law (NI Water)	Johnny McArthur (NIAS)	Rodney Ballentine (NIE)
Susan Topping (DARD)	David McCullough (NI Water)	Paddy Simpson (NIAS)	Tony Stitt (NI Housing Executive)
Steven Millar (DARD)	Steven McDowell (NIEA)	Joanne McKenna (British Red Cross)	Kate Cairns (Ulster Farmers Union)
Jeff Glass (DoE)		Julie Cuming (OFMDFM)	David Brown (Ulster Farmers Union)
		Richard Knox (Translink)	Matthew Harrison UFU)

The De-Brief Session was facilitated by Alan Strong (newly appointed Winter Flooding Reviewer), as well as presentations by David Porter (RA Chief Executive), Jonathan McKee (RA Director of Development) and John Wylie (Met Office). The following information has been collated and summarised in no particular order of importance.

3.2 What Went Well

3.2.1 Preparation in planning proved vital in the ability to deliver as follows:

Contact Directories	Networks	Conference calls
Clear awareness of roles and responsibilities	Good processes that worked	Positive use of flood maps
Local Knowledge	Timely communications	Good multi-agency communications, co-operation and co-ordination
Situational awareness	Appetite to do it right, by all involved	Self-help/mutual aid ethos

3.2.2. Overall co-ordination plus the collegiate/community approach. Willingness of people to step up to the mark even when roles and responsibilities were blurred.

3.2.3 Communication – quality of focus on hot spots, potential impacts, dynamic shared information. Pre-declaration of Level 1. Good communications between core Department and Rivers Agency delivered early with all angles covered in terms of briefings for Ministers, Committees, Top Management, Stakeholders, Public and Press. Good 'Lines to Take' communications.

3.2.4 The positive leadership, roles and responsibilities that Rivers Agency assumed as Lead Government Department (LGD). Decisive and clear leadership from Rivers Agency. David Porter's visibility, confident approach, professionalism and his use of layman's language.

3.2.5 Activation of LGD role. Note that it takes resourcing especially over a holiday period.

3.2.6 Community Resilience Pilots were very pro-active and ensured that these areas were prepared. This only worked in areas where the lead resident and the multi-agency partners had developed a relationship.

3.2.7 Multi-Agency Conference Calls – these were extremely valuable in ensuring joint decision making. Positive sharing of information. Excellent information impact i.e. telemetrics.

3.2.8 Good Will – Going the Extra Mile – Mutual respect built on previous experiences and relationships between agencies. Intangible benefits but peoples resilience is less likely to responds as effectively during a prolonged periods of flooding.

3.2.9 Weather forecasting (Met Office) – before and during event was excellent. Tracking storms provided more accurate information. The new storm naming process was valuable. Seasonal forecasting improved the planning process.

3.2.10 Positive measures put in place to help householders and farmers in Enniskillen and Lough Neagh areas. Pumping was put into action quickly.

3.3. Challenges

3.3.1 Lack of uniformity in Civil Contingency Group NI protocols, some based on assumptions, need to factor in Local Government change both at Council and Departmental levels. New council areas need to ensure they have reviewed and have their emergency plans and protocols completed and up to date.

3.3.2 Formalise and fund structures. The lack of certainty and resilience in local government around proper funding and the need for adequate resource needs to be clear. Lack of capital investment.

3.3.3 Improve staff resources in terms of having a resilient, experienced, trained people available in emergencies. However, be mindful of 'Burn Out', good will of staff and work life balance. Note the impact of Voluntary Exit Scheme in terms of loss of experience and knowledge.

3.3.4 Flooding Incident Line – improvement required as follows:

a. Fully resourced and staffed throughout an emergency;
b. 'Quality of Live' information needs to improve such as access to sandbags;
c. Citizen accesses are confusing such as the requirement of post codes when reporting floods; and
d. The process of using the Flooding Incident Line should be promoted making it more visible to the public.

3.3.5 Develop Communications – suggestions for improvement are as follows:

- Ability to disseminate communication to the media, timeliness, strategic messages etc.
- Information demands – note that the continuous demands on Rivers Agency staff to supply information has a knock-on effect in terms of the demands of actually dealing with the floods on the ground.
- More autonomy at multi-agency partners level to disseminate sub-regional communications to media through local press releases. Suggest a bank of 'Lines to Take' is made available.
- Manage public expectations through timely clear media statements. Getting the messages out as early as possible at all level i.e. NI wide, Regional and Local (street level) to manage public expectations. Consider Media/Press Conferences on a daily basis. Messages should be disseminated using all types of communication channels including social media.
- Information capturing e.g. utilise Spatial (NI) and Resilience Direct - all data of homes, schools, roads, welfare assistance and infrastructure impact, this should be pre-loaded and available for future flooding incidents. This will improve multi-agency situational awareness and avoid duplication.

3.3.6 NI Executive needs to show strategic ownership. Possible appointment of Minister for Resilience.

3.3.7 Acceptance that this type of exceptional weather is now a more frequent event. As a consequence resources and strategic emergency planning should be the norm. Rural Proofing – this flooding had a negative impact on rural communities and rural dwellers as a result they felt extremely disadvantaged. Remember that it's not just about houses, 7,500 acres of farm land flooded for 2-3 months with approximate £2.7 million uninsured loss to the farming community. Not forgetting animal health and welfare issues and possible pollution from fallen animals, silage effluent etc. Promote a closer relationship between rural dwellers and rural business owners.

3.3.8 Investigate if there is budget resource/financial support available to rural dwellers/communities through EU Solidarity Fund.

3.3.9 Lough Neagh - consider opening gates sooner. Consider commissioning a Jeremy Benn Associates (JBA) Style Report (done for L Erne) for Lough Neagh. Action should be taken on the JBA Lough Erne Report.

3.3.10 The lack of co-ordination of volunteers and volunteering Group (SAR) who self deployed resulted in poor use of assets. The volunteers are a value adding asset which should be embraced for civil protection as it is for search and rescue.

3.3.11 Conflicting boundaries i.e. the challenge is how to link the 11 Local Authorities and 5 Emergency Planning Groups (EPG's) as opposed to Policing, Fire Service and Health Authorities. Co-terminus areas are best.

3.3.12 Consider single platform for mapping system that is kept up to date and that all emergency personnel have access to.

3.3.13 LGD Toolkit – need to revise in light of events and also to agree the use of Tele-conference minutes in place of SITREPs (Situation Report) and CRIPs (Common Recognised Information Picture).

3.4 Consensus-Building Exercise

A Consensus-Building Exercise, facilitated by the Reviewer, involved interaction among delegates, selection and prioritisation of 'issues that needed fixed or replaced'. Consensus was established, through interaction of delegates and voting rights for each person, on the 'Challenges needing attention'. The Reviewer clarified that this was only a starting point for the Winter Flooding Review and could be skewed by the balance of those present.

Ranking	'Challenge needing attention'	Points Allocated
1	More Staff (retaining same)	28
2	Multi-Agency Structures (Permanent and Funded)	27
3	Improved Community Resilience (Engagement and Independence)	22
4	Civil Contingency Agency Legislation	18
5=	Increase Funding for Flood Risk	15
5=	JBA Style Report for Lough Neagh (Review Stat Lough Levels)	15
7=	Action on (JBA) Lough Erne Report	12
7=	Better IT Systems	12

Ranking	'Challenge needing attention'	Points Allocated
9	Appoint Minister for Resilience (NI Executive Ownership)	6
10	Uniform EPG Protocols Across NI	6
11	Better Communications (Flood Incident, Weather and Localised)	5
12	Reduce Bureaucracy – Clarify boundaries between DCs and EPGs	4
13	Better Flood Line System	3
14	River Bann (Lower) – Deepen and Widen	3
15	Learn from Other (e.g. Scotland)	1
16=	Local Government = 1st Responder	0
16=	Infrastructure Costs are Not the Deciding Factor	0
16=	Reduce to 3 EPGs (ring-fenced funding)	0

4. METHODOLOGY – 'HOW THE JOB WAS TACKLED'

4.1 Introduction

This Flooding Review was established with the following Objectives, which were an enhancement of the original brief, and agreed with the Minister and her Officials:

1. To engage with the formal DARD/Rivers Agency 'Regional Review of Winter Flooding (Nov, 2015 – Jan., 2016)', using its prompt controls of Preparedness, Co-ordination, Response, Communication and Recovery. This will allow the Department to:
    a. Capture issues in relation to the causes of the widespread flooding experienced from November 2015 to January 2016;
    b. Conduct a regional debrief into the multi-agency emergency response;
    c. Consider the current management and operating regimes to control water levels in Lough Neagh and detail the Review arrangements;
2. To investigate correlations between alleged Climate Change, Flood Water Management, Water Control structures and Warning systems, in the context of Risk Assessment;
3. To appraise the impacts of the Flooding across a number of receptors and parties, addressing issues such as Quality of Life/Wellbeing, Stakeholders' Responses, Inter-Departmental collaboration, Staff and Systems Resilience, Communication Networks;
4. To triangulate Review elements and findings across Policy, Practice (past and present) and future Strategy; and
5. To draw up and present Recommendations to the DARD Minister (or similar) and Rivers Agency.

4.2 High Level Methodology

It was agreed that the Flooding Report outcomes would be evidence-based. The following draft methodology was initially agreed in March 2016, and was subject to availability of Stakeholders and to the extent of emerging findings, as well as giving due attention to previous similar reviews.

Objective No.	Methodology	*Sources	Barriers	Key dates
All	Literature Review of Policies, Reports and Outcomes	PfG; UN; IPCC; RA; NI Water; Environment Agency; Professional journals	Limited Access; Scaling of literature to NI	Feb – July 2016
1.	Manage formal Review (with others); seek consensus views through Stakeholders	Process driven by RA; Consensus Building process by Author	Securing buy-in from broad range of stakeholders	16 March 2016
2.	Correlate 'Technical Literature' material with expert opinion; set in context of Water Framework Directive; hold structured interviews; collaborate with EA et al	NI Water, Climate NI; NIEA, DRD; EPA, EA; Professional Bodies: ICE, CIWEM, RICS; use of sustainable technologies	Obtaining sufficient engagement and 'considered evidence'	April – July 2016
3.	Correlate 'Social Science and Governance Literature' with Expert opinion; hold structured interviews to identify or consolidate social impact of flooding events	Key Stakeholder groups – UFU, NGO's, Local Authorities, Commerce, Urban Groups; CBI; SIB, Government Departments; RA Staff	Describing the Flooding impacts in social, economic and environmental terms	April – July 2016
4.	Desktop review of linkages across: i. Policy, Flood Management Practice and Future Flood Mitigation and Adaptation	Using summary of findings to seek an enhancement of Flooding Knowledge and Understanding	Finding sufficient and meaningful connectivity to engage fully and equally with Experts	August-October 2016
5.	Draft Review Report; identify 6 (min) – 10 (max) key recommendations (including Policy, Governance and Economic implications)	Review findings; liaison with RA, DARD and Other key Decision Makers	Sufficient time and full appreciation of all issues	September-November 2016

* Subject to availability

4.3 Detailed approach to information capture and revised Methodology

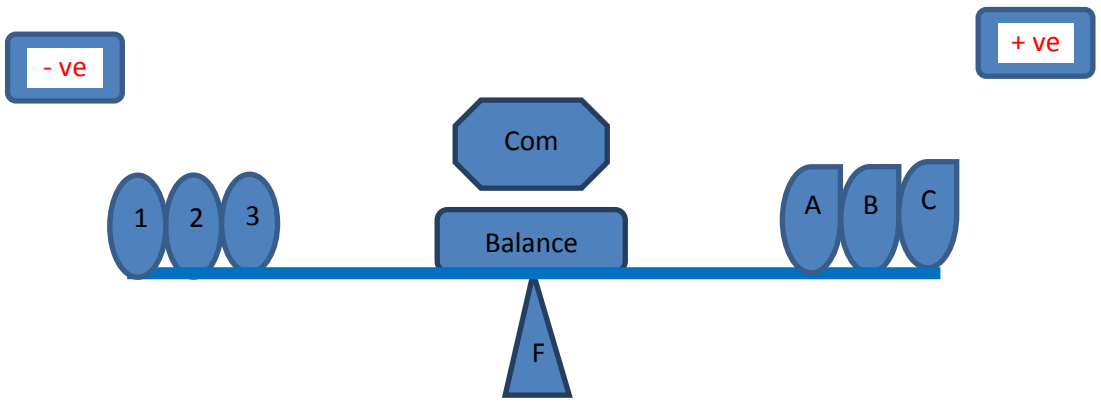
4.3.1 During the early phases of Literature Review and the initial Stakeholder Session (March 2016), it became evident that the Review was best served by a systematic approach to a number of discrete issues, some of which may be inter-connected, whilst retaining the evidence-based approach. However, this did not dictate that the Review followed the pattern of previous reports. Also at this stage, early findings

identified the over-arching themes of **Resilience, Risk and Resource**, and these became a constant in reviewing the discrete issues.

4.3.2 The identification of discrete issues to be reviewed was an interactive process; an open mind to the importance or significance of issues and the potential to develop actions and recommendations allowed flexibility throughout the study. It was also decided that some issues were best served by 'Commendations' for satisfactory outcomes, thereby giving due recognition to positive outcomes as well as Recommendations for deferred or future outcomes needed, falling in line with current NI Programme for Government 'bottom up and top down' thinking.

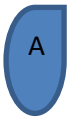
4.3.3 Following this alternative approach to Review reporting, the concept of each discrete issue was addressed systematically by identification of '**Resilient Issue Beams'**, being described as "an issue which sits in the balance, depends on positive and/or less helpful inputs, and requires a form of balance in order to secure Resilience for the future". In addition, each Resilient Issue must be supported by a range of inputs, from Stakeholders, Reports and Literature.

The Resilient Beam Issue approach gained approval from Stakeholders and is represented diagrammatically as follows:



Resilience Beam Nomenclature:

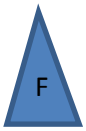
- Represents a positive or helpful contribution to the Resilient Issue



- Identifies the positive element or input which adds/contributes to the security of this Resilient Issue

- Represents a negative or unhelpful contribution to the Resilient Issue

- Identifies the less satisfactory element or input which reduces/contributes to the insecurity of this Resilient Issue



- The Fulcrum of the Resilient Issue beam; it identifies what is the critical driver(s) for this Resilient Issue to be kept in balance; e.g. Legislation, Policy, Expectation, International trend etc.

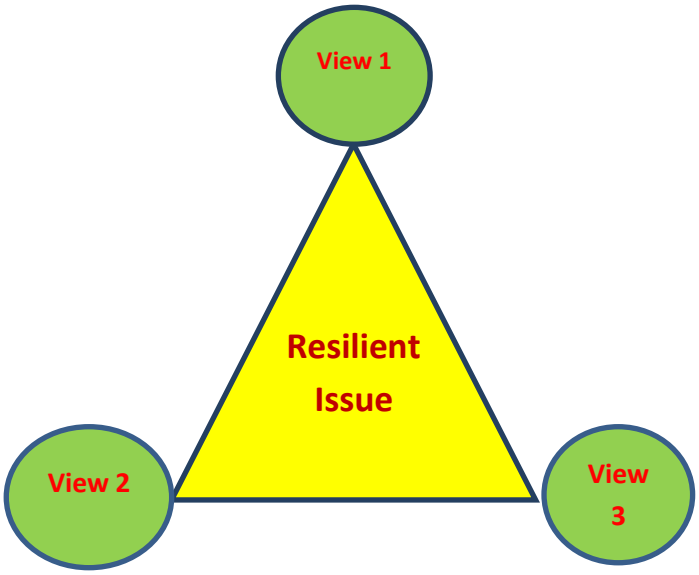
- Actions which are required to secure this Resilient Beam Issue in balance, by accounting for the positive and negative influences; these therefore provide Balancing Actions for each Resilient Action, and form the basis for the Review Recommendations.

- Actions or processes which have already contributed to the security of this Resilient Issue, thereby providing 'Commendations of good practice' for the Review.

It should be noted that a Resilience Issue Beam which leans to the '+ve side' is one which is dominated by positive influences, while the reverse is the case for those dominated by negative influences.

4.3.4 Triangulation of information is central to this Methodology, and aligns with the requirement of Objective 4 above. This approach sought to consolidate the

(differing) views of Stakeholders and collaborate with the views expressed in Literature (Reports, Policies, Journal papers etc.) in order to confirm and affirm the Resilient Issues status; this also avoided bias towards one or another group or stakeholder, and prevented the Author's views or that of the Client being dominant. Typically, this is represented diagrammatically as follows:



4.3.5 This Review sought the views of many Stakeholders and Literature. While most were captured into summaries or notes, this Report only gives a precis of those views, and acknowledges the contributors. These precis statements were normally agreed with each stakeholder at the conclusion of that session.

4.3.6 This congested approach is recorded in a standard 'Flooding Review Issues Template', on which each Resilient Issue can be adequately described and articulated in a systematic way. Where this is not possible and when further comment or explanation is needed, the Discussion chapter grasps these additional points. The **'Flooding Review Response Template'** is shown in outline below:

FLOODING REVIEW RESPONSE TEMPLATE

Resilient Issue:	**Status of Issue:**
Stakeholders providing Evidence to this Issue (ideally aligning with positive and negative aspects of the Resilient Issues Views given, and in Triangulation Views; [identified by abbreviated title]: • • •	
Summary of evidence: + + + + + +	
Triangulation:	
Resilient Issue Beam:	
Commentary	
Commendations	**Balancing Actions**

5. IDENTIFICATION OF RESILIENT ISSUES

A review of literature, strategies and previous Flooding Review reports led to an initial scoping of possible Resilient Issues which satisfied the description of a Resilient Issue, see 4.3.3 above.

Subsequent gathering of evidence from a range of Stakeholders allowed a consolidation of 11 resilience issues, categorised into 4 sectors, as follows:

RESILIENT ISSUES

'Human Interaction'		
STAFF	COMMUNICATIONS	COMMUNITY NETWORKS
'Science and Engineering'		
HYDRAULICS	RIVERS and INFRASTRUCTURE	WEATHER DATA
'Governance'		
EMERGENCY PLANNING		FLOOD ECONOMICS
'Agriculture and Land'		
LAND USE	CATCHMENTS	FARMERS

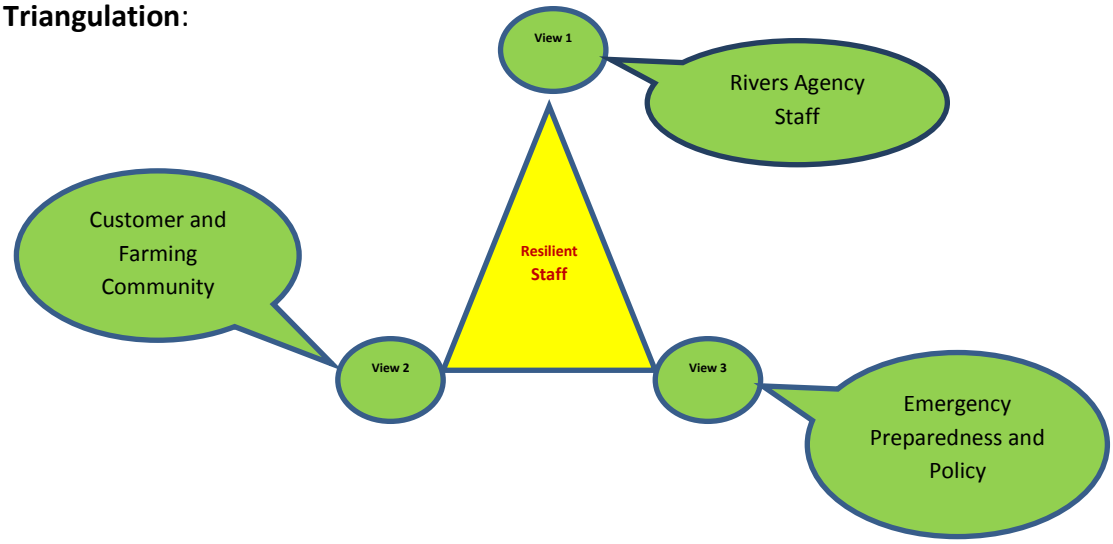
5A. Human Interaction

5.1 RESILIENT STAFF

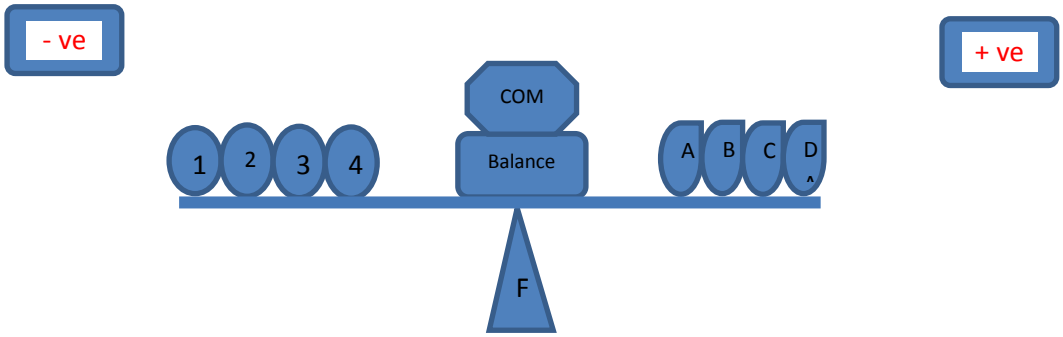
RESILIENT STAFF	**Status of Issue:** **Medium Term (~ 1 year)**
Stakeholders providing Evidence to this Issue (ideally aligning with positive and negative aspects of the Resilient Issues Views given, and in Triangulation Views): • Rivers Agency Head Office Staff [RA HQ] • Rivers Agency Regional Staff (Bann and Fermanagh) [RA Reg.] • Department for Infrastructure Water Policy [DfI WP] • PSNI, NI Fire and Rescue Service; NI Ambulance Service [Blue Lights] • Ulster Farmers Union (Upper Bann Group) [UFU U Bann] • Ulster Farmers Union (Erne Group) [UFU Erne] • Ulster Farmers Union (Aghadowey Group) [UFU L Bann] • Regional Community Resilience Group [RCRG] • SOLACE representatives (R Wilson and L Hanratty) [Solace]	
Summary of evidence: + Separate and equal challenges for HQ and Regional Staff + Regional Staff could repeat marathon (14 week) Flood Alleviation and maintenance duties + Regional Staff felt rewarded and recognised by RA HQ + Regional Staff had immense respect for RA Chief Executive and HQ Staff + Some evidence of Multi-Agency working + Timely visits and intervention by Minister Michelle O'Neill MLA (DARD Minister) + Strong bond of loyalty and mutual support among Regional Staff + Good relationships on the ground with Blue Lights + NICS Voluntary Exit Scheme would probably reduce capacity, knowledge and capability to meet regional needs; + NICS Voluntary Exit Scheme, and other unfilled posts, caused staff reduction: Omagh (40 down to 33), Fermanagh (36 down to 23), Armagh (49 down to 40) = 23% staff reduction + RA HQ Staff were stretched to the limit in carrying out a range of functions – managing, giving strategic guidance, responding to Ministers, District Councils and Departmental Emergency Planning protocols and Press Calls + Flood response is a welcome statutory duty for NI Fire and Rescue Service + Some RA Equipment was 'at its limit in capacity and condition', due to age and usage + Hint of 'limited willingness' to repeat another Marathon Flood event + Confusion about lines of communication from Flood Incident Line alerts – who, when, what follow up? + Potential stronger links with Transport NI Operative staff and Winter Weather responses + Underlying current of Staff Stress and 'health at risk' + Frustration that 'not all immediate tasks could be done'	

+ The award to Rivers Agency of the Northern Ireland Civil Service, 'Customer Service Award' for its work during the winter flooding', was a positive reflection on all those who supported flood relief

Triangulation:



Resilient Staff Beam:



1	Insufficient and untrained Staff
2	Staff stress and health risk
3	RA Equipment at limit or obsolete
4	RA HQ Staff load not shared

A	Willing and Capable Staff
B	Staff trained and experienced
C	Mature Flooding Response leadership
D	Staff are rewarded and Recognised

F: 'Expectation of sustained flood maintenance and alleviation staff service; strategic and operational capability to lead and deliver professional flooding incident response'

Commentary

Staff Resilience is one of those 'elephants in the room' of Flood Alleviation as it is assumed that Resources are in place and that 'it is all about being able to deliver Preparedness, Co-ordination and Response'; however the issue of Staff having to be on-the-ball for 14 weeks of continuous rain and its resulting flooding is only Part 1; Part 2 is about Recovery - take both parts together and the evidence revealed a deep sense of 'Could do it again, but would we?'. This was echoed by all three viewpoints; nevertheless, the formidable efforts by all RA Staff were notable and were

complemented by the other Agencies and complimented at the Regional Review De-Brief (March 2016). It is vital to note the considerable stress and human sacrifice made by both HQ and Regional RA staff, frequently working 16+ hour days, missing family events and willingly giving time and expertise. This 'at risk' service must be enhanced before the 'inevitable return of flooding in some scale' (quote Regional Staff)

Commendations (COM):

+ Impressive leadership by David Porter (RA Chief Executive) in fronting-up in the Media and giving a strategic lead, ably supported by RA HQ Staff;
+ Clear political leadership by Minister O'Neill;
+ Painstaking attention to duty and strong work ethic by RA Regional staff;
+ Winning the Northern Ireland Civil Service, 'Customer Service Award'

Balancing Actions (Balance):

+ Enhance Staff quota for 'flood event response' as result of a full audit of staff needs (at all levels);
+ Evaluate the possibilities of 'Training up DfI staff from Roads to supplement Rivers staff';
+ Increase collaboration of Merged Emergency Functions across Flooding Response and Extreme Weather Roads protection, within DfI;
+ Inspect condition and quantity of all Flood Response equipment and invest for future events.

5.2 RESILIENT COMMUNICATIONS

RESILIENT COMMUNICATIONS	**Status of Issue:** **Short Term (~ 3 months)**

Stakeholders providing Evidence to this Issue:

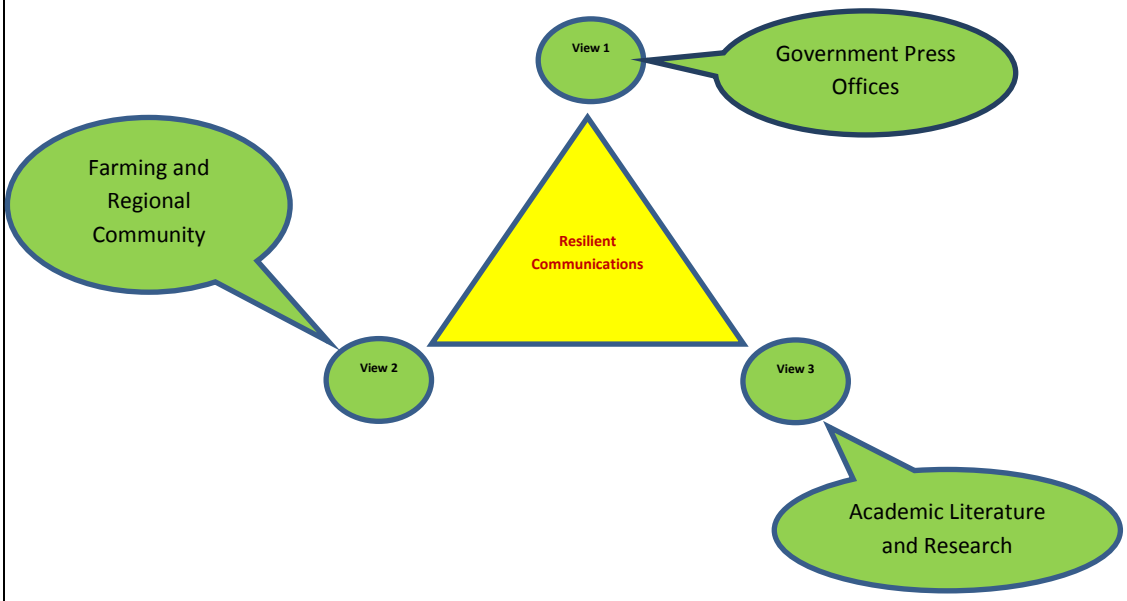
- Minister Michelle O'Neill MLA
- Department for Infrastructure and DRD Press Offices [PO]
- Rivers Agency HQ Staff [RA HQ]
- Regional Community Resilience Group [RCRG]
- Meteorological Office [Met Office]
- Ulster Farmers [UFU]
- Fintona Community Resilience Group [FCRG]
- DARD Policy Branch (currently DAERA [DARD]
- Academic Research (K Cronin) [Academia]

Summary of evidence:

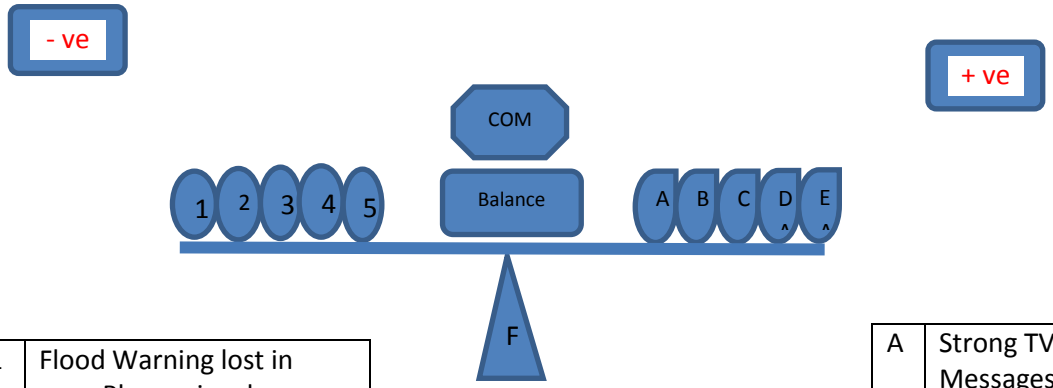
+ Good Tag-team approach to Media Flood Messages by Minister O'Neill and D Porter (RA CE)
+ Minister O'Neill provided 'public confidence' from media outputs
+ Met Office provided a sustained service though Media and in conjunction with Rivers Agency
+ Weather forecasts were best for immediate (24 hour) messages, but could not be considered to be accurate for any forecast into a further 3-5 days
+ Flooding Incident Line outputs were helpful to RA Regional Staff
+ Flooding Incident Line outputs were confusing to local Councillors
+ Flood warnings were communicated effectively through TV and Radio bulletins, but needed a more systematic approach
+ Local Flood warnings depended on 5 Regional EPCOs and on Local Community Resilience Group (CRG) leaders
+ Use of texting for informal Flood Warnings worked well at local level only, when phone network signal was sufficient
+ An emergence of Twitter Messaging was promising, but not perceived as the 'ideal solution', due to restricted phone and broadband signals in rural areas
+ Suspicion existed on 'detail of media outlets was not always trusted as it did not reflect accuracy of facts'
+ Any media reference to 'storm return periods in 1 in x year language' was not helpful, as this was not used by RA Staff during Flooding period
+ Need to find new way of describing 'risk and impact of flooding'
+ Not all Local Authority Councillors were fully aware of the Flood Communications networks and methods
+ Dramatic flooding stories in the media served to educate the public, but also generated a 'damage limitation' approach by Government staff in order to prevent any unnecessary or unjustified concerns

+ Release of Press Statements could have been faster, but needed agreement by all relevant departments or agencies
+ NI Water confirmed that the multi-agency approach during Flooding was in line with its evolving emergency planning approach
+ Media coverage of flooding was generally accurate
+ All stakeholders agreed that the human element of any flooding emergency was of primary importance

Triangulation:



Resilient Communications Beam:



1	Flood Warning lost in poor Phone signals
2	Social media may not reach 'those at risk'
3	(Media) Flood frequency (1/x yrs.' - not helpful
4	FIL – messaging system was not always clear
5	Who takes 'first steps' after Flood Warning?

A	Strong TV and Radio Messages
B	Flood Incident Line was accurate
C	Public had confidence in RA Staff and Minister
D	Volunteers in CRGs - vital for warnings
E	Local knowledge was vital

F: 'Efficient and effective communication to ensure that all at risk are alerted in a timely fashion in suitable language'

Commentary

Resilient Communications need to be maintained across a range of parties, using language that is consistent, heard in a timely fashion and instantly understood. This consistency and effectiveness was achieved in the media by Minister and RA Chief Executive; this was strongly endorsed and confirmed by the Press Office. The roles of local councillors, alongside RA Regional, were not fully understood, thereby occasionally causing confusion. Public and its representatives were not well served by hints of 'storm long return period' descriptions, implying that 'these were infrequent/unusual events and would not be repeated soon'; while it was not RA policy to use 'Storm Return periods' to describe the severity of events, the media has traditionally sought this style of description. While much work had been done on refreshing the FIL messages and prompt questions, there was still frustration by the public, and what happened to the messages.

Commendations (COM):

+ Sustained and effective national media messaging by Minister and RA Chief Executive, with suitable balance of general and technical content
+ Impressive voluntary roles played by CRG leaders

Balancing Actions (Balance):

+ Seek greater clarity in messages which deal with 'Flood Warning', 'Severity and frequency of floods' and the 'Flooding Incident Line prompts'
+ Support CRGs though training, effective message networks and equipment as required;
+ Learn more about use of Social Media through research and corroborate with DEFRA, and in line with emerging Departmental 'social media' development
+ Develop 'Flood Warning' nomenclature to reflect likely impacts and not by a 'time return period' e.g. "Flood will cause extensive land flooding up to 19xx levels"
+ Further develop FIL systems and refresh Flood Warning Literature
+ Produce and publish a Flood Information CD for new Councillors to include - Who does What and When, likely environmental and social impacts, role of key agencies.

5.3 RESILIENT COMMUNITY NETWORKS

RESILIENT COMMUNITY NETWORKS	Status of Issue: Short Term (< 1 years)

Stakeholders providing Evidence to this Issue:

- Ulster Farmers Union [UFU]
- Local Authorities [LA]
- Emergency Planning Coordinating Officers [EPCOs]
- Consumer Council [CC]
- Red Cross [RC]
- Civil Contingency Group NI [CCG NI]
- 'Blue Lights' [BL]
- Regional Community Resilience Group [RCRG]
- Fintona Community Resilience Group [F-RCG]
- Rivers Agency [RA]
- Civil Contingencies Group Policy Branch TEO [CCG]
- SOLACE [S]
- Community and Political Representatives [P]

Summary of evidence:

+ The award to Rivers Agency of the Northern Ireland Civil Service, 'Customer Service Award' for its work during the winter flooding', was a positive reflection on all those who supported flood relief and strove to protect Community Resilience
+ Regional Community Resilience Group (RCRG) was formed in Jan 2013 under the joint chairmanship of RA and Local Government to bring partner organisations together to develop a 'Community Resilience Delivery Programme' across the region; membership of RCRG has expanded to include Belfast City Council; the four district council groupings responsible for civil contingencies matters at sub-regional level; Belfast Resilience; PSNI; NIFRS; NI Water; the Met Office; Roads Service; Red Cross, the Consumer Council and NIE
+ Purpose of RCRG is to work on multi-agency basis to facilitate consistent, prioritised and focussed planning and preparation for community response and recovery activities to help pre-identified communities, known as Community Resilience Groups (CRG), deal with emergency incidents
+ Initial engagement with 10 communities, at known flood risk, via RCRG, resulted in work to: i. raise awareness of flood risk issues; ii. establish effective community self-help; iii. develop communication structures; iv. promote provision of local sand-bag storage
+ The 10 community pilot was reviewed by Consumer Council, supported by Red Cross, who found that it was largely successful; notable points identified: i. River alerts have been installed, where appropriate, with registered text alert recipients; ii. 7 out of 10 communities have an 'agreed community emergency plan'; iii. All 10 communities have designated community lead contacts; iv. flood warden scheme is being trialled; v. 13No. sandbag stores (nearly all) installed; vi. 10No. nominated community leads have registered for Met Office

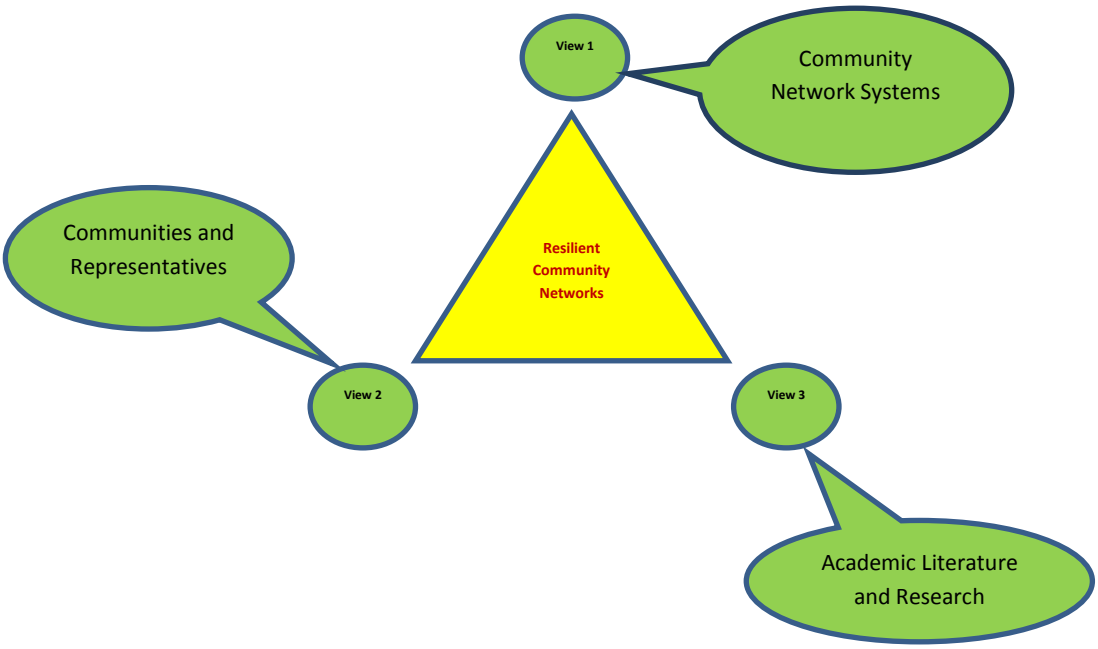
Hazard Manager service to improve ability to respond to flooding

+ The CC Review highlighted considerations on how this work can be refined, concluding that 'as much of the RCRG work was resourced through goodwill and commitment of its members', it would need to be appropriately resourced going forward if warning and informing, as part of a wider community resilience programme, is to continue
+ CCG (NI) also endorsed that this RCRG work and status of CRGs should continue
+ Benefits of RCRG and the CRGs work was evidenced during the winter flooding winter, when communities were activated and preparedness actions were taken in advance
+ 5 Emergency Planning Groups (EPGs) exist in NI and each has an EPCO who are employees of local councils, though the posts are funded by central Government; scope of the Emergency Planning Groups is currently under review with a view to possibly reconciling them with the 3 PSNI areas; Red Cross is represented on all 5 Groups
+ Local councils are empowered to engage with local communities through 'General Power of Competence' (NI Assembly 2014) and in accordance with the Assembly Ministerial Code, using this power to work with others to provide cost-effective services and facilities in new ways to meet the needs of local communities, in flood emergency planning
+ The 5 EPCOs are very committed and capable in roles of advocacy, leadership, guidance and planning; they advised that facilitating the CRG groups is resource intensive and arguably too focussed on flooding, with suggestion that the scope of the groups should be widened to include community planning and should be more risk based;
+ The CRGs are active, highly thought of, but possibly restricted by a sustained community involvement, also reflected in views from the CRGs
+ The development of CRGs is possibly driven by need, with West-based groups being more pro-active e.g. Bereagh, Fintona and Coalisland, and further groups in developmental stage
+ RCRG has identified 20 suitable locations/CRGs in the Floods Directive Flood Risk Management Plans for NI; work is also underway to expand the group's activities to engage with communities in relation to severe weather, particularly snow and ice related issues - an initial location being considered is the Dromara area
+ Winter flooding has resulted in 15 additional communities being identified that require support in becoming more flood-resilient; giving a total of 45 communities that are now programmed for engagement, if the necessary resources are allocated
+ Funding is a big issue with Community Networks; EPCOs felt that the level of bureaucracy made it very difficult for public to make applications and the systems were disproportionate to the level of funding; procedures to apply for the Homeowner Protection Scheme should have been in place generically as they are unambiguous
+ Levels of support post-emergency quickly dissipate, leaving individuals and communities to fend for themselves
+ Parallels were drawn with a Red Cross research report into the aftermath of flooding in Greater Belfast from 2007 to 2009, entitled 'Living in Fear of the Rain'; Report suggested: i. medium and long term effects of flooding are similar to impact of crime - both introduce a fear that it will happen again; ii. Level of anxiety and stress, post flooding, on communities is

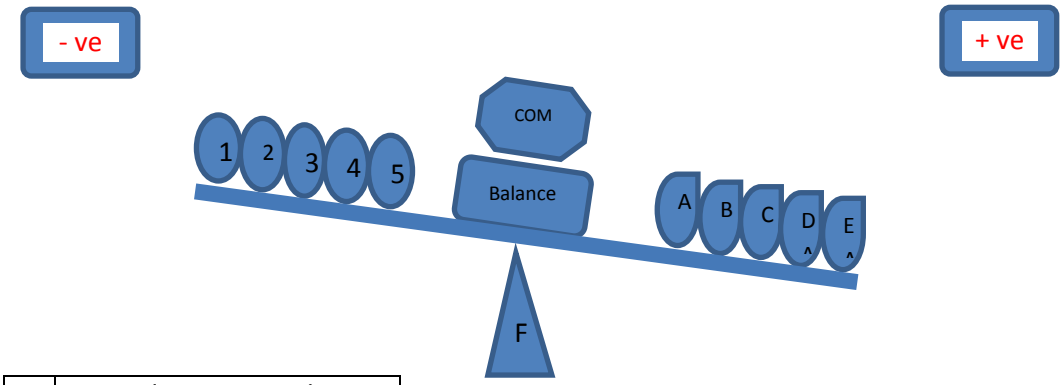
palpable with increased attendance at GP surgeries and ill health; iii. communities affected are constantly on alert and continuously looking at weather reports; iv. some individuals are reluctant to leave their homes, even during the summer, for fear of flooding in their absence

+ There were calls for more help, post-flooding, for emotional resilience and well-being - Morpeth (England) is an exemplar
+ CRGs spoke openly about their experiences and commented: i. willingness to help others in the local community, citing strong bonds being developed cross-community in times of need; ii. concern that CRGs rely on the leadership of a very small number of genuine engagers to sustain the service; iii. saw winter snow and flooding as similar painful experiences; iv. frustration at not having all the resources to assist in protecting domestic properties; v. applauded the Home Safety system for flood and water protection; vi. limited access to innovative material usage such as plastic; vii. 'dirty jobs' of cleaning up and removing damaged or un-useable sandbags; viii. genuine application of principles of Symbiosis and Community Engagement in which members of the public brought their equipment and skills for the 'betterment of others'
+ Most of the local authorities or 'super councils' also had Emergency Co-ordination staff who gave local support, and brought valuable help and local knowledge to the 5 ECCOs
+ NIFRS proactively made contact with communities by boat and wading through flood water to ensure that residents were OK; this enabled them to compile a map of the worst affected areas. This proved to be very valuable and was shared with other organisations – very supportive and knowledge of Community Networks
+ The development of Cross Border Emergency Management Group (CBEMG), with purpose of 'acting as a multi-agency group in emergency management on a cross border basis'; its laudable and welcomed objectives related to: i. acting as a multi-agency emergency planning group for the statutory agencies in NI and RoI; ii. enhancing cross border co-operation and resilience in Emergency Management and Civil Protection; iii. developing joint protocols, training and the sharing of information in line with the parent emergency management framework documents; iv. strengthening and coordinating cross border emergency management for risk assessment, prevention, preparedness, mitigation and response; v. furthering the development of a support network between the respective agencies; vi. ensuring the interoperability of major emergency plans and response arrangements
+ A schematic of the CBEMG is shown in ANNEX 4
+ Role of local councillors in Community Networks was viewed in a range of ways – 'Very Helpful and Supportive ' to 'No real value other than Publicity for Council and Party'
+ Potential to develop a 'Farming Resilience Group' base on the lines of CRGs, but with industrial support

Triangulation:



Resilient Community Networks Beam:



1	Limited capacity within RCG's
2	Lack of sustained funding for CRGs
3	Insufficient coping systems for those stressed by flooding
4	Farmer Resilience Group potential not exploited
5	Inadequate support on the post-flooding and Recovery phase

A	Strong EPCO support for Community Networks
B	Growing roles and functions for CRGs with advance planning
C	RCRG have deep awareness of human effects of flooding
D	CBEMG has sound rationale and potential
E	Good RCG exemplars, built round committed leaders

F: 'Community Resilient Networks support those who need assistance in times of emergency, need or disruption to normal life'

Commentary

"Community Resilience – Resilient Communities", regardless of the subject of the phrase, is a concept that has been around for a long time as people have congregated into groupings, allegiances, parishes, villages, teams, corporations; frequently there have been common themes or aspirations or goals to drive on the concept. In the case of Winter Flooding and Emergencies, the drive was to basically survive the ravages of severe rainfall and probable flooding in a cold winter; the EPCOs, CRGs and local emergency planning staff, assisted by the multi-discipline RCRG and the Blue Light services, all worked together to ease the pain and retain community well-being. However, the undertone of stress, fear, blocked roads, loss of business, lack of funds etc. continued to cause community distress. The existing systems were stretched but gave adequate support, while additional funding could have been used to minimise even further the anxiety.

Commendations (COM):

+ Rivers Agency won the Northern Ireland Civil Service, 'Customer Service Award' for its work during the winter flooding' – a true reflection on all who were engaged
+ Community Resilience Groups have emerged as an essential part of Emergency Planning

Balancing Actions (Balance):

+ Greater support for the management, materials and sustainability of CRGs to ensure that the CRG network grows and matures as well as being an integral part of rural society;
+ Proper resourcing of emergency and community planning and the introduction of legislation that places a clear requirement on all stakeholders to play their part
+ Consolidation of post to lead and co-ordinate the EPCOP work, administered by Solace
+ More emphasis on post flooding support for communities, especially in stress relief
+ Consolidation of EPCO management and the Cross Border Emergency Management Group.

5B. Science and Engineering

5.4 RESILIENT HYDRAULICS

RESILIENT HYDRAULICS (L Neagh and L Erne)	**Status of Issue: Long Term (> 3 years)**

Stakeholders providing Evidence to this Issue:

- Loughs Neagh Users Groups [LN – U]
- UFU Erne Farmers [UFU – E]
- UFU Upper Bann Farmers [UFU - UB]
- UFU Lower Bann Farmers [UFU - LB]
- Kinnego Marina Employers [KM]
- Lough Neagh (Eel) Fishermen's Co-operative Society Ltd [LN F]
- Waterways Ireland [WWI]
- Civil Engineering Group [CEG]
- Rivers Agency HQ [RA]
- Rivers Agency Coleraine Staff [RA - C]
- Lough Neagh Agencies

Summary of evidence:

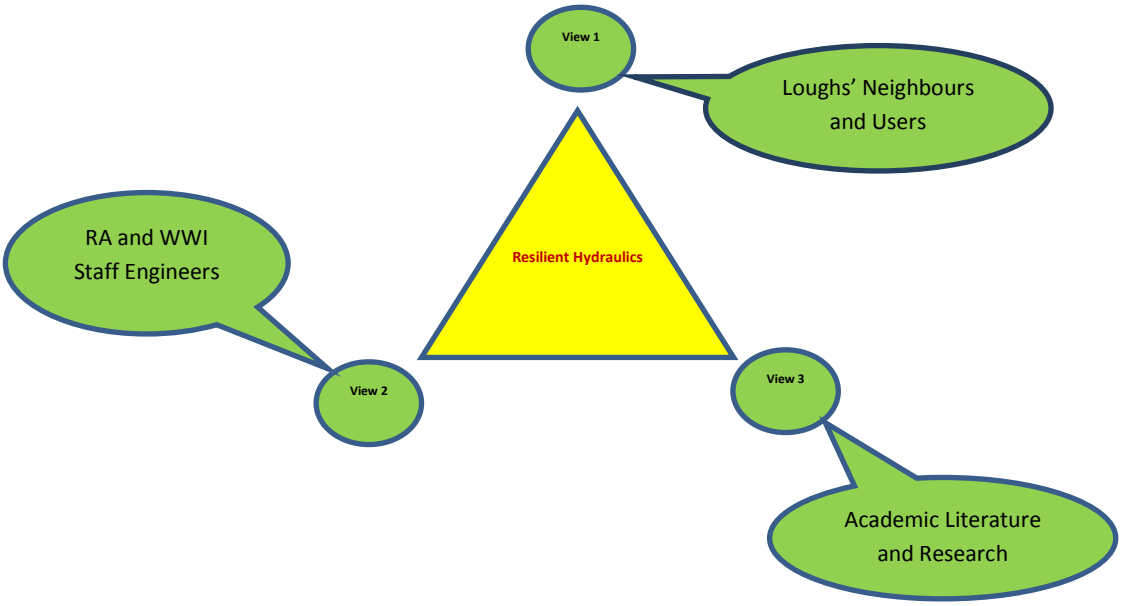
+ Lough Neagh: Area - 151 sq. miles (392 km^2); largest lake in Ireland, the 15th largest freshwater lake in European Union; ranked 31st in ' largest lakes of Europe'
+ L Neagh: catchment area (4,550 km^2); 9% in RoI and 91% in NI; 43% of the land area of NI drains to lough; it flows out northwards to Sea via the Lower Bann
+ Lough Neagh catchment drains 43% of land area (NI) + some border areas in RoI
+ Upper Bann Farmers and Marina Industry wanted 'lowering of Lough Neagh levels', faster release to Lower Bann and more warning
+ L Neagh water levels are controlled by Rivers Agency via Toome flood gates at head of Lower Bann; further controlled in Lower Bann by two sets of flood gates: Portna (near Kilrea) and Cutts (Coleraine)
+ RA is required to regulate and control water levels, as far as climatic conditions allow, in L Neagh within a365 specified range: 12.45 metres to 12.60 metres (OD); see L Neagh Levels Scheme (1955)
+ L Neagh serves a number of interests across angling, fisheries, boating and sailing, recreation, wastewater disposal, aggregate supply, etc.; is owned by Earl Shaftesbury
+ L Neagh has several designations: Area of Scientific Interest (1965) re-designated ASSI (1992); Ramsar Site - 1973 due to large numbers of wintering wildfowl; 8 Nature Reserves; Special Protection Area (1998) under EC Habitats legislation
+ In extreme rainfall (Storms Clodagh to Frank) L Neagh received circa 1000 m^3/sec and released circa 300 m^3/sec to Lower Bann – hence flooding onto the floodplain
+ High level inflows to L Neagh, during Winter Flooding, were: R. Ballinderry - 171.9 m3/s;

+ R. Blackwater - 196.6 m3/s; R. Maine - 233.0 m3/s; R. Moyola - 119.9 m3/s; R. Sixmilewater - 104.7 m3/s; R. Upper Bann (Moyallan) - 101.9 m3/s; Total Inflow - 928 m3/s
+ High level outflow from L Neagh to R. Lower Bann was: 382 m3/s
+ Movanagher Fish Farm (supplies government owned public angling estates) – typically 600k trout on site; annual running cost - £400k; vulnerable to Lower Lough flooding
+ Eel Fisheries Co-operative (£3m annual turnover, with no central funding) owns the eel fishing rights on L. Neagh, and rights to all "scale" fishing on Lough
+ Brown Eel fishery (season: May – Nov.,) is non-profit making; other parts of the business are profit making; 250 Brown Eel self-employed fishermen on the Lough - 110 are licensed boat owners
+ Silver (older) Eels leave the Lough for the Sargasso Sea to breed during autumn; success relies on a strong, high flow of water in Lower Bann combined with moonless nights, which can be compromised by extreme flooding; Co-operative - legally required by EU Eel Management Plan (2007) to allow 40% of Silver Eels to escape to Sargasso; remaining 60% is caught by Co-op. at its fisheries on the Lower Bann and sold to market, mainly in Europe
+ Scale fish include – trout, pollan, roach, bream and pike. The Co-operative acquired the fishing rights in 1992
+ Co-op. acknowledges and accepts Rivers Agency responsibilities for monitoring Lough and river levels for all stakeholders – this view is widely accepted; in turn, it is opposed to any proposals to lower water levels on the Lough as this would impact adversely on ability of fishermen to access the Lough from their quays
+ Co-op. has no responsibility to maintain fishermen's quays; this lies with RA
+ Farmers: L Neagh to be lowered in summer/autumn to enable better detainment of 'inevitable water from winter rainstorms'
+ There is no engineering solution which could possibly reduce the level of flooding on Lough Neagh; however an hydraulic model could investigate the possible adjustments of Gates etc. to optimise the Lough and Rivers performance
+ 'Need for a co-ordinated approach to ownership and management of the Lough'
+ Lough Erne is in two, upper (38km^2) and lower (111km^2), joined by the River Erne. Lough has several islands, historical sites, significant wildlife and numerous boating or sailing facilities
+ Upper Lough is a 'Special Area of Conservation in Northern Ireland'
+ Lower Lough is larger and popular with sailors and tourists, shores being lined with slipways, jetties, bars and restaurants
+ Water level control in Erne is undertaken by RA in conjunction with ESB in the RoI, as in 1950 agreement, when R. Erne was harnessed for hydroelectric power
+ Water levels in Upper and Lower Lough Erne are managed by control structures at Portora (Enniskillen), Cliff (near Belleek) and Ballyshannon in RoI
+ Rapid draw down of water levels in the Upper Lough Erne is prevented by the restricted capacity of the inter-lough channel section at Portora, Enniskillen
+ Rivers Agency (for Department for Infrastructure), has responsibility for managing the Lough Erne Estate - mainly bed and soil of Upper and Lower Lough Erne and foreshore, which was

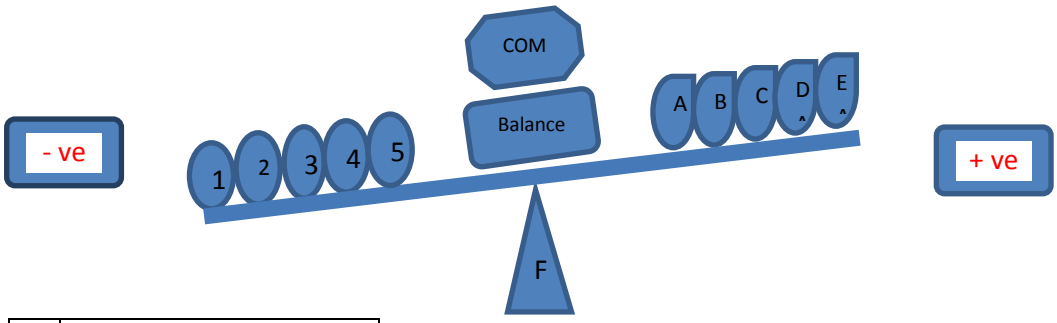
created as a result of previously lowered lough levels

+ Review of Lough Erne Operating Regime" Report (2013) following 2009 floods, considered 4 alternative options for improvements to the management or the physical make-up of the Erne System, including earlier autumn reduction of water levels; none lead to major reductions in the levels, frequency or duration of floods
+ (Erne) Flooding Taskforce (2009 and later) Report concluded: a. not economically or environmentally feasible to increase system capacity to a level where extreme flooding events e.g. Nov. 2009, could be prevented; b. not feasible to significantly reduce existing water levels, given the detrimental impact on natural environment and water based tourism; c. capacity of the inter lough and Belleek Channel channels, are major restricting factor in water discharge from the Erne System
+ "Ongoing concern about hydraulics of Erne Connecting channel (no work done since 1954) due to need to get water away quicker"
+ WWI, responsible for navigation on Erne System, as well as Ireland's other navigable waterways, has fixed assets on Erne e.g. jetties and slipways; during flooding, many were under water or not accessible; inspections being done to assess for structural damage due to flooding or siltation
+ Loss of recreation amenity was not an issue as flooding was in winter months; much different story if it occurred in summer due to many boats registered on L. Erne
+ Upper Erne Catchment flooding was about 6" lower in 2016 than in 2009, with therefore less area flooded, but over a longer period – this prolonged length of time floodwater stayed on land did the damage to grassland. Farmers were prepared to accept flooding but not the length of time floodwater remained on the land
+ Specific concerns expressed about River Sillees causing problem in Boho, as it could not drain into Upper Lough as allegedly its entrance was silted up, causing flooding to roads
+ To the contrary, the Boho area is in a natural floodplain, and it is unfortunate flooding is due to incapacity in the river channel – hence silt does not cause flooding; there is no affordable or justifiable reason to carry out works
+ Transport NI had raised or repaired 5 key roads, 3 of which cross the Lough; 55 roads in total had been closed
+ Extensive areas flooded, estimated from satellite imagery at approx. 3000 acres (Erne) and 5000 acres (Bann/Neagh)
+ RA Lough water levels only online on Mondays to Fridays; insufficient for farmers
+ Farmers believe reasons for flooding were a combination of: i. Climate Change and excessive rainfall; ii. Late or inadequate lowering of water levels at Upper Erne and L Neagh Sluices; iii. Lack of de-silting in river or entry to loughs; iv. Irregular or inefficient maintenance of Rivers
+ De-silting or dredging had significant environmental impacts

Triangulation:



Resilient Hydraulics Beam:



1	Floodplains damaged and slow to recover
2	Erne Roads flooded and not safe
3	River maintenance queried by farmers
4	Portora channel - not enough flow to Lower Erne
5	Toome Gates - not enough flow to Lower Bann

A	Control Gates in Lower Bann operated to 1955 scheme levels
B	Navigation channels were kept open
C	Current settings suit fishing/angling in Neagh
D	Erne agreements on flows were honoured
E	Interest groups did not want change

F: 'Expectation that loughs can capture all flood waters or have capacity to act as a reservoir to minimise flooding onto floodplains during extreme events'

Commentary

The multi-use and demands on Lough Neagh is surely symbolic of this 'largest Irish lake'; however this accolade does not mask the tension across industry, environmentalists, water suppliers and

wastewater dischargers, fishing experts and aqua-life, as well as the very visible need to manage rainfall and river-water flows, both in and out of the Lough. These competing demands are partly enshrined in agreements around the operation of Control Gates at Toome, Portna and The Cutts. Suspicion by those who work in industry or farming in the floodplains, both in the Upper and Lower Bann area, about gate operation, need for dredging and river maintenance was exacerbated during this Winter Flooding period. A 'Do Nothing' option cannot work; review of Lough Water levels, against the competing needs of users is a minimum answer. There is no engineering solution which could reduce the level of flooding on Lough Neagh; however a hydraulic model could investigate the possible adjustments of Gates etc. to optimise the Lough and Rivers performance. Therefore the Author, as an Engineer, remained unconvinced of the real benefits of building an hydraulic model of the flows in and out of Lough Neagh, but was 'damned if he did suggest a model, and damned if he did not'.

The 'flat' Erne system is idyllic to tourists, but has constant needs to manage the watercourses and loughs to prevent flooding rippling upstream due to any minor change in river performance downstream. The comprehensive JBA Study confirmed this conundrum, but does not prevent or excuse the need to continually monitor water levels, prepare better for winter rains and continue to give attention to river maintenance. There is very limited long-term possibility that major capital funding would be justified for major enlarging and/or re-aligning of the critical Belleek and inter-lough channels, and this was rigorously examined in the 'Review of Lough Erne Operating Regime Report (JBA Consulting) in December 2013.

Environmental designations in both basins are well earned, and should not be compromised, but should be set alongside genuine hydraulic challenges in the ultimate need to provide Resources which enhance 'quality of life' for all.

Greater understanding of ownership of Lough Neagh and the common issues for Upper and Lower Erne group can only assist in better communications and more active support. Recommendations in Resilient Catchment and Resilient Farmers address this organisational matter.

Commendations (COM):

+ Gates on Lough Neagh and along the Lower Bann were operated in accordance with agreements
+ Fishing Industry survived in difficult circumstances

Balancing Actions (Balance):

+ Review of Lough Neagh Water Controls, in the form of an investigation: 'An in-depth review of the operating regime for the Neagh/Bann system to ensure that the arrangements and parameters for its management are adequate to meet modern day needs'
+ In recognition of the integrity of the 'Review of Lough Erne Operating Regime' Report (2013), continue to consider small scale actions in the Erne System such as minor changes in Gates' operation to provide greater pre-winter floods protection and ongoing regular maintenance of rivers and tributaries
+ Consolidation of the status and management of the Lough Neagh Development Trust, to capture the differing interests and retain the environmental designations

5.5 RESILIENT RIVERS AND INFRASTRUCTURE

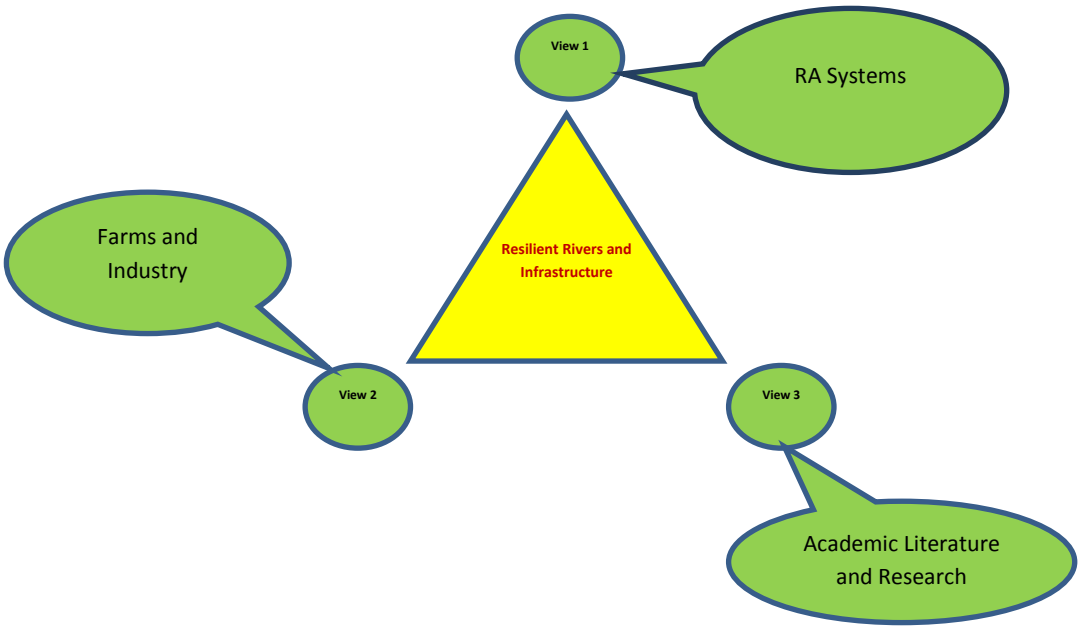
RESILIENT RIVERS and INFRASTRUCTURE	**Status of Issue:** **Medium Term (< 2 years)**
Stakeholders providing Evidence to this Issue: • UFU Erne Farmers [UFU – E] • UFU Upper Bann Farmers [UFU - UB] • Upper Bann Councillors • Linen Green Ltd and Neptune Group (Parent Company) [LG] • UFU Lower Bann Farmers [UFU - LB] • Edge Watersports [Recreation] • Movanagher Fish Farm • Civil Engineering Group [CEG] • Rivers Agency [RA] • Rivers Agency Regions [RA-R] • Waterways Ireland [WWI] • UFU Erne Farmers [UFU – E]	
Summary of evidence: + The Erne catchment has the two major Loughs, connected by an inter-lough channel (22km long); the catchment is integral with a complex maze of wide river channels + Lough Neagh is fed by over 300km of tributaries including the Rivers Main, Six Mile Water, Upper Bann, Blackwater, Ballinderry and Moyola, and discharges its outflow via the Lower Bann out to the Sea at Coleraine + Rivers Agency [RA] has a network of 161 active hydrometric stations to measure water levels; these are normally given on an external website + Environmental Considerations are central to the function of RA, requiring environmentally sensitive practices when carrying out work on all rivers; enhancement aims to increase its environmental value by improving the habitat for fish numbers; rivers' drainage and flood alleviation should not damage river status + River Restoration aims to return a watercourse to its pre-disturbed state, but can be hindered by permanent changes in land use or urban development + Typical river rehabilitation and enhancement measures include flood banks removed or set back from watercourse, restoration of meanders and natural channel depth/width, addition of gravels within salmonid rivers, native riverside tree planting, creation of berms, backwaters and different channel profiles + WWI is the Statutory Navigation Authority for the Lower Bann, the Erne Navigation and the Shannon Erne Navigation; it has a keen interest in flows and levels on navigable channels and reserves the right to approve/reject proposals that impact + Farmers are concerned about river water flow and ability to handle heavy rainstorms; they acknowledge the essential function of the floodplains, but argue that river maintenance, de-silting, dredging and cleaning are vital to the river operation	

+ River or lake dredging can drastically affect large colonies of species, and disrupt biodiversity with long-term consequences
+ Some farmers believe that there is an over-emphasis on the environmental requirements for watercourses at the detriment of 'releasing water flows'
+ Numerous examples of 'alleged flooding' due to 'lack of river maintenance or de-silting'; countered by RA Staff
+ Out-of-river or floodplain flooding also resulted in urban damage. e.g. Clady, Strabane, Fintona, Aughnacloy
+ Linen Green Shopping Village, Moygashel experienced heavy flooding, affecting all 31 outlet shopping units, on Sunday 6 December 2015, which 'was to be its first ever Sunday trading in the lead up to Christmas and a lot of time, energy and money had been invested in getting the Village ready'. Flooding was caused by a blocked grille; while the total cost cannot be calculated accurately, there were building repair and refurbishment costs
+ Urban waste (plastic, timber, gadgets) deposits from flooded rivers onto adjacent land causes farmers considerable time to clear, to avoid equipment and crop damage
+ Regular cleaning or repair of River Grilles was sustained over the Flood period, but clearage of trees, debris and waste in watercourses after the storms was not completed immediately
+ Rural river maintenance is typically 'once per six years' on a rolling cycle
+ Recreation businesses and users have differing perspectives on river operation, mainly in Lower Bann: i. Product Development review (2016) of Lower Bann reflects interests of key stakeholders; ii. main issue is management of water levels; iii. in the past stakeholders were not alerted to gate movements; iv. communications have improved greatly and are more sympathetic to river users' needs; v. misconceptions of how the river levels are managed persists; vi. need for more sophisticated means of communicating gate operation to key stakeholders; vii. operation of gates in summer allows river levels to fall and in autumn, gates opened resulting in higher flow and bank erosion; viii. Build-up of silt in the river - costly to remove
+ £300k flood-induced damage to water-based recreation industry that depends on river usage; typically loss of £3k per month per business
+ Need to recognise economic and recreation value of Lower Bann and balance this with the needs of other river and lough users
+ Significant research indicates that natural and man-made flood protection systems need to work together to protect the environment and let nature manage water flows
+ Reduce flood risk through rewilding; re-creation of flood meadows and making woody or leaky dams, tree planting and improved soil management has reduced river flow and flooding by 1+% in Cumbria
+ Lanes, roads and vehicles damaged by floods, with Transport NI repairing public roads and farmers bearing cost of lane refurbishment, not always to original standard due to expense
+ Road transport disruption was worst in the west – 55 No. roads were closed, which was more than in 2009, but normally same roads were affected
+ Road and land safety is 'holding on by a thin thread'- cannot be neglected – several 'accidents

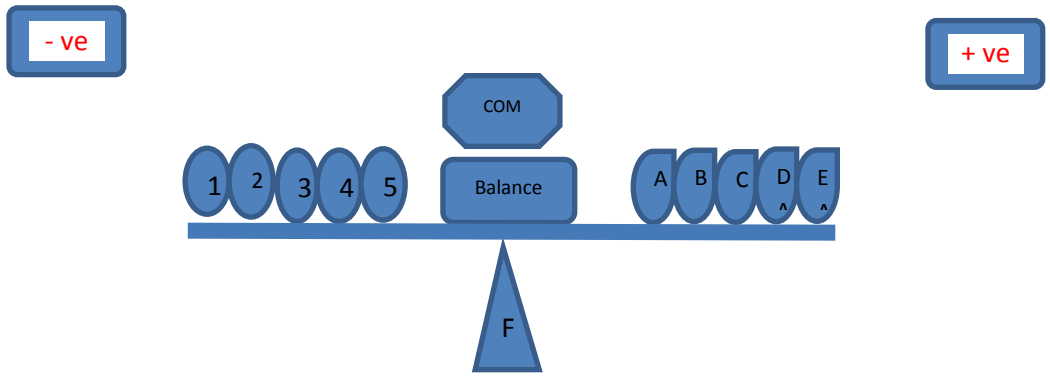
waiting to happen', due to vehicles travelling on water inundated roads without any signage

+ Transport NI committed staff, time and knowledge to maintain 'vehicle and person access' during storm period
+ 'Risk to Masonry Arch Bridges due to flooding' was considered in 2009, but no further surveys or repair programmes were developed
+ £1.25m was spent raising Fermanagh roads after 2009 flooding; flooded again in 2015/16 but not to the same level. i.e. roads were passable with care
+ Trains do not operate when water is above track level; Buses do not access closed roads; Translink has its own weather forecasting, specific to trains (leaf fall etc.) but otherwise rely on being alerted by Rivers Agency - has good communication channel with Rivers Agency-culverts/monitoring of water levels
+ Considerable loss of revenue due to trains/buses not running, especially on Belfast/Dublin route as customers do not return if part journey requires bus; Scarva/Poynzpass had track most badly affected with 12 days of disrupted service - engineering solution exists but the estimated capital cost is circa £14m – not affordable; School transport was badly affected
+ Possible (unconfirmed) damage to adjacent underground services such as Tele-comms, Electricity, Watermains, Sewers due to reflective cracking or subsidence
+ Flooding coincided with 'loss of power' due to bad weather, putting further stress on the Emergency systems

Triangulation:



Resilient Rivers and Infrastructure Beam:



1	Several villages flooded and transport disrupted
2	Road damage gave danger to drivers
3	1 blocked grille caused flooding at Linen Green Outlet
4	Silting caused some flooding
5	Lower Bann Water sports – business setback

A	River Grilles were cleaned during storms
B	Rivers operated naturally, using floodplains
C	RA manage rivers and lakes efficiently
D	Emergency Services (NIFRS) monitored out-of-river flooding
E	Desire to initiate 'natural flood management'

F: 'Rivers exist to convey normal and extreme water flows, and naturally depend on their floodplains in that function; they provide a means and place for several uses and users to be facilitated in a mutually respectful way, in tandem and support of adjacent infrastructure'

Commentary

Rivers should and can be allowed to operate in their normal mode of carrying water in their channels or extended floodplains in order to cater for excessive rain water. However when rivers spill water onto land due to all grilles or structures being in full operation, there can be excessive damage; such a dilemma occurred when the Achilles heel of 'grilles blocked' caused excessive damage at Linen Green Shopping Centre. This raises a bigger issue of the cause and effect of rivers spilling water; hence the maintenance and operations of rivers, to keep waterways clear, cannot ever be neglected, whether by silting or debris deposits, even though there was no clear evidence that any flooding occurred for these reasons. Also the breakdown of adjacent infrastructure such as roads, bridges and services could be a 'sleeping giant'. Economic impact of loss of school and public transport infrastructure cannot be ignored.

Commendations (COM):

+ Most Grilles were kept open or repaired during extended flooding period
+ Roads were kept passable despite considerable risk to vehicles and people

Balancing Actions (Balance):

+ River Maintenance frequency to be considered for performance rather than economic reasons

- Investigate the need for a comprehensive survey on ‘the impact of rivers on adjacent infrastructure and bridge structures’
- Rivers are recognised as a central function within a Catchment (See Chapter 5.10), and become integral with a more holistic appraisal and development of each catchment
- Road and farm access safety, during extreme flooding, must be considered.

5.6 RESILIENT WEATHER DATA

RESILIENT WEATHER DATA	Status of Issue: Long Term (> 3 years)

Stakeholders providing Evidence to this Issue:

- Climate NI [CNI]
- Meteorological Office [Met]
- Academia [Aca]
- Rivers Agency [RA]
- Ulster Farmers Union [UFU]
- NI Water [NIW]
- Civil Engineering Group [CEG]
- Translink [T]
- Transport NI [TNI]
- Belfast City Council [BCC]

Summary of evidence:

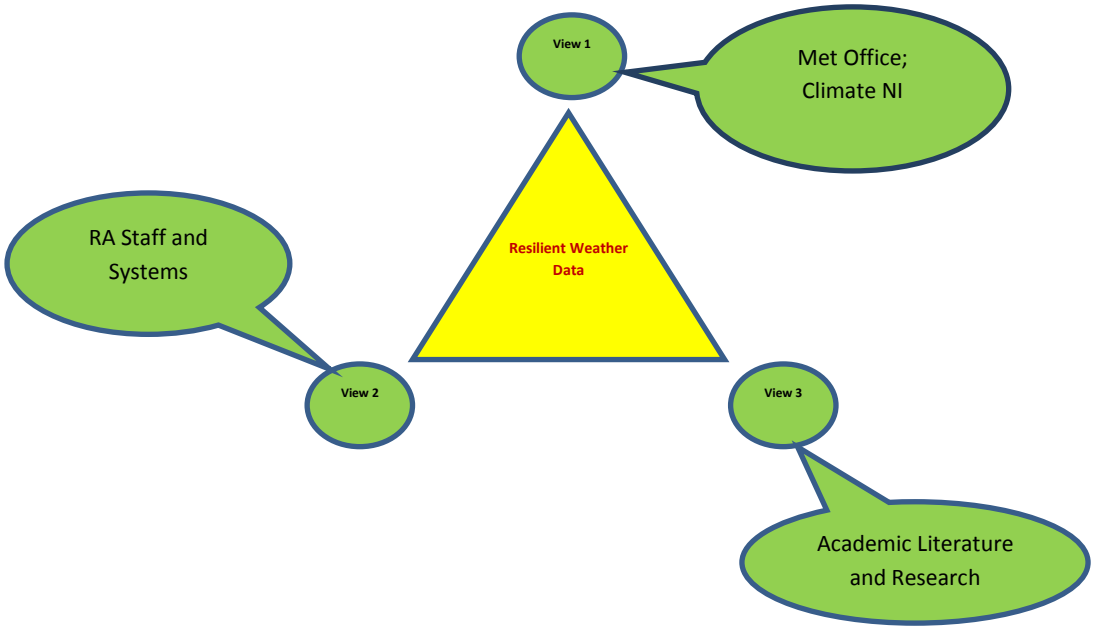
+ Debate on 'is climate change real and man-induced' was contentious issue with several contributors, as it was perceived to be directly linked to Weather Data
+ Paris Climate Conference (COP21) in Dec., 2015, for the first time in 20 years of UN negotiations, agreed a legally binding and universal agreement on climate, and to keep global warming below $2^{o}C$
+ Debate on the development of Climate Change legislation such as a Bill or Act is ongoing, with strong support for it by a number of professional bodies and member organisations
+ Northern Ireland's biodiversity is internationally important with 20,000 species found in its terrestrial, freshwater, coastal and marine habitats; NI is one of the most geologically diverse areas of the planet – key factor in understanding its biodiversity
+ Climate change poses risks to NI's soils, farming, freshwater resources, natural carbon stores, marine ecosystems, wildlife and habitats; more action is called for to build resilience to these risks
+ More evidence is sought to fully understand other climate change risks that are likely to be important for NI's natural environment, including potential changes in agricultural and forestry productivity and land suitability as well as impacts on freshwater and marine ecosystems
+ Group set up to try and understand risks associated with climate change on an all-Ireland basis; RoI - more information available – National risk register available
+ High proportion of NI land is constrained in its use due to climatic conditions, primarily in the uplands
+ Warming climate allows for a potential expansion of land used for agriculture and forestry; many areas that are currently marginal for cultivation due to climatic limitations could experience an improvement in land capability
+ NI Climate Change Adaptation Programme, based on risk assessments, responds with plan

which addresses risks identified and is wider than government departments; efficiency of programme/plans will be judged on how it deals with extreme weather events and resilience to flooding or other weather events

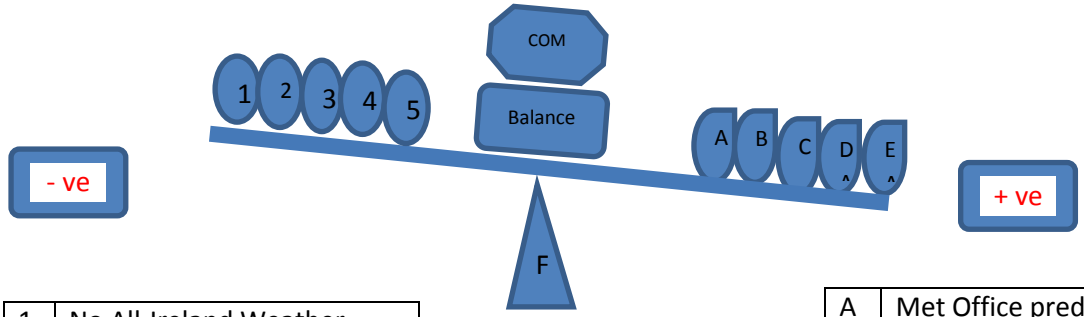
+ Met Office provides a Public Weather Service, servicing government and the people; this costs approx. £80m per annum for processes required to provide a forecast; it is part of Department of Business, Innovation and Skills (UK Government); information and data for formulation of statistics, provided via the Public Weather Service, is free; more detailed data has a charge
+ Severe weather warnings are issued via National Severe Weather Warning Service; warnings are by colour (red, amber and green) depending on combination of both the likelihood of the event happening and the impact the event may have
+ Met Office 'Flood Forecasting Centre', a joint venture between EA and Met, provides flood risk guidance for England and Wales, based in Exeter; this role is performed by SEPA in Scotland; EA and SEPA are responsible for issuing flood warnings for areas at risk of flooding for rivers and/or the sea in their regions
+ No flood warning capability in NI; Met works with Rivers Agency and provides heavy rain warnings. RA uses HYRAD information and monitors flows on rivers to provide input to blue light organisations
+ Possible merit in having an all-Ireland weather forecasting system; links with Met Eireann in Storm naming was effective
+ Winter Warning short-term forecasts (1-5 days) was accurate and helpful; longer period outlooks suggested 'wetter than average 3 months' but risk assessment on impact was difficult
+ Rainfall associated with Storm Frank (late Dec.) was correctly identified as a 'game changer', resulting in escalation of co-ordination to Level 1
+ Government needs a common vocabulary on flood warning – use of colours to emphasis severity; needs to be consistent; examples of how others are communicating flood risk: Insurance Co's, Red Cross, Joseph Rowntree Foundation
+ Multi-agency engagement was 'more than adequate', but all parties are needed and saying the same thing; delay in joint press statements negated some benefit of 'rapid weather warnings'
+ Strong leadership from RA in building teams and getting 'right messages out'
+ Rivers Agency Flood Maps are based on sound hydrological and weather data; they have been developed to provide a general overview of the flood risk in NI, with main aim to increase awareness among public, local authorities and other organisations, of the likelihood of flooding and to encourage them to take appropriate action to manage risk. They contain a suite of detailed flood hazard maps that have been produced in accordance with the requirements of the EU Floods Directive. These maps have been prepared for areas that have been determined by government to be at significant risk of flooding and are an important step that will lead to the development of flood risk management plans for these areas

+ Civil Engineers support the concept of Climate Change, recognise the need for accurate weather data and the analysis of Weather Station rain data to predict long-term storm return periods and seek to use data for both fluvial and surface water flows and design scenarios
+ Translink has its own weather forecasting, externally purchased and specific to trains e.g. leaf fall, but also relies on alert by Rivers Agency, via Met Office
+ A case was made for a RA-Met Office arrangement in which all weather data was held in-government for benefit of all Departments.

Triangulation:



Resilient Weather Data Beam:



1	No All-Ireland Weather data predictions or analysis
2	Expectation for accurate long-term weather predictions
3	No central Resilience Centre
4	Weather data usage not maximised
5	CC and Weather Risk needs developed

A	Met Office predictions (1-5 days) accurate
B	Met Office predictions (1-3 months) helpful
C	Strong RA-Met Office communications
D	Multi-Agency awareness of Climate Change risks
E	Flood Maps – sound vehicle to give application of weather data

F: "Weather data should provide accurate short-term predictions and long-term trends, based on sound analysis and applicable to a range of users"

Commentary

"More than a billion people will be at risk from flooding caused by climate change in just a few decades' time" warned the charity, Christian Aid. It says that huge numbers of people in coastal cities could be exposed to rising seas, flooding, extreme weather and storm surges by 2060." (Nov 2016).

The strong links between Rivers Agency and its host Department and the Met Office augured well for the accurate, timely and succinct weather predictions. The public attuned well to the weather nomenclature, but the issue of Press statements was not always as fluid. There is a community of scientists and engineers who are fully engaging with the climate change debate, how to interpret it and how industry, agriculture and society might responds to it. This report cannot possibly categorise all the arguments, but accepts that there is, at least, a 'Changing Climate' and suggests that a better and cleaner environment is a minimum and just reward for climate change mitigation and adaptation practices; therefore there needs to be deeper understanding of the risks, resilience and resource implications.

Education, as always, can play a vital part in all aspects of the 'greenhouse gas - global warming – changing climate – weather – forecasting – analysis – food security etc.' roles and correlations, by developing understanding, investigating linkages and applying information to a range of users

Commendations (COM):

+ Weather service by Met Office was consistent and accurate
+ Flood Maps, provided by Rivers Agency, are helpful to many parties

Balancing Actions (Balance):

+ Consider the establishment of a government-owned company which provides weather data and analysis, links with Climate Change Risk Assessment as well as Mitigation and Adaptation measures, and produces reports specific to several sectors e.g. Infrastructure, Health, Agriculture, Sport
+ Establish a NI-based Centre for Resilience, to monitor a range of resilience issues, develop research and inform Decision Makers
+ Educate people about climate change and flooding, including educational programme in schools relating to flooding, probability, forecasting, games etc.

5C. Governance

5.7 RESILIENT EMERGENCY PLANNING

RESILIENT EMERGENCY PLANNING	Status of Issue: Medium Term (< 2 years)

Stakeholders providing Evidence to this Issue:

- UFU [UFU]
- Local Authorities [LA]
- Emergency Planning Co-ordinators [EPCOs]
- Red Cross [RC]
- 'Blue Lights' [BL]
- Consumer Council [CC]
- DAERA Corporate Services [DAERA]
- Regional Community Resilience Group [RCRG]
- Rivers Agency [RA]
- Civil Contingency Group Policy Branch TEO [CCG]
- SOLACE [S]
- NI Water [NIW]
- Translink [T]
- Transport NI [TNI]

Summary of evidence:

+ The NI 'Civil Contingencies Framework' provides a structure around emergency planning, explained through guides to Emergency Planning, Risk Assessment, Emergency Plan Preparation and Evacuation
+ The Civil Contingencies Group (CCG) co-ordinates the response across the NI Departments and provides an interface with other emergency co-ordination bodies in NI and at UK level
+ The Major Emergency Response Plan (MERP), owned by DARD at the time of Winter Flooding, is a comprehensive suite of guidance, covering Triggers and Activation Procedures, Lead Department Arrangements, NI Central Crisis Management Arrangements, DARD Strategy Group (Gold), Tactical and Operational Responsibilities (Silver and Bronze), Communications Room, Staff Welfare, External Communications, Contacts, Recovery, Stand-down and Training
+ DARD is required to assume lead Department responsibilities in the following circumstances: animal, plant and fish diseases; farm animal welfare; flooding (fluvial and coastal), via Rivers Agency; forest fires on Forest Service owned land and animal feed safety incidents
+ DARD, as Lead Government Department (LGD) facilitated multi-agency co-ordination of the strategic response to the Level 1 flooding emergency (significant). It acted as co-ordinator for overall Government response, providing leadership, resources and policy support to those responding to flooding; this lead role was considered by Top Management Group/Strategy Group and approved by the Permanent Secretary
+ All Core Functions for each 'Level of Emergency' were adhered to satisfactorily – see Part A of

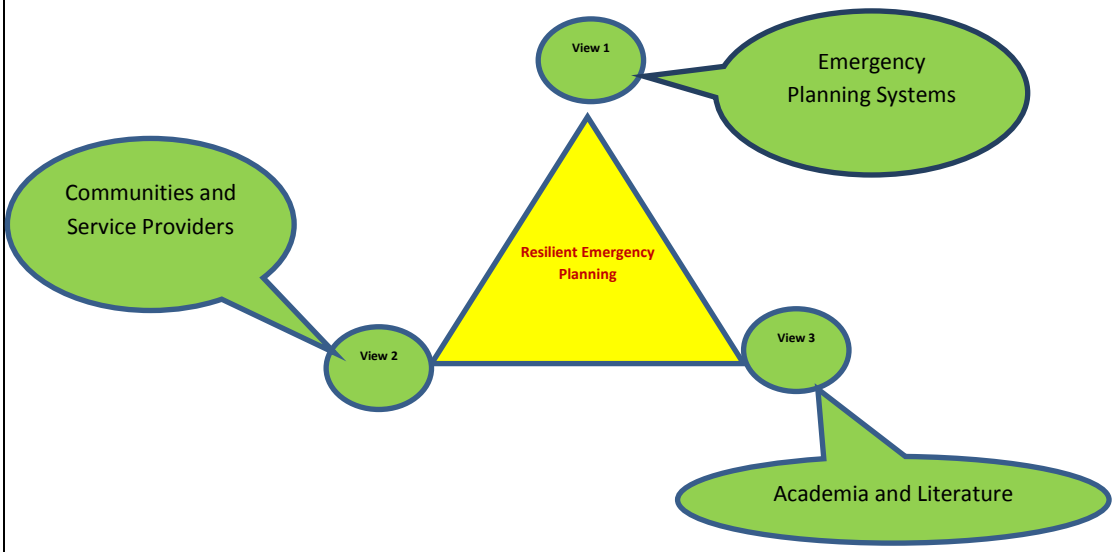
Annex 4 below

+ Strong support and confidence was expressed in the DARD/Rivers Agency LGD Roles and Responsibilities as described in Parts B and C in Annex 4 below
+ The LGD toolkit was identified for review after the Flooding
+ All Response Departments and agencies benefitted from a 'walk-through exercise' in Sept 2015 as vital preparation for the emergency
+ Escalation to Level 1 Emergency was satisfactory due to good working relationships between DARD Core, RA, and Local authorities, with conference calls being a valuable asset
+ Effective development of CCG protocols, along with DARD MERP's and RA experience must be constantly reviewed, especially after a major event
+ DAERA has developed the 'agricultural commodities contingency plan in an emergency or incident affecting the agriculture commodities sector' to help ensure the ongoing production, processing and trade of agricultural commodities originating from, or being further processed, in Northern Ireland, through technical and policy advice and stakeholder engagement; it describes roles of relevant bodies and individuals in the event of an emergency or incident, such as severe weather – this back-up plan was not needed
+ SOLACE Northern Ireland, an Irish Branch of the Society of Local Authority Chief Executives and Senior Managers (UK),was well represented by Roger Wilson (Chief Executive, Armagh City, Banbridge and Craigavon) and Liam Hannaway (Chief Executive, Newry Mourne and Down) in their roles in escalation of flooding to Level 1; shared Chair responsibilities of Inter-Region meeting to review Level 1 response
+ SOLACE co-ordinate the work of the 5No. Emergency Planning Co-ordinators, and has recently secured funding from NICS for a 'Manager for this EPC function', with uncertainty about its long-term security
+ Each of the 11No. NI 'new super councils' had its Emergency Planning staff to supplement the work of the 5No. Regional EPC's, and this staff resource layer was beneficial during flooding emergency
+ SOLACE was concerned about the need for a mixture of 'flood warning communication streams', and saw a greater role for each DC to manage its social media systems
+ SOLACE commended the use of 'Resilience Direct' website as a suitable platform or communicating across agencies during emergency
+ SOLACE recommended the retention of regular dialogue between the Councils and RA et al, suggesting a 'Flood Review Report update to all Council members'
+ PSNI reported that: i. Flooding had little impact on operations and less than anticipated; ii. Communication at local level with other 'blue light' organisations was continuous throughout the flooding events; iii. Able to service all 999 calls that it received over period - expected as crime levels in Fermanagh were low; iv. Was involved in both local and regional conference calls, and both worked well; v. Local Emergency Preparedness Group worked well in Fermanagh area
+ NIAS reported: i. Little flooding impact on its service; ii. but, Some disruption as access to patients was difficult; iii. Involvement in conference calls was good; iv. No stats available on

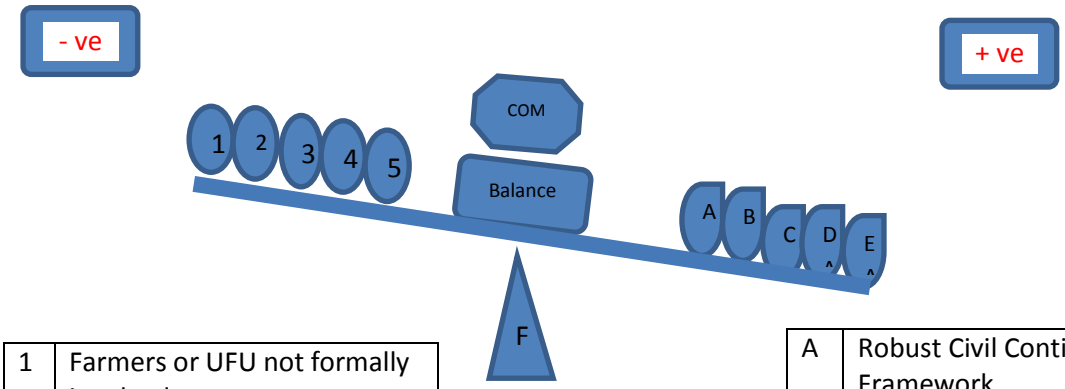
'number of vulnerable clients accessing the service'; v. Rural communities appear to be more resilient though this can be problematic as they tend not to seek help until it becomes an emergency

+ NIFRS reported: i. it has statutory responsibility to rescue people from floods; ii. It has 216 staff trained in flood and water rescue; iii. It is normally first responders for flooding, partly as it takes time for RA staff to attend, if it is out of hours; iv. It took part in all conference calls; v. Received 103 emergency calls and completed 80 rescues, mostly in the West, at a cost of circa £30k; vi. 12 rescues occurred in Strabane; vii. Fermanagh Council established a helpline - NIFRS and Red Cross assisted people in need by delivering prescriptions, provisions and assisting medical teams visiting sick; viii. Service proactively made contact with communities by boat and wading through flood water to ensure that residents were OK - this enabled them to compile a map of the worst affected areas, proved to be valuable and shared with other organisations; ix. Infrastructure/roads problems in Fermanagh can make access difficult; 'this needs to be addressed'
+ RA and the RCRG were highly complimented during and after flooding incidents
+ Some concerns, or compliments, were expressed by several parties about: i. Flooding incident Line - capacity issues; ii. Emergency planning procedures - much improved; iii. EPCOs are vital but need to be properly resourced + long term funding secured; iv. Most, but not all, local authorities adhere to civil contingences framework; v. Need to address Emergency Planning through a Floods Bill and/or Civil Contingencies Act NI; vi. More lessons to be learned from 'Emergency response and recovery' documents in UK Cabinet Office and Scottish Parliament
+ European Floods Directive (2007/60/EC) is about 'protecting the community from the risk and impact of flooding'; it's a new approach to managing flood risk on a catchment wide scale
+ Incident management lessons - learned from NI Water; will be facilitated in new DfI

Triangulation:



Resilient Emergency Planning Beam:



1	Farmers or UFU not formally involved
2	Lack of total joined up approach
3	Lack of certainty for Regional Co-ordination
4	Some uncertainty about EP Roles
5	No evidence of EP being disseminated to other areas

A	Robust Civil Contingency Framework
B	Multi-agency working at all levels
C	RA Staff and Systems were fit-for-purpose
D	Move to DfI gives more linking opportunities
E	NIFRS gave sustained and hands-on help

F: 'Emergency Planning serves to minimise risk and increase resilience of systems and processes by providing guidance during an emergency, ensuring that people and resources are managed in a safe and secure manner'.

Commentary

Emergency Planning can be bogged down in protocols that are either too complicated or are not relevant to the specific subject; these NI Government systems have been developed on the joint approach of being systems-driven and borne out of previous experience. This is mainly why they worked well in the hands of willing and capable staff. The robustness of the systems or the staff willingness cannot be taken for granted; hence the need to seek continuous improvement. The NIFRS optimises this desire to find new ways by its pro-active review of the on-the-ground operations and its quest for more functional processes. The elephants in the room of this 'very safe' Resilient issue are the possibility of immense staff reductions and the complacency to 'not embed lessons learned' well before there could be another emergency.

Commendations (COM):

+ Multi-agency working was evident and successful
+ RA Staff led through RCRG, Conference Calls and co-ordination of agencies

Balancing Actions (Balance):

+ Civil contingency systems and protocols to be reviewed in light of flooding emergency, UK Flooding legislation and advent of new Department for Infrastructure
+ Funding secured for long-term appointment of a 'Regional Co-ordination of the work of the EPCOs', through SOLACE or others
+ Appraise the impact of Staff reduction on systems
+ Ensure that Emergency Planning and delivery remain central in the full integration of the Floods Directive and possible Floods Bill

5.8 RESILIENT FLOOD ECONOMICS

RESILIENT FLOOD ECONOMICS	Status of Issue: Medium Term (< 2 years)
Stakeholders providing Evidence to this Issue: All of the Stakeholders, who contributed to the other Resilient Sections, gave some indication of economic matters related to the 'economic impact of flooding'; in addition, there was some correspondence received to supplement the Stakeholder content.	

Summary of evidence:

Evidence for this Resilient Flood Economics section was drawn from all the other ten Resilient Themes, so is not duplicated again. In summary, the NI Assembly secured and spent £1.3m for flooding on preventative measures and preparing for future incidents. The three departments (DRD, DARD and DoE) worked closely together.

The major emerging Resilient Flood Economics themes or issues which were affected by Winter Flooding are:

A. Farms and Buildings

+ The Scheme of Emergency Financial Assistance (SEFA) to District Councils to cover Flooding in Small Businesses and Non Domestic Properties was issued on April 2016
+ SEFA indicated that the Department would reimburse councils for expenditure resulting from immediate action after the emergency situation (7 Nov., 2015 to 31 Jan 2016). Eligible expenditure included: i. payments to individual small businesses, recreational and community facilities and places of worship ii. payments to individual farm businesses in connection with farm land only; iii direct costs incurred by councils; iv. services contracted out (indirect costs)
+ SEFA farm payments were typically up to £1000; this was conditional on all of these being met: i. only farmland which is actively farmed and part of the 2016 Single Application Form (SAF); ii. farmland within the specified areas in townlands around south and south east Lough Neagh and Upper Lough Erne; iii. those farmlands within the specified townlands and have been underwater for at least 14 days within the Nov 2015 – Jan 2016 period; iv. farm businesses where the area of flooding was 10% or more of the total land actively farmed
+ The SEFA £1000 was an offer of practical assistance to farm businesses, small businesses, recreational and community facilities and places of worship that have suffered severe inconvenience; it is not a compensation payment
+ The SEFA payment was considered to be unfair in that all eligible farms, regardless of size, received the same payment – this was therefore disproportionate to the need
+ Factual and anecdotal evidence of financial stress experienced by farmers who had not planned or could not deal with the exceptional costs associated with retaining a farm which normally depends on the grass or silage yield from its fields; ANNEX 1 is an example of this situation
+ There has been allegedly 'very slow administration' of the farm payments

+ Fermanagh and Omagh District Council has initiated an 'Economic Impact of Flooding Study', using Fermanagh as its pilot area; this work will address the losses in physical, infrastructural, financial and, possibly, even in human capital, as a result of reductions in economic activity and losses of capital in a wide variety of categories and sectors. This detailed proposal has not yet been financed by the Executive

B. Domestic Support

+ CRGs are not properly funded; the allocation of a standard resource kit, to include basic tools, Sandbags, protective clothing, signage etc. in a suitable weatherproof shed or unit is needed
+ The pilot Homeowner Flood Protection Grant Scheme (NI) was awarded £1m by the Executive in early 2016; it is a government Scheme, designed to encourage owners of residential properties that have flooded before and/or are located within known flood-prone areas, to modify their properties to make them more resistant to flooding, and is specifically aimed at residential properties that have had internal flooding in the past
+ Rivers Agency has developed a demonstration Home Protection Scheme
+ The Home Owner Flood Protection Grant, if approved, covers 90% of costs, up to £10k (max), of the total survey and estimated installation; a successful homeowner is required to make a 10% contribution of the survey and estimated installation costs, and any additional cost above £10k and this involves an initial 'up-front' payment of £50 towards the cost of the specialist survey

C. Insurance

+ Flood Re helps people who live in flood risk areas to get affordable home insurance and was launched on 4 April 2016; it is not a home insurer itself, but works with existing insurance companies to helps them offer more affordable flood insurance to those in areas at risk of flooding; only people who live in flood risk areas will benefit from Flood Re, and even then it will depend on how much they pay for the flooding part of their home insurance
+ Flood Re only applies to domestic property (urban or rural) built after 2009; it would not apply to farm buildings or other commercial property. It has not yet made a notable impact in N Ireland
+ Farmers cannot normally obtain insurance cover for their land.
+

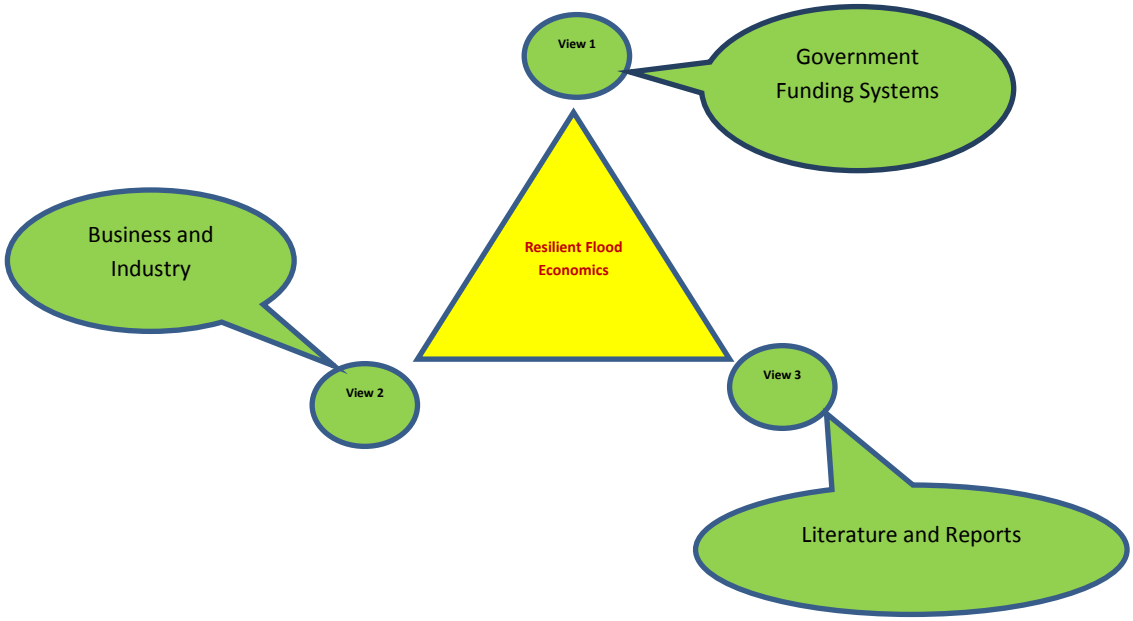
D. Commercial Buildings

+ Loss of income and earnings, insurance cost as well repair and refurbishment from flooding at Linen Green shopping has not yet been established, but is considered to be circa £15m loss
+ Factual and anecdotal evidence of 'considerable loss of income' by small business enterprises and retail outlets in rural villages and towns due to 'effects of winter Flooding e.g. One Retail Outlet had its Christmas income reduced by 40% due to loss of footfall and/or blocked or water-logged roads

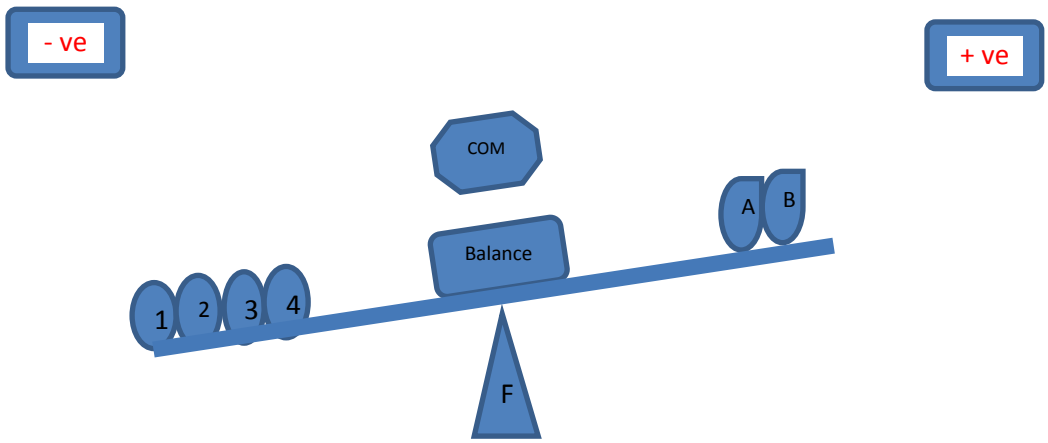
E. Infrastructure

+ £1.25m was spent raising Fermanagh roads after 2009 flooding; flooded again in 2015/16 but not to the same level. i.e. roads were passable with care, but some 'raised roads' were not effective in preventing water from submerging roads, so further expenditure will be required
+ Trains do not operate when water is above track level; Buses do not access closed roads hence, considerable loss of revenue due to trains/buses not running, especially on Belfast/Dublin - engineering solution exists but the estimated capital cost is circa £14m – not affordable
+ School transport was badly affected; Costs cannot yet be estimated
+ Repair of (unconfirmed) damage to adjacent underground services such as Tele-comms, Electricity, Water mains, Sewers due to reflective cracking or subsidence, need to be costed
+ Masonry Arch Bridge damage or vulnerability not known, and could be expensive to repair or replace

Triangulation:



<u>Resilient Flood Economics Beam</u>:



1	Lack of funds for several aspects: CRGs, farmland insurance, bridge and road infrastructure etc.
2	Full costing of flooding impact not known
3	Cost-benefit analysis of flood prevention unknown
4	SEFA Award scheme was complex

A	Timely NIA support of £1.3m for flood prevention and support
B	Homeowner Flood Protection Grant Scheme and Demonstration Kit

F: 'Flood economics allows a full explanation of the implications of flood damage and alleviation, accounting for an integrated approach across all key stakeholders'

Commentary

Costing of the impact of flooding is clearly the domain of several users – not just construction replacement costs, but loss of earnings, reduction in trade, negative health impacts, and effects of external issues such as tourism and industry, never mind education and recreation.

Flood Economics cannot be taken in isolation as one aspect, but must include a Whole Life Costing to assist in decision making and give a full appreciation of capex and opex. The total bill for a 'full return to the status before flooding' in not yet known and does not have a clear set of metrics through which to measure it in a multi-discipline environment.

Commendations (COM):

+ Homeowner Flood Protection Grant Scheme

Balancing Actions (Balance):

+ Development of a model contract for 'A Study on the Economic Impact of Flooding' to include a broad range of criteria, and allow this model contact or programme to be applied to other areas
+ Develop a future 'Scheme of Emergency Financial Assistance' which operates on the principle of proportionality' with awards relating to farm or business size, and not applying a flat rate for all applicants
+ Realistic costing and methodology to develop sustained solutions, including use of Natural Resource Management, to minimise flooding risk
+ Infrastructure engineered solution list of key projects drawn up with full costing attached
+ Support for Education, Research and Development in areas of 'potential increased knowledge and application' e.g. costing models, re-wilding, infrastructure replacement Cost Benefit Analysis

5D. Agriculture and Land

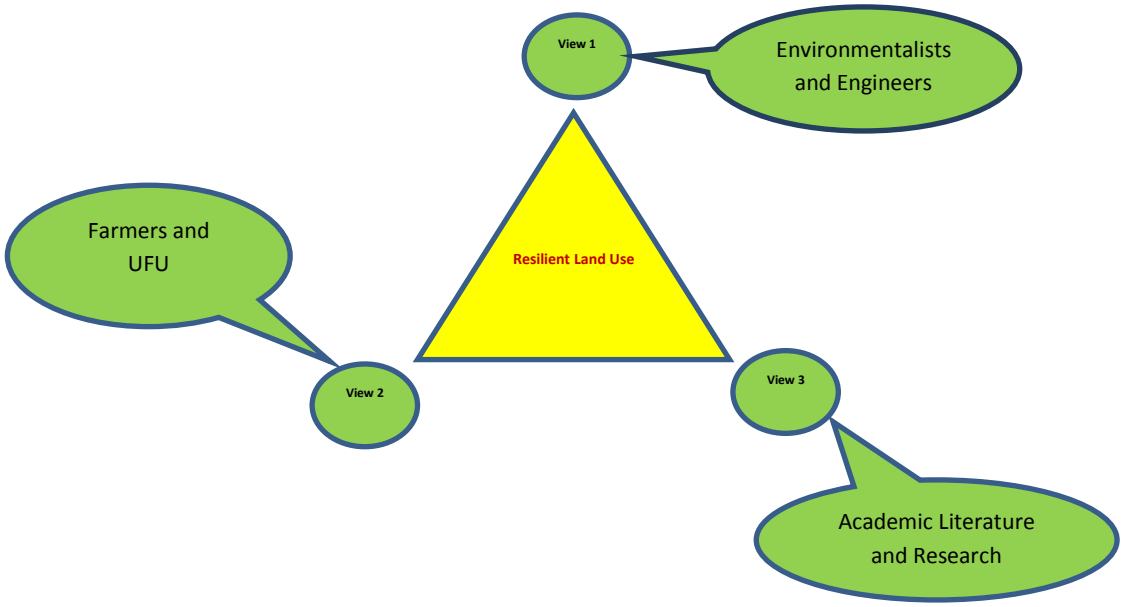
5.9 RESILIENT LAND USE

RESILIENT LAND USE	Status of Issue: Long Term (> 3 years)
Stakeholders providing Evidence to this Issue: • Ulster Farmers Union [UFU] • UFU Erne Farmers [UFU - F] • UFU Upper Bann Farmers [UFU - UB] • UFU Lower Bann Farmers [UFU - LB] • Council for Nature Conservation and the Countryside [CNCC] • CAFRE Development Service [CAFRE] • Civil Engineering Group [CEG] • Northern Ireland Environment Agency [NIEA] • Sustainable Land Management – Dr J Gilliland [JG]	
Summary of evidence: + 'Going for Growth' is a key NI Executive strategic action plan for the agri-food sector (£4b sales annually; 10% private sector employment) + 'Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland' – critical evaluation of future Land Use + Management of agricultural land needs addressed, as i. grass utilisation is significantly below optimal levels; ii. < 10% of farmland has current soil analysis; iii. 64% of our soils are not at optimum pH; iv. circa 30% of agricultural land is let in short-term Conacre, which denies tenants security and impedes long term planning + Seek greater linkages and synergies in activities of flooding alleviation (RA) and snow clearance (TNI) + CAFRE Development Advisers (40No.) and Veterinary Services support farms - good but limited + Scheme for Emergency Financial Assistance (SEFA) for small businesses and non-domestic properties - welcome and limited; best spent (£1k per farm) on large scale flood alleviation; payment was not proportionate to land area. Risk of losing SFP + CAFRE Survey revealed ryegrass death, weed ingress; extensive reseeding was required on farms substantially affected by the extreme flooding event, which significantly reduced the area available for grazing and silage production during the spring and summer months, in some instances necessitating destocking (cattle) - resulting in the prospect of long term negative impacts on farm business performance + Farm Debris/Urban Waste deposition - stones, sticks, bottles, reeds, roots, timber, plastic, glass; clearance vital for fields to be used for grass and silage; possible damage to equipment and silage contamination + Lough Neagh water levels were initially low prior to the Storms, but this did not prevent	

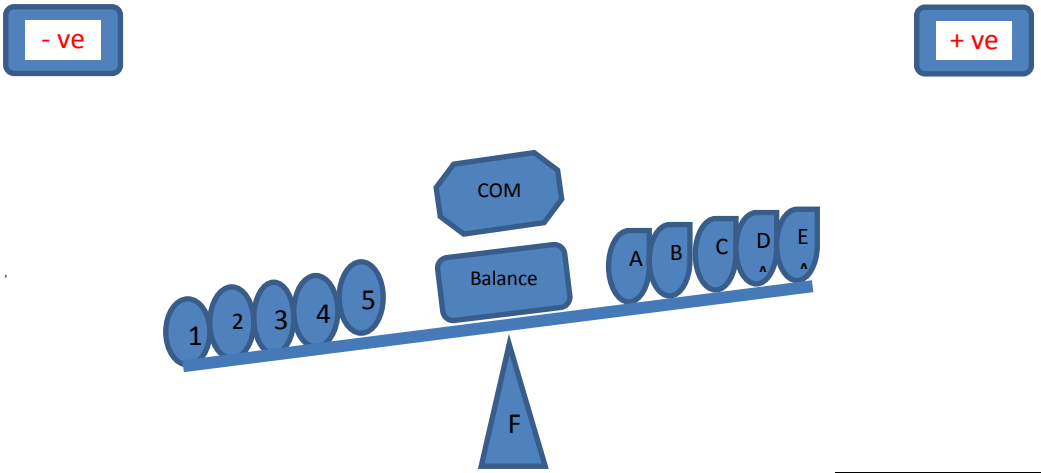
sustained flooding

+ Specialist horticultural land suffered - reduced crops and lack of key nutrients
+ Designated drains on the Upper Bann need to be regularly maintained; farmers speculated that 'environmental interests were preventing the drains from being cleared'
+ EU Solidarity Fund possible funding for farmers. Brexit development may prevent
+ UFU continues to engage with farmers, research, lobbying politicians
+ Food Security is being compromised by poor-yielding land in the floodplain; evidence of small pockets of 'alternative crop 'usage
+ Farmers were generally stoical about flooding; see 5.11 'Resilient Farmers'
+ CAFRE supports the Agri-Food sector through industry training, knowledge and technology transfer, benchmarking and business development planning
+ Dredging exemplars from England raise expectations for Erne, and Bann catchments
+ Flood-induced reduction in wildlife and biodiversity is a concern
+ Good response and impact by 'blue lights', noting sustained work by NIFRS
+ Lanes, roads and vehicles damaged by floods, but not perceived as a land matter
+ Land must be seen as a food provider, protector of habitats, place for recreation
+ Agriculture seen as both contributor to and mitigation solution to 'climate change'
+ Road transport disruption was worst in the west - 55 Roads were closed, which was more than 2009 but many of same roads were impacted again, therefore were vulnerable
+ Road and land safety is 'holding on by a thin thread'- cannot be neglected
+ £1.25m was spent raising Fermanagh roads after 2009 flooding; flooded again in 2015/16 but not to the same level. i.e. roads were passable with care

Triangulation:



Resilient Land Use Beam:



1	Land flood-damaged and slow to recover
2	Roads and transport hubs not safe
3	Urban Waste carry over after flooding
4	Inadequate research on flood-stressed land
5	Wildlife and habitats damaged

A	Sound Farm Advising system in place
B	Sustainable Agri-Land Management Strategy
C	Land Management is 'a way of life' and essential
D	A few examples of alternative crop usage
E	UFU lobbying for farmland support and solutions

F: 'Expectation of well-drained land, rivers and loughs operating within their floodplains and land capable of providing a living for the agriculture industry'

Commentary

Land Use is seen as the domain of the farming community, but it would do well to seek and obtain extensive help through Research, from the new DAERA Report on 'Sustainable Agricultural Land Management' and in conjunction with the Business Development sector. Farmers are sometimes unsure or unconvinced about the benefits and planning for engaging in alternative activities such as new crops, forestation or diversification into horticulture; this is surely an option for some farmers. Undoubtedly, some farmland has suffered frequently from water inundation, resulting in stress to both land and farmer – these wider issues are dealt with in Resilient Catchments and Resilient Farmers. Things never stand still - there is a new paradigm in the (community) planning sphere and in the agriculture industry. The sector, led and advised by UFU, CAFRE, AFBI and others needs to engage fully and contribute as the key stakeholders.

Commendations (COM):

+ New 'Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland'
+ Farming and farmers retain their commitment to the land, down the generations

Balancing Actions (Balance):

+ AFBI develop its applied research and investigation on 'Impact of Flooding on farm and horticulture businesses', through DAERA
+ Full soil analysis is carried out to develop greater understanding of Catchment performance

(see 5.10 Resilient Catchments' and Annex 3)

+ Community Planning and Land Use Planning are seen as collaborative to prevent any further floodplain development. Farmers and UFU must be seen as the key stakeholders
+ Incentives and schemes are developed at Departmental level to support use of alternative crops, re-forestation and horticultural development
+ Niche land use for unusual or historic buildings such as those with 'Listed status' need to be re-considered, to ensure legacy and heritage are preserved and not compartmentalised
+ Farm Insurance to be considered by the wider industry

5.10 RESILIENT CATCHMENTS

RESILIENT CATCHMENTS	Status of Issue: Long Term (> 3 years)

Stakeholders providing Evidence to this Issue:

- Ulster Farmers Union [UFU]
- Edge Watersports [Recreation]
- Civil Engineering Group [CEG]
- DFI Water Policy [DfI W]
- Council for Nature Conservation and the Countryside [CNCC]
- N Ireland Fresh Water Taskforce [FWT]
- Waterways Ireland [WWI]
- Ulster University Academics [A]
- NI Environment Agency [NIEA]
- CAFRE's Development Service[CAFRE]
- Climate NI and Institution of Civil Engineers [CNI and ICE]
- EA, SEPA and Natural Resources Wales

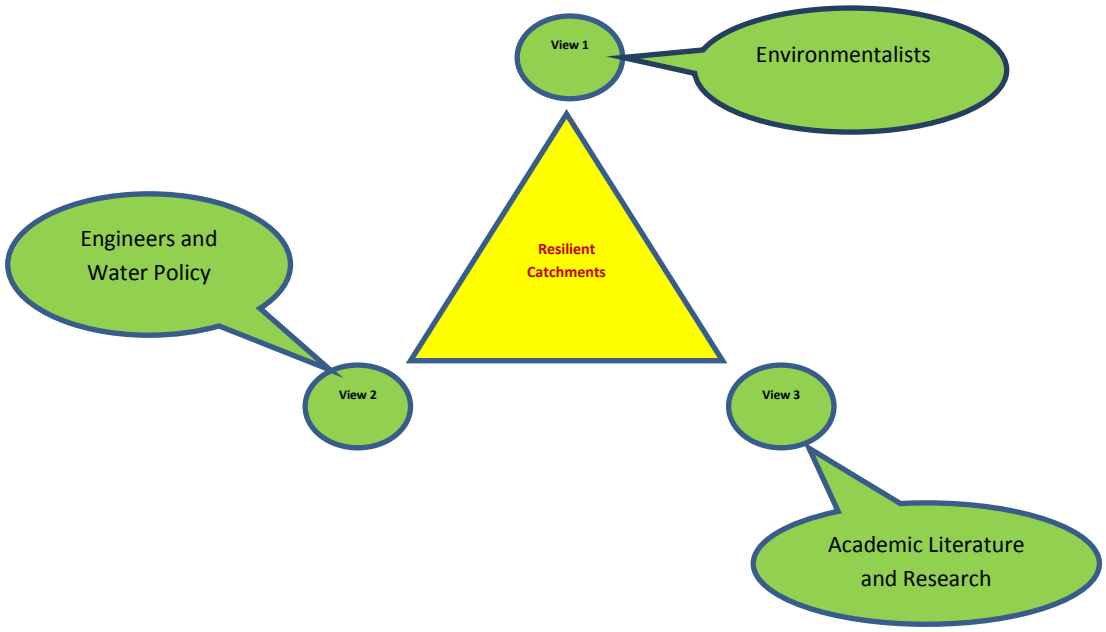
Summary of evidence:

+ Flooding alleviation has been normally provided with (hard) engineering solutions
+ Off-line storage may prevent flash floods impacts and protect stream/ loughs/land
+ Sustainable Drainage systems are developing a track record, but not all clients readily accept the 'whole life costing'
+ Rivers Agency Flood Maps play key role in catchment planning
+ Planning permission should not be given to any inappropriate floodplain developments
+ Environmentalists and engineers need to have an awareness of flooding potential and post-flooding expectations
+ Improved description of flood frequency is needed by all users, avoiding a '1 in x year storm' nomenclature; probability theory can help, but education also has a role
+ Risk of flooding is linked to the resilience of the catchment, and this needs to be better understood, ideally using mathematical modelling and terminology
+ Modelling of catchments, ideally including a lough or lake, is needed
+ The European Water Framework Directive, as a legal requirement and sister directive to the 'Floods Directive', provides a framework for river basin modelling, and has been a significant driver in integration of water related standards
+ Catchment development is at the heart of the Sustainable Water - A Long-Term Water Strategy for Northern Ireland (2015-2040)– see Sections 2B, 2C, 2E
+ Examine Mitigation phase before Adaptation in River/Lough re-engineering;
+ Key measures of success in protecting users from land flooding include Integrated Catchment approach, inclusion of Climate Change trends and impact, expected levels of protection, value of future proofing of Land Use Planning
+ 3 types of water management in NI: a. Water Quantity b. Water Quality c. Water as a

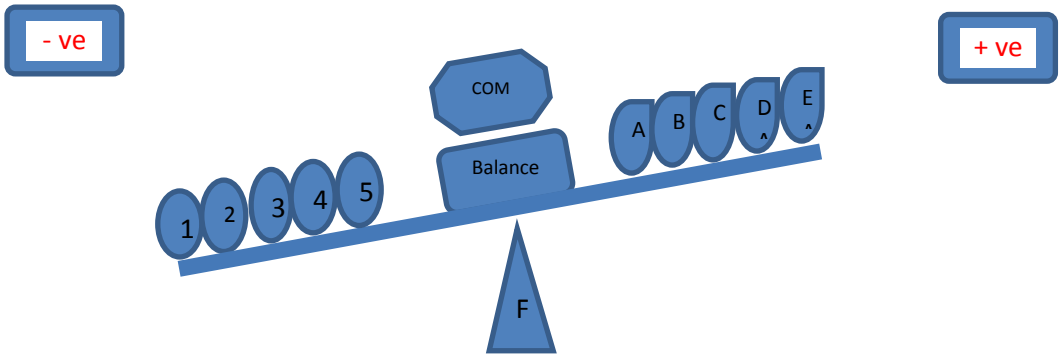
Resource (NI Water, Industry, Agriculture, Leisure); co-ordinate these into single appraisal + multi-stakeholder usage to avoid single solution approach: Integrated Catchment Plans using Natural Flood Management (NFM) techniques and covering Habitats, Water Quality etc. and reference CBA, storage options, Floods Directive, Reservoir Act, Urban Flooding, use of soft engineering solutions such as SuDS

+ Blue Green Cities approach by RA, seeks to use natural flood management as solution in '1st cycle Flood Risk Management Plan'; managed in DfI Water and Drainage Policy as part of new departmental structure (2016)
+ Ecological status of catchments in decline; biodiversity declines will lead to subsequent declines in ecosystem functioning and ecosystem stability
+ Significant research indicates that natural and man-made flood protection systems need to work together to protect the environment and let nature manage water flows
+ NI Water Sustainable Catchment Management Plan (SCaMP), has objective to improve the quality and reliability of the raw water received at NI Water's raw water abstraction points through sustainable catchment based solutions that focus on protecting the natural environment through achieving favourable conditions and habitat improvement
+ 'Reduce flood risk through rewilding', such as recreation of flood meadows and making woody or leaky dams, tree planting and improved soil management has reduced river flow and flooding by 1+% in Cumbria
+ Planting trees and woods on farms, often referred to as re-wilding, can protect water and manage water quality/quantity
+ Water Recreation has a key part to play in any catchment to meet social needs, provide employment and develop water-based skills on a prestigious river.
+ 'Green light to 1000km of greenways' Infrastructure Minister Chris Hazzard (Nov '16); paths, for use by walkers, runners and cyclists, to be traffic free and use disused railways, riverside paths, abandoned canal towpaths or flood embankments, reinventing them for use by future generations
+ State of the Environment (NI) Report (2016) clarifies the need for greater integration and measurement of Catchment Uses
+ Catchment Development - useful tool, HARMONISE (A Holistic Approach to Resilience and Systematic Actions to Make Large Scale Built Infrastructure Secure), a project funded from EU's Seventh Framework Programme for research, technological development: www.harmonise.eu

Triangulation:



Resilient Catchment Beam:



1	Flood protection – costly on cash and nature
2	Biodiversity and ecology in decline
3	Recreation can damage catchments
4	Upland catchment impact unknown
5	Fluvial and surface flooding confused

A	Engineers desire to adopt hard and soft flood defence solutions
B	SuDs can mitigate flash flood impacts
C	Blue Green Cities
D	Food security depend on catchment management
E	SCaMP: small and effective plus 'leaky dams'

F: 'Catchments are treated as a means and place for several uses and users to be accommodated in a mutually respectful way; sustainable development as a driver allowing economic, environmental and social interests to exist in balance'.

Commentary

Each catchment has its unique features, often described by its topography and landscape, with its main river being the central spine with several functions, none less than that it receives rainfall and surface runoff water in variable and unpredicted intensities. Resilient catchments are also the provider and receptor of many species, some of which are in danger of becoming extinct. In the midst of these dilemma, is the desire to protect humanity, and this has frequently been achieved by the construction of hard and necessary structures to protect properties and land against flooding. There is an increased awareness and appreciation, between the Engineering and Scientific groupings, of the benefit of a mixture of soft (natural) and hard (man-made) flood alleviation solutions, and this will reduce risk of breakdown of systems in the catchment. This integrated approach can extend to greenways as well as the evaluation of the impact and role of separate elements and users of a catchment; the quest is to mitigate flooding impacts in harmony with nature, while pursuing suitable development of each catchment. Broader integrative thinking and Resources will be needed.

Commendations (COM):

+ Operation and positive value of RA Flood Maps
+ Small scale catchment SCaMP working for NI Water
+ Alignment of thinking across Engineering and Environmental experts on need for 'Integrated Catchment Planning'

Balancing Actions (Balance):

+ Commission an Integrated Catchment Wide Model (pilot) – see ANNEX 3
+ Promote Natural Flood Management techniques as an option in all flood alleviation schemes
+ Review work of CNCC and FWT with view to linking and remedying the role of Catchment Planning as a possible contributor to ecosystem decline
+ Develop rational messaging on the 'communication of severe storms' to the public
+ Review or develop tools to describe natural flood management, alongside engineering structures, in economic and environmental terms.

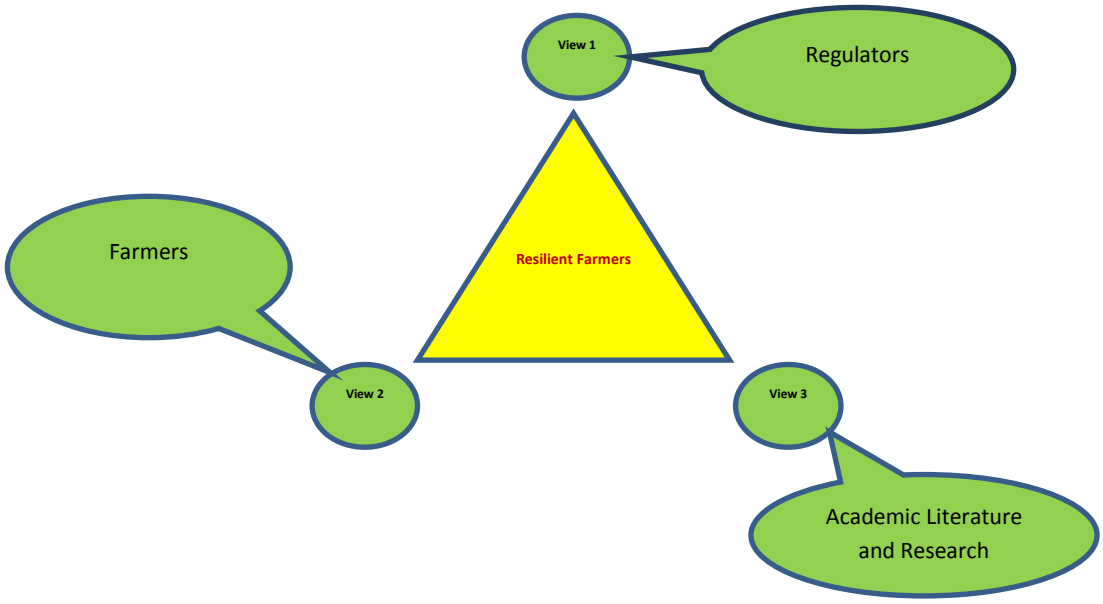
5.11 RESILIENT FARMERS

RESILIENT FARMERS	Status of Issue: Medium Term (1-2 years)
Stakeholders providing Evidence to this Issue: • Ulster Farmers Union [UFU] • UFU Erne Farmers [UFU - F] • UFU Upper Bann Farmers [UFU - UB] • UFU Lower Bann Farmers [UFU - LB] • NI Ambulance Service [NIAS] • NI Fire and Rescue Service [NIFRS] • Police Service NI [PSNI] • Rural Support (NI) [RS] • DARD (CAFRE's Development Advisers and Veterinary Service)	
Summary of evidence: + Farmers have immense pride and generational responsibility in their farms + Farmers were tolerant of flooding but the prolonged winter flooding period was a severe test + Risk to life; fear of fatalities or death if similar flooding happens again + Farmers used tractors and 4-by-4 vehicles to help neighbours, take children to school and generally assist + NIFRS used boats, waders and equipment to assist domestic householders and farmers + Feelings of community isolated, and some lack of confidence in Authorities + Councils were prepared and Rivers Agency provided sandbags, pumps and staff + Family Stress included children, especially relating to school attendance; also elderly with carers not able to access households for 5 weeks + Farmers' concern over insurance issues + Financial stress due to loss of crops and silage, knock-on effect for next year's fodder, cattle not able to graze after winter flooding in Spring – need to purchase feed, silage and rent grazing land + Harnessing the capacity of the affected community as a resource + Importance of local knowledge in assisting community resilience + Farmers need to develop even greater risk awareness and an acceptance of risk + Promotion of adaptive capacity through 'Property Level Protection' + Flood insurance needed as a resilience tool + Tension between farmers from different catchments over 'levels of help' + Farmers wanted to find sources of help and be able to help, but felt dis-engaged + Few farmers favoured diversification of land use, mainly through future uncertainty or lack of knowledge of flood-resistant crops + CAFRE Development Advisers (40No.) and Veterinary Services support farms - good but limited; + Scheme for Emergency Financial Assistance (SEFA) for small businesses and non-domestic	

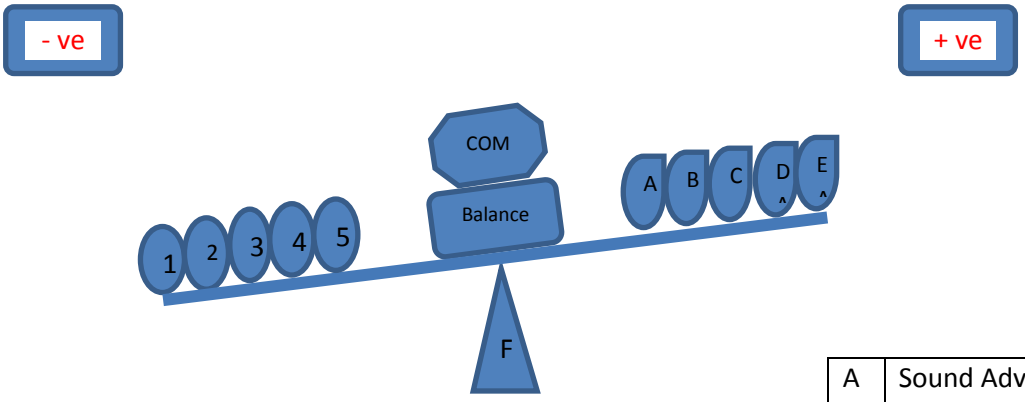
properties - welcome and limited; best spent (£1k per farm) on large scale flood alleviation; payment was not proportionate to land area; risk of losing SFP; and challenge to manage applicants expectations

+ Confusion on who can apply for SEFA grant brought more uncertainty
+ What happens after Brexit?
+ UFU continues to engage with farmers, research, lobbying politicians
+ Farmers were generally stoical about flooding
+ Financial stress was taking its toll on farmers, but few were willing to give details; Case Study 1 (Annex 1) gave real-time data on costs and the impact; Case Study 2 (Annex 2) indicated the impact of flooded land on people and communities
+ Some farmers were annoyed with Minister stating that 'for natural floodplains there was not always an engineering solution and people may have to live with flooding'
+ Few farmers had availed of the services of CAFRE for training and up-skilling
+ Dredging examples in England have raised expectations for Erne, and Bann catchments;
+ Farmers concerned for Flood-induced reduction in wildlife
+ Good liaison with 'blue lights'; effective daily work by NIFRS
+ Farm Health and Safety came under greater focus during flooding due to flooded properties, land and road access

Triangulation:



Resilient Farmers Beam:



1	Farmers stressed
2	Limited financial support
3	Doubt over Brexit Impact
4	Flooding Impact severe
5	Generational concerns

A	Sound Advice from Rural Support
B	CAFRE support if requested
C	Land Management is 'a way of life' and essential
D	Pockets of innovative or alternative farming
E	UFU lobbies and supports farmers

F: 'Farming is seen as essential to employment, food yield and society, while farmers have job security and can retain family heritage and tradition'

Commentary

Farming and its farmers are a way of life, embedded in generations, wedded to the land and feeling 'more stress than ever', brought on by Winter Flooding in a time of uncertainty, poor prices and the uncertain future after Brexit. Help is available through UFU and Rural Support, while the emergency services provide timely help during flooding. However, there is no easy way to overcome the stress of financial loss, family pressures and the 'almost inevitability of more storms to come'. There needs to be a greater understanding of risk so that the resilience of the farming families can be improved with appropriate resources to include financial aid, guidance, support, full appreciation of challenges and (eventually) greater confidence in the Flood Risk Management systems and operators.

Commendations (COM):

+ Valuable support for Farmers by UFU and Rural Support Northern Ireland
+ Farmers retain their commitment to the land, down the generations and to their local communities, as well as providing vital knowledge and information

Balancing Actions (Balance):

+ Establish Pilot Farming Resilience Group through Industry leadership – see ANNEX 5
+ Systems remain vigilant about the well-being of farmers and their families
+ Incentivise farmers to investigate land use diversification, alternative crops, re-forestation and horticultural development
+ Farmers are upskilled on key farm-related activities
+ Farm and Farmers' Safety retains necessary guidance and public information support, especially for times of emergency

6. COMMENTARY ON RESILIENT ISSUES

The content of each of the Resilient Issue sections (Chapter 5.1 – 5.11) is self-explanatory. Each draws on a number of key stakeholder engagements, along with correspondence and literature.

6.1 Benefit of Resilient Issues approach

The analysis of these 'presentations or books of evidence' involved a number of processes by the Reviewer. In summary, these were:

i. Developing a precis of each Stakeholder meeting, with the assistance, in most cases, of Rivers Agency administration;
ii. Categorising each evidence statement into one or more of the 'Resilience Issues'
iii. Obtaining contra or alternative views to earlier Stakeholders, in order to acquire a broad and balanced input to each Issue section;
iv. Summarising the content of each Stakeholder Meeting record into key evidence;
v. Triangulating these views with Academic Literature and/or Government Reports and Strategies;
vi. Corralling this ranging body of evidence into significant elements on which the Resilient Issue depends, either positively or negatively;
vii. Selecting actions which could lead to a more balanced situation for that Resilient Issue by balancing its Resilient Beam; therefore referring to these as 'Balancing Actions'; and
viii. Identifying 'items of good practice' and noting these as Commendations.

These processes brought consistency of approach and served to categorise the breadth of issues created by Winter Flooding. In turn, the 11 issues were listed under 4 Headings of: Human Interaction, Science & Engineering, Governance and Agriculture & Land. The 4 headline categories have assisted in addressing Winter Flooding across the aspects of Society, Science, Legislation and Natural Environment, thereby addressing the initial international context of Sustainable Development.

This bottom-up approach has assisted in reviewing the Winter Flooding impacts from a range of perspectives and allocating responsibilities in a joined-up fashion, primarily by attaching actions/recommendations and challenging the Department for Infrastructure to respond, alongside other Departments as appropriate.

6.2 Resilience – Risk - Resource (RRR) Nexus

This RRR Nexus is demonstrated in the following Figures:

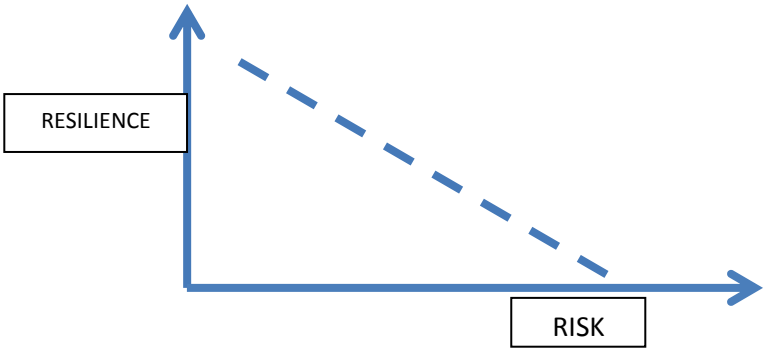


Figure 6.1: Risk v. Resilience Linear Relationship

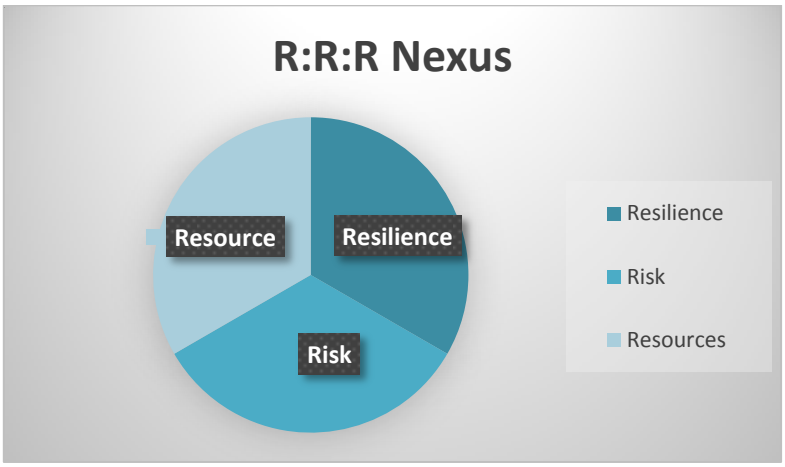


Figure 6.2: Resilience, Risk & Resource in Balance

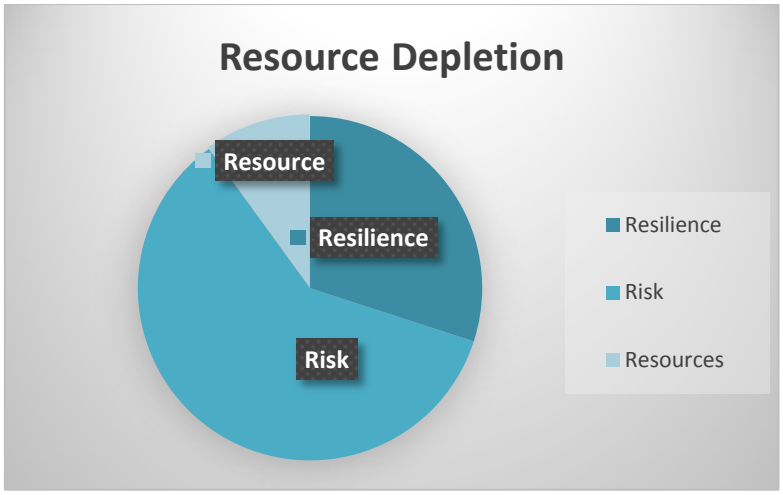


Figure 6.3: Resource Depletion leading to Risk Increase and Resilience Reduction

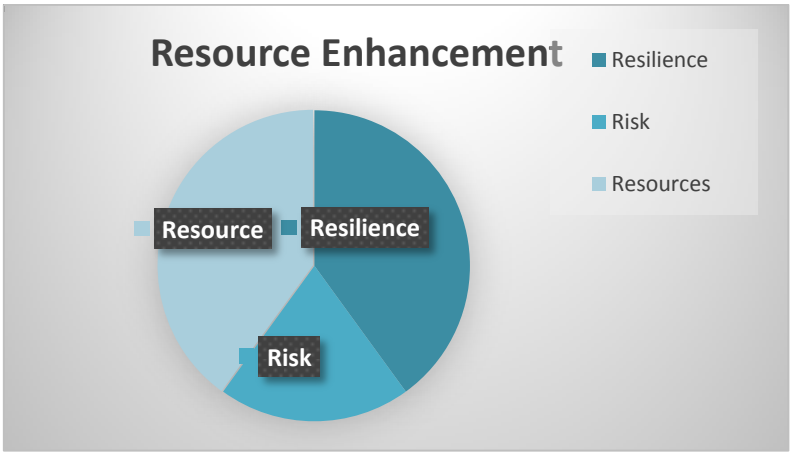


Figure 6.4: Resource Enhancement leading to Risk Reduction and Resilience Increase

This RRR Concept brings a balanced appraisal of any issue, and is applied to the Winter Flooding challenges.

6.3 Consolidation of the Resilience Beams and RRR Nexus

Linking Resilient Beam balancing actions and the RRR Nexus approach can be reconciled by taking the major issue(s) and identifying what 'Resource' is needed to reduce the Risk associated with that issue, while increasing its Resilience or Sustainability. It is fully acknowledged that this is not an exact scientific approach, but goes some way towards rationalising Winter Flooding Impact Mitigation and Adaptation solutions through an integrated and future-looking process.

Following the **Programme for Government (2016)** methodology of 'Output Driven with Input Data', the following table suggests an allocation of outputs, in the sense of Resources, for each Resilient Issue.

The alignment of the Resilient Beam and RRR nexus is as follows:

- Resilience is linked to the Resilient Beam Fulcrum
- Risk is linked to the balance between Positive and Negative impacts on the Beam
- Resource is directly related to the Balancing Actions for each Beam

Figure 6.5 elaborates on these Linkages

Resilient Issue	Desirable level of RESILIENCE	RISK associated with potential loss of Resilience	RESOURCE needed to achieve adequate or greater Resilience
Resilient Staff	"Expectation of sustained flood maintenance and alleviation staff service; strategic and operational capability to lead and deliver professional flooding incident response"	Loss of Service at both managerial and operational levels; non-delivery of essential provision	1. Enhance Staff quota for 'flood event response' as result of a full audit of staff needs (at all levels) 2. Evaluate the possibilities of 'Training up DfI staff from Roads to supplement River staff' 3. Increase collaboration of Merge Emergency Functions across Flooding Response and Extreme Weather Roads protection, within DfI 4. Inspect condition and quantity of all Flood Response equipment and invest for future events
Resilient Communications	"Efficient and effective communication to ensure that all at risk are alerted in a timely fashion in suitable language"	Frustrated and uninformed public; industry living in fear while not obtaining suitable messaging	1. Seek greater clarity in messages which deal with 'Flood Warning', 'Severity and frequency of floods' and the 'Flooding Incident Line prompts' 2. Support CRGs though training, effective message networks and equipment as required 3. Learn more about use of Social Media through research and corroborate with DEFRA, and in line with emerging Departmental 'social media' development 4. Develop 'Flood Warning' nomenclature to reflect likely impacts and not by a 'time return period' e.g. "Flood will cause extensive land flooding up to 19xx levels" 5. Further develop FIL systems and refresh Flood Warning Literature 6. Produce and publish a Flood Information CD for new Councillors to include - Who does What and When, likely environmental and social impacts, role of key agencies
Resilient Community Networks	"Community Resilient Networks support those who need assistance in times of emergency, need or disruption to normal life"	Loss of help when it was expected and most needed – possible risk to life	1. Greater support for the management, materials and sustainability of CRGs to ensure that the CRG network grows and matures as well as being an integral part of rural society 2. Proper resourcing of emergency and community planning and the introduction of legislation that places a clear requirement on all stakeholders to play their part 3. Consolidation of the new post to lead and co-ordinate the EPC work, administered by Solace 4. More emphasis on post flooding well-being support for communities,

Resilient Issue	Desirable level of RESILIENCE	RISK associated with potential loss of Resilience	RESOURCE needed to achieve adequate or greater Resilience
			especially in stress relief 5. Consolidation of EPCO management and the Cross Border Emergency Management Group
Resilient Hydraulics	"Expectation that loughs can capture all flood waters or have capacity to act as a reservoir to minimise flooding onto floodplains during extreme events"	Flooding increases as effects of 'changing climate' become more common	1. Review of Lough Neagh Water Controls, in the form of an investigation: 'An in-depth review of the operating regime for the Neagh/Bann system to ensure that the arrangements and parameters for its management are adequate to meet modern day needs' 2. In recognition of the integrity of the 'Review of Lough Erne Operating Regime' Report (2013), continue to consider small scale actions in the Erne System such as minor changes in Gates' operation to provide greater pre-winter floods protection, ongoing regular maintenance of rivers and tributaries 3. Consolidation of the status & management of the Lough Neagh Development Trust, to capture the differing interests and retain the environmental designations
Resilient Rivers & Infrastructure	"Rivers exist to convey normal and extreme water flows, and naturally depend on their floodplains in that function; they provide a means and place for several uses and users to be facilitated in a mutually respectful way, in tandem and support of adjacent infrastructure"	River threaten or start to flood/overspill beyond their natural floodplains	1. River Maintenance frequency to be considered for performance rather than economic reasons 2. Investigate the need for a comprehensive survey on 'the impact of rivers on adjacent infrastructure and bridge structures' 3. Rivers are recognised as a central function within a Catchment (See Chapter 5.10), and become integral with a more holistic appraisal and development of each catchment 4. Road and farm access safety, during extreme flooding, must be considered
Resilient Weather Data	"Weather data should provide accurate short-term predictions and long-term trends, based on sound analysis and applicable to a range of users"	Weather expectation and forecasting returns to being a gamble without adequate scientific data and intelligent analysis	1. Consider the establishment of a government-owned company which provides weather data and analysis, links with Climate Change Risk Assessment as well as Mitigation and Adaptation measures, and produces reports specific to several sectors e.g. Infrastructure, Health, Agriculture, Sport 2. Establish a NI-based Centre for Resilience, to monitor a range of

Resilient Issue	Desirable level of RESILIENCE	RISK associated with potential loss of Resilience	RESOURCE needed to achieve adequate or greater Resilience
			resilience issues, develop research and inform Decision Makers 3. Educate people about climate change and flooding, including educational programme in schools relating to flooding, probability, forecasting, games etc.
Resilient Emergency Planning	'Emergency Planning serves to minimise risk and increase resilience of systems and processes by providing guidance during an emergency, ensuring that people and resources are managed in a safe and secure manner'	Structure become confused, responsibility is ill-defined and there is 'an accident waiting to happen'	1. Civil contingency systems and protocols to be reviewed in light of flooding emergency, UK Flooding legislation and advent of new Department for Infrastructure 2. Funding secured for long-term appointment of a 'Regional Co-ordination of the work of the EPCOs', through SOLACE or others 3. Appraise the impact of Staff reduction on systems 4. Ensure that Emergency Planning and delivery remain central in the full integration of the Floods Directive and possible Floods Bill
Resilient Flood Economics	'Flood economics allows a full explanation of the implications of flood damage and alleviation, accounting for an integrated approach across all key stakeholders'	Impact of flooding is not understood, with possible consequences of misinformed allocation of Resources, including funding	1. Development of a model contract for 'A Study on the Economic Impact of Flooding' to include a broad range of criteria, and allow this model contact or programme to be applied to other areas 2. Develop a future 'Scheme of Emergency Financial Assistance' which operates on the principle of proportionality' with awards relating to arm or business size, and not applying a flat rate for all applicants 3. Realistic costing and methodology to develop sustained solutions, including use of Natural Resource Management, to minimise flooding risk 4. Infrastructure engineered solution list of key projects drawn up with full costing attached 5. Support for Education, Research & Development in areas of 'potential increased knowledge and application' e.g. costing models, re-wilding, infrastructure replacement Cost Benefit Analysis.
Resilient Land Use	'Expectation of well-drained land, rivers and loughs operating within their floodplains and land capable of providing a living for the	Land management is poorly executed, crops fail and livestock are compromised	1. AFBI develops its applied research and investigation on 'Impact of Flooding on farm and horticulture businesses', through DAERA, and possibly CAFRE 2. Full soil analysis is carried out to develop greater understanding of Catchment performance (see 5.10 Resilient Catchments' and Annex 3)

Resilient Issue	Desirable level of RESILIENCE	RISK associated with potential loss of Resilience	RESOURCE needed to achieve adequate or greater Resilience
	agriculture industry'		3. Community Planning and Land Use Planning are seen as collaborative to prevent any further floodplain development. Farmers and UFU must be seen as the key stakeholders 4. Incentives and schemes are developed at Departmental level to support use of alternative crops, re-forestation and horticultural development 5. Niche land use for unusual or historic buildings such as those with 'Listed status' need to be re-considered, to ensure legacy and heritage are preserved and not compartmentalised 6. Farm Insurance to be considered by the wider industry
Resilient Catchments	'Catchments are treated as a means and place for several uses and users to be accommodated in a mutually respectful way; sustainable development as a driver allowing economic, environmental and social interests to exist in balance'	Catchment management is not co-ordinated, biodiversity is damaged and there ceases to be a reasonable yield of crop and income from the catchment	1 Commission an Integrated Catchment Wide Model (pilot) 2. Promote Natural Flood Management' techniques as an option in all flood alleviation schemes 3. Review work of CNCC and FWT with view to linking and remedying the role of Catchment Planning as a possible contributor to ecosystem decline 4. Develop rational messaging on the 'communication of severe storms' to the public 5. Review or develop tools to describe natural flood management, alongside engineering structures, in economic and environmental terms.
Resilient Farmers	'Farming is seen as essential to employment, food yield and society, while farmers have job security and can retain family heritage and tradition'	Farming declines as a vocation and an essential part of rural society	1. Establish Pilot Farming Resilience Group through Industry leadership – see ANNEX 5 2. Systems remain vigilant about the well-being of farmers and their families 3. Incentivise farmers to investigate land use diversification, alternative crops, re-forestation and horticultural development 4. Farmers are upskilled on key farm-related activities 5. Farm and Farmers' Safety retains necessary guidance and public information support, especially for times of emergency

Figure 6.5 Resilience – Risk – Resource Nexus application to reaching solutions for improvement in Winter Flooding Response.

7. CONCLUSIONS AND RECOMMENDATIONS – 'WHERE'S IT HEADING?'

7.1 Conclusions

This Review has captured or described a range of elements as **drivers** (e.g. strategies, policies, and legislation), **activities** (e.g. work programmes, initiatives, and schemes) and **evaluations** (e.g. reports, reviews, action plans) which directly relate to Flood Risk Management. None of these elements were found to be unsatisfactory, albeit several aspects could be improved. In the emergency situation of the winter of 2015/16, this outcome was adequate, akin to 'Very Good, but could have done better'.

A deeper review, or evaluation, found that several systems worked in isolation e.g. 'Farmers were not aware of the detailed responses by Emergency Services'; or 'Rumours about payments were exaggerated causing raised expectations, possibly leading to stress, when it did not happen' etc. This led to a need to identify how ownership could be better understood and operated, and the need to better links between **Risk**, **Resilience** and **Resources**. **Forward planning** was critical to this Nexus.

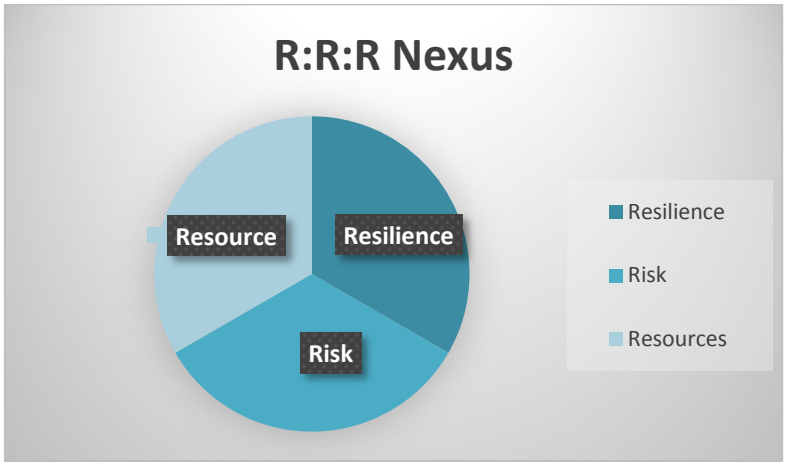
In the review of the 11 'Resilient Issues', it was evident that each could do with greater Resource (stock or supply of money, materials, staff, and other assets), in order to create better performance and manage more integration and accountability. This is explained in Chapter 6 Commentary.

The comprehensive review of literature and documents from across the jurisdictions of Global, Regional and Local confirmed that this relatively new Nexus of Risk : Resilience : Resource was a valid concept on which to build new and improved integration for Flood Risk Management.

For completeness, the R-R-R Nexus is summarised as the Concept of:

- **Resilience** of Systems, People and Resource;
- **Risk** assessment of actions, activities, anticipated events; and

- **Resource** allocation to provide balance and enhancement across Resilience: Risk Nexus (Resource includes systems, funding, skills development, education, research).



Resilience : Risk : Resource Nexus Diagram

Against this RRR Nexus, there were notable contributions, referred to throughout the Report as Commendations, and there were areas of work or activities which needed further attention, referred to as Balancing Actions.

7.2 Commendations

The following Commendations were each lauded in at least one or more of the Resilience Issues sections, and are worthy of special mention in this highlights chapter:

Comm1: Distinct leadership, on the ground and in the media by Minister and Rivers Agency Chief Executive;

Comm2: Notable support and guidance by the Ulster Farmers Union for its members across the province;

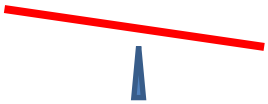
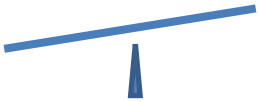
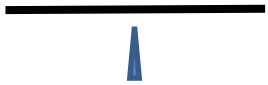
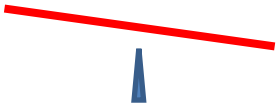
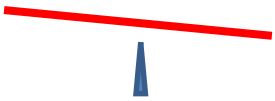
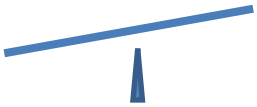
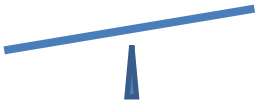
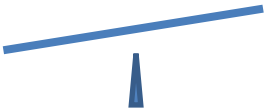
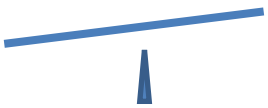
Comm3: Strong resilience, in the face of adversity and medium to long-term disruption, by many in the rural community;

Comm4: Vision to engage with Natural Flood Management Systems; and

Comm5: Sustained efforts by Emergency Planning Groups, Community Resilience Groups and Service providers over a 14 week period.

7.3 Performance Summary

The Resilient Beam performance of each issue is informative and helpful in identifying the success and 'work still to be done'. It should be noted again that a Beam which is dominated by 'positive inputs' will lean to the right, coloured **Red** (e.g. Community Networks), while those with dominant negative inputs will lean to the left, coloured **Blue** (e.g. Hydraulics); hence those in a neutral position, coloured in **Black** (e.g. Staff), indicated balance during the Winter Flooding. These analyses are captured in this table of Beams below:

'Human Interaction'		
STAFF 	COMMUNICATIONS 	COMMUNITY NETWORKS 
'Science and Engineering'		
HYDRAULICS 	RIVERS and INFRASTRUCTURE 	WEATHER DATA 
'Governance'		
EMERGENCY PLANNING 		FLOOD ECONOMICS 
'Agriculture and Land'		
LAND USE 	CATCHMENTS 	FARMERS 

Each of the Issues had typically 15-30 items of stakeholder evidence which were interpreted into 4 or 5 positive and 4 or 5 negative impacts; this resulted in an overall configuration for each issue as shown above. Also each Issue was awarded at least one item of Commendation for 'evidence of good practice' and a number of Balancing Actions for 'work

that should be applied or investigated to provide greater balance. These amounted to 50 Balancing Actions.

In summary, it is noted that three issues were in balance (**in Black**); three were positive (**in Red**), and five were negative (**in Blue**). This appraisal was influenced by a desire to identify the R:R:R Nexus and therefore to derive Headline Recommendations.

7.4 Recommendations

From each of the eleven 'Resilient Issues', it was identified that there are a small number of key Recommendations, following on from the overall evidence presented. The Reviewer advises that the host Department should inspect these as well as all of the Balancing actions.

The following high level recommendations are given to bring focus and direction to the overall Review Report:

One Concept and a 10 C-Plan:

One Concept or Overarching Approach of "**Resilience** links to **Risk** though the appropriate and sustained allocation of **Resource**"

10 C-Plan, based on R:R:R Nexus Concept:

C1: Commission: Procurement of a Hydraulic Model of Lough Neagh flows, leading to *a review of the statutory water levels in Lough Neagh*;

C2: Crops: Increased research and development work, through DAERA, to examine *crop performance and potential for alternative land* uses in floodplains;

C3: Communications: Seek greater clarity in messages which deal with *'Flood Warning'*, '*Severity and frequency of floods'* and the '*Flooding Incident Line prompts*';

C4: Collaboration of Staff and Resources: Seek greater integration of multi-agency working including *innovative solutions for staff and resource shortages*, initially at Departmental level. Sharing of skills and responsibilities is highly desirable in an inter-departmental work area;

C5: Connection: with and support for farmers in areas of potential flooding to be enhanced through the investigation of a new *Farming Resilience Group (FRG) model,* ideally led by the agriculture industry;

C6: Civil Contingency Systems: review connections and develop a (more visible) suitable management organogram to facilitate the integration of departmental Major Emergency Response Plan(s), Emergency Planning Coordinating Officers and Community Resilience Groups, ensuring adequate policies and efficient delivery. Cross-border liaison is highly desirable, with due attention to checks across Preparedness, Co-ordination, Response, Communication and Recovery;

C7: Catchment Modelling: investigate and develop an *Integrated Catchment Wide Model (ICWM)* to simulate the activities of an entire catchment and interrogate possible new or additional uses/applications. The consolidated ICWM has the possibility to be re-used on several catchments, to bring integration across economic, environmental and social aspects and promote the use of Natural Flood Management techniques. Included may be a review of maintenance work programmes to ensure that key rivers and/or 'designated watercourses' continue to function effectively;

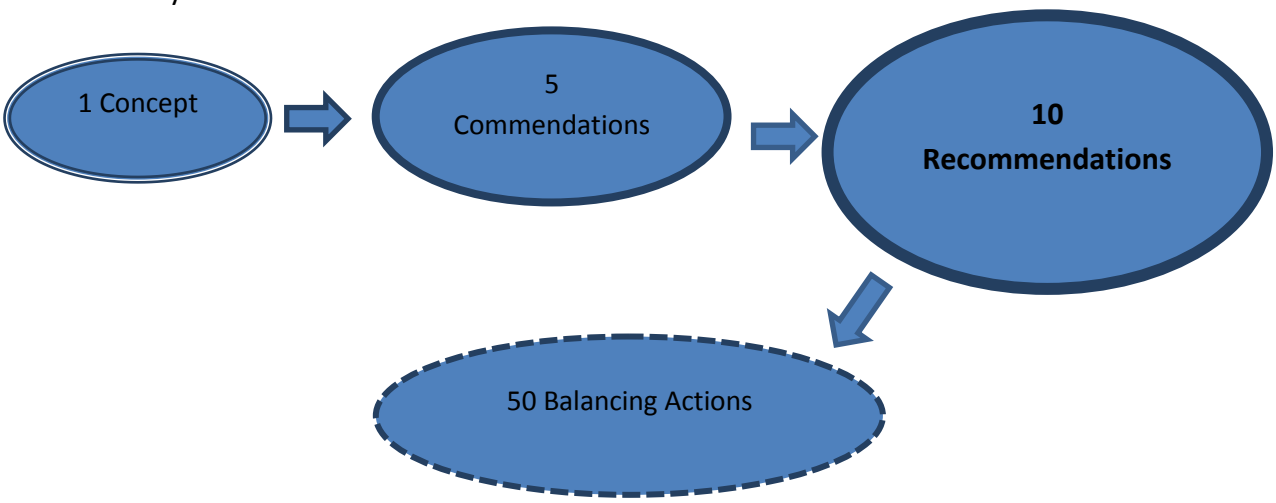
C8: Community Resilience Groups: enhancement of arguably the 'jewel in the crown' for survival of many aspects during extended flooding; greater support for

the management, materials and sustainability is needed to ensure that the CRG network grows and matures as well as being an integral part of rural society;

C9: Connecting Resources requires a mature and broad interpretation of the role of Resources in the RRR Nexus, to include capital and operational funds, knowledge, research and experience-informed decisions as well as fit-for-purpose systems for Flood Risk Management. An increased need for Resources in the form of FUNDING will emerge;

C10: Curricula of all education sectors (primary, secondary, tertiary) should include and be made aware of Emergency Planning, using Flood Risk Management and allied activities as key exemplars. Gaining **Public Confidence** is central to the acceptability of this Review and to an improved response to any further severe flooding.

In Summary:



It is finally recommended that the outputs of this Review, covered by the 10 C-Plan and the sectional items in each Resilience Issue section, should be evaluated independently within a 2-year period, say December 2018. It should also be subject to the normal NI Assembly Ministerial and Committee scrutiny.

7.5 ACTION PLAN – 'Who could do what?'

The Reviewer did not seek nor receive sufficient evidence to allocate responsibilities for the Recommendations.

These recommendations arise at two levels in this Report:

a. Headline Recommendations in 7.1 – 7.4 above - Conclusions and Recommendations 'Where's it Heading'; these constitute 5 Commendations and the 10 part C-Plan;
b. Sub-Recommendations, within each Resilient Issue section of Chapter 5, as they are pertinent to that issue alone; these total to 50No. Sub-Recommendations.

The apportionment of responsibility for both levels of Recommendations lies with the Department for Infrastructure; it is anticipated that there will also be cross-Departmental activity in order to address the holistic and integrating aspects of Winter Flooding Response. This table links the Headline Recommendations with each Resilience Issue and shows a genuine response to an overall aspiration of 'Increased Public Confidence'.

Resilient Grouping	Resilient Issue	Headline Recommendations	Overall
'HUMAN INTERACTION'	Resilient Staff	C4 - Multi-Agency Working	**C10 - INCREASED PUBLIC CONFIDENCE and 'Use of RRR-Nexus as a guide to progress'**
	Resilient Communications	C3 - Flood Messaging Clarity 1	
	Resilient Community Networks	C8 – Community Resilience Group support for growth	
'SCIENCE and ENGINEERING'	Resilient Hydraulics	C1 - Lough Neagh Hydraulic Model and Water Level Determination	
	Resilient Rivers and Infrastructure	C7 - 'Integrated Catchment Wide Model' development	
	Resilient Weather Data	C3 - Flood Messaging Clarity 2	
'GOVERNANCE'	Resilient Emergency Planning	C6 - Emergency Response Integration	
	Resilient Flood Economics	C9 - Flood Risk Management funding	
'AGRICULTURE and LAND'	Resilient Land Use	C2 - Land and Crop Development Research	
	Resilient Catchments	C7 - 'Integrated Catchment Wide Model' development	
	Resilient Farmers	C5 - Farmer Resilience Groups	

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ACKNOWLEDGMENTS

W Alan Strong, as Flooding Review Independent Author, wishes to sincerely thank all of those who have given so freely of their time and expertise in meetings, correspondence, advice and support in soliciting Stakeholders' views, analysing inputs and writing this Report, in the period March – November 2016. Those who assisted in many ways fall into four equally important categories:

A. Employer Approval and Acknowledgement

- Professor Ian Montgomery, Professor Philip Griffiths [Ulster University]

B. Administration, logistics and document construction:

- Kieran Brazier, Roisin Rice (nee Gilchrist), Mary McKeown, Kathy Maskey, Shona Adamson, Shaun Donnelly [Rivers Agency]
- Elizabeth McKeown, Dr Rodney McDermott, Pearl Bartley [Ulster University]

C. Government Commissioning, Advice and Progression Monitoring

- Michelle O'Neill MLA (DARD Minister) – initial engagement; Chris Hazzard MLA (Department for Infrastructure Minister) – Receiving of Report
- David Porter [Chief Executive, Rivers Agency]

D. Stakeholder Views

- Jonathan McKee, Graeme Anderson, Owen McGivern [Rivers Agency HQ]
- Barclay Bell, Ivor Ferguson, Kate Cairns [UFU HQ]
- Alan Cooper and Sam Philips (AECOM), Alan Skates and Julie Templeton (Atkins Global), Andrew Jackson (RPS), Tommy Stevenson (WDR and RT Taggart), Bill Gowdy and Stephen Blockwell (NI Water), Brian Mullan (WWI) [Civil Engineering Group]
- David Neill (Belfast CC), Joan McCaffrey (Fermanagh and Omagh DC), Eugene Cunningham (Armagh City, Banbridge and Craigavon BC), Joanne McKenna (Red Cross) [Emergency Preparedness Group]
- Ryan Gough (Armagh), Tommy O'Neill (Omagh), Alistair Payne (Armagh), Michael McCreesh (Armagh), Malachy Loughran (Armagh), George Thompson (Fermanagh), Paul McDonald (Fermanagh), Robert Taylor (Fermanagh), Mike O'Gorman (Omagh), Donal McGill (Omagh), Martin Kelly (Omagh) [Rivers Agency Regional Staff]
- Brian Mullan, Joe Gillespie, Stephen Forrest [Waterways Ireland]
- Kerry Anderson [NIEA]
- Jim Shaw and Eleanor Glendinning (Met Office, Scotland), Jane McCullagh (Climate NI), Pardis Biglarbeigi (Ulster University) [Climate Change Group]
- George Sloan, Andrew Sloan, Matthew Harrison, Nigel Rainey, Seamus Donnelly, Joe Mulholland, Pat Smith, Andrew Hayes, Barclay Bell, Kate Cairns [Upper Bann Farmers' Delegation]
- Ivor Ferguson and Kate Cairns (UFU), Alec McQuillan and Andy Law (NI Water),David Neill (Belfast CC), Graham Smith (Consumer Council) [Personal Impact Group]

- Albert Foster (Host), David Brown (Local UFU representative), Douglas Rowe (former UFU President), Stephen Johnston, Geoffrey Read, David Jordan, Barry Read, Robert Kettyle, Henry Mayne, Andy Wilson, Michael Reihill, Bertie Swann and Albert McClelland; Barcley Bell, Ivor Ferguson and Kate Cairns (UFU) [Lough Erne Farmers' Delegation]
- Eric Long [CAFRE]
- Lex McCoubrey (Police Service of NI - PSNI); Jeremy Cowen (NI Ambulance Service - NIAS); Mark Deeney (NI Fire and Rescue Service -NIFRS) [Emergency Services]
- Ronan Henry (DAERA), Clair Baxter (DE, formerly DRD), Carol Duffy (NI Water) [Media Group]
- Keith Jagelman, Julie Cuming [Civil Contingency Policy Branch, TEO]
- Steven Millar, Michael McLean [DAERA Group]
- Stephen McCabe (NIEL), John Martin (RSPB), Robbie Marshall (Ulster angling) [Freshwater Taskforce]
- Fionnuala McEldowney (Linen Green Ltd.), Doug Jarvie (Neptune Group) [Linen Green Shopping Village]
- Pat Close [Lough Neagh Fishermen's Co-operative Society Ltd.]
- Conor Loughry, Henry Robinson [Transport NI West]
- Liam Hannaway, Roger Wilson [SOLACE Group]
- Julian Orford, Sue Christie, Emily Smyth [CNCC]
- Paddy Brow [DfI 'Living with Water' Programme]
- Brendan Hegarty (Chief Executive) and members of Fermanagh and Omagh District Council
- John Kane [Senior Fisheries Officer, DAERA]
- Diane McKain, John Wylie [NI Met. Office, Aldergrove]
- Tracey Teague [DAERA Corporate Services]
- Peadar Davis, Kate Cronin, Rodney McDermott, Jill Stephenson [Ulster University Academics]
- Dan and Kate McQuillan [Crabtree Cottage]
- Ian Frazer (L Neagh Regeneration Association), Conor Jordan (L Neagh Partnership), John Palmer (Lisburn and Castlereagh City Council), Arnold Hatch (Armagh City, Banbridge and Craigavon Borough Council) [All linked to Lough Neagh Development Trust]
- Members of the Drainage Council NI
- Environment Agency, Scottish Environment Protection Agency, Natural Resources Wales Senior staff [Members of National Flood Review Meeting]
- De-Briefing Session at Loughrey College – 53 delegates

I am truly grateful for all of your help, advice, documentation and support.

W Alan Strong
November 2016

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ANNEX 1

CASE STUDY 1: <u>Impact of prolonged flooding on a Dairy Farm Finances.</u>

This information was provided to the Report Author in confidence by a Dairy Consultant, who provided the detail with the full agreement of the farmer and landowner; all references to either the Dairy Consultant or Farmer are removed for copyright reasons and to preserve the anonymity of both parties.

The Author fully acknowledges the willing co-operation of Consultant and Farmer, expressed his gratitude and wishes the Farmer a full recovery and well-being in his undoubted pursuit and passion for being a successful farmer.

Topic: *Economic impact of prolonged field flooding on A Dairy Farm Business, based in the Upper Bann Catchment in the Upper Bann Floodplain*

Case Study style: *Exact words and written comment by Dairy Consultant*

"Following our recent meeting at this farm, I'm writing to you with supplementary information as promised. Our discussion focused on the financial implications of flooding on the farm business – the affects were a combination of direct factors such as grass sward deterioration, and indirect consequences such as extended housing of animals/additional fodder requirement. The farm is situated in the Lough Neagh basin; much of the land is adjacent to the Upper Bann River.

The farm has 120 dairy cows along with replacement heifers and beef cattle. The holding is owned/operated by the family with casual labour employed when necessary. Like many other dairy farms in N. Ireland, the farm has invested in recent years in additional facilities e.g. slurry storage, cattle housing, silos; the cattle based enterprises are entirely dependent on grass as the forage, either as grazing or conserved as silage.

The farm had approximately 100 acres underwater for a period of 4 months (Nov 15 to Feb 16). The fields affected included 50 acres for cow grazing of which 10 acres grazed by drystock and 40 acres normally cut for silage. The flooding had a major physical impact on the farm as follows:

- significant quantities of detritus left by flooding (silt/plastic/timber/vegetation);
- ground compaction caused by weight of water, over 1.8m in places, over an extended period;
- almost complete loss of grass sward; and
- loss of nutrients in soil after period due to prolonged leaching.

These issues have a negative impact on farm productivity and will therefore impact on overall farm viability, with short and long term consequences. The financial effects are outlined below;

The following comments are also relevant:

- Cows would have been grazed this year from mid-April – given the lack of available grass, cows will be housed for at least an additional 6 weeks whilst swards are re-established;
- The additional silage required, combined with extra concentrate feeding, over and above typical supplementary feed given to cows at grass, will add significantly to costs;
- The extra silage fed during the extended housing period is in addition to the silage forfeited due to flooding on 40 acres land. Assuming 8t/acre (1st cut silage crop), this equates to approx. 320t (estimated £25/t);
- The extra housing necessitates both additional workload in relation to managing animals and also extra expense e.g., bedding; and
- Re-seeding 100 acres land will incur significant expense – these costs include cultivation, grass seed and fertiliser – a conservative figure for these items is £110/acre.

In summary, the cost implications of the flooding are as follows;

			£
Cow concentrate	5kg x 50days x 100milkers x £215/t	=	5,375
Extra silage fed	100 cows x 42kg x 50 days x £25/t	=	5,250
Reduced silage area	40 acres x 8t/acre x £25/t	=	8,000
Reseeding	100 acres x £110/acre	=	11,000
Bedding cost		=	500
Bank interest charge		=	1,500
Total			**£31,625**

Comment:

Whilst the costs shown are significant, they probably underestimate the actual amounts incurred; assuming 120 cows averaging 7,000lts pa, the extra expenses amount to almost 4ppl. Given that the base price paid last month by the farm's milk purchaser was 17.2ppl, 4ppl represents a major proportion of farm turnover. Milk price in N. Ireland has been falling since spring 2014; it peaked at over 30ppl and has averaged 24ppl in the last 10 years. If current milk prices persist, many dairy farmers will be forced to exit the industry. The issue of flooding on this farm poses a significant threat to the long-term viability of the business.

The areas highlighted represent the physical/financial consequences of flooding to the farm. We should not underestimate the significant stress caused to the farm family, particularly in light of the current financial backdrop to the dairy sector."

Reviewer's Comment:

a. Costs for re-seeding above are significantly less than those advised by CAFRE, as the family undertake most farm fieldwork themselves; therefore the costs quoted reflect direct expenses only and do not include an allowance for machinery use, labour or time spent). The following extract from the CAFRE document 'Improving Soil and Sward Performance ' (2013), CAFRE, Greenmount Campus, ISBN: 978-1-84807-398-2 , gives 3 levels of Re-Seeding costs:

	Reseeding with ploughing		Reseeding with minimal cultivation		Sward Renovation by stitching-in (overseeding)
	£/Ha	£/acre	£/	£/acre	£/acre
Total £	**6**	**281**	**6**	**265**	**187**
Reliability	H		Moderate - high		Moderate
Rate of improvement	R a		Very rapid (2-3		Modera te (3-6

These CAFRE costs cover soil analysis, spraying, ploughing, seeding, fertiliser and lime additions, pest/disease control;

b. By selecting the median value of £265/acre, the 'Cost implications table above is altered by an additional £155 (£265 less £110) per acre; hence the total cost will increase by £15,500 (100 acres x £155);

c. **The <u>Total Cost</u>** to this individual farmer is now calculated to be [£31,625 + £15,500] = **<u>£47,125</u>**

d. Land compaction has a major impact on land productivity – reduced crop yields and reduced fertiliser efficiency are proven issues directly affecting farm viability; there are also significant environmental consequences due to increased emissions of ammonia/nitrous oxide, increased surface run-off (main source of phosphate contamination of UK waterways) and soil erosion.

e. The client was clearly stressed during a farm visit, evidenced by nervousness, 'arguably early re-seeding of hard ground that had been submerged in water for approx. 10 weeks'.

f. The generational element of farming was evident with a younger farmer (client) showing concern for his father who currently lived on the Farm but had less input;

g. There is a sense of ‘absolute despondency’ in that the cost of retaining farm stock greatly outweighed any income, and Flooding was a contributing factor giving a ‘sense of inevitability that storms would re-occur’.

h. This brief and accurate Case Study draws out the ‘**plight of a farmer who relies heavily on land which is predominately in the floodplain of a major river, which is subject to periodic severe flooding’**; there is personal stress and financial instability.

ANNEX 2

CASE STUDY 2: <u>Impact of prolonged flooding on Farm Performance.</u>

A. Context.

This information was provided to the Report Author by an interested, articulate and professional farmer; it was agreed that his name be kept anonymous for confidentiality reasons.

This story was chosen as it was clearly based on a number of attributes of the farmer:

- Experience
- Depth of understanding
- Awareness of river hydraulics, lough performance
- Ability in, and forward thinking about, farm management
- Knowledge of weather, rainfall and seasonal systems and variations

B. Facts.

The Farm:

- Situated in the Upper Bann Catchment, and in the Floodplain of the River Bann
- Subject to seasonal winter flooding which has become more regular and prolonged in last 10 years
- 150 acres of which 120 acres were normally used for grass, grazing and silage
- Improvements over the years ensured 120 acres of grassland was of good condition and yielding efficiently
- Ravaged in the Winter of 2015/16, when the 120 acres of land was reduced to 20 acres of viable crop land for a minimum of 10 weeks
- Land is/was an important habitat for many species of wildlife which were displaced/died due to flooding

The Farmer:

- Remained fully aware of the likely impact of any rainstorm by regularly accessing the Met Office Weather Forecasts and checking on the Rivers Agency Flood Maps and Flood Warning messages
- Provided agricultural vehicle transport assistance for 6 vehicles and for local children to get to school as roads and lanes were unpassable for 3 weeks
- Was a third generation famer and had invested heavily and wisely into an efficiently run farm
- Estimated, without exact details given, that he incurred £30k in additional cost or loss of income, due to this demanding Winter Weather 2015-16 period
- Has grave concerns about the management and operation of the Toome Sluice Gates in their role of managing the Lough Neagh water levels; "even within the existing statutory Lough Level limits, the water levels could be managed better - levels are always towards the upper limit, unless there is significant spells of drought, and could be managed more towards the lower limits and more responsive to weather predictions" (Quote)
- Is concerned that current statutory lough levels are outdated and would like to see an independent review of statutory lough levels and management
- Continues to review the viability of farming in a Floodplain if there remains uncertainty on the Lough Levels and its capacity to receive more of the flood waters
- Recently had a farm incident in which it was essential to have urgent medical attention; he speculated that this could not have happened during 3 weeks of the Winter Flood!
- Recognises that the continuing trend of 'climate change impacts' and the probable impact on 'increased intensity and frequency of severe flash flooding' will only add to the stress on floodplain land and the possibility of farming it in a financially attractive manner
- Reviews the future, if any, of 'farming in a traditional manner'

C. Reviewer Comments

a. It was possible to corroborate most facts with other agencies, and find them to be accurate;
b. There was concern about this Farmer's appreciation of the dilemma of 'managing Lough Neagh water levels to meet the statutory requirements and the needs of other stakeholders', so it is not possible to agree with the comments on the Toome Sluice Operation provided by the Farmer;
c. The Farmer was a regular source of hands-on and local information to all government agencies - this is most valuable;
d. This case study demonstrates the frustration by floodplain farmers about the systems and processes in place to support them;
e. Could there be more Farming Community involvement through volunteering, contract work allocated for maintenance, or in giving advice?

The Reviewer fully acknowledged the willing co-operation of the Farmer and how he expressed his openness. The Reviewer wished the Farmer a full recovery in pursuit of retaining his farming legacy and returning to the operation of a successful farm.

ANNEX 3

Proposal to Develop an Integrated Catchment Wide Model (ICWM)

Background: Managing water flows from the top to bottom of river catchments helps to reduce flood risk, in many cases more cost-effectively than simply building flood defences in towns, villages or settlements. Early trials in the UK are encouraging for smaller river catchments: there is sufficient evidence to roll-out 'catchment scale' approaches for a far greater number of small river basins. Rivers Agency and other bodies need more evidence on how effective these measures might be at a larger scale.

This proposal is made on the desire to develop a tool or model which will take into consideration several elements of a catchment. Lessons from the Blue-Green Cities Research Project and River Restoration Centre can assist. The proposal is drafted into a set of research and development Objectives to include rationale, methodology, operational plan, potential users and benefits, as follows:

1. **ICWM Aim**: To develop a generic mathematical model which will allow a holistic appraisal of the performance and interaction of several elements of a catchment, with the intention of transferring this ICWM approach to several other catchments while using the river course as the centre or subject of the model.

2. **ICWM Objectives**. The model will plan to:
    a. Select a modest sized catchment which has a range of users and stakeholders;
    b. Investigate and describe the range of users and their driving legislation;
    c. Interrogate the possible inter-action and impacts between these users;
    d. Construct a mathematical model which reflects the range of users and their inter-action;
    e. Calibrate the ICWM model using live data from the catchment;
    f. Evaluate the possible impact of new or additional users in that catchment;
    g. Consolidate the ICWM Model so that it can be transferred to evaluate the performance of other catchments.

3. **ICWM Approach** and model is based on:

   a. Concepts of Sustainable Development, employing environmental enhancement, social engagement and economic stability in equal measure;

   b. Principles of 'Natural Flood Management', using a range of techniques or interventions such as sustainable drainage, water storage, Low-level bunds, tree planting or re-forestation, restoration of woody debris dams in streams or tributaries, wetlands restoration, biodiversity and landscape enhancement, etc.

   c. Desire to understand water quantity (flooding) issues alongside water quality profiles, land use planning, biodiversity value and measures, business and recreation demands, fisheries development, water storage initiatives, renewable energy exploitation, health and wellbeing concerns, response to climatic variations, soil conditioning, environmental impacts;

   d. Attention to key drivers such as Water Framework Directive, Rivers Classification, Habitats Directive, Planning Laws and Planning Policy Statements, Community Planning, Historic and Listed Buildings;

   e. Need to develop a deeper understanding of catchment performance and rhythm, seasonally and into the future;

   f. Appreciation that the ICWM model will allow a range of investigations which have previously been done on a 'single theme approach';

   g. Inter-departmental and cross-discipline thinking.

4. **ICWM Operational Plan** must negotiate and sustain the following engagement:

   a. Lead Government Department to scope out the ICWM supply and negotiate/obtain funding for ICWM; DfI is the preferred department;

   b. Establish a ICWM Management Team/Board to direct the initial scoping description and to oversee the development; membership needs to reflect the breadth of catchment users and have experience of applying legislative drivers and working on inter-disciplinary projects; appropriate reporting mechanisms are essential;

   c. Consider the use of 'The Harmonise Handbook' (The Harmonise Consortia) Educational Tool as a framework through which the range of variables can be

examined – based on HARMONISE (A Holistic Approach to Resilience and Systematic Actions to Make Large Scale Built Infrastructure Secure), a project funded from EU's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 312013; visit www.harmonise.eu;

d. Procure a service provider who can work to 'time and budget, with expertise/experience in modelling as well as an appreciation across the natural and built environment nexus; the concept of 'model design and build' should be applied;

e. Set targets for delivery to ensure that the ICWM can be applied in the operation and development of other catchments;

f. Ensure that the ICWM Model has a maintenance service agreement built in.

5. ICWM Timeframe

It is expected that the following draft timeframe can be applied:

DATE	ACTIVITY	PROVIDER	KEY PERFORMANCE INDICATOR
January 2017	Minister(s) and Department(s) scope out or agree ICWM Descriptor	Departmental staff + Key ICWM Lead	Get buy in from Executive
February 2017	Minister appoint a 5-7 person ICWM Board (balanced, public and private)	ICWM Lead and Minister secure members by invitation; reflect agencies and users	Establish a coherent and cross-disciplinary team
March 2017	Minister aligns ICWM with PfG Output(s) and secures Budget	Minster + ICWM Lead + Executive	Rationale established and cross-departmental engagement
June 2017	Procure services of ICWM Development Consultant	Departmental staff, ICWM Lead and CPD	Attract interest from international practitioners and secure 'value for money' and expert service provider
December 2017	ICWM Consultant reports on a 2-monthly basis, with 1st Model iteration designed	ICWM Consultant	Progress targets agreed and delivered
March 2018	ICWM Model calibrated and iterations displayed	ICWM Consultant	Progress targets agreed and delivered

DATE	ACTIVITY	PROVIDER	KEY PERFORMANCE INDICATOR
June 2018	ICWM Model consolidated and applied to a 2nd catchment	ICWM Consultant	Progress targets agreed and delivered ICWM Evaluation by independent assessor
September 2018	ICWM Model fully operational in suitable media with 'User's Manual 'and 5 (min) Departmental staff trained	ICWM Consultant ICWM Board sign off on evaluation	Progress targets agreed and delivered Application of ICWM model to other situations

ANNEX 4

EMERGENCY PLANNING PROTOCOLS and PROCEDURES

A. FLOOD RESPONSIBILITIES MATRIX – RESPONSE (as defined by DARD in Winter 2015/16)

CORE FUNCTIONS	**5. REVIEW** **This involves facilitation of a multi-agency review of the collective response (may link with review of the recovery).**	Local Government or PSNI (depending on which organisation co-ordinated the response). Supported by Lead Department	Lead Department Supported by PSNI / Local Government.	NICCMA (CCG(NI)) Chaired by OFMDFM and supported by Lead Government Department(s) and other key responders.
	4. CO-ORDINATION RESPONSE (where duration of response phase permits) **This involves co-ordination of the response to an emergency which has occurred or is anticipated. It does not include recovery or restoration of normality.**	Local Government OR PSNI (where there is a perceived major and imminent threat to life).	DARD/ Rivers Agency (Strategic Co-ordination) Default in the first instance with transfer to DRD as appropriate. Local Level Co-ordination continues in support of the strategic layer above	NICCMA (CCG(NI)) (Strategic Co-ordination) Chaired by OFMDFM and supported by Lead Government Department(s) and other key responders. Local Level Co-ordination continues in support of the strategic layer above
	3. PROVISION OF EXPERTISE **This is to inform the management of the response.**	DARD /Rivers Agency Default in the first instance with transfer to DRD as appropriate.	DARD /Rivers Agency Default in the first instance with transfer to DRD as appropriate.	DARD / Rivers Agency Default in the first instance with transfer to DRD as appropriate.
	2. COMMUNICATION **Co-ordination of communication prior to and during an emergency.**	DARD /Rivers Agency Default in the first instance with transfer to DRD as appropriate. Supported by PSNI / Local Government / NIFRS	DARD /Rivers Agency Default in the first instance with transfer to DRD as appropriate. Supported by PSNI / Local Government/ NIFRS	NICCMA (CCG(NI)) Chaired by OFMDFM and supported by Lead Government Department(s) and other key responders.

	1. PREPARATION **This involves facilitating ongoing multi-agency planning to prepare for emergencies.**	DARD /Rivers Agency Supported as necessary by other key responders.	DARD /Rivers Agency Supported as necessary by other key responders.	DARD /Rivers Agency Supported as necessary by other key responders.
		Local	**Level 1 Significant**	**Level 2 Serious / Level 3 Catastrophic**
		LEVELS OF EMERGENCY		

B. DARD / RIVERS AGENCY LEAD GOVERNMENT DEPARTMENT ROLES AND RESPONSIBILITIES

ROLE	RIVERS AGENCY	DARD
Preparing for Flooding	• Develop LGD arrangements • Develop, review and communicate Flood Emergency Plans. • Facilitate multi-agency planning to prepare for emergencies. • Test Plans through exercises or live events.	• Develop, review and communicate DARD Major Emergency Response Plan (MERP). • Test MERP and the interaction with RA and other organisations in relation to LGD responsibility for emergencies. • Admin support for location arrangements for LGD coordinating roles.
When Flooding Is Forecast	• Liaise with the Met Office on weather and UKCMF on tide forecasts. • Provide flood information and expertise to co-responders (Annex C). • Notify DARD Core, to facilitate LGD/MERP shadow mode • Initiate Media engagement using LTT (Annex C). • Contact Community RCRG Leads.	• Use Rivers Agency Reports to anticipate events (and their likely scale) as far as possible to provide triggers for the right levels of preparedness in NICS. • Initiate communications across NICS, including press offices as necessary, liaising with RA on issuing LTT • Initiate preparation of situation reports (Sit-Reps). • Assess with Rivers Agency, level of admin and IT support necessary.
When Flooding Happens	• Provide support to Gold, Silver and Bronze commands. • Provide flood information and expertise to co-responders (Annex C). • Provide situation reports (Sit-Reps) and other briefings to DARD and OGDs. • Liaise with RCRG leads. • Support Ministerial visits. • Work with CCPB and Local Government in escalating or de-escalating the central Government response. • Work closely with DARD Core in fulfilling	• Collate Rivers Agency and other organisations (see list at Annex D) Sit-Reps into CRIP summaries. • Distribute these CRIP reports at agreed intervals to those identified at Annex E • Advise DARD Senior Management, Ministers, CCPB and other Government Departments / agencies on the developing scale of events. • Ensure effective communications with NICS, using LTT Annex C for media engagement, and updating NIDirect

ROLE	RIVERS AGENCY	DARD
	LGD function.	website • Engage with either regional Local Government or PSNI Co-ordination of the event to deal with regional, strategic or political decisions needed to aid response. • Facilitate Ministerial and other VIP visits to the affected areas. • Ensure that clear responsibilities established and team in place to oversee Recovery phase.
When Flooding Subsides	• Support follow-up Ministerial visits. • Media engagement as appropriate.	• Advice on follow-up Ministerial/VIP visits.
Post-Flood Review	• Where DARD Rivers Agency is LGD in the response to a level 1 event facilitate multi-agency review of collective response to the emergency. • Take forward identified 'lessons learned' and follow-up action.	• Provide support and secretariat to Rivers Agency in reviewing the response. • Ensure arrangements are in place to identify any 'lessons learned' and monitor implementation process through Action Plans.

C. DARD/Rivers Agency, in their Lead Government Department responsibility role for certain Core Functions, has delivered 'Lines to Take' (LTT) for each stage in any flooding emergency:

LTT - PREPARATION

- Rivers Agency's preparedness remains consistent throughout the year as heavy rainfall events can occur at any time, winter or summer, indeed over the past few years the greatest impacts have occurred during the summer months.
- Rivers Agency staff will be placed on-call in anticipation of the need for any potential response to flooding throughout the [e.g. winter / summer/week-end] period.
- As we face the winter, there's always an increased risk of adverse weather, which could lead to flooding conditions.
- Rivers Agency constantly monitors any potential adverse weather conditions, particularly in relation to flooding, throughout the winter / summer period. We have an agreement with the Met Office to provide a broad assessment of ground conditions and river levels which will enable the Met Office to assess the potential impacts of any heavy rainfall warning.

- Maintenance of inlet grilles to culverts will continue as necessary in order to reduce the potential impacts of flooding. We would ask the public not to dump material into watercourses which may be drawn down to trash grilles during heavy rain, leading to increased flood risk.
- Rivers Agency is in close contact with colleagues in the Met Office and UKCMF (UK Coastal Monitoring and Forecasting) in relation to monitoring the current potential coastal surge situation. The Agency will work with co-emergency responders to inform an appropriate response.
- Rivers Agency's flooding emergency duty officer and flooding officer rotas will continue to operate to facilitate an out-of-hours response to flooding related incidents.

LTT COMMUNICATION

- As Lead Government Department for flooding, DARD/Rivers Agency meets regularly with other departments, local councils and agencies who also respond to flooding, in planning and preparing for flooding emergencies.
- Best Practice Guidelines exist among the 3 Flood Responding Agencies (FRAs) and NI Fire and Rescue Service and these provide clear roles and responsibilities with those organisations.
- As part of any wider Government response to severe weather, Rivers Agency will actively participate in local and regional discussions. This will help us and others to assess what actions are needed by way of response to this flooding.
- The drainage agencies will do their utmost to minimise the impact of flooding, but it is important to remember that on occasions, intense heavy rainfall can overwhelm drainage systems.
- Rivers Agency has strong links with the Met Office and the UK Coastal Monitoring Forecasting Service (UKCMF) and has agreed processes in place for preparing for and dealing with flooding emergencies.
- Anyone wanting to report a flooding emergency should contact the Flooding Incident Line on 0300 2000 100.

LTT PROVISION OF EXPERTISE

- Rivers Agency is the statutory drainage authority for Northern Ireland and the Competent Authority for the implementation of the EU Floods Directive. This provides the legislative basis for the Agency's flood risk management role. In light of this the Agency is recognised as having appropriate expertise in managing flood risk and mitigating the effects of flooding.
- Because of the significant risk to life, PSNI is leading the coordination of the response to recent major flooding but Rivers Agency is providing the technical expertise to determine which areas may be worst affected.
- It is very simplistic to suggest that now that all drainage agencies are located within one department that it would solve all flooding problems.
- The fact remains that extreme rainfall, as witnessed in recent days, will overwhelm infrastructure and that is the reality of the situation. Since the PEDU report was published in 2012, DARD has been at the forefront of leading initiatives such as developing systems of flood warning and informing and a programme of community engagement and these have been well received. In taking forward this very important work, the Department has received whole-hearted support from a range of partners including DRD, Local Government, the Emergency Services and Voluntary Sector groups.
- Since the publication of the PEDU report, there has been clear evidence of improved levels of co-operation and collaboration between Rivers Agency and other partners. This has been reflected, not only in the development of solutions to flooding problems in vulnerable areas, but also in ongoing work in relation to community engagement, emergency planning and the development of the Flooding Incident Line (0300 2000 100).

LTT RESPONSE CO-ORDINATION

- Rivers Agency is leading the response to this major flooding emergency because it is mainly river-related and because [for example the Agency's river defences were overwhelmed during the peak of the flood].
- Coordination of response to recent flooding has been passed over to DRD because the incidents relate mainly to surface water drainage systems which belong to TransportNI.

- Rivers Agency staff responded to a major burst water main, but coordination of the emergency response has been handed over to NI Water which is the agency responsible.
- We maintain very close links with Met Office colleagues throughout the year and obviously that level of engagement is stepped up at times like this when there is the likelihood of flooding as a result of heavy downpours/prolonged heavy rainfall.
- Government agencies have been preparing for this event for some time. Preparations have included**:**
    - Clearing gullies and grilles;
    - Putting staff on stand-by;
    - Arranging for sandbags to be made available to people most likely to be at risk;
    - Engaging with communities at known flood risk; and
    - Providing expertise to other co-emergency responders, to allow appropriate forward deployment of resources.
- In addition we continue to engage closely with the Met Office and we are monitoring the situation very closely.
- The response agencies are aware of the distress suffered by the people who were affected by flooding. The sheer amount and persistence of the rain overwhelmed drainage systems. Our first priority has been to respond to those who need assistance. After that we need to examine what viable and practical steps could be taken to reduce the risk of flooding in this area in the future.

LTT SUDDEN HEAVY DOWNPOUR

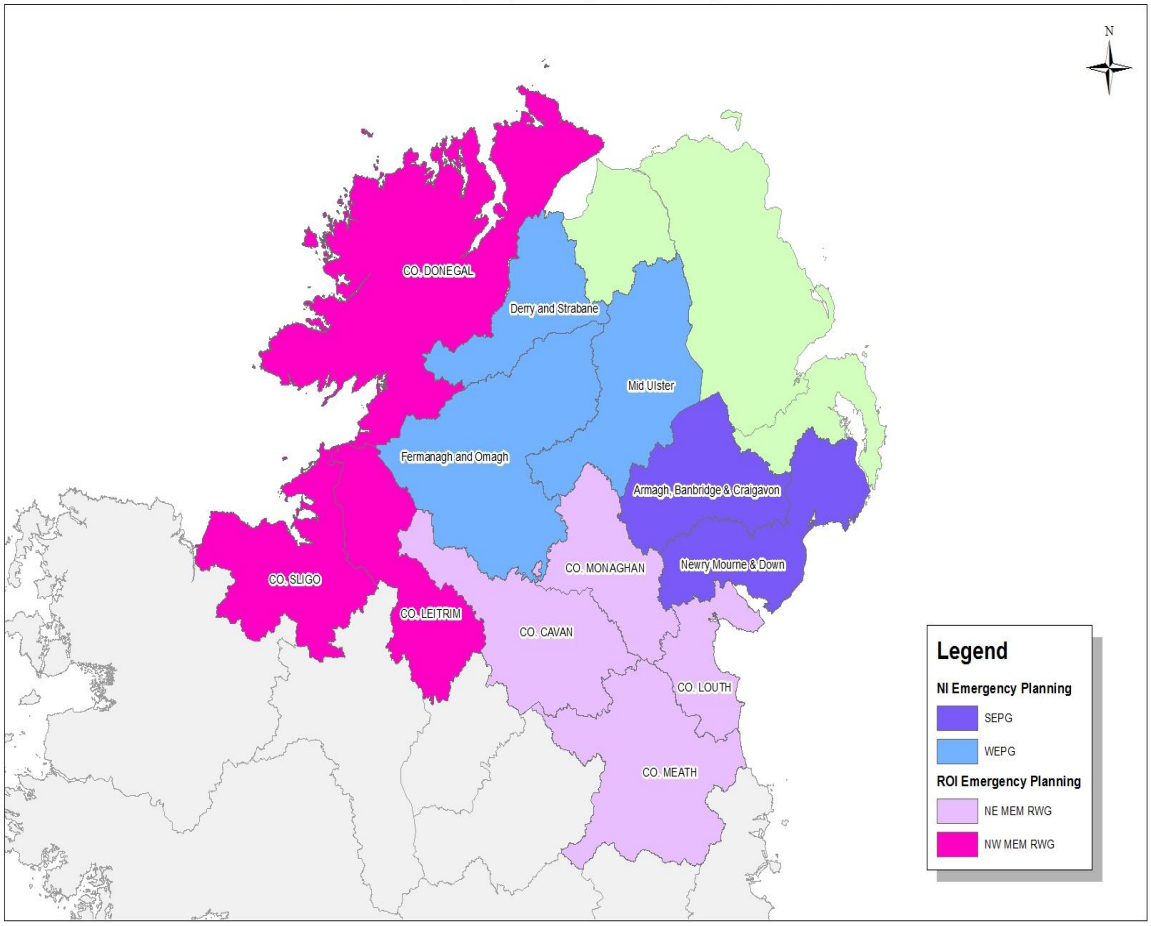
- The drainage agencies have staff out on the ground who are working very hard to help those whose homes have been flooded. Our priority at this stage is to try and establish the cause of the flooding and make sure that whatever assistance we can provide is made available as quickly as possible.

LTT REVIEW

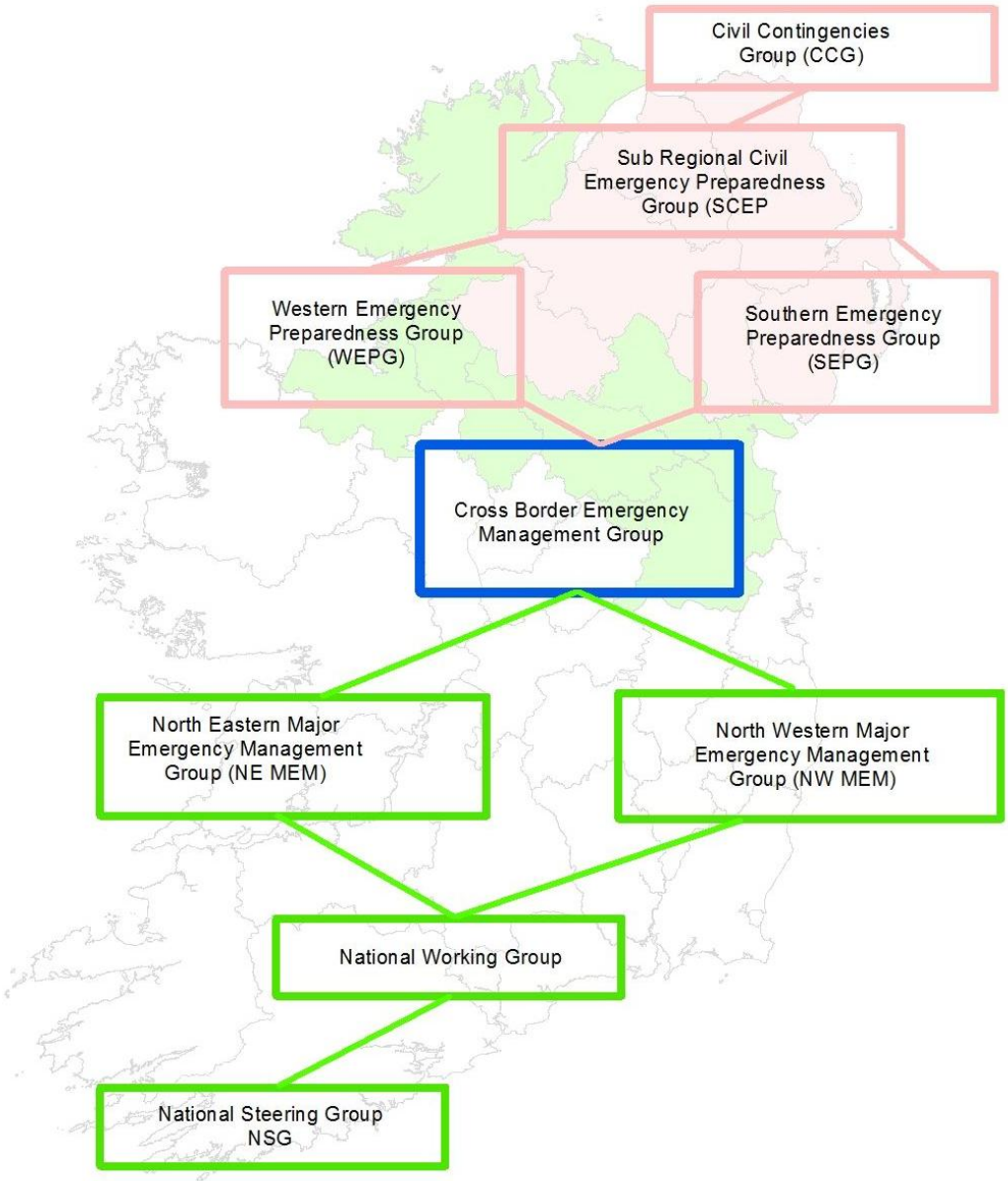
- Along with the other flood response agencies, Rivers Agency is currently reviewing the recent flooding and will determine what actions will be necessary to reduce future flood risk and which organisations will take these measures forward.
- Rivers Agency and its co-emergency responders have commenced a multi-agency review of recent major flooding. This will include an assessment of the extent of flooding, properties affected and the preparedness and performance of the respective agencies and the Flooding Incident Line.
- Rivers Agency will be recommending that an independent review into the recent serious flooding is carried out in order to determine whether improved response would mitigate the flood risk or whether infrastructure upgrading is required.
- A key message here is that Government cannot prevent all flooding. For example when we experience the type of sudden, heavy rainfall that we saw here in June 2012, there will be flooding. This is because the sheer intensity of the rainfall will exceed the design capacity of drainage infrastructure – in other words, the drainage systems are not designed to cope with that volume of water in a short space of time.
- All departments are facing budget pressures. We continue to use our allocations to provide the maximum benefit in terms of managing flood risk.
- If Pressed – Obviously we look to improve our efficiency and rationalise our approach in terms of managing the budget pressure, however, with less money the scope to undertake the same level of maintenance will prove difficult.

D. Cross Border Emergency Management Group (CBEMG)

Cross Border Emergency Management Group Boundaries



Appendix 2: Governance Arrangements for Cross Border Emergency Managment Group



ANNEX 5

Proposal for a Model 'Farming Resilience Group (FRG)'

The concept of Community Resilience Groups (CRG) has been established internationally and has been applied to good effect across Northern Ireland with the potential for forty five groups to be fully mobilised.

A. Background

There is a plethora of advice and legislation built around the Community Resilience Networks or Groups, grounded in the Northern Ireland Civil Contingencies Framework.

The key drivers are associated with:

- Guide to Emergency Planning Arrangements in Northern Ireland
- Guide to Risk Assessment in Northern Ireland
- Guide to Plan Preparation
- Guide to Evacuation in Northern Ireland
- Northern Ireland Standards in Civil Protection (2001)

In addition, access to the following is important:

- UK Emergency Response Planning
- Police Service of Northern Ireland (PSNI)
- NI Ambulance Service
- NI Fire and Rescue Service
- Maritime and Coastguard Agency
- Met Office Severe Weather
- Public Health Agency for Northern Ireland
- Northern Ireland Environment Agency (NIEA)

Rivers Agency, along with the Emergency Preparedness Co-ordinators, through the Regional Community Resilience Group, has developed a strong and effective network of Community Groups.

B. Development of Farming Resilience Groups (FRG)

The advent of CRGs has proved beneficial in the time of emergencies, especially during extreme flooding; however the rural and often widely spread out farming communities do not benefit tangibly from the work of CRGs.

It is proposed to develop a model Farming Resilience Group as a pilot for a possible enlargement of this new FRG concept.

The FRG will be based on the CRG model, and may have similar structures.

In addition it is recognised that the FRG could bring further assistance and maturity to each farming community, in times of emergency, as it seeks to:

- Work closely with all the statutory and support agencies and organisations
- Provide a source of mutual help
- Co-ordinate local rural activity
- Facilitate joint use of Machinery and Equipment, such as Pumps, Hoses, and Generators
- Use principles of Symbiosis, in the sharing of different resources
- Help with organising re-skilling and up-skilling of the farming community
- Be an essential vehicle and conduit for emergency communications
- Provide and/or manage common use of Animal and Resource storage
- Be a means or tracking system of identifying those in 'extreme stress'
- Identify need for and ways of providing family and educational support
- Evaluate the potential for a 'Co-operative Organisation' approach
- Share transport
- Be a link for Agriculture and Farming to Councils and Councillors
- Consider being a means of obtaining funding and education
- Develop improvement for communication with EPC's
- Provide or secure genuine emergency assistance e.g. pregnancy help, care help, link with NIFRS etc.

C. Way ahead

This concept of FRG's need to find a home; under 'The General Power of Competence Empowering councils to make a difference' and the new Community Planning function within the new Local councils, it is pertinent that the following authorities make an initial evaluation with the view to establishing a Pilot FRG:

- Agriculture Industry, in lead role
- SOLACE, to represent the 11No. District councils
- DAERA to represent the agriculture brief
- DfI to represent Rivers and Roads
- UFU to represent the Farmers
- An independent chair to seek progress and secure funding.