

CABINET OFFICE OF THE ISLE OF MAN

Laxey Flood of 1 October 2019 Independent Review

Final Report



ARUP



Executive Summary

INTRODUCTION

On behalf of the Chief Minister (Howard Quayle MHK), Arup was commissioned by the Isle of Man Government Cabinet Office to undertake an independent external review, into the flooding event that occurred in the village of Laxey on the 1st October 2019.

Arup has made 10 recommendations which if implemented should reduce the risk, and improve a return to normality if and when future storms on the Isle of Man are experienced.

Arup had independence of action and access to a wealth of information held by the Isle of Man Government and its agencies, as well as information gained first hand by research and the engagement of stakeholders. The Arup expert leading the commission was David Wilkes, Arup Global Flood Resilience Leader.

Arup is grateful to many members of the public who met with the team and who wrote sharing their experiences, to Members of the House of Keys, to the Garff Commissioners, and to members of staff from the Cabinet Office, Manx Utilities Authority (MUA), Department for Environment, Food and Agriculture (DEFA) and Department of Infrastructure (DoI) all of whom who gave their full cooperation to assist the review.

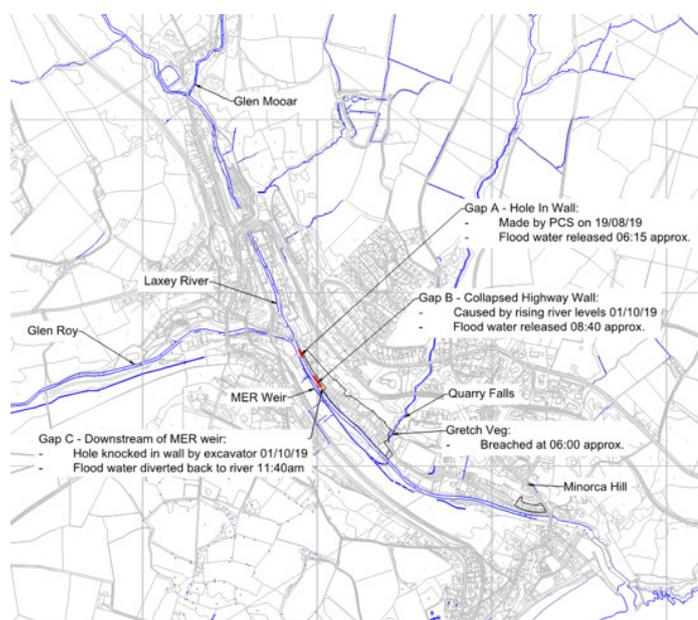


Figure 1 - Map of the centre of Laxey, with labels outlining the events of the 1st October 2019 Flooding.

Sequence of events

During the evening of the 30th of September and early morning of the 1 October 2019, the Laxey catchment experienced heavy rainfall with over 100mm recorded in the preceding 24 hours.

In the aftermath of this rainstorm severe flooding of the village of Laxey caused significant disruption to life and substantial damage to at least 62 private and commercial properties.

Several flood mechanisms were at work during this event, triggered by many contributing factors (all timings are approximate). A location plan is included as Figure 1.

Chronologically the first flooding was at 06:00 from Gretch Veg, the stream flowing from Quarry Falls. Potential debris blockages have been attributed to the occurrence of this localised flooding, which affected several nearby properties.

At 06:15 flooding began to occur further up Glen Road when levels in the River Laxey reached road level and started to spill out of a gap in the wall adjacent to the Laxey Woollen Mills. We have termed this gap or hole in the wall as Gap A. This gap was formed in August 2019 as a means of temporary access into the river for the structural works that were being undertaken at the nearby weir. It does not seem that any temporary barrier or other means of protection was in place to prevent escape of water once the level of the road was reached. A mechanical excavator used as part of the weir repair works was present in the river channel on a small newly formed ramp, adjacent to Gap A, and this disturbance to the river flow increased water levels locally and increased the amount of flow through Gap A.

During the storm, large amounts of woody debris from felled trees washed off the hillsides and down into the swollen river channels. In turn this large woody debris caught on the superstructure of the Manx Electric Railway (MER) weir. This restriction to flow (estimated at some 50 cubic metres in size) caused river levels in the Laxey to rise rapidly.

At 08:40, the river levels reached such a height that a 20m section of wall upstream of the MER weir collapsed under the pressure of water, releasing a further 'flood-wave' into the Glen Road (Gap B). This flooding mechanism caused most of the severe flood impacts on 1 October 2019, as supported by our own assessment and confirmed by hydraulic modelling undertaken by JBA (1). At 11:40 a section of wall downstream of the MER was demolished to allow flood waters to be diverted from Glen Road back into the river (Gap C).

Several other properties in Laxey flooded from local heavy rainfall surcharging drainage systems due to a lack of capacity in underground drainage systems, and not from water escaping from the watercourses. This is often called surface water or pluvial flooding. Most significant surface water flows were noted in association with the Minorca Hill catchment, where major flows diverted into the car park behind the Mona Lisa restaurant and flooded several properties in the area. These were both commercial and residential properties.

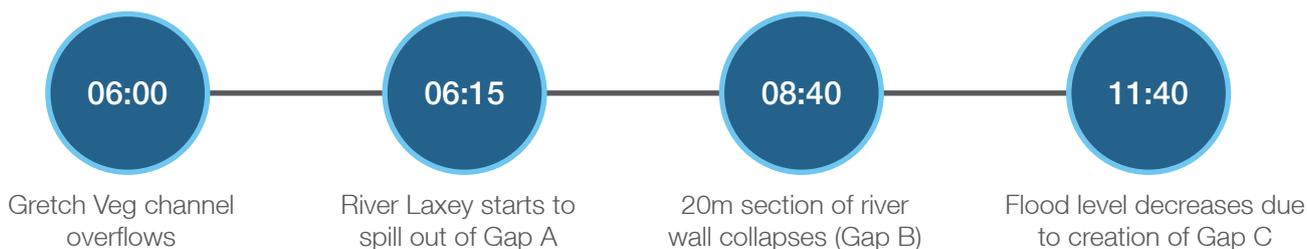


Figure 2 - Timeline of major events of 1 October 2019 event.

Recommendations

The following 10 recommendations are based on our assessment of what happened in Laxey on 1 October 2019, from studies of the evidence which was shared with us, plus our own UK and international experiences.

We recommend that:

1. Greater priority is given to preparing to deal with flood risks and flood resilience on the Isle of Man.
2. The governance of flood risk management across the Island should be reviewed.
3. The current provision of resource for flood risk management is reviewed.
4. Greater urgency is given to delivering the National Strategy on Sea Defences, Flooding and Coastal Erosion 2016.
5. An investigation by the Treasury of continuing access to and affordability of Flood Insurance should be resolved.
6. The consents process outlined in the Flood Risk Management Act 2013 should be implemented for all works on designated watercourses.
7. Management of blockage and debris risks in high risk catchments is improved
8. Greater attention and more urgency is given to existing plans to deal with surface water flooding.
9. Review and improve practices of flood forecasting and warning.
10. Recognising the impact that flooding can have on well-being, open a dialogue with the National Flood Forum to explore whether their services can be extended to the Isle of Man.

The rationale behind these recommendations follows.

Recommendation 1

Greater priority is given to preparing to deal with flood risks and flood resilience

Increasing flood resilience and minimising the impacts of flooding on people and the economy, should be given greater priority and urgency on the Isle of Man agenda. The points below highlight why this is pertinent:

Climate change around the world is increasing the frequency and intensity of storms (flooding from the sea created by rising water levels, tidal surges, wind and waves, or from heavy rainfall to rivers, streams and overflowing drainage systems). The Isle of Man is no exception to these global trends.

Previous flood mapping exercises have shown that over 4,000 properties are potentially vulnerable to flooding (2). At least 10% of the Manx population is potentially at direct risk of flooding and a significantly larger percentage could be indirectly affected.

Records show that there have been at least 27 floods affecting different communities on the Isle of Man since 2000. Direct flood risk damages are estimated to have cost communities well in excess of £28 million (3) (4) .

It is estimated that across the Isle of Man there could be potentially £900m of direct flood damages over the next 100 years. There are 180 critical Manx assets at risk of flooding including high flood vulnerability to 63 schools and GP surgeries, 32km of major roads and 6km of railway (1).

Land-use and location of properties on the Isle of Man tend to be clustered around the coast, along the rivers and at inlets to the sea. By comparison land-use is less intense around the areas of higher elevation and in the central area of the Island. The higher value land zones are more vulnerable to flooding.

There is an expectation of continued economic expansion and growth of the Isle of Man's population by almost 20% to 97,000 by 2050 (5). It will be important that there should be no new development in areas at unacceptable risk of flooding and this can be achieved if the January 2020 development guidance related to flood risk is operated and enforced (6).

The 2008 Pitt Review, Learning Lessons from the 2007 Floods, provides analysis of flood risk management in England and gives many useful pointers on priorities and considerations for the re-shaping of flood risk practices (7).

It is noted that much of the primary legislation and high-level guidance needed for good practice seems to be in place, such as the Flood Risk Management Act 2013, Watercourse Management in the Isle of Man guidance document and the Making a Planning Application – A Guide for Applicants published by DEFA in January 2020.

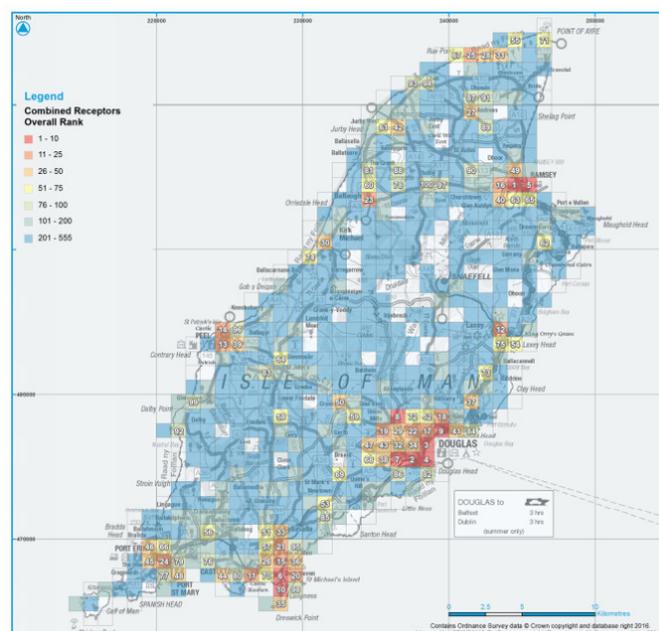


Figure 3 - Map showing cumulative risk hotspots across the Isle of Man (JBA Consulting, 2016)

RECOMMENDATION 1

We recommend greater priority is given to preparing to deal with flood risks and flood resilience

The Isle of Man Government should ensure that greater attention is given to the preparing for and dealing with flood risk than has occurred previously. Potential floods impact directly on over 10% of the Island's population, 4000 properties and have a forecast of £900m potential flood damages over the present century. The cumulative flood impacts will also change as the effects of climate change are realised and because of increases in population and economic development.

Recommendation 2

Review of IoM Governance of the management of flood resilience

We recommend that a review of the governance of flood resilience investment and activities is undertaken. The current statutory arrangements on the Isle of Man place the MUA as the lead department for dealing with heavy rainfall induced flooding under the Flood Risk Management Act 2013; and the Department for Environment Food and Agriculture, DEFA, as effectively the lead department for flooding from tides and the sea under the Coastline Management Act 2005. DEFA are also charged with Planning and Building Control under the Town and Country Planning Act 1999, and consistent with these responsibilities, to ensure that new land allocations and buildings avoid sites which are particularly vulnerable to flooding.

The Department for Infrastructure, DoI, also lead on matters of surface water flooding from highways, and owns much of the coastal flood protection infrastructure around ports and harbours and also provides Met Office weather forecasting services and emergency response capabilities. Staff from DoI also regularly provide Project Management services for public funded flood risk projects.

We question whether this division of leadership activities across these different government departments is consistent with good practice for dealing with the risks and priorities of flood risk in a fully integrated and public facing manner.

Effective management of flood resilience requires careful balancing of many, and often conflicting objectives. From experience we have seen this achieved by a statutory flood risk committee/board with members representing the relevant agencies of government, some representing stakeholders and some bringing specialist competencies to bear. We expect any committee would sit to advise, assist and scrutinise the relevant departments on the policies and plans for delivering good flood risk management practices across the Isle of Man.

The remit for such a committee could include:

Encouraging efficient, targeted and risk-based investment in flood protection and coastal erosion risk management which represents good value for money, benefits local communities and the economy and protects and enhances the natural environment.

Ensuring there are coherent mechanisms and plans in place to deliver and to maintain policy standards of flood risk and coastal erosion, including mitigating and adapting to climate change.

(We expect these mechanisms and plans to include capital works programmes, operational and maintenance consideration and enforcement of the relevant statute in respect of act or omission of others)

To act as a link across MUA, DoI, DEFA, the Commissioners and the Tynwald, and with the wider public to help build understanding of the needs to better manage flood risk and coastal erosion across these bodies and more widely.

RECOMMENDATION 2

We recommend that the governance of flood risk management across the Island should be reviewed.

This should include:

- appropriate exercise of supervisory duties under the Flood Risk Management Act 2013;
- the Duties and responsibilities for flood risk across MUA, DoI and DEFA;
- the consideration of a Committee/Board to help establish and monitor the effectiveness of flood risk management plans and practices whose members are recruited to reflect different interests and the aspiration of the population.

Recommendation 3

Review resourcing and critical mass of officer numbers

For much of 2019 the Flood Risk Management team was reduced to two fulltime members of staff. Some flood risk management activities are the responsibility of other staff but on a shared-time basis. Staff in the Department of Infrastructure, and Department for Environment Food and Agriculture also support flood risk activities as part of their wider job responsibilities.

The Isle of Man Flood Risk Management Act 2013 confers a power to exercise supervision of flood risk (from heavy rainfall events) to the MUA.

The annual operating expenditure budget allocated to the MUA team is currently £0.5m and we understand this has remained static for several years. This is spent mostly on contracted services and consultancy fees, suggesting that much of the intellectual understanding and knowledge about flood risk on the Isle of Man is provided and retained by commercial organisations.

We understand that the MUA flood risk team act as sponsors to capital flood protection projects and managed by officers at DoI; and as client for Planning and any Planning enforcement activities discharged by DEFA.

We recommend that the current provision of resourcing for flood risk management is reviewed. This would best be undertaken in parallel with any governance changes (in Recommendation 2 above):

It should include the adequacy of budgetary provision to meet the duties of the Flood Risk Management Act 2013 and other guidance notes and to promote good flood risk management practices.

It should also look at staff resourcing arrangements in terms of fragmentation across departments and the balance of knowledge and understanding which is currently held within commercial organisations.

Even recognising the relatively small size of the Isle of Man and the strong collaboration across public sector departments we cannot see clear lines of responsibility to others on how the provisions of the Flood Risk Management Act 2013 should be discharged.

RECOMMENDATION 3

We recommend that the current provision of resourcing for flood risk management is reviewed.

This would best be undertaken in parallel with any governance changes (in Recommendation 2 above):

- It should include the adequacy of budgetary provision to meet the duties of the Flood Risk Management Act 2013 and other guidance notes and to promote good flood risk management practices.
- It should also look at staff resourcing arrangements in terms of fragmentation across departments and the balance of knowledge and understanding which is currently held within commercial organisations.
- It should consider greater clarity of responsibility to all on how the provisions of the Flood Risk Management Act 2013 should be discharged.

Recommendation 4

Greater urgency in delivering the National Strategy on Sea Defences, Flooding and Coastal Erosion 2016

The National Strategy on Sea Defences, Flooding and Coastal Erosion was commissioned by the Department of Environment, Food and Agriculture.

It is pleasing to see that the strategy was developed under a steering group to represent and integrate the duties of MUA and DoI and that as part of this development, Government Ministers and other Members of the House of Keys were also engaged. The strategy was formally approved by Tynwald and released in July 2016, however due to the general election the Programme for Government was launched in January 2017.

Assessments provided in the strategy give strong scientific evidence on the cumulative risks and suggests where public expenditure should be focused to enable the best social and economic returns on investment.

The strategy highlights 23 Priority Action Areas across the Island. Laxey is ranked as the 5th action area and the strategy suggests that the main flood risk is due to fluvial/surface water sources and not tidal.

Given that the government has already set aside £50m for the first tranche of funding to deliver the strategy, we question why there are not more schemes and projects delivered or at an advanced stage than seems apparent to us from the notes of the Flood and Coast Action Group, FCAG.

We would like to point out that addressing the Action Areas highlighted in the strategy will not mitigate all flood risks. Activities such as inspection, maintenance, monitoring and enforcing acts or omissions of third parties (especially land-owners and developers) are all part of good flood risk management practice.

RECOMMENDATION 4

We recommend greater urgency in delivering the National Strategy on Sea Defences, Flooding and Coastal Erosion 2016.

- We recommend that more senior and high-level scrutiny is assigned to oversee delivery of the Strategy. Perhaps with the Flood and Coastal Action Group (FCAG) being the officer working group seeking consent for its progress and plans from the Committee/Board suggested in Recommendation 2.
- We recommend that the national strategy should be renewed and refreshed for appropriateness at timely intervals. At a frequency of no more than every 10 years would be wise for a substantial update, and perhaps with a lighter review once every 5 years. For example, the IPCC (International Panel on Climate Change) is regularly publishing new guidance with the next Assessment Report due in 2022 and similarly the strategy needs to consider changes in climate impacts and accord with the social and economic needs of the Island.

Recommendation 5

An investigation of continuing access to and affordability of Flood Insurance

We understand, and are not surprised to hear, that some of the 62 owners of properties flooded in Laxey have already been refused flood insurance cover or have been quoted unaffordable premiums and/or excesses in the light of flood risk.

This adds to the emotional stress of people who are attempting to recover from the trauma of flooding.

Also, the absence of flood insurance cover puts a blight on properties making them difficult to sell, or significantly influences the property value which in turn restricts owner's ability to move (or as at least two residents told us leave something of value from their life's work when they die).

Of course, with 4,000 residential properties at risk of flooding on the Isle of Man it is likely that the owners and occupiers of these properties across the island will also experience difficulty obtaining flood insurance at some point.



Photograph 1 - Flooded property of Laxey Resident on 1 October 2019

RECOMMENDATION 5

We recommend that the Treasury of the Isle of Man investigates the continuing access to and affordability of Flood Insurance.

We are pleased to hear that the IoM Government is actively exploring an extension of the Association of British Insurers Flood-Re arrangements to properties on the Island. If agreed the Flood-Re scheme should enable property owners and tenants to secure continuing flood insurance cover at reasonably commercial rates for the vast majority of properties.

Flood-Re operates as a re-insurance scheme for conventional household properties and becomes viable by government subsidy and a regulatory compliant small “tax” on all household premiums.

Recommendation 6

The consents process outlined in the Flood Risk Management Act 2013 should be implemented for all works on designated watercourses

Section 18 of the Flood Risk Management Act 2013 (8) says “A person must not unlawfully interfere with designated Flood Risk Management works or a designated watercourse... a person unlawfully interferes... if it does any of the following without the Authority’s written consent (a “works consent”).

It is our interpretation that Section 18 will apply, for both

- a) the permanent works, that is the situation when any changes are complete and the design intent is achieved.
- b) during construction phases when transitional restrictions to watercourse flow or removal of flood protection features may be required for practicable reasons.

Further it is also our interpretation that the intention of Section 18 is to ensure that any potential increase in flood risk is properly considered by the Authority and that decisions made are recorded in writing and with the explicit consent of the Authority.

Section 20 describes the process and guides on the style of “Applying for and obtaining works consent”, and an application form, FRM20 is available to download from the MUA web site (8).

Somewhat curiously Section 20 (1) seems to give discretion in that it uses the word may rather than must “...*apply to the Authority for a works consent.*”

From discussion with officers at MUA and DoI we understand it is normal practice, and because they are acting on behalf of government, to omit preparing the written documentation on applying for works consent but that any potential increase in flood risk is duly considered. In explaining their practice on this they refer to the discretion allowed by Section 20.

We have examined the practices and documentary evidence for managing Health and Safety risks associated with MUA works opposite Laxey Woollen Mills and also the DoI works to repair the road and riverside wall after the October 2019 flood. These follow a process we would expect to see, however there is an absence to cross referencing a similar process for works consent under Section 18 of the Flood Risk Management Act 2013.

RECOMMENDATION 6

We recommend that Section 18 of the Flood Risk Management Act 2013 should apply to all parties, including agents of government.

We recommend that decisions taken about minimising flood risk and the justification for them should be written down in line with the FRM20 form and the processes described in Section 20.

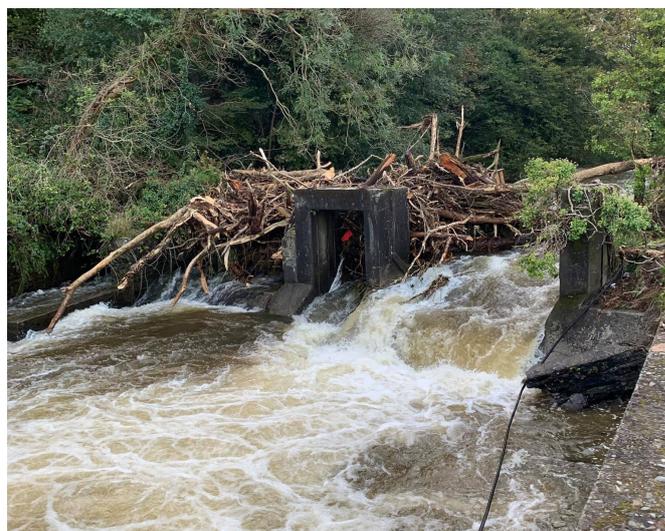
Further that the MUA should operate with independence to ensure that these provisions of the Act are upheld and if necessary that enforcement action can be taken.

Recommendation 7

Management of blockage and debris risks in high risk catchments is improved

An estimated 50 tons of woody debris, comprising felled tree trunks and limbs of trees, mostly from Laxey Glen on the Glen Roy River was washed into the watercourse and flowed into the Laxey river where it caught and snagged on the superstructure of the MER weir. This caused a major restriction to the combined flood flows of the Laxey River and the Glen Roy, and water levels rose very quickly. In turn the rising flood levels resulted in hydrostatic force on the riverside wall such that a structural failure of the wall over a 20m length occurred. This sudden collapse of the wall resulted in a sudden rush of floodwater onto Glen Road and into properties lying close to the road. It is our assessment and supported by the modelling of this storm undertaken by JBA (1), that it was this particular chain of events that is the reason for the largest proportion of flood impacts experienced on 1 October 2019. We note that reports of the flooding and collapse of the Laxey Harbour Bridge in December 2015 also refer to trapped flood borne debris associated with this event.

A Blockage Management Guide was published by the Environment Agency in November 2019 (11), ironically just a few weeks after the October 2019 Laxey flood. This outlines good practice for dealing with the risks of blockage management and justifying the relative priority of actions.



Photograph 2 - Accumulation of debris behind the MER weir on the 1 October 2019

RECOMMENDATION 7

We recommend that closer attention is given to addressing the risks of potential debris blockage to vulnerable zones across the Isle of Man.

The Environment Agency Blockage Management Guide, published in November 2019, describes what we consider to be good flood risk management practice.

In summary we recommend:

- Identifying all the glens and river valleys where there is a potential for debris blockages to trigger significant flood impacts.
- Identify and resolve specific features of the watercourse system in these zones to reduce the risks of snagging and catching significant volumes of woody debris.
- Establishing a regular routine of inspecting and dealing with potential causes of flood blockage.
- That a sense of balance and proportionality in approach is achieved which minimises the risk of future flooding but also does not destroy the natural beauty and ecology of the glens.

Recommendation 8

Greater attention and more urgency is given to existing plans to deal with surface water flooding

Section 4 of the Flood Risk Management Act 2013 defines surface run-off and the capacity of sewers being exceeded as some of the potential causes of flooding and it is the MUA who have the powers to take any actions they deem necessary under the Act.

The evidence we have seen suggests that most of the surface water flooding during the October 2019 flood and other events previously has been conveyed by the road network and onto people's land and properties.

It is DoI who generally have responsibility to commission drainage works on the public highways on the Island.

We were pleased to learn and see that, for instance, that modelling of the surface water catchment feeding onto Minorca Hill has recently been completed and indeed that the modelling replicates the surface water flow paths seen during the October 2019 event; and further that DoI now intends to implement measures within this surface water catchment to reduce potential flood impacts to people and property.

We also understand that surface water flooding from non-road pathways has caused serious impacts on people's property and lives and it is MUA who have a supervisory duty under the act to consider whether any further action is necessary.

Just to underline the impact of this surface water flooding, information shared with us by the public suggests that the impact and cost of the flooding is such that they can no longer secure flood insurance cover or further surface water flood damages is threatening the sustainability of their businesses.

Case law offers some assistance in guiding when surface water flooding works should be undertaken. It suggests that where flooding is foreseeable and with consequential risks to people and property then there is an expectation that the risk of flooding should be reduced unless the scale of the work involved would be unreasonable and disproportionate to the risk, or the person or body who may be expected to take action can do so in a reasonably practicable manner and has the resources available.

RECOMMENDATION 8

We recommend closer attention is given to instances of surface water flooding on people and property, and that the MUA should exercise their supervisory duties under the FRM Act in 2013 this respect.

MUA should encourage DoI and other organisations and landowners to take actions which the authority deems reasonable and proportionate.

Recommendation 9

Review and improve practices of flood forecasting and warning

Due to the rapid response characteristic of watercourses on the Isle of Man to rainfall, flood warnings based on observed rainfall are of limited value due to short lead times.

More emphasis should be put on the forecast of rainfall which could result in either surface water or fluvial flooding. The following suggestions are made to support the future forecasts:

An assessment of the depths and durations of rainfall for surface water and/or fluvial flood risk for the Isle of Man is undertaken based on historical or design modelled events. This is to produce high-level regional or catchment-based rainfall depth-duration thresholds to be used in conjunction with forecasts.

We recommend that a quantitative review of the rainfall forecast performance over the Isle of Man is undertaken by the UK Met Office and the Ronaldsway Met Office on the 'deterministic data feeds' which are used currently, UKV being the priority for assessment. This is to understand the nature of a general trend for over-estimation of rainfall forecast reported by the Ronaldsway Met Office. In contrast to this more general trend the deterministic feed on 1 October event under-estimated the rainfall depth observed.

As current forecast feeds into Ronaldsway are predominantly 'deterministic based', we recommend that a review of the performance of the 'UK Met Office's ensemble forecast prediction system, MOGREPS-UK', is also undertaken.

This could be adopted as an additional operational feed to enable Ronaldsway forecasters to better assess the likelihood of a significant rainfall event occurring.

The final stage would then be coupling of the review of flood inducing rainfall depth-durations with the preferred forecast arrangements to inform future flood warnings. It is suggested that the forecast should be ensemble based and the system designed to account for the spatial uncertainty in the forecast.

This would be similar to Heavy Rainfall Alert tools similar to those used by other forecasting and warning authorities.

RECOMMENDATION 9

We recommend the Isle of Man review and improve practices for flood forecasting and warning, including:

- an assessment of the rainfall depths and duration of pluvial &/or fluvial flood risk for the Isle of Man is undertaken alongside a review of historical events.
- a quantitative review of the current deterministic forecast performance for rainfall over the Isle of Man is undertaken.
- a review of the performance of the UK Met Office's probabilistic ensemble forecast prediction system, MOGREPS-UK, is undertaken, and adopted in future, if suitable.
- coupling of the review of flood inducing rainfall depth-durations with the preferred forecast arrangements to produce a Heavy Rainfall Alert tool.

Recommendation 10

Recognising the impact that flooding can have on well-being, open a dialogue with the National Flood Forum to explore whether their services can be extended to the Isle of Man

Like in so many other communities affected by flooding people in Laxey shared their concerns about the impact the floods caused and continue to have on their emotional health and well-being. There are social as well as actual economic costs associated with this situation. Typically, medical professionals and friends and family, and the wider community will do what they can to assist, but so often these people do not have the experience and the knowledge to draw from.

The National Flood Forum is a charity that exists to support individuals and communities at risk of flooding. Their priority is to enable people to take control of their own flooding concerns, as well as providing more general help and support (15).



Photograph 3 – The scene on Glen Road on 1 October 2019

RECOMMENDATION 10

We recommend that the Isle of Man Government opens a dialogue with the National Flood Forum and explores whether their services can be extended to the Isle of Man.

The Forum is a charity that provides practical advice including emotional support to individuals and families in advance of flooding and post flooding.

We understand that given the limited resources of the charity they much prefer to invest their services when they have engagement of public bodies and authorities.

Document verification

ARUP

Job title				Job number 272861-00	
Document title				File reference	
Document ref		LAXEY FLOOD 1 OCTOBER 2019 INDEPENDENT REVIEW			
Revision	Date	Filename	PH 2020-03-12 Laxey Flood Independent Review Issue.docx		
Draft 1	3 Feb 2020	Filename			
		Description	First Draft		
			Prepared by	Checked by	Approved by
		Name	Phoebe Hornsby	Abi Morgan	David Wilkes
		Signature			
Issue	13 March 2020	Filename			
		Description	Final Report		
			Prepared by	Checked by	Approved by
		Name	Phoebe Hornsby	Abi Morgan	David Wilkes
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
Issue Document verification with document					<input checked="" type="checkbox"/>



Contents

	Page
1. Cabinet Office Brief and Methodology	1
1.1 Community Engagement	1
1.2 Stakeholder Engagement	1
2 What Happened	2
2.1 Flood Event	2
2.2 Timeline of Events	3
2.3 Source - Climatic Event	5
2.4 Receptors – Laxey Properties and Community	6
3 Review and Interpretation of Factors that Led to the 1 October 2019 Flood	7
3.1 Flood Mechanisms	7
3.1.1 The Overflow of Gretch Veg	7
3.1.2 The Removed Highway Wall Adjacent to Laxey Woollen Mills	7
3.1.3 The Collapse of the Highway Parapet Upstream of the MER Weir	8
3.1.4 Surface Water Flooding	9
3.2 Contributing Factors	10
3.2.1 Lying Trees and other Debris	10
3.2.2 Control of Works in and near Rivers through Permanent and Temporary Consenting Legislation	11
3.2.3 Geometry of the MER Weir	12
3.2.4 Discharge of Surface Water	12
3.2.5 Inadequate capacity of drainage infrastructure	13
3.3 Operational Management	14
3.3.1 Inspection Regime	14
3.3.2 Planned and Reactive Maintenance	15
3.3.3 Riparian Landowners	17
3.3.4 Funding of Maintenance and Capital Investment Works	18
3.3.5 Adequacy of Staff Resources	19
4 Progress with 2016 National Strategy on Sea Defences, Flooding and Coastal Erosion	20
5 Joint Working and Responsibilities of Manx Agencies	22
5.1 Interaction with the Community	22



6	Policies and Standards of Flood Risk Management	24
6.1	Pre-October 2019	24
6.2	Alternative Practices	24
7	Recommendations	26
7.1	Recommendation 1 - Greater priority is given to preparing to deal with flood risks and flood resilience	27
7.2	Recommendation 2 - Review of IoM Governance of the management of flood resilience	29
7.3	Recommendation 3 - Review resourcing and critical mass of officer numbers	31
7.4	Recommendation 4 - Greater urgency in delivering the National Strategy on Sea Defences, Flooding and Coastal Erosion 2016	32
7.5	Recommendation 5 - An investigation of continuing access to and affordability of Flood Insurance	33
7.6	Recommendation 6 – The consents process outlined in the Flood Risk Management Act 2013 should be implemented for all works on designated watercourses	34
7.7	Recommendation 7 - Management of blockage and debris risks in high risk catchments is improved	35
7.8	Recommendation 8 - Greater attention and more urgency is given to existing plans to deal with surface water flooding	36
7.9	Recommendation 9 - Review and improve practices of flood forecasting and warning	37
7.10	Recommendation 10 - Recognising the impact that flooding can have on well-being, open a dialogue with the National Flood Forum to explore whether their services can be extended to the Isle of Man	38
	References	39
	Appendices	41

Tables

Table 1 - Timeline of events regarding the 1 October flood.

Table 2 - Summary of Recorded flood events that have occurred on the Isle of Man.

Table 3 - Description of several individual pluvial flooding issues in the Laxey catchment.

Table 4 - Extract from the 2016 National Strategy on Sea Defences, Flooding and Coastal Erosion (Table 5.2 of the Evidence Report - Action Area Analysis for Laxey)

Table 5 - Recommendations made in Section 7 of the 2016 National Strategy's Evidence Report, with the Review's perceived progress.

Table 6 - Suggested activities to fulfil functions from the Flood Risk Management Act 2013, with assessment of relevant actions.

Figures

Figure 1 - Map of the centre of Laxey, with labels outlining the events of the 1st October 2019 Flooding.

Figure 2 - Timeline of major events of 1 October 2019 event.

Figure 3 - Map showing cumulative risk hotspots across the Isle of Man (JBA Consulting, 2016)

Figure 4 - Source-Pathway-Receptor model for 1st October 2019 events in Laxey.

Figure 5 - Location of blocked culvert and waterfall.

Figure 6 - Map of the Isle of Man showing designated watercourses.

Figure 7 - Map showing cumulative risk hotspots across the Isle of Man (JBA Consulting, 2016).

Figure 8 - Model showing the various streams of information gathering.

Figure 9 - Image showing catchment modelling outputs at the bottom of Minorca Hill area.

Figure 10 - Image showing flow paths at Upper Cronk Orry and Ramsey Road Cul de Sac

Figure 11 - Image showing flow path on the New Road (left) and photograph of area after heavy rainfall event (right).

Figure 12 - Image showing flow paths affecting properties on Mines Road.

Photographs

Photograph 1 - Flooded property of Laxey Resident on 1 October 2019.

Photograph 2 - Accumulation of debris behind the MER weir on the 1 October 2019.

Photograph 3 - The scene on Glen Road on 1 October 2019.

Photograph 4 - Excavator of PCS on the riverside of the hole in the wall (Gap A).

Photograph 5 – Hole in the wall (Gap A) adjacent to Laxey Woollen Mills.

Photograph 6 - Collapsed wall during flood event (Gap B), nearside of wall is Glen Road.

Photograph 7 - MER weir and sluice gate superstructure in the River Laxey, before removal.



- Photograph 8 – Surface water flows, opposite the Garff Commissioners office.
Photograph 9 - Accumulation of debris behind the MER weir.
Photograph 10 - Tree-jam in the Glen Roy River in 2018.
Photograph 11 - Ballacregga Reservoir.
Photograph 12 - Photographs taken looking downstream from Glen Road bridge in 2010 (left) and 2019 (right).
Photograph 13 - Surface water flow over the new Laxey Harbour bridge, looking towards Minorca Hill.
Photograph 14 - Flooding at the New Road bridge, adjacent to Laxey Working Mens Institute.
Photograph 15 - Tree-jam in the Glen Roy River in 2018.
Photograph 16 - David speaking in the House of Commons.

Appendices

- | | |
|----|---|
| A1 | Methodology |
| A2 | Independent Community Questionnaire Response Summary |
| A3 | Government Agencies Roles and Responsibilities |
| B1 | Flood Risk and Source-Pathway-Receptor Model |
| B2 | Flood History |
| B3 | Weather warnings, Forecasting and Hazard Response |
| C1 | Detail of Surface Water Flooding Instances |
| C2 | Incident of Debris Build up |
| C3 | Laxey Woollen Mills Weir Works |
| C4 | MER Weir Geometry - Further Information |
| C5 | Pluvial Flooding Case Law |
| D1 | Submission from Garff Commissioners |
| E1 | 2016 National Strategy - Laxey |
| E2 | 2016 National Strategy Recommendations and Perceived Progress |
| F1 | Flood Risk Management Activities |
| G1 | David Wilkes – C.Eng, CWEM, BSc, HonFellow CIWEM, MICE |



1. Cabinet Office Brief and Methodology

The Cabinet Office of the Isle of Man Government, on behalf of the Chief Minister, commissioned Arup to carry out an independent review into the flood event that occurred at Laxey on 1 October 2019. This report has been prepared to inform the Chief Minister what happened, including:

- why it happened,
- what had been done to address flood risks that were or should have been known,
- what should have been done to address these flood risks,
- what must now be done to ensure that flood risks are, so far as is reasonably practicable, tolerable.

The review involved the analysis of a significant amount of information gathered from a number of sources. A detailed outline of the methodology is included in Appendix A1.

1.1 Community Engagement

The involvement of the community of Laxey was crucial from the outset of the review, as their local knowledge is invaluable. A dedicated and confidential email address was provided and a questionnaire developed to gain the views and experiences of those that lived in and around the areas affected by the 1 October flooding.

A summary of the questionnaire and the responses received is available in Appendix A2. A drop-in session was hosted in the village of Laxey on the 12th December 2019, during which Arup representatives met face-to-face with local residents to discuss their concerns.

1.2 Stakeholder Engagement

Key stakeholders as outlined by the Cabinet Office were engaged in the review. These included:

- Department of Environment, Food and Agriculture (DEFA)
- Department of Infrastructure (DoI)
- Manx Utilities Authority (MUA)
- Garff Commissioners
- some Members of the House of Keys

Meetings and group discussions took place in the Isle of Man on the 12th and 13th December 2019 between Arup and these key government agencies. The engagement of the various groups has allowed a well-rounded view of this event and the factors that led to its occurrence. The relevant roles and responsibilities of the government agencies are outlined in Appendix A3.

2 What Happened

2.1 Flood Event

The Source-Pathway-Receptor model is often used to describe flood hazards and risks. Background information about the model is provided in Appendix B1.

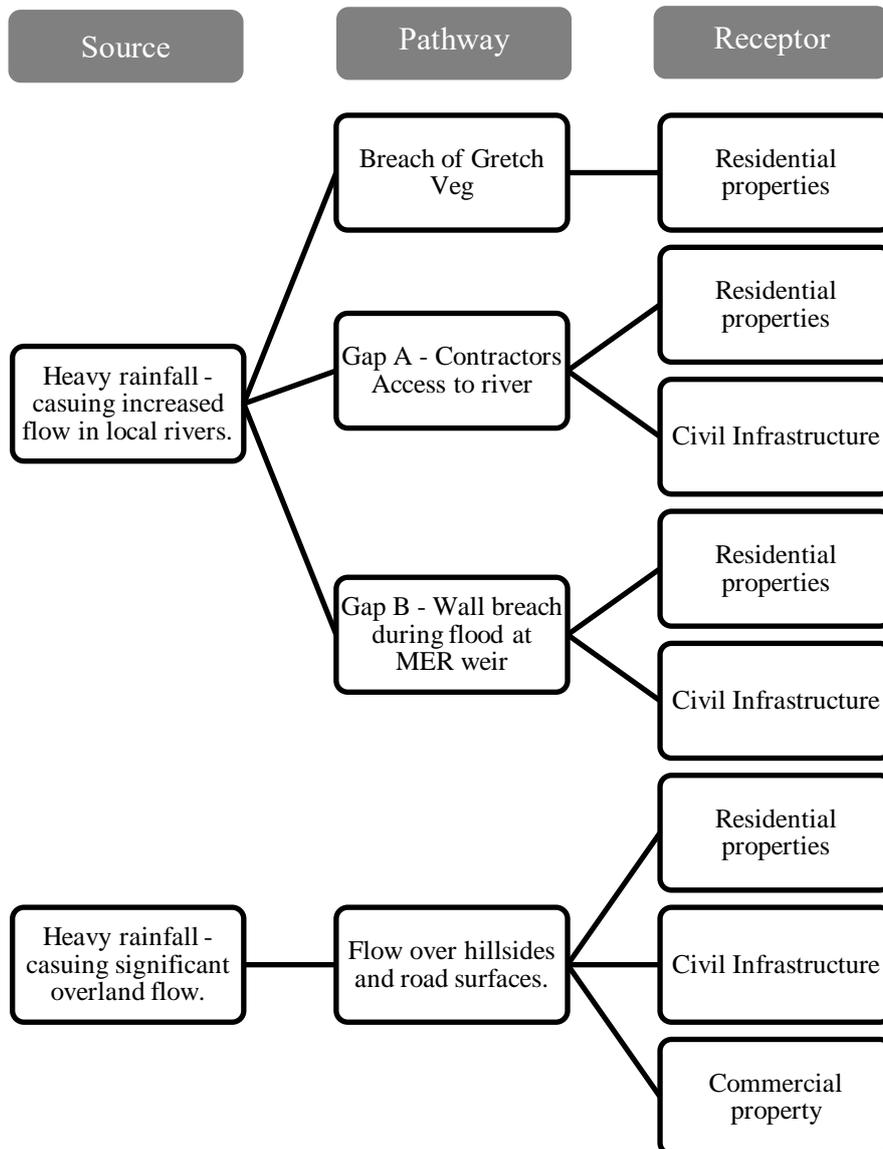


Figure 4 - Source-Pathway-Receptor model for 1st October 2019 events in Laxey.



Flood risk management practice often utilises the Source-Pathway-Receptor model, to consider ways of reducing the risk of exposure of the receptor to the hazard, or reducing the magnitude of the consequences of exposure to the hazard. As in many instances the source and receptors of flooding cannot be readily modified, and the pathways become the element of the model most typically proposed for change or control. Figure 3 shows a simple Source-Pathway-Receptor model for the flood event that occurred in Laxey on the 1 October 2019.

The sequence of climatic factors, described in Section B3, led to heavy rainfall over the Laxey catchment leading to two primary Sources of floodwater i) high water levels in the Glen Roy and Laxey rivers and ii) high volumes of overland flow across the catchment.

The receptors of the event were those residents (and their properties) of Laxey, in various locations around the valley, which experienced both material losses as well as emotional trauma. Many of the residents have experienced flooding in Laxey in the past, either from the rivers or from overland flow.

Flooding has been a major issue throughout recorded history in the Isle of Man, as shown in Appendix B2.

2.2 Timeline of Events

The following table gives a timeline of events that describe how the 1 October 2019 event unfolded. The information has been gathered from various sources, accounts and evidence, and aims to highlight key events regarding the flood event.

Table 1 - Timeline of events regarding the 1 October flood.

Time (approx.)	Event	Detail
19 August 2019		
	Contractors, appointed by MUA, demolished a small section of wall to allow excavator access to Laxey Woollen Mills weir (Gap A)	
29 September 2019		
04:30	Weather Forecast	Rain to arrive 30th September afternoon and heavy overnight.
11:40	Weather Forecast	Rain to arrive 30th September afternoon and heavy overnight.
16:10	Weather Forecast	Rain to arrive 30th September afternoon and heavy overnight.
30 September 2019		
04:45	Weather Forecast	Wet this evening (30 th September), rain heavy at times, risk of localised flooding where drains blocked.
10:30	YELLOW Weather Warning issued by Met Office	Risk of Coastal Overtopping / Inner Harbour Flooding - Valid from 23:30 to 03:30 (01/10/19)
11:00	YELLOW Weather Warning issued by Met Office	Risk of Heavy Rain - Valid from 17:00 to 10:00 (01/10/19) : 10-20mm expected across the Island, and 20-35mm over the hills. Strong winds may cause debris to block drains, with a risk of localised flooding.
11:45	Weather Forecast	Rain expected 4pm onwards.
14:30	Weather Forecast	Outbreaks of rain expected to be heavy at times.
15:00	Approx. start of rainfall event	
15:45	PCS Site Manager received phone call from DEFA Fisheries officer regarding the inclement weather.	



16:00	Rain due now onwards	
16:15	Project Manager visited site	
17:20	PCS Staff left site	Excavator and associated temporary works remained in river channel at Laxey Woollen Mills weir. The site was secured with a heras fence panel.
10:00pm onwards	Laxey valley experienced high levels of rainfall (over 100mm falling between 14:00 30 th September and 14:00 1 October) vs 35mm forecast.	Weather stations at Mountain Box and the Corran, close to the Laxey catchment, both recorded over 100mm in this timescale.
01 October 2019		
1:37	High Tide	
00:15	UKMO MAE	Heavy rain across S Scotland, Northern Ireland and NW England is expected to ease over the next few hours, before increasing in intensity by around dawn – 10-15mm likely quite widely with the potential for localised accumulations 30-40mm by 0900 Z. MOGREPS shows low likelihood. (0450Z MAE similar story lines, but both show heavy rainfall over Isle of Man)
04:00	Weather Forecast	Rain to continue this morning (1 October), with heavier bursts possible.
6:00 - 6:15	Gretch Veg began to flood out of bank and enter local properties.	Report from first responder.
6:15-6:30	Rising flood water in Laxey river reached road level and began to flow out of hole in the wall (Gap A), down Glen Road and into properties.	
6:21	Peak flow recorded at Laxey River Gauge as 2.255m water depth.	
6:30	Fire serviceman responded to scene.	
7:00	Blockage starts to build up at the concrete superstructure of the weir locally known as the MER weir.	
07:00	First calls to emergency services (ESJCR) received.	First calls to DoI about Glen Road received at 07:35. Other calls received from 07:00.
07:13	Civil defence alerted to attend event	
08:00	Glen Road closed due to flooding	
08:07	Low Tide	
08:13	Laxey village closed to through traffic.	
08:30	AMBER Weather Warning issued by Met Office	Heavy rain to continue, bringing further 15-20mm widely and 30-35mm over the hills.
08:40	Highway wall upstream of MER weir collapsed (Gap B).	Sudden release of water from the Laxey River created a 'flood-wave', increasing flood depths.
08:49	Major Incident declared	Officers move to Major Incident room.
08:50	IoM Coastguard assistance requested from DoI. DoI requests helicopter from UK MCA.	
08:55	Reports of people trapped in homes	
09:00	MUA and DoI called to silver command emergency liaison meeting.	Silver command fully established
09:11	DoI provide chainsaw gang at request of police.	
09:31	Nobles Hospital placed on major incident standby.	
09:38	Coastal Overtopping Yellow alert.	
09:40	Terms of Reference for incident response set by Silver Command	Save life, minimise damage and risk to property, staff safety and welfare, communication to public, vulnerable people, return to normality.



09:54	Helicopter arrived on scene	
10:00	Fuse pulled in Laxey Glen Road to isolate supplies.	
	DoI delivers tote bags to reinforce highway wall	
10:22	MUA pulled fuse at Laxey (Primary) - 150 off supply.	
10:28	Coast Guard have boat 'on the scene' at Laxey.	
10:30	DoI structural engineers on site	
10:32	Met Office state little concern for coastal flooding.	
10:45	MUA staff dispatched to Laxey.	
11:29 – 11:45	Deliberate breach in river wall downstream of the MER weir (Gap C) to release trapped flood waters.	Flows returned to river through Gap C, quickly reducing flood depths in Glen Road.
11:59	MUA inform that power supply is now back on in Laxey. MUA stay on site at Laxey.	
12:47	Declared end of major incident and recovery phase commenced.	
13:00	End of rainfall event.	
13:55	High Tide	Additional DoI staff arrive on site to commence clear-up
02 October 2019		
	Debris removed from MER weir.	DEFA operatives attended from 05:00, with full Central team present from 07:30 onwards.
03 October 2019		
	Superstructure of MER weir removed.	

2.3 Source - Climatic Event

During a typically unsettled period across the British Isles in September 2019, a deepening low-pressure system developed to the South West of Ireland and tracked north and then east. The associated weather fronts were active, typical for such low-pressure systems in autumn and were gradually occluding as they pushed northwards across the Irish Sea and into southern Scotland.

However, the occlusion stalled during the night of the 30th September into the early morning of the 1 October as a small secondary low formed between Anglesey and the Isle of Man, increasing the dynamic rainfall processes over North West England and the Isle of Man. This stalling produced slow-moving areas of heavy rain along the frontal zone, made more intense by some embedded cells of convection running along the front. This secondary low pressure also caused tightening to the surface pressure gradient to give a strong north-easterly wind in the north of the Irish Sea, which also increased the orographic rainfall processes on the windward hills in the N and NE of the Isle of Man.

Over 100 mm of rainfall was recorded from 14:00 on the 30th September to 14:00 on the 1 October at gauges around the Laxey catchment, calculated by JBA Consulting’s post-event analysis as a 1 in 5-10 year return period (1). The catchment response to heavy rainfall would have been accentuated due to the antecedent (wet) conditions associated with heavy rainfall which had occurred in the region before and on the 29th September. Further review of the forecasting and associated hazard perception can be found in Appendix B3.



2.4 Receptors – Laxey Properties and Community

The receptors of the flood on the 1 October include the 62 properties affected (1) and the wider community of Laxey. The consequences of the flooding were extensive and are in many cases still being felt by the victims. These effects are reported to include but are not limited to:

- Water inundation up to 2 ft deep within homes was described.
- Serious emotional distress and associated impacts on health and well-being. Anxiety about a repeat event has also been widely described.
- Several people were trapped in the village, and in some cases in their homes, during the 1 October event.
- Great financial losses, reportedly up to £300,000 for some individuals, and loss of personal possessions which cannot be replaced or valued in monetary terms alone.
- Devaluation of properties or a struggle to sell them at all.
- Loss of insurance, or significant increase in premiums (reported to be up to 400%) and excesses (in tens of thousands of pounds).
- Many residents displaced from their homes, some expected to be for up to 10 months whilst building and repair works take place.
- Missed flights, school days and work days.

3 Review and Interpretation of Factors that Led to the 1 October 2019 Flood

3.1 Flood Mechanisms

The main pathways for the flooding in Laxey on the 1 October are illustrated in Figure 3. Reports indicate that the first pathway of flooding was from Gretch Veg due to a blocked culvert downstream of Quarry Falls, shortly followed by the spilling out of the Laxey River from the pre-existing hole (Gap A) in the wall adjacent to Laxey Woollen Mills. Later in the event, the accumulation of tree debris at the weir known locally as the MER (Manx Electric Railway) weir caused the failure of the adjacent highway wall, releasing what has been described as a ‘flood-wave’. Additional to these fluvial sources of flooding, widespread incidents of surface water flooding were also reported at various locations around the Laxey catchment.

This flood event happened close to the time of low-tide (08:07), so it is unlikely that tidal flooding had any significant effect. Coastal/tidal flooding is a known issue in Laxey, but there has been little indication it was a major contributing factor during the 1 October event.

3.1.1 The Overflow of Gretch Veg

The first mechanism of flooding on the 1 October is reported to have occurred from the small stream to the west of Laxey football pitch, known as Gretch Veg. The stream, which flows from Quarry Falls to the River Laxey, is directed through a culvert under the Glen Road. Flood water from this stream is known to have entered local homes at around 06:15, according to public accounts.

The occurrence of this flooding is suggested to in part be due to the blockage of the watercourse. A response to the independent questionnaire stated that dead wood in this stream had been reported to commissioners during summer 2019, without subsequent action. During Arup’s site visit in December 2019, the wall adjacent to the culvert was also found to be partially collapsed, rubble from which was also likely to have caused blockage. The culvert, which is under the ownership of DoI, was deemed ‘not fit for purpose in heavy rainfall’ after inspection on the 2 October 2019¹.

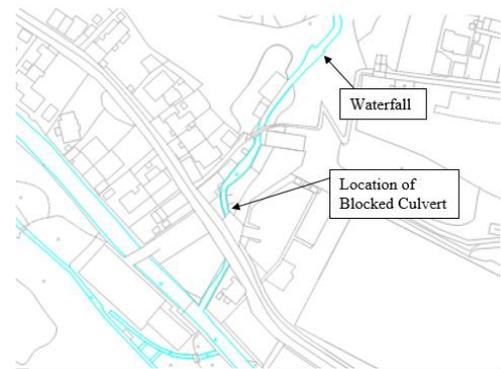


Figure 5 - Location of blocked culvert and waterfall.

3.1.2 The Removed Highway Wall Adjacent to Laxey Woollen Mills

The Laxey Woollen Mills is located on Glen Road, adjacent to the confluence of the Glen Roy and Laxey Rivers, with the Woollen Mills weir located just downstream of this confluence. In summer 2019, works were undertaken on this weir to undertake structural repairs to the weir and at the same time improve fish passage. The works were commissioned by Manx Utilities Authority. Paul Carey & Sons Ltd (PCS) were the contractor selected, out of two companies who tendered, to complete the works. JBA were appointed as the Planning Supervisor to provide a Construction Phase Health & Safety Plan, which was then incorporated into PCS’s project documentation.

¹ Laxey General Works Update (provided by DoI).

On the 19th August 2019, the contractor removed approximately 4 m of the highway wall adjacent to the Laxey Woollen Mills in order to access the river with a Hitachi excavator.

On the night of the 30th of September to 1 October 2019, the excavator being used by PCS was left in the Laxey River adjacent to the hole in the wall (Gap A), as can be seen in Photograph 1. When the river levels began to rise on the 1 October, this hole in the wall became a significant pathway for flooding on to the Glen Road area. However, the JBA Post Incident Review indicates that if the wall been intact during the flood event, then only one property would have been saved from flooding (1).



Photograph 4 - Excavator of PCS on the riverside of the hole in the wall (Gap A).



Photograph 5 – Hole in the wall (Gap A) adjacent to Laxey Woollen Mills.

Anecdotal public evidence and post-event analysis suggest that the presence of the excavator contributed to the volume of flow from the River Laxey (2), through the hole in the wall (Gap A) into Glen Road. Photograph 2 shows the Gap A, and the barrier that was installed to protect it. This Heras style fencing, while serving the function to prevent people and to some extent vehicles from accidentally entering the river, would serve no function in preventing the river from escaping onto the road and towards properties.

3.1.3 The Collapse of the Highway Parapet Upstream of the MER Weir

The Manx Electric Railway (MER) weir, as it is known locally, is located across the River Laxey, approximately 150 m downstream of the Glen Road Bridge. The weir superstructure includes concrete upstands that historically housed sluice gates, visible in Photograph 3.

On the 1 October 2019, an accumulation of tree debris was noted to have collected behind the concrete superstructure of the MER weir from approximately 07:00 onwards. This blockage caused significant flow restriction to the river and led to the raising of water levels upstream of the MER weir. The water levels are reported to have risen above the level of the wall on the left-hand side of the river, causing river flows to overtop into the road, before a 20 m section of the highway wall collapsed shortly after under the pressure of floodwater.



Photograph 7 - MER weir and sluice gate superstructure in the River Laxey, before removal.



Photograph 6 - Collapsed wall during flood event (Gap B), nearside of wall is Glen Road.

The collapse of this highway wall just upstream of the MER Weir occurred at approximately 08:40. The primary purpose of the wall was that of a highway boundary rather than a floodwall. As it will not have been designed to contain flood waters it failed under the pressure of the raised water levels. The occurrence of the collapse of this section of wall has been described by residents as the second flood to occur that day. The force of water as it left the river when the wall collapsed is said to have caused a wave effect and to have significantly increased the severity of flooding throughout Laxey. It was the occurrence of this ‘flood-wave’ that caused the civil defence van to be swept along the Glen Road.

This blockage and subsequent failure of the wall is deemed the most dominant flood mechanism sequence on the 1 October 2019. Modelling also indicated that the blockage of trees and woody debris increased the volume of flow that exited the river from the hole in the wall at the Woollen Mills (1).

3.1.4 Surface Water Flooding

The fluvial flooding was not the only flooding mechanism that happened on the 1 October. The occurrence and consequences of surface water flooding, often known as pluvial flooding have been reported widely to us. The mix of steep sided hills and impermeable surfaces cause and focus potentially hazardous volumes and velocities of surface water runoff, which contributed to the flooding of properties via numerous paths.

Accounts from Laxey residents describe these surface water flows, particularly in the areas of Minorca Hill and Ramsey Road. Many local residents suggest inadequate or poorly maintained drainage systems are the reason for such significant surface water flooding, as the systems are said to regularly surcharge during non-extreme rainfall events. DoI state that highway drainage is designed to cope with 1 in 5 year rainfall events, which is in line with modern standards (3). Several specific pluvial flood issues that have been described to the Review are detailed in Appendix C1.



Photograph 8 – Surface water flows, opposite the Garff Commissioners office.

3.2 Contributing Factors

There are many factors that led to the occurrence and severity of the above flood mechanisms, which are described in the following sections.

3.2.1 Lying Trees and other Debris

Restriction and blockage of watercourses by vegetation, especially large woody debris, and other materials reduces flow capacity and raises water levels. The accumulation of tree debris behind the MER weir, visible in Photograph 7, is potentially the most significant factor which caused the severity of this flood event. Debris build up is also suggested by neighbouring residents to be a key factor in the flooding from Gretch Veg.

As a heavily wooded catchment, river maintenance and management in the Laxey and Glen Roy valleys is vital because of the risk that dead or felled trees can wash downriver and snag leading to much increased risk of flooding to property and infrastructure. Accounts and images from the public suggest that a lack of adequate maintenance has been an issue for many years. The MUA have stated that *'Trimming of overhanging branches that could potentially trap debris (is) generally reactive we use(d) to plan it in when we walked the whole river lengths but due to other commitments this has not been undertaken for some time'*². Accounts also describe incidences during which tree trunk removals were completed, but the cuttings were left on the river banks, which highlights a lack of flood risk appreciation by those undertaking and/or managing the works that these could mat up and form a blockage at a critical place on the downstream river system.

The major debris build-up in the Glen Roy River, that is believed to have travelled downstream during the 1 October 2019 flood had existed since October 2018 and can be seen in Photograph 6. This is discussed further in Appendix C2.



Photograph 10 - Tree-jam in the Glen Roy River in 2018.

Photograph 9 - Accumulation of debris behind the MER weir.

The severe flooding and bridge collapse in Laxey in December 2015 have also been attributed in part to the accumulation of tree debris. With these instances in mind, whilst the possibility of debris accumulation on the weir as a flood mechanism had been identified, it would have been prudent to implement mitigation to reduce the risks.

² Email correspondence from MUA to Arup (January, 2020).



In order to reduce the risk of such occurrences, the Manx authorities could consider implementing risk-based management of blockages, as is detailed in the EA's Blockage management guide published in November 2019. In summary this approach should include:

- Identifying all the glens and river valleys where there is a potential for debris blockages to trigger significant flood impacts.
- Identify and resolve specific features of the watercourse system in these zones to reduce the risks of snagging and catching significant volumes of woody debris.
- Establishing a regular routine of inspecting and dealing with potential causes of flood blockage.
- That a sense of balance and proportionality in approach is achieved which minimises the risk of future flooding but also does not destroy the natural beauty and ecology of the glens.

3.2.2 Control of Works in and near Rivers through Permanent and Temporary Consenting Legislation

As detailed in Section 3.1.2 a key flood mechanism was the escape of water through a construction access hole in the highway wall (Gap A). Further details and analysis of the works carried out at Laxey Woollen Mills Weir are included as Appendix C3. It is Arup's assertion that works that are to be carried out in or near a designated watercourse should be controlled through proper processing and issuing of written consents for both permanent and temporary works, under Section 20 of the Isle of Man's Flood Risk Management Act 2013. This is to ensure the protection of the people and environment surrounding the works. As well as contractual obligations, those involved also have a duty of care through the Flood Risk Management Act (detailed in Section 6) to ensure this protection.

In their capacity as the flood risk supervisory authority for the Island, MUA have the ability to enforce permitting of all works to be carried out in watercourses, which is done through the 'Application for Consent for Works Affecting Watercourses' (4). No evidence has been provided of a consent being in place for the 2019 temporary or permanent works at the Laxey Woollen Mills. It is understood that MUA saw it as counterintuitive to complete their own form in this circumstance, as DoI did with regards to the repair works to the Laxey river wall.

Review of available pre-tender Risk Assessments and Method Statements (RAMS) and other correspondence indicates a lack of consideration as to the risk of flooding associated with the proposed works and the decision to remove a section of the highway wall. Whilst the main purpose of this wall is a highway parapet, its secondary function to retain the river at high flows should have been made absolutely clear to the contractor. MUA state that '*Communications were made to the contractor to block up the gap. Unfortunately the contractor misunderstood the reasoning behind the requested action.*' Meanwhile PCS state that '*Neither the Client (MU Flood Risk Management) or DEFA Representatives made any comment, Nor ... More Importantly did they (The Specialist in this field) say any Flood Prevention Measures would have to be implemented to mitigate the risk of flooding during work activities, or when the site was secured at the end of each working day.*'

It is understood that updated risk assessments were completed by PCS once on site at the Woollen Mills weir, but these have not been made available for review. While the duty for RAMS ultimately lies with PCS as the Principal Contractor, MUA also have a degree of accountability as client, part of which was discharged through the appointment of a Planning Supervisor who produced a Pre-tender H&S Plan for the Principal Contractor's use, and is by law required to act as the liaison between the Client and the Principal Contractor. Additionally, part of the condition for approval for the works was that the Method Statement would be submitted to and agreed with the Planning Directorate within DEFA. While the documents were submitted to some members of DEFA, they were supposedly not



sent to the Planning Directorate and put on file, and so works were undertaken in contravention of the approval. This highlights again that procedures need to be clearly laid out and followed, to ensure full compliance.

It is important that MUA ensure that permitting procedures are rigorously applied to all works, regardless of who is responsible for carrying them out, to ensure the proper consideration of flood risks for permanent and temporary works. The completion of the application for the Woollen Mills work would likely have at least ensured that PCS were aware the works were located in a high flood risk area.

3.2.3 Geometry of the MER Weir

As highlighted in 3.1.3, the MER weir included a concrete superstructure that extended above the normal water level that had originally housed sluice gates. During the 1 October flood event, this unusual geometry of the weir became a snag point for debris and subsequently caused a blockage to river flows. In 1930, a similar accumulation of debris at the weir also caused destructive flooding in Laxey. However, the MER weir concrete superstructure remained in place, until being removed two days after the October 2019 flood event. Further information about the hazard posed by the MER weir is included as Appendix C4.

3.2.4 Discharge of Surface Water

Section 3.1.4 and Appendix C1 describe situations whereby accumulations of surface water runoff have caused flooding in Laxey. Most of these situations involve runoff from roads. Impermeable surfaces such as roads do not allow infiltration of rainfall, and their low roughness generates high velocities. The discharge of duties and responsibilities regarding surface water can be complicated, with parties on the producing and receiving end often in dispute.

In the Isle of Man the Department of Infrastructure is the lead authority responsible for all aspects of highways and highway maintenance, with local authorities having devolved duties to undertake some areas of road side maintenance, drainage and hedge cutting. The devolution of highway maintenance is set out by the Highways Act 1986 Delegation of Functions to the Local Authorities, with costs for such delegated function to be met by the local authority.

The Flood Risk Management Act 2013 Section 4 gives a power to the MUA to supervise many forms of flooding including surface water runoff and the capacity of a sewer being exceeded. This means that any prescriptive responsibility to resolve surface water or sewer overflow is avoided. Case law offers some assistance in guiding when surface water flooding works should be undertaken and is discussed in Appendix C5. It suggests that where flooding is foreseeable and with consequential risks to people and property then there is an expectation that the risk of flooding should be reduced unless the scale of the work involved would be unreasonable and disproportionate to the risk, or the person or body who may be expected to take action can do so in a reasonably practicable manner and has the resources.



3.2.5 Inadequate capacity of drainage infrastructure

The nature of the surface water in the catchment leads to concentrations of runoff from relatively large catchment into small drainage systems which become overwhelmed.

The wide range of issues presented highlights a need for better catchment management, and for investigation into the adequacy of current drainage provisions. The devolution of drainage duties could potentially have played some part in this. For example, it cannot be expected that the local authority makes infrastructure upgrades at any scale to highway drainage, as it is beyond their powers and budget. There are also instances where significant surface water flows from a main road flow into small residential roads, and their minor drainage systems are being expected to cope with these high flows, and yet this also warrants resolution.

The surface water runoff flow paths have caused many issues in Laxey, such as the major flooding of the Mona Lisa restaurant, Laxey Laundrette and surrounding properties. Many of these flow paths have now been identified by JBA's current catchment modelling³ and should be addressed as part of flood risk management. Flow path management can effectively reduce pluvial flood risks. While not necessarily solely their duty, DoI as the highway authority should take steps to ensure the presence and condition of their roads and drainage provisions is not worsening the effect of flooding to neighbouring properties. Pluvial sources and mitigation options for pluvial flood risks are being considered as part of the Laxey Flood Alleviation Scheme that is currently underway.

³ JBA Surface Water Modelling underway in Spring 2020.



3.3 Operational Management

The operation and management of assets within the catchment are also key factors in terms of the reduction of risk from flooding.

3.3.1 Inspection Regime

MUA

MUA are the designated body to exercise supervision of all flood risk management matters under the Flood Risk Management Act 2013. This can include a broad range of activities but is primarily concerned with looking after watercourses in order to ensure the well-being of the river and its surrounding environment.

MUA undertake T98 Visual Asset Inspections of weirs, river walls and other such structures associated with watercourses. These inspections however are concerned with the structural integrity of specific elements. A number of sites are also subject to annual gravel inspections. In terms of tree maintenance, MUA advise this is mainly done on a reactive basis. They commented that proactive inspection of the whole catchment is more difficult over recent years as other commitments limit the availability of operatives to walk the length of rivers to identify maintenance activities.

DoI

DoI is the authority responsible for highways, and state that inspection of the drainage on the main road through Laxey is undertaken twice annually, with problem areas being checked more frequently and after significant rainfall. All other drains are the concern of the Garff Commissioners, who can report faults to the DoI if further assistance is required. However, correspondence between the two parties, which has been provided to Arup, indicates a lack of action when this assistance is required. The fire service is also said to be called out to recurring flooding on roads and one individual suggests there is no method for reporting such occurrences.

Inspections that have been carried out, such as a drain inspection in Laxey in March 2018, have been suggested to have had little outcome, and even specific issues identified have not been addressed. While this may be feeding into the wider study of the area, short-term solutions could have been addressed. With many reports that drainage provisions in Laxey are outdated and inadequate, it seems that inspection regimes may be particularly important, and should go towards informing a potential programme of updates.

Ballacregga Reservoir

Ballacregga Reservoir is located upstream of the village of Agneash and is understood to have had limited maintenance since it was sold to a private buyer some years ago. With a reported storage volume of over 16,000m³, the reservoir is not subject to Schedule 3 of the Isle of Man Water Act 1991. However, we consider that the reservoir owner has a duty of care to maintain the dam and reservoir to protect those who live downstream from an uncontrolled release of water in the event of dam failure.



Photograph 11 - Ballacregga Reservoir.

The dam was inspected by DoI Structural Engineers, as well as a Supervising Engineer engaged by MUA, after the October 2019 flood and no immediate dangers were noted, but maintenance and monitoring of this type of water impoundment are said to be of concern to the DoI. The Department states it is working with other public bodies to consider the merits of implementing inspections of private dams where there is a risk to the public and the land owner appears unwilling or may not be capable of inspecting and maintaining the structure.

3.3.2 Planned and Reactive Maintenance

According to the independent questionnaire, detailed in Appendix A2, local residents perceive a lack of river maintenance as the primary cause of the severity of the 1 October Flood. A lack of maintenance has been raised at many levels over the years, including in Tynwald Court. Planned maintenance is one method of reducing the risks arising from the contributing factors within this report: debris, blockage risks and surface water drainage capacity.

In the past local 'gangs' would be responsible for maintenance of rivers and drainage, and this is said by local residents to have been an effective way of managing the areas, however floods did still occur in this period. Labour costs, developments in machinery and resources cuts mean this method of maintenance is no longer undertaken.



Photograph 12 - Photographs taken looking downstream from Glen Road bridge in 2010 (left) and 2019 (right).

As described in the previous section, there seems to be a limited routine inspection regime to ascertain vegetation management works that may be required. As the flood risk authority, MUA could hold themselves as well as other landowners accountable on a regular basis to these river management requirements. A lack of clarity amongst residents on who is to undertake this maintenance, and how need for it should be reported seems to add to this issue.

The majority of maintenance activities appear to be reactive, for example, in response to persistent resident requests, or to flood events. Expenditure on Flood risk management in the Laxey catchment for the past 5 years show significant spending on works has been undertaken, but again a large majority of these seem to be reactive works – with money spent on rectifying issues rather than mitigating/protecting against them.

The reactive works since the October 2019 event have been extensive. Activities undertaken by all agencies have seen drastic change to the village of Laxey. While mostly welcomed, and seen as long-awaited action finally taken, others are perhaps more questionable. The felling of trees along the river corridors was noted to be potentially excessive during Arup's site visit in December 2019, and evidence of many healthy trees being cut down was visible. Whilst it is important to show that action is being taken it is also important to implement preventative plans to reduce flood risk in the long term.

3.3.3 Riparian Landowners

A riparian landowner is someone whose land has a watercourse running through or next to it and who has responsibility for managing that watercourse. This is applicable to all watercourses in the Isle of Man, except for those determined as designated watercourses under the Flood Risk Management Act 2013, which can be seen in Figure 5 - Map of the Isle of Man showing designated watercourses. The designation shown for Laxey covers the River Laxey from its confluence with the Glen Mooar river to Laxey Bay. Designated watercourses are under the jurisdiction and supervisory oversight of MUA, who may provide, maintain, improve or extend designation of watercourses or flood risk management works to protect the Island. While MUA are responsible for flood risk, their powers under the 2013 Act are permissive, which means they have discretion to decide whether to exercise them in any situation.

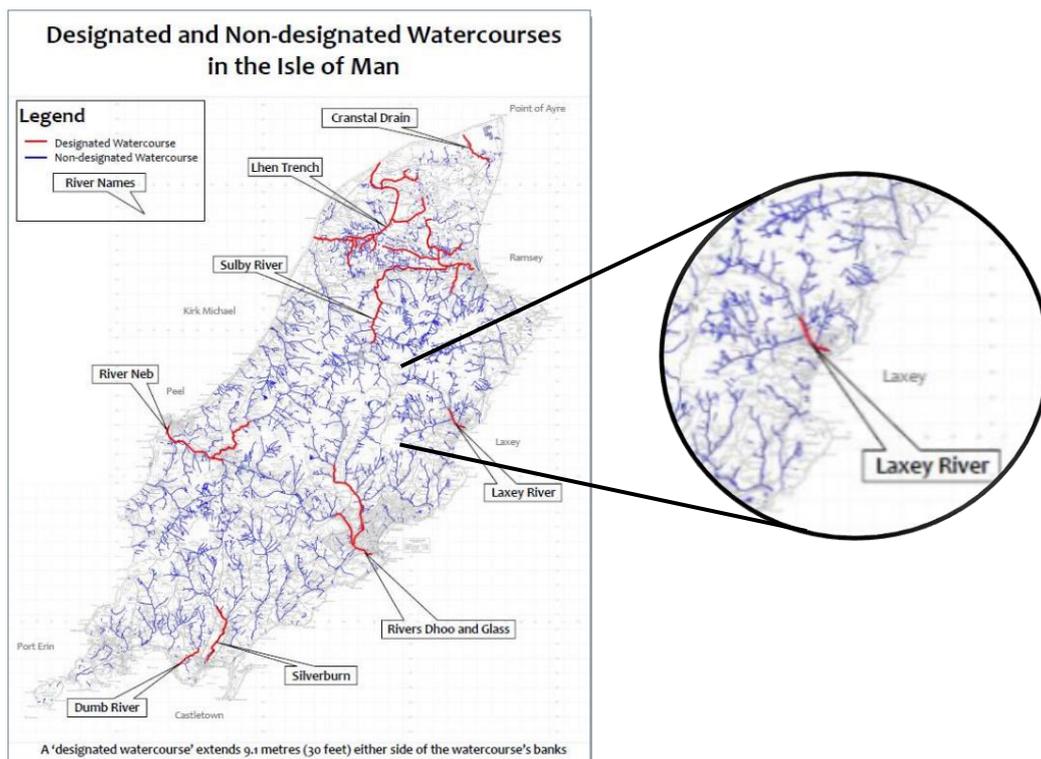


Figure 6 - Map of the Isle of Man showing designated watercourses.

With Laxey's many tributaries, the possible extension of the designation of watercourses could be considered. The lack of designation for the downstream part of the Glen Roy is surprising, as its relation to flood risk in this area is arguably equally as important as the Laxey River. MUA state that a Designation Order has since been drafted, and subject to consultation and approval, the Order will extend the designated river to include the Glen Roy tributary.

MUA provide guidance to the rights and responsibilities of riparian landowners through the document 'Watercourse Management in the Isle of Man'. This document was re-released in December 2019. The clarification that the Authority is only responsible for designated watercourses is the impact ascertained from this update.

Since the 1 October event, MUA are pursuing the strengthening of such powers to enable them to undertake the required maintenance and then charge it back to the landowner. Whilst this could be a positive step, a rigid inspection and notification of required works would be expected. However, community/landowner flood risk awareness-raising should be the approach in the first instance. This



could also help combat other related issues, such as reports of rubbish and debris being thrown into the river by some residents. The enforcement of the provisions of the Flood Risk Management Act 2013 and as set out in Watercourse Management in the Isle of Man guidance document is the pragmatic next step.

3.3.4 Funding of Maintenance and Capital Investment Works

From meetings with the relevant agencies it was apparent that; while funds are often available for capital investment works, the funding of more everyday activities such as maintenance is limited. It seems that the large budgets of capital works programmes can be unlocked, as long as the cost-benefit analysis can be proved to the Treasury. However, proving the case for increased annual revenue budgets was said to be a lot more difficult, with attempts for additional budget provisions in both 2016 and 2019 being met with requests for further information of the full commitment required for the schemes in question.

MUA currently have a revenue budget of £0.5million per year for the management of rivers and flood risk, which remained unchanged the same for many years. This sum equates to more revenue funding per property at flood risk and per capita than the English equivalent. However, the discharge of duties seems to be less spread, with the absence of a UK equivalent to Lead Local Flood Authorities (LLFA). MUA have incurred average annual costs of around £0.8 million over the last 5 years, which have been absorbed in order to support maintenance activities alongside the national strategy workstream. DoI are the sponsoring department of MUA, and provide support to them as they possess the Government's structural and civil engineering competence base and will often under take design work for the MUA when requested, but this cannot be financial help. As the £0.5million budget has proved to not be adequate for several years, Arup would advocate a budget based review of supervision duties (including enforcement of flood risk legislation and guidance), maintenance, inspection and operations.

Recommendations from the 2016 National Strategy included the development of capital investment funding criteria and potential investment partnerships, much like Flood and Coastal Erosion Resilience Partnership Funding Policy in England. This was raised in previous FCAG meetings, but progress made is unclear. The National Strategy brought about a lot of extra work for the agencies, which was expected to be met with an increase in project development funding to match. This was not the case, meaning that budget struggles have intensified since the release of the strategy. The same small budget of MUA is now expected to not only cover the same day to day, year to year duties, but also the implementation of a strategy covering flood risk for the next 100 years.



3.3.5 Adequacy of Staff Resources

On the 12th December 2019, Arup met with representatives from DoI, MUA and DEFA. From these meetings it was established that the supervisory oversight for flood risk management fell almost solely on MUA Flood Risk Team, which is made up of only three full time employees with an annual expenditure budget of £0.5million. The positions held are; Flood Risk Management Manager, Water Resources Specialist and a Projects & Flood Risk Assistant, with the Head of Projects & Strategic Planning managing these roles as part of wider responsibilities. For much of 2019 the FRM team were down to two members of staff, some of whom have a water resource remit as well as flood risk management. The core staff are tasked with not only the day-to-day works required of flood risk management specialists, but also supporting the development, progression and implementation of the 2016 National Strategy. In addition, there seems to be no provision for formal support or response with the Ronaldsway Met Office in relation to increasing planning and awareness for flooding.

While the Isle of Man is a relatively small place, it is still felt that this is an disproportionate burden to carry for three people and such a small expenditure budget. No maintenance/ground force staff are employed by the MUA, and these tasks are completed by contractors. The 2019/2020 budget for flood risk management shows that £580,000 is to be spent by MUA on agency staff, contracted services and consultancy fees, which raises some concern about knowledge and understanding of Manx flood risk residing in commercial organisations and not within the Authority.

Within MUA, DoI and DEFA there are other staff who carry some flood risk management responsibilities, but these responsibilities are just part of their job remit. DoI have also stated that the Department's key constraint has been the lack of experienced staff of all grades rather than a shortage of funding.

We recommend a staff resources and priorities review of the MUA's Flood Risk Management Team.



4 Progress with 2016 National Strategy on Sea Defences, Flooding and Coastal Erosion

The 2016 National Strategy on Sea Defences, Flooding and Coastal Erosion was developed for the Isle of Man government by JBA Consulting to contribute to economic, environmental and social resilience to current and future climate risks. The Evidence Report was published in June 2016, while the Government Document which sets out how the Strategy will be delivered was released in July 2016. Island wide flood risk from rivers, the sea and surface water together were assessed with coastal erosion. The main output from this review was a list of 24 sites at high flood risk, 13 of which were identified as being priorities for intervention within the next 10 years. A large element of this strategy is effectively a programme of flood alleviation works (new or improved infrastructure) to be implemented at the 24 high flood risk sites. The assessment of risk and recommendations outlined with regards to Laxey can be seen in Appendix E1.

Another outcome of the 2016 Nation Strategy was the formation of the Flood and Coastal Advisory Group (FCAG). This is a steering group including representatives of DEFA, DoI and MUA as well as Treasury, with the purpose of managing and implementing the actions recommended by the strategy. The September 2016 general election is said to have delayed action on this, but after launching the Programme for Government in January 2017, the Group met for the first time in September 2017. They originally intended to meet every 2 months, but between the first meeting and August 2019, only 5 meetings took place. Minutes from these meetings were made available for this review. The meetings, while being based around the National Strategy, do not seem to effectively develop and implement the ‘Action Plan’. Instead the meetings seem to be more of a progress update between departments.

Despite the 2016 Strategy clearly stating the justification for the Laxey Tidal scheme was ‘questionable’, it was still being pursued by DoI until Summer 2019. Parallel to this, modelling was being undertaken by MUA for Laxey fluvial and surface water flooding. The two schemes have since been combined to look at modelling and potential schemes for the wider Laxey catchment. This holistic approach may have been delayed due to the segregation of responsibilities between departments. DoI have a responsibility as owners for harbours, whilst MUA have a supervisory duty of rivers. The different resources available to each department may also affect which kind of schemes are pushed forward most effectively. From meetings with the agencies, it was also established that political influence can also have a distorting effect on which projects are made priorities.

Debris which could cause blockages was also highlighted in the 2016 Strategy as a potential flood mechanism in Laxey. While it is known that development of a debris catcher is underway, it seems that this could have been a ‘quick-win’ solution shortly after the Strategy was published, to combat a known issue. The implementation of a debris catcher scheme could have prevented the occurrence of tree accumulation that occurred at the MER weir on the 1 October. It was also suggested that flood awareness should form part of the response in Laxey, but education on the hazard or on topics such as land management do not seem to have been communicated to the residents before the 1 October event, except through flood maps available on the MUA website – however, not to a high resolution.

While the National Strategy was a good step for the Island in terms of prioritisation of desirable new infrastructure for sites at risk, it seems that its implementation has been more as a capital works schedule, rather than a strategy. The list of priority sites seems to have been used to guide the schemes to complete. As capital schemes take many years in planning, design and construction, it is perhaps disappointing that other aspects of flood risk management were not facilitated more readily. There also seems to be a lack of scrutiny over the progress made with the National Strategy, which was



admitted by members of the FCAG themselves. The recommendations made in the 2016 Strategy Evidence Report, along with comments on the progress/actions made, are summarised in Appendix E2.



5 Joint Working and Responsibilities of Manx Agencies

The Department of Infrastructure (DoI), the Manx Utilities Authority (MUA) and the Department of Environment, Food and Agriculture (DEFA) all work together regarding flood and coastal risk management and is evident through the FCAG. DoI and DEFA report to the Environment and Infrastructure Committee, where DoI also represent the views of MUA. Due to the small nature of government in the Isle of Man, the agencies work closely on many matters on a daily basis. During meetings between Arup and the agencies, all agencies expressed that their relationships and joint working were very good.

However, the discharging of their day to day duties is not perceived well by the public. Reports of emails from residents being forwarded from agency to agency, with each passing responsibility to the next undermines the image as a collaborative group of agencies working for the general good of the Isle of Man. Each agency has been reported to have lacked at time under their individual jurisdictions. Whilst all agencies are committed to delivering a good service, it seems a lack of joined up thinking may have led to a lack of public confidence.

Responses during and after the 1 October 2019 event have been better perceived, with residents praising the emergency and government responses to the incident. Whilst the joint working in these circumstances was successful, it reinforces thoughts of a reactive rather than proactive government.

It seems that it is only amber weather warnings which trigger a multi-agency response. A review of how weather warnings are perceived and acted upon might suggest that some training and changes are required. In addition a move towards probabilistic based warnings as is done in the UK could be beneficial, with response to warnings being in line with the likelihood and impact categories (e.g. actions taken for a yellow warning issued when it is a forecast for a **significant impact** event with a **low likelihood** of occurrence).

5.1 Interaction with the Community

It was reported that the usual adequacy of interaction between government agencies and local residents was poor. This interaction is in part facilitated by the local commissioners, who themselves at times struggle to effectively engage the agencies. The most common complaint is the lack of response to emails residents receive when submitting queries or complaints. The Review has received significant evidence of this claim. Part of the issue seems to be a lack of clarity of who residents should be contacting regarding certain matters. The independent questionnaire asked respondents *'If you saw something within the catchment that you believed could contribute to flooding, would you know who to contact?'*, to which 52% responded 'Yes'. However, when asked who they would contact, a range of eight answers were given, and are listed in Appendix A2. Despite prolonged efforts by the agencies to encourage the public to use the DoI's 'Report a Problem' system, it seems this is yet to become common practice.

The independent questionnaire also revealed that Laxey residents believe that nothing has been done with regards to flood risk management since the December 2015 event. Whilst MUA have been commissioning extensive modelling of the catchment over the past years, the need and plans for this has not been made clear to the community. As important as the modelling, optioneering and design development process is to ensure an effective project, it is also a timely process. Residents have been left waiting in fear, with little tangible activities undertaken to alleviate flood risks while these processes are underway. During the FCAG meetings, there was discussion around employing someone with the task of publicity and public information regarding flood risk management and



projects associated with the National Strategy. Ultimately, there was insufficient budget for this, but it was a valid idea that could have alleviated a lot of tension before and after the 1 October event.

There is evidence of several cases where government agencies have engaged with community members, but as the outcomes are not always satisfactory for residents, these issues are ongoing. With no formal process for these complaints or issues to be logged and progressed, even the task of closing them out is arduous.

Since the 1 October event, a further reported lack of communication has led residents to question their trust in the government agencies. The village of Laxey is still recovering from the devastation, and with life yet to return to normal, real sensitivity is needed. Employing PCS to undertake the re-building of the Glen Road wall may be deemed insensitive, as trust in the contractor was diminished by leaving the hole in the wall unprotected when a yellow weather warning was issued. Residents have also described that the long period of closure of the Glen Road through Laxey is segregating the village, worsening the 'ghostly' feel of the road where many have had to move out of their homes due to the flood damage.

Certain attempts to interact with the community after the 1 October event were made, such as the facilitation of a flood liaison officer. However, this is known to have not been effective as proper understanding of the situation was not gained. There seems to be a lack of recognition of the effect on wellbeing the event has had on the residents, and of what they really need from the agencies. Involvement of the community in the works undertaken since the event is said by some residents not to have happened, however meetings that have occurred between the agencies and Garff Commissioners are a positive step.



6 Policies and Standards of Flood Risk Management

The Isle of Man's Flood Risk Management Act 2013 sets out the core functions of the flood risk authority as:

- a) they must administer the Act, and monitor and enforce compliance with it; and
- b) they are responsible for, and must generally supervise, all matters relating to FRM.

MUA are the flood risk authority, and to perform these functions may do any or all of a set of activities listed in Appendix F1, together with details of the perceived actions taken. A review of these indicates several shortfalls as highlighted in this report.

6.1 Pre-October 2019

With regards to the factors that led to the events of the 1 October, shortfalls can be identified with respect to flood risk management. However, not all elements are the sole responsibility of Government; some are landowner responsibilities. The identified shortfalls are as below:

- Vegetation management and debris clearance;
- Control of consents;
- Mitigation of temporary flood risks from construction works;
- Blockage management or mitigation;
- Management of surface water flows.

6.2 Alternative Practices

There are several factors that if carried out differently could have significantly reduced the severity of the 1 October flood in Laxey. With regards to the shortfalls identified, the following approaches and actions could have mitigated the risk of this flood occurring:

- Adequate inspection and assessment of the catchment, over and beyond the T98 structural condition surveys, and enforcement of powers to maintain and remove debris and trees with a foreseeable risk of causing blockage and flooding
- The compliance with the FRM Act 2013 consenting procedures regarding working in watercourses could have made the potential flood risk of temporary works more apparent, and therefore initiated the consideration of mitigation of this risk. We believe the need for these consents should be required equally from all departments of Manx government and the projects they commission as well as works by third parties. This will be so that the necessary thought processes to off-set any potential change to flood risk can be properly and independently considered.
- Ensuring risk assessments and method statements from contractors fully identify and address the flood risks associated with working in watercourses should also be the responsible of the flood authority. This should be examined on a project specific basis and it should be ensured that site specific flood risks are understood.



- The identification of potential blockage locations and mitigation of such high-risk sites could have been undertaken. Removal of snag points has the potential to be easier and more effective than debris management.
- Maintenance of drainage systems is vital, but more pertinent in this case seems to be the presence and adequacies of such systems. Investigation into the upgrade of many of these systems has been needed for many years. Known surface water flow paths in Laxey could have been modified since previous floods to attempt to reduce their impact.



7 Recommendations

The following 10 recommendations are based on our assessment of what happened in Laxey on 1 October 2019, from studies of the evidence which was shared with us, plus our own UK and international experiences.

We recommend that:

1. Greater priority is given to preparing to deal with flood risks and flood resilience on the Isle of Man.
2. The governance of flood risk management across the Island should be reviewed.
3. The current provision of resource for flood risk management is reviewed.
4. Greater urgency is given to delivering the National Strategy on Sea Defences, Flooding and Coastal Erosion 2016.
5. An investigation by the Isle of Man Government of continuing access to and affordability of Flood Insurance should be resolved.
6. The consents process outlined in the Flood Risk Management Act 2013 should be implemented for all works on designated watercourses.
7. Management of blockage and debris risks in high risk catchments is improved
8. Greater attention and more urgency is given to existing plans to deal with surface water flooding.
9. Review and improve practices of flood forecasting and warning.
10. Recognising the impact that flooding can have on well-being, open a dialogue with the National Flood Forum to explore whether their services can be extended to the Isle of Man.

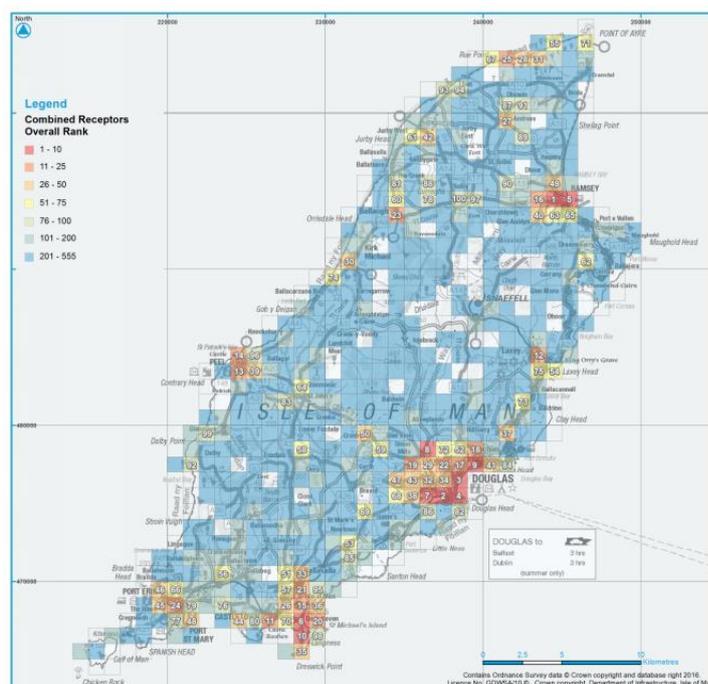
The rationale behind these recommendations is included below.

7.1 Recommendation 1 - Greater priority is given to preparing to deal with flood risks and flood resilience

Increasing flood resilience and minimising the impacts of flooding on people and the economy, should be given greater priority and urgency on the Isle of Man agenda. The points below highlight why this is pertinent:

- Climate change around the world is increasing the frequency and intensity of storms (flooding from the sea created by rising water levels, tidal surges, wind and waves, or from heavy rainfall to rivers, streams and overflowing drainage systems). The Isle of Man is no exception to these global trends.
- Previous flood mapping exercises have shown that over 4,000 properties are potentially vulnerable to flooding (5). At least 10% of the Manx population is potentially at direct risk of flooding and a significantly larger percentage could be indirectly affected.
- Records show that there have been at least 27 floods affecting different communities on the Isle of Man since 2000. Direct flood risk damages are estimated to have cost communities well in excess of £28 million (6) (7) .
- It is estimated that across the Isle of Man there could be potentially £900m of direct flood damages over the next 100 years. There are 180 critical Manx assets at risk of flooding including high flood vulnerability to 63 schools and GP surgeries, 32km of major roads and 6km of railway (1).
- Land-use and location of properties on the Isle of Man tend to be clustered around the coast, along the rivers and at inlets to the sea. By comparison land-use is less intense around the areas of higher elevation and in the central area of the Island. The higher value land zones are more vulnerable to flooding.

Figure 7 - Map showing cumulative risk hotspots across the Isle of Man (JBA Consulting, 2016).





- There is an expectation of continued economic expansion and growth of the Isle of Man's population by almost 20% to 97,000 by 2050 (8) . It will be important that there should be no new development in areas at unacceptable risk of flooding and this can be achieved if the January 2020 development guidance related to flood risk is operated and enforced (9).
- The 2008 Pitt Review, Learning Lessons from the 2007 Floods, provides analysis of flood risk management in England and gives many useful pointers on priorities and considerations for the re-shaping of flood risk practices (10).
- It is noted that much of the primary legislation and high-level guidance needed for good practice seems to be in place, such as the Flood Risk Management Act 2013, Watercourse Management in the Isle of Man guidance document and the Making a Planning Application – A Guide for Applicants published by DEFA in January 2020.

RECOMMENDATION 1

We recommend greater priority is given to preparing to deal with flood risks and flood resilience

The Isle of Man Government should ensure that greater attention is given to the preparing for and dealing with flood risk than has occurred previously. Potential floods impact directly on over 10% of the Island's population, 4000 properties and have a forecast of £900m potential flood damages over the present century. The cumulative flood impacts will also change as the effects of climate change are realised and because of increases in population and economic development.



7.2 Recommendation 2 - Review of IoM Governance of the management of flood resilience

We recommend that a review of the governance of flood resilience investment and activities is undertaken. The current statutory arrangements on the Isle of Man place the MUA as the lead department for dealing with heavy rainfall induced flooding under the Flood Risk Management Act 2013; and the Department for Environment Food and Agriculture, DEFA, as effectively the lead department for flooding from tides and the sea under the Coastline Management Act 2005. DEFA are also charged with Planning and Building Control under the Town and Country Planning Act 1999, and consistent with these responsibilities, to ensure that new land allocations and buildings avoid sites which are particularly vulnerable to flooding.

The Department for Infrastructure, DoI, also lead on matters of surface water flooding from highways, and owns much of the coastal flood protection infrastructure around ports and harbours and also provides Met Office weather forecasting services and emergency response capabilities. Staff from DoI also regularly provide Project Management services for public funded flood risk projects.

We question whether this division of leadership activities across these different government departments is consistent with good practice for dealing with the risks and priorities of flood risk in a fully integrated and public facing manner.

Effective management of flood resilience requires careful balancing of many, and often conflicting objectives. From experience we have seen this achieved by a statutory flood risk committee/board with members representing the relevant agencies of government, some representing stakeholders and some bringing specialist competencies to bear. We expect any committee would sit to advise, assist and scrutinise the relevant departments on the policies and plans for delivering good flood risk management practices across the Isle of Man.

The remit for such a committee could include:

- Encouraging efficient, targeted and risk-based investment in flood protection and coastal erosion risk management which represents good value for money, benefits local communities and the economy and protects and enhances the natural environment.
- Ensuring there are coherent mechanisms and plans in place to deliver and to maintain policy standards of flood risk and coastal erosion, including mitigating and adapting to climate change.
- (We expect these mechanisms and plans to include capital works programmes, operational and maintenance consideration and enforcement of the relevant statute in respect of act or omission of others)
- To act as a link across MUA, DoI, DEFA, the Commissioners and the Tynwald, and with the wider public to help build understanding of the needs to better manage flood risk and coastal erosion across these bodies and more widely.



RECOMMENDATION 2

We recommend that the governance of flood risk management across the Island should be reviewed.

This should include:

- appropriate exercise of supervisory duties under the Flood Risk Management Act 2013;
- the Duties and responsibilities for flood risk across MUA, DoI and DEFA;
- the consideration of a Committee/Board to help establish and monitor the effectiveness of flood risk management plans and practices whose members are recruited to reflect different interests and the aspiration of the population.



7.3 Recommendation 3 - Review resourcing and critical mass of officer numbers

The Isle of Man Flood Risk Management Act 2013 confers a power to exercise supervision of flood risk (from heavy rainfall events) to the MUA.

For much of 2019 the Flood Risk Management team was reduced to two fulltime members of staff. Some flood risk management activities are the responsibility of other staff but on a shared-time basis. Staff in the Department of Infrastructure, and Department for Environment Food and Agriculture also support flood risk activities as part of their wider job responsibilities.

The annual operating expenditure budget allocated to the MUA team is currently £0.5m and we understand this has remained static for several years. This is spent mostly on contracted services and consultancy fees, suggesting that much of the intellectual understanding and knowledge about flood risk on the Isle of Man is provided and retained by commercial organisations.

We understand that the MUA flood risk team act as sponsors to capital flood protection projects and managed by officers at DoI; and as client for Planning and any Planning enforcement activities discharged by DEFA.

We recommend that the current provision of resourcing for flood risk management is reviewed. This would best be undertaken in parallel with any governance changes (in Recommendation 2 above):

- It should include the adequacy of budgetary provision to meet the duties of the Flood Risk Management Act 2013 and other guidance notes and to promote good flood risk management practices.
- It should also look at staff resourcing arrangements in terms of fragmentation across departments and the balance of knowledge and understanding which is currently held within commercial organisations.
- Even recognising the relatively small size of the Isle of Man and the strong collaboration across public sector departments we cannot see clear lines of responsibility to others on how the provisions of the Flood Risk Management Act 2013 should be discharged.

RECOMMENDATION 3

We recommend that the current provision of resourcing for flood risk management is reviewed.

This would best be undertaken in parallel with any governance changes (in Recommendation 2 above):

- It should include the adequacy of budgetary provision to meet the duties of the Flood Risk Management Act 2013 and other guidance notes and to promote good flood risk management practices.
- It should also look at staff resourcing arrangements in terms of fragmentation across departments and the balance of knowledge and understanding which is currently held within commercial organisations.
- It should consider greater clarity of responsibility to all on how the provisions of the Flood Risk Management Act 2013 should be discharged.



7.4 Recommendation 4 - Greater urgency in delivering the National Strategy on Sea Defences, Flooding and Coastal Erosion 2016

The National Strategy on Sea Defences, Flooding and Coastal Erosion was commissioned by DEFA, which feels appropriate given their duties in respect of potential flooding from the sea and high tides and their role of ensuring wise planning and development control, including consideration of flood risk for new developments.

It is pleasing to see that the strategy was developed under a steering group to represent and integrate the duties of MUA and DoI and that as part of this development, Government Ministers and other Members of the House of Keys were also engaged. The strategy was formally approved by Tynwald and released in July 2016, however due to the general election the Programme for Government was launched in January 2017.

Assessments provided in the strategy give strong scientific evidence on the cumulative risks and suggests where public expenditure should be focused to enable the best social and economic returns on investment.

The strategy highlights 23 Priority Action Areas across the Island. Laxey is ranked as the 5th action area and the strategy suggests that the main flood risk is due to fluvial/surface water sources and not tidal.

Given that the government has already set aside £50m for the first tranche of funding to deliver the strategy, we question why there are not more schemes and projects delivered or at an advanced stage than seems apparent to us from the notes of the Flood and Coast Action Group, FCAG.

We would like to point out that addressing the Action Areas highlighted in the strategy will not mitigate all flood risks. Activities such as inspection, maintenance, monitoring and enforcing acts or omissions of third parties (especially land-owners and developers) are all part of good flood risk management practice.

RECOMMENDATION 4

We recommend greater urgency in delivering the National Strategy on Sea Defences, Flooding and Coastal Erosion 2016.

- We recommend that more senior and high-level scrutiny is assigned to oversee delivery of the Strategy. Perhaps with the Flood and Coastal Action Group (FCAG) being the officer working group seeking consent for its progress and plans from the Committee/Board suggested in Recommendation 2.
- We recommend that the national strategy should be renewed and refreshed for appropriateness at timely intervals. At a frequency of no more than every 10 years would be wise for a substantial update, and perhaps with a lighter review once every 5 years. For example, the IPCC (International Panel on Climate Change) is regularly publishing new guidance with the next Assessment Report due in 2022 and similarly the strategy needs to consider changes in climate impacts and accord with the social and economic needs of the Island.



7.5 Recommendation 5 - An investigation of continuing access to and affordability of Flood Insurance

We understand, and are not surprised to hear, that some of the 62 owners of properties flooded in Laxey have already been refused flood insurance cover or have been quoted unaffordable premiums and/or excesses in the light of flood risk.

This adds to the emotional stress of people who are attempting to recover from the trauma of flooding.

Also, the absence of flood insurance cover puts a blight on properties making them difficult to sell, or significantly influences the property value which in turn restricts owner's ability to move (or as at least two residents told us leave something of value from their life's work when they die).

Of course, with 4,000 residential properties at risk of flooding on the Isle of Man it is likely that the owners and occupiers of these properties across the island will also experience difficulty obtaining flood insurance at some point.

RECOMMENDATION 5

We recommend that the Cabinet Office of the Isle of Man investigates the continuing access to and affordability of Flood Insurance.

We are pleased to hear that the IoM Government is actively exploring an extension of the Association of British Insurers Flood-Re arrangements to properties on the Island. If agreed the Flood-Re scheme should enable property owners and tenants to secure continuing flood insurance cover at reasonably commercial rates for the vast majority of properties.

Flood-Re operates as a re-insurance scheme for conventional household properties and becomes viable by government subsidy and a regulatory compliant small "tax" on all household premiums.



7.6 Recommendation 6 – The consents process outlined in the Flood Risk Management Act 2013 should be implemented for all works on designated watercourses

Section 18 of the Flood Risk Management Act 2013 (4) says “A person must not unlawfully interfere with designated Flood Risk Management works or a designated watercourse... a person unlawfully interferes... if it does any of the following without the Authority’s written consent (a “works consent”).

It is our interpretation that Section 18 will apply, for both

- a) the permanent works, that is the situation when any changes are complete and the design intent is achieved.
- b) during construction phases when transitional restrictions to watercourse flow or removal of flood protection features may be required for practicable reasons.

Further it is also our interpretation that the intention of Section 18 is to ensure that any potential increase in flood risk is properly considered by the Authority and that decisions made are recorded in writing and with the explicit consent of the Authority.

Section 20 describes the process and guides on the style of “*Applying for and obtaining works consent*”, and an [application form](#), FRM20 is available to download from the MUA web site (4).

Somewhat curiously Section 20 (1) seems to give discretion in that it uses the word may rather than must “...*apply to the Authority for a works consent.*”

From discussion with officers at MUA and DoI we understand it is normal practice, and because they are acting on behalf of government, to omit preparing the written documentation on applying for works consent but that any potential increase in flood risk is duly considered. In explaining their practice on this they refer to the discretion allowed by Section 20.

We have examined the practices and documentary evidence for managing Health and Safety risks associated with MUA works opposite Laxey Woollen Mills and also the DoI works to repair the road and riverside wall after the October 2019 flood. These follow a process we would expect to see, however there is an absence to cross referencing a similar process for works consent under Section 18 of the Flood Risk Management Act 2013.

RECOMMENDATION 6

We recommend that Section 18 of the Flood Risk Management Act 2013 should apply to all parties, including agents of government.

We recommend that decisions taken about minimising flood risk and the justification for them should be written down in line with the FRM20 form and the processes described in Section 20.

Further that the MUA should operate with independence to ensure that these provisions of the Act are upheld and if necessary that enforcement action can be taken.



7.7 Recommendation 7 - Management of blockage and debris risks in high risk catchments is improved

An estimated 50 tons of woody debris, comprising felled tree trunks and limbs of trees, mostly from Laxey Glen on the Glen Roy River was washed into the watercourse and flowed into the Laxey river where it caught and snagged on the superstructure of the MER weir. This caused a major restriction to the combined flood flows of the Laxey River and the Glen Roy, and water levels rose very quickly. In turn the rising flood levels resulted in hydrostatic force on the riverside wall such that a structural failure of the wall over a 20m length occurred. This sudden collapse of the wall resulted in a sudden rush of floodwater onto Glen Road and into properties lying close to the road. It is our assessment and supported by the modelling of this storm undertaken by JBA (1), that it was this particular chain of events that is the reason for the largest proportion of flood impacts experienced on 1 October 2019. We note that reports of the flooding and collapse of the Laxey Harbour Bridge in December 2015 also refer to trapped flood borne debris associated with this event.

A [Blockage Management Guide](#) was published by the Environment Agency in November 2019 (11), ironically just a few weeks after the October 2019 Laxey flood. This outlines good practice for dealing with the risks of blockage management and justifying the relative priority of actions.

RECOMMENDATION 7

We recommend that closer attention is given to addressing the risks of potential debris blockage to vulnerable zones across the Isle of Man.

The Environment Agency Blockage Management Guide, published in November 2019, describes what we consider to be good flood risk management practice.

In summary we recommend:

- Identifying all the glens and river valleys where there is a potential for debris blockages to trigger significant flood impacts.
- Identify and resolve specific features of the watercourse system in these zones to reduce the risks of snagging and catching significant volumes of woody debris.
- Establishing a regular routine of inspecting and dealing with potential causes of flood blockage.
- That a sense of balance and proportionality in approach is achieved which minimises the risk of future flooding but also does not destroy the natural beauty and ecology of the glens.



7.8 Recommendation 8 - Greater attention and more urgency is given to existing plans to deal with surface water flooding

Section 4 of the Flood Risk Management Act 2013 defines surface run-off and the capacity of sewers being exceeded as some of the potential causes of flooding and it is the MUA who have the powers to take any actions they deem necessary under the Act.

The evidence we have seen suggests that most of the surface water flooding during the October 2019 flood and other events previously has been conveyed by the road network and onto people's land and properties.

It is DoI who generally have responsibility to commission drainage works on the public highways on the Island.

We were pleased to learn and see that, for instance, that modelling of the surface water catchment feeding onto Minorca Hill has recently been completed and indeed that the modelling replicates the surface water flow paths seen during the October 2019 event; and further that DoI now intends to implement measures within this surface water catchment to reduce potential flood impacts to people and property.

We also understand that surface water flooding from non-road pathways has caused serious impacts on people's property and lives and it is MUA who have a supervisory duty under the act to consider whether any further action is necessary.

Just to underline the impact of this surface water flooding, information shared with us by the public suggests that the impact and cost of the flooding is such that they can no longer secure flood insurance cover or further surface water flood damages is threatening the sustainability of their businesses.

Case law offers some assistance in guiding when surface water flooding works should be undertaken. It suggests that where flooding is foreseeable and with consequential risks to people and property then there is an expectation that the risk of flooding should be reduced unless the scale of the work involved would be unreasonable and disproportionate to the risk, or the person or body who may be expected to take action can do so in a reasonably practicable manner and has the resources available.

RECOMMENDATION 8

We recommend closer attention is given to instances of surface water flooding on people and property, and that the MUA should exercise their supervisory duties under the FRM Act in 2013 this respect.

MUA should encourage DoI and other organisations and landowners to take actions which the authority deems reasonable and proportionate.



7.9 Recommendation 9 - Review and improve practices of flood forecasting and warning

Due to the rapid response characteristic of watercourses on the Isle of Man to rainfall, flood warnings based on observed rainfall are of limited value due to short lead times.

More emphasis should be put on the forecast of rainfall which could result in either surface water or fluvial flooding. The following suggestions are made to support the future forecasts:

- An assessment of the depths and durations of rainfall for surface water and/or fluvial flood risk for the Isle of Man is undertaken based on historical or design modelled events. This is to produce high-level regional or catchment-based rainfall depth-duration thresholds to be used in conjunction with forecasts.
- We recommend that a quantitative review of the rainfall forecast performance over the Isle of Man is undertaken by the UK Met Office and the Ronaldsway Met Office on the ‘deterministic data feeds’ which are used currently, UKV being the priority for assessment. This is to understand the nature of a general trend for over-estimation of rainfall forecast reported by the Ronaldsway Met Office. In contrast to this more general trend the deterministic feed on 1 October event under-estimated the rainfall depth observed.
- As current forecast feeds into Ronaldsway are predominantly ‘deterministic based’, we recommend that a review of the performance of the ‘UK Met Office’s ensemble forecast prediction system, MOGREPS-UK’, is also undertaken.
- This could be adopted as an additional operational feed to enable Ronaldsway forecasters to better assess the likelihood of a significant rainfall event occurring.
- The final stage would then be coupling of the review of flood inducing rainfall depth-durations with the preferred forecast arrangements to inform future flood warnings. It is suggested that the forecast should be ensemble based and the system designed to account for the spatial uncertainty in the forecast.
- This would be similar to Heavy Rainfall Alert tools similar to those used by other forecasting and warning authorities.

RECOMMENDATION 9

We recommend the Isle of Man review and improve practices for flood forecasting and warning, including:

- an assessment of the rainfall depths and duration of pluvial &/or fluvial flood risk for the Isle of Man is undertaken alongside a review of historical events.
- a quantitative review of the current deterministic forecast performance for rainfall over the Isle of Man is undertaken.
- a review of the performance of the UK Met Office’s probabilistic ensemble forecast prediction system, MOGREPS-UK, is undertaken, and adopted in future, if suitable.
- coupling of the review of flood inducing rainfall depth-durations with the preferred forecast arrangements to produce a Heavy Rainfall Alert tool.



7.10 Recommendation 10 - Recognising the impact that flooding can have on well-being, open a dialogue with the National Flood Forum to explore whether their services can be extended to the Isle of Man

Like in so many other communities affected by flooding people in Laxey shared their concerns about the impact the floods caused and continue to have on their emotional health and well-being. There are social as well as actual economic costs associated with this situation. Typically, medical professionals and friends and family, and the wider community will do what they can to assist, but so often these people do not have the experience and the knowledge to draw from.

The National Flood Forum is a charity that exists to support individuals and communities at risk of flooding. Their priority is to enable people to take control of their own flooding concerns, as well as more general help and support (12).

RECOMMENDATION 10

We recommend that the Isle of Man Government opens a dialogue with the National Flood Forum and explores whether their services can be extended to the Isle of Man. The Forum is a charity that provides practical advice including emotional support to individuals and families in advance of flooding and post flooding.

We understand that given the limited resources of the charity they much prefer to invest their services when they have engagement of public bodies and authorities.



References

1. **JBA Consulting**,. *Laxey October 2019 Flood Incident Review*. Skipton : Jeremy Benn Associates Limited, 2020.
2. **JBA Consulting**. *Laxey Post Event Review: Gap A Analysis*. Douglas : JBA, 2019.
3. **The Highways Agency**. *Design Manual for Roads and Bridges: Volume 4: Section 2*. 2006.
4. **Isle of Man Government**. *Flood Risk Management Act 2013*. Douglas : Isle of Man Government, 2013.
5. **JBA Consulting**. *National Strategy on Sea Defences, Flooding and Coastal Erosion*. s.l. : JBA Consulting, 2016.
6. **Metroeconomica; acclimatise**. *The Isle of Man Climate: Costing the impacts of climate change: estimated costs of three historic events*. s.l. : The Government of the Isle of Man, 2006.
7. **Isle of Man Government**,. *National Strategy on Sea Defences, Flooding and Coastal Erosion 2016*. [Online] 2016.
<https://www.gov.im/media/1352048/national-strategy-on-sea-defences-flooding-and-coastal-erosion.pdf>.
8. **World Population Review**. *Isle of Man Population 2020*. [Online] 2020.
<http://worldpopulationreview.com/countries/isle-of-man-population/>.
9. **DEFA, Department of Environment, Food and Agriculture**. *Making a Planning Application – A Guide for Applicants*. Douglas : Isle of Man Government, 2020.
10. **Pitt, Sir Michael**. *Learning Lessons from the 2007 Floods*. London : U.K. Government, 2008.
11. **Environment Agency**. *Blockage Management Guide: Guide*. [Online] 2019.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/846147/Blockage_management_guide_-_guide.pdf.
12. **National Flood Forum**. *National Flood Forum - What we do*. [Online] 2020.
<https://nationalfloodforum.org.uk/how-we-help/>.
13. **Manx Electric Railway Online**. *Buildings – Laxey Power Station and Turbine House (1894)*. [Online]
<https://manxelectricrailway.co.uk/features/infrastructure/buildings/lcs/power-station/>.
14. **The In-House Lawyer**. *Legal Responsibilities for Flooding*. [Online] 2014.
<http://www.inhouselawyer.co.uk/legal-briefing/legal-responsibility-for-flooding/>.
15. **Manx Utilities**. *Watercourse Management in the Isle of Man: A guide to the rights and responsibilities of riparian ownership*. [Online] 2019.
<https://www.manxutilities.im/media/1833/watercourse-management-iom-dec-19.pdf>.
16. **Isle of Man Government**. *Coastline Management Act 2005*. [Online] 2005.
http://www.legislation.gov.im/cms/images/LEGISLATION/PRINCIPAL/2005/2005-0006/CoastlineManagementAct2005_1.pdf.



17. **Isle of Man Government.** Town and Country Planning Act 1999. [Online] 1999.
https://www.gov.im/media/1349046/townandcountryplanningact1999_4.pdf.

Appendix A

Methodology

- A1 Methodology
- A2 Government Agencies Roles and Responsibilities
- A3 Independent Community Questionnaire Response Summary
- B1 Flood Risk and Source-Pathway-Receptor Model
- B2 Forecasting and Hazard Response
- B3 Flood History
- C1 Detail of Pluvial Flooding Instances
- C2 Incident of Debris Build up
- C3 Laxey Woollen Mills Weir Works
- C4 MER Weir Geometry - Further Information
- C5 Pluvial Flooding Case Law
- D1 Submission from Garff Commissioners
- E1 2016 National Strategy - Laxey
- E2 2016 National Strategy recommendations and perceived progress
- F1 Flood Risk Management Activities
- G1 David Wilkes Biography



A1 Methodology

As a village flooded extensively in the past, including two major floods in less than 4 years, the Review felt in order to be independent it must hear victims first-hand. The several streams of engagement proved extremely informative and revealed a significant amount of information and perspectives to consider. The involvement of the three main agencies, DoI, MUA and DEFA, was also key to the Review. The masses of relevant information they supplied allowed the formation of a well-informed report, which was reliant on the transparency of these organisations.

The following chart aims to summarise the various streams of information gathering that were undertaken in order to inform the review

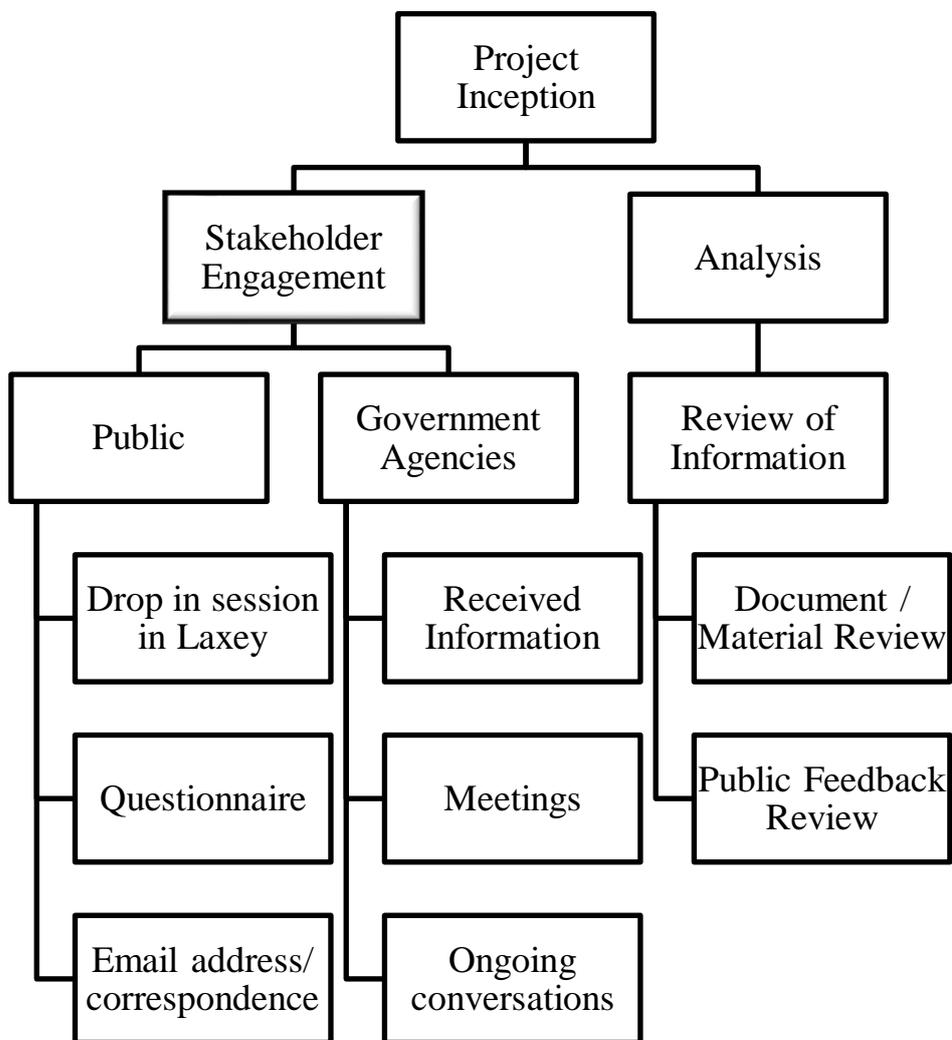


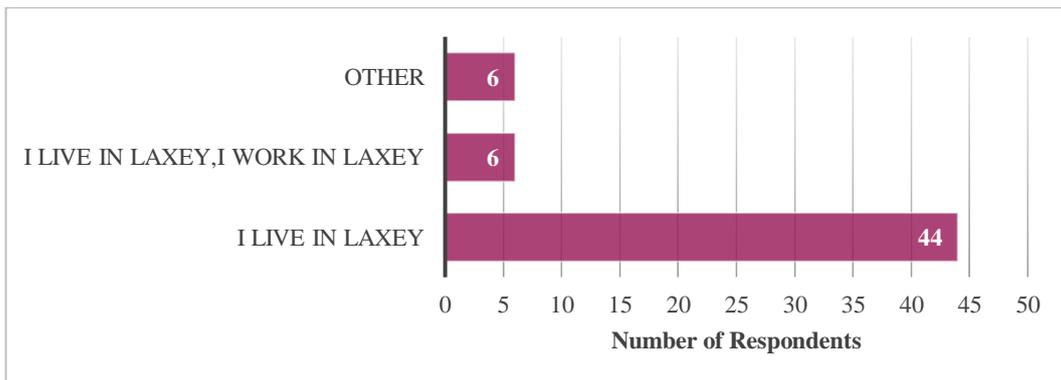
Figure 8 - Model showing the various streams of information gathering.

A2 Independent Community Questionnaire Response Summary

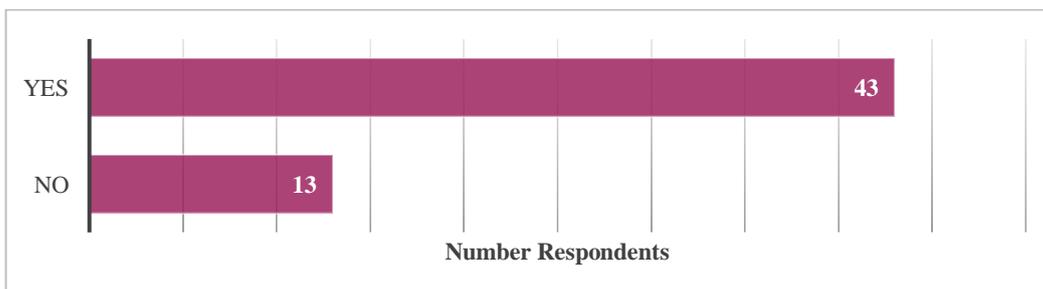
The Laxey Independent Flood Review Community Questionnaire was launched online on the 10th of December 2019, shortly before Arup’s visit to the Isle of Man, and closed on the 6th of January 2020. Paper copies of the Questionnaire were available during the community event held in Laxey Working Men’s Institute on the 11th of December 2019, which could be returned via post or scanned and emailed to the Laxey Independent Flood Review email address. For data protection reasons, detailed answers from the questionnaire cannot be released, but a high-level summary is provided below:

56 responses (52 online responses, 4 hand written)

What is your connection to the village of Laxey?



Were you directly affected by the flooding in Laxey on the 1 October 2019?



76.8% of respondents were directly affected in many ways, and described affects such as:

- Reported flood depths in homes included: 18 inches, 9 inches, 2 ft;
- unable to get to work, school missed;
- being displaced until as late as April (2020);
- reports of up to £300,000 losses;
- landslips on property due to flooding;
- cat was deceased due to drowning during the 1 October flood;

- cars written off;
- some individuals were trapped on the second floor of their home from 06:30 to 16:00;
- missed flights;
- Not possible to obtain flood cover on policy renewal, or 400% increases in insurance premiums;
- struggle to sell properties, and associated devaluation;
- emotional trauma and stress.

In your own experience, please describe what happened on the 1 October 2019 with regards to the flooding in Laxey.

Detailed responses were received, which correlate with the story relayed by the media and Manx Agencies who had been engaged, and detailed in this report. Examples of additional information that members of the public reported included:

- Water entered a home through the floorboards and lavatory;
- Initially (around 06:00) sandbags were locked behind gates at football pitch and Fire station yard;
- Foul smells from drains in car park behind Mona Lisa’s restaurant.

In your own experience, what has happened since the 1 October 2019 with regards to the flooding in Laxey.

Respondents widely acknowledged that a lot of flood risk management work has been done in Laxey since the October flood, but many residents feel this is all ‘too little, too late’ and should have been done after the 2015 floods. Concerns were raised over a ‘a too-hasty response involving the felling of much timber along the river bank, and others commented on the continued disruption to Laxey due to the prolonged closure of Glen Road. A lack of ongoing communication and consultation from the authorities was also mentioned by several respondents.

In your opinion, what were the major causes that led to the severity of the Laxey 1 October flooding?

It seems residents felt that the major cause of flooding was a lack of river maintenance, followed closely by the hole in the wall at the Woollen Mills. Other causes outlined by respondents are detailed below:

Major causes that led to the severity of the Laxey 1 October flooding	Count
Failure to remove trees/lack of river maintenance	39
The hole in the wall at Laxey Woollen Mills weir	38
Lack of maintenance of drains	14
Concrete superstructure of the weir trapped debris	11
Excavator in the river caused a blockage	10

Drainage systems unable to cope	6
Failure to act on warnings	2
Government and agencies (not enough ground staff, too much management)	2
Wrong time of year for the works	2
Overdevelopment around Laxey	2
Impact that global warming is having on rainfall.	1
Lack of government awareness of the flood risk	1
Failure to learn from 2015 event	1
Unnecessary river works	1
Inadequate availability of sandbags	1

Were you aware of the risk of flooding to Laxey on the 1 October 2019 before the event occurred?

45% of respondents said they were aware of the flood risk in Laxey, but mainly due to past personal experience. 3 respondents stated they were aware of the weather warnings that was in place.

Do you have any comment on the flood warnings you may have received?

Very few respondents were aware of a flood warning before the event, and those that were suggest as it was an Island wide weather warning they did not feel directly at risk.

Did you receive any help or assistance on the day or afterwards by any public body or from volunteer organisations, from neighbours family or friends; if so please describe:

Those that provided assistance on the day and after have been praised widely, including the civil defence, emergency services, Paul Carey & Sons, MUA, DoI, the local MHKs and the local commissioners.

If you saw something within the catchment that you believed could contribute to flooding, would you know who to contact?

Only 52% of respondents said they would know you to contact if they saw something in the catchment they believe could contribute to flooding. But when asked who they would contact in this event, respondents gave a range of 7 answers/possibilities, listed below:

Who would you contact?	Count
Commissioners	16
Government	3
DOI	9
MUA	6
DEFA	2
Emergency services	1

MHK	2
-----	---

Since the previous flooding event in 2015, are you aware of any Flood Risk Management activities that have taken place?

No respondents stated they were aware of any flood risk management activities that had taken place since the 2015 flood event, except for specific capital schemes, such as the replacement of the Old Laxey Bridge and the undertaking of the topographic survey.

Please share with us any lingering doubts or concerns about the possibility of flooding in future, feel free to list as few or as many things as you wish:

Many lingering doubts and fears were described from the people of Laxey, but a general sense of hope that this event will finally see them gain better protection and care from any repeat scenarios.

A3 Government Agencies Roles and Responsibilities

DEFA

DEFA’s responsibilities regarding flood risk management are mainly concerned with the uplands, of which they are a major landowner. Any proposed in-channel works which may impact fish populations or their habitats require prior consultation with DEFA Fisheries. Removal of material from a river bed requires consent under Section 18 of the Fisheries Act. The Department bring a scientific background to the FCAG and have a duty in implementing action against climate change. As a significant landowner on the Isle of Man, DEFA has an interest in developing and promoting NFRM techniques on its own land, however, it has no powers to act on land in third party ownership. DEFA are also responsible for the planning applications on the Island, while planning policy sits with the Cabinet Office. DEFA Fisheries will comment on any planning applications which involve in-channel works to ensure the protection of fish and their habitats and officers liaise with MUA regarding applications submitted under the FRM Act for works affecting watercourses. DEFA also administer The Tree Preservation Act 1993, under which a licence is required to fell particular trees.

DoI

DoI is responsible for a wide range of infrastructure across the Island, such as airports, harbours, sea defences and Government buildings. It is the highways authority for the Isle of Man, making it responsible for the draining all highways. River maintenance on main rivers was formerly a ‘qualified duty’ of the Department under the 1934 Land Drainage Act, since repealed and replaced by a modern ‘permissive power’ for Manx Utilities to maintain what became designated watercourses under the FRM Act from April 2014. A senior DoI officer chairs the FCAG meetings, and the Department take responsibility for projects concerning harbours and coasts. DoI still has a relatively large

maintenance workforce, despite it having fallen from 400 to 100 over recent years.

The **Island's Met Office** service, often known as Ronaldsway Met Office is also managed by the DoI, with the main purpose of providing weather reports for the airport. The issuing of weather warnings often sees the deployment of a duty officer in the Island's main Ellerslie Control Room, with field support teams around the Island under DoI control to deal with any issues that may occur. The aftermath and recovery from extreme weather events is often undertaken by DoI, as it is most able to mobilise staff and civil engineering resources.

MUA

MUA was created in April 2014, following the merger of the Isle of Man Water and Sewerage Authority and the Manx Electricity Authority. It has a Statutory Board of the Government through sponsorship by the DoI. The Authority runs under six business streams; energy, water supply, sewerage, natural gas transmission, powers to run telecoms arm and flood risk management. The first five streams are revenue earning sections and are expected to be self-funding, while flood risk management is the only function which operates through revenue budget funding from the Isle of Man Government.

MUA carries a supervisory duty, as the flood risk management authority for the Island, role under the Flood Risk Management Act 2013. While its duties under the Act are mostly permissive, there is an expectation that they will take actions to manage the risks in high flood risk areas. It has the powers to undertake maintenance and improvement works for sections of rivers deemed designated watercourses, the corridors of which extend 9.1m either side of each bank.

Local Authorities

The Isle of Man's local authorities undertake a range of duties, from refuse collection to running libraries. Laxey is part of the Garff parish district, which was formed in 2016 through a merger with the parish districts of Lonan and Maughold. The local authority has some responsibilities for highway drainage maintenance under the Highways Act 1986 Delegation of Functions to the Local Authorities. They also have some powers of vegetation maintenance under the Trees and High Hedges Act 2005, however these powers are regarding neighbour disputes on hedging rather than river maintenance.

Appendix B

What Happened

- A1 Methodology
- A2 Government Agencies Roles and Responsibilities
- A3 Independent Community Questionnaire Response Summary
- B1 Flood Risk and Source-Pathway-Receptor Model
- B2 Forecasting and Hazard Response
- B3 Flood History
- C1 Detail of Pluvial Flooding Instances
- C2 Incident of Debris Build up
- C3 Laxey Woollen Mills Weir Works
- C4 MER Weir Geometry - Further Information
- C5 Pluvial Flooding Case Law
- D1 Submission from Garff Commissioners
- E1 2016 National Strategy - Laxey
- E2 2016 National Strategy recommendations and perceived progress
- F1 Flood Risk Management Activities
- G1 David Wilkes Biography



B1 Flood Risk and Source-Pathway-Receptor Model

The term ‘risk’ has a multitude of meanings and applications, with the different definitions often reflecting the needs of the decision-makers. The terminology of ‘risk’ has been developed so broadly that it is now open to some misunderstanding and misrepresentation. More technical risk assessments rely on the distinction between the words ‘risk’ and ‘hazard’.

In order to understand the link between hazard and risk, it is useful to consider the Source-Pathway-Receptor model. The simple conceptual model represents systems and processes that lead to a consequence such as the destruction caused by flooding. For a risk to be realised, there must be three things:

- A ‘Source’, or initiator event, is the origin of the hazard, which in the case of flooding is most often heavy rainfall;
- A ‘Receptor’, is the entity that may be affected by the hazard occurring;
- And a ‘Pathway’, which is the route the hazard takes between the source and the receptor, such as overland flow or the overtopping of riverbanks.

A hazard does not always lead to a harmful effect, as the harm depends on the exposure to the hazard and the characteristics of the receptors.

Flood risk management (FRM) is effectively a way of assessing the Source-Pathway-Receptor model, so to reduce the risk of the Receptor being exposed to the hazard or reduce the magnitude of the consequences of exposure to the hazard. As the Source or Receptors of flooding cannot be readily modified, it leads to the Pathways being the element of the model most typically controlled. A simple Source-Pathway-Receptor model for the flood event that occurred in Laxey on the 1 October 2019 is included in the report.

The ultimate Source of this event was the Climatic Event that led to heavy rainfall over the Laxey catchment, creating two principal sources of flood water, firstly flows in the local watercourses, and second just surface water runoff over land and down the road systems.

The Receptors of the event were the residents and properties of Laxey, in various locations around the valley, that have suffered both material losses of homes and cars as well as emotional traumas, many of whom have been exposed to this hazard in the past.

The Pathways in this event came in various forms, but the most significant have been summarised as those above. The occurrence and management of such pathways is the main topic of investigation in this report, and whether different control could have reduced the consequences of the hazard.

B2 Flood History

Table 2 - Summary of Recorded flood events that have occurred on the Isle of Man.

Date	Place	Flood Mechanism
September 1873	Ramsey	Tidal flooding
October 1891	Ramsey	Tidal flooding
October 1896	Ramsey	Tidal flooding
	Castletown	Tidal flooding
February 1899	Douglas	Severe tidal flooding
	Ramsey	Severe tidal flooding
	Castletown	Severe tidal flooding
October 1901	Castletown	Surface water flooding
November 1904	Douglas	Tidal flooding
March 1910	Sulby	Surface water flooding
	Ramsey	Surface water flooding
November 1910	Douglas	Surface water flooding
1915	Sulby	Surface water flooding
	Ramsey	Surface water flooding
February 1912	Douglas	Tidal flooding
January 1924	Douglas	Tidal flooding
December 1924	Douglas	Tidal flooding
	Ramsey	Tidal flooding
February 1929	Greenlands	Surface water flooding
December 1929	Peel	Surface water flooding
	Foxdale	Surface water flooding
	Ramsey	Surface water flooding
	Andreas	Surface water flooding
September 1930	Peel	Surface water flooding
	Ramsey	Surface water flooding
	Laxey	Surface water flooding
	Douglas	Surface water flooding
	Castletown	Surface water flooding
1931	Laxey	Surface water flooding
	Peel	Surface water flooding
November 1931	Douglas	Surface water flooding
	Greenlands	Surface water flooding
	Ramsey	Surface water flooding

August 1932	Douglas	Tidal and surface water flooding
January 1936	Ramsey	Surface water flooding
July 1936	Douglas	Tidal and surface water flooding
December 1936	Ramsey	Surface water flooding
January 1937	Douglas	Tidal flooding
November 1938	Port St Mary	Tidal and surface water flooding
January 1940	Port St Mary	Fluvial flooding
November 1940	Laxey	Blocked culvert
January 1942	Douglas	Surface water flooding
	Laxey	Surface water flooding
September 1950	Douglas	Surface water flooding
January 1953	St Johns	Surface water flooding
November 1953	Ramsey	Surface water flooding
October 1954	Castletown	Surface water flooding
December 1954	Laxey	Surface water flooding
November 1955	Douglas	Tidal flooding
September 1956	Douglas	Surface water flooding
January 1958	Ramsey	Surface water flooding
October 1959	Ramsey	Surface water flooding
March 1962	Douglas	Tidal flooding
	Ramsey	Tidal flooding
February 1966	Ramsey	Tidal flooding
April 1966	Douglas	Surface water flooding
March 1967	Ramsey	Tidal flooding
December 1969	Douglas	Tidal flooding
1971	Douglas	Surface water flooding
February 1977	Colby	Fields flooded
December 1979		15 major but isolated flood occurrences
September 1982	Castletown	Surface water flooding
	Foxdale	Surface water flooding
	Colby	Surface water flooding
	Port St Mary	Surface water flooding
October 1982	Castletown, Foxdale, Colby, Port St Mary	
December 1982	Onchan	Surface water flooding

February 1997	Ramsey	Tidal flooding
	Douglas	Tidal flooding
	Castletown	Tidal flooding
January 1999	Douglas	Surface water flooding
	St Johns/Peel	Surface water flooding
February 2002	Douglas	Tidal flooding
	Laxey	Tidal flooding
	Castletown	Tidal flooding
	Peel	Tidal flooding
	Port St Mary	Tidal flooding
	Ramsey	Tidal flooding
October 2002	Douglas	Surface water and tidal
	Laxey	Surface water and tidal
	Onchan	Surface water and tidal
November 2002	Douglas	Tidal flooding
March 2003	Laxey	Fluvial flooding
March 2008	Ramsey	Fluvial flooding
September 2008	Sulby	Fluvial flooding
October 2008	Sulby	Fluvial flooding
November 2010	Sulby	Fluvial flooding
October 2012	Foxdale	Surface water flooding
	Colby	Surface water flooding
November 2012	Laxey	Tidal flooding
2013	Colby	Surface water flooding
January 2014	Douglas	Tidal flooding
	Laxey	Tidal flooding
	Onchan	Tidal flooding
December 2015	Douglas	Fluvial and surface water flooding
	Laxey	Fluvial and surface water flooding
	Sulby	Fluvial and surface water flooding
October 2019	Laxey	Fluvial and surface water flooding
	Douglas	Fluvial and surface water flooding

B3 Weather warnings, Forecasting and Hazard Response

Five-day forecasts are issued by the Ronaldsway MO daily by 6am.

In the lead up to the October event the synoptic conditions (general weather patterns) and likelihood of rainfall occurring appears to have been forecast in advance, with the risk of heavy rainfall overnight reported from the 29th onwards. However, the rainfall totals forecast was low at 8-15mm on the 29th, increasing to 15-20mm with 30-40mm over hills by the morning of the 30th September.

Discussion with Ronaldsway MO revealed that the operational forecasters have formed the opinion over time that the feeds from weather forecast models (the UK Met Office deterministic model tend to overestimate " the precipitation totals 80% of the time.

By contrast in the case of the 1 October 2019 event it appears that the deterministic forecasts significantly underestimated the precipitation totals.

It should be noted that a quantitative assessment of the forecasts models has not been undertaken as part of this commission. The spatial scale and topography of the Isle of Man will result in significant variability in precipitation totals which will significantly challenge the performance of forecast models, especially in regard to rainfall. In addition, the high precipitation totals of the October 2019 event were a function of the convective activity along the stalled front as well as significant orographic enhancement, and detail (location, intensity and likelihood) of convective rainfall is also a known limitation of forecast models, although one which has been significantly improved in recent years, as is orographic enhancement.

The MAE (Model Assessment and Emphasis) report from the UKMO does suggest that convective activity to the south of the front in the IoM region could be a feature overnight from the 30th into the 1st, however, this was issued as the rainfall event was occurring.

The discussion with Ronaldsway MO also indicated that the weather warnings for heavy rainfall are not associated with a formal assessment of fluvial and/or pluvial flood risk for the Isle of Man. The operational guidance for issuing weather warnings was reviewed in 2016 and the warning category thresholds were adjusted to be more aligned with the UKMO. This to reduce the chance of confusion by the public between different weather warnings from the come from UKMO and Ronaldsway MO. During the 2016 review it was also said that the previous thresholds were too low resulting in a higher number of warnings being issued and the warnings being disproportionate with the risk or resulting impact. Although the principle of alignment of weather warnings is good, the UKMO do not have the sole responsibility for flood forecasting and warning and there have often been discussions about how weather warnings in the UK can be "at odds" with the flood warnings. The UKMO are also supported by the Flood Forecasting Centre and EA and SEPA regional and local teams who have detailed knowledge of how their catchments respond to rainfall, and work has been done to assess the

rainfall depths and durations which could result in flood impacts. This assessment helps to guide the weather warning categories.

Appendix C

Factors of Flooding

- A1 Methodology
- A2 Government Agencies Roles and Responsibilities
- A3 Independent Community Questionnaire Response Summary
- B1 Flood Risk and Source-Pathway-Receptor Model
- B2 Forecasting and Hazard Response
- B3 Flood History
- C1 Detail of Pluvial Flooding Instances
- C2 Incident of Debris Build up
- C3 Laxey Woollen Mills Weir Works
- C4 MER Weir Geometry - Further Information
- C5 Pluvial Flooding Case Law
- D1 Submission from Garff Commissioners
- E1 2016 National Strategy - Laxey
- E2 2016 National Strategy recommendations and perceived progress
- F1 Flood Risk Management Activities
- G1 David Wilkes Biography

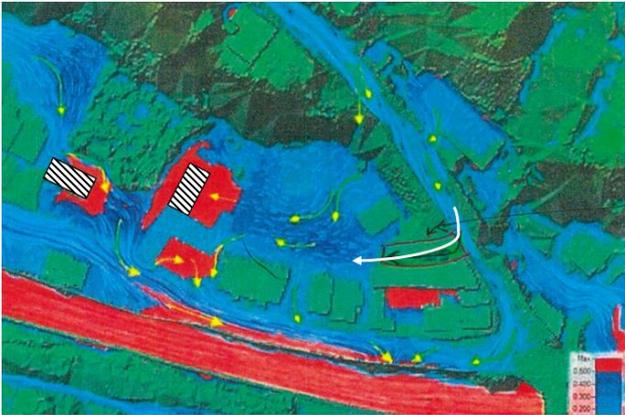


C1 Detail of Surface Water Flooding Instances

Table 3 - Description of several individual pluvial flooding issues in the Laxey catchment.

This table has been developed from various sources of evidence, most informative of which were discussions with local residents and commissioners. The several independent instances of surface water flooding highlight issues occurring in the wider catchment.

Location	Description
<p>Properties at the bottom of Minorca Hill, including the Mona Lisa restaurant and Laxey Laundry</p>	<p>Significant surface water running down Minorca Hill road is a known issue and several properties on the northside of Glen Road, just upstream of Laxey Bridge, were flooded significantly solely from this mechanism and not by fluvial means.</p> <p>This has been attributed in part to lack of maintenance, but descriptions of the frequency and severity of runoff suggests that the drainage provision is inadequate for the flows received on a regular basis. Whilst an infrastructure upgrade may be required, flow routing should also be considered as an effective way to manage flows.</p> <p>The road has a relatively large catchment area, and with a lack of adequate drainage, the cumulative flows are described to become significant and in cases hazardous. The runoff is said to cause many issues, but its most severe damage is done at the bottom of the hill. Flows are diverted down the side road behind the Mona Lisa restaurant, over a dropped kerb that is lowered for vehicle access. Large volumes of water were diverted this way on the 1 October, flooding the car park of the apartments and the properties in front of them.</p>

	<p>The image below shows modelling outputs completed by JBA for predicted 100-year with 30% climate change flows in the area, provided to the Review by a member of the public. Local knowledge questions the flows indicated by this modelling (yellow arrows) and suggests the real flow path is that shown by the white arrow. The properties shown in black and white are those deemed most at threat, which correlates with the modelling. This information was also shared with MUA and has been forwarded to the modellers in order to make modifications.</p>  <p>Figure 9 - Image showing catchment modelling outputs at the bottom of Minorca Hill area.</p>
<p>The Shore Hotel</p>	<p>The location of the Shore Hotel means it has been flooded by various mechanisms for many years. However, flooding from surface water runoff has evidently increased since the replacement of the Old Laxey Bridge after the 2015 flood event. The change of bridge superstructure from humped to flat has meant that runoff from Minorca Hill now flows across the bridge to the south side of the Laxey River. While a highway drain is installed on the southside at the bridge, accounts state that the runoff largely misses this drain and runs onto the carpark of the Shore Hotel subsequently flooding the basement of the property, as shown in the image below supplied by a local resident who performed an experiment using milk as a dye in the rainfall runoff.</p> <p>During the 1 October event, the Laxey River did not significantly overtop at the Shore Hotel, however the property was flooded. CCTV footage shows how the car park gradually fills with runoff from the road.</p>

	<p>Despite this evidence, the basement flooding at the Shore Hotel is likely to in part be due to subsurface water ingress, and tanking on the underground element of the property should be considered.</p>  <p>Photograph 13 - Surface water flow over the new Laxey Harbour bridge, looking towards Minorca Hill.</p>
<p>Ramsey Road runoff</p>	<p>Significant surface water runoff from the A2 Ramsey Road and the hills to its north is noted to affect residents of Minorca Vale (several properties heavily flooded), Upper Cronk Orry (1 property flooded) and Ramsey Road Cul de Sac (2 properties flooded).</p>

A lack of drainage along a long length of Ramsey Road as it enters Laxey from the east is noted to cause a build-up of runoff flowing down the road. The drainage that is provided further down the hill is said to be inundated on a regular basis. As the flow comes into the residential area, it finds various paths which cause issues to properties. The image below demonstrates flow paths that are known to cause flooding to properties on Upper Cronk Orry and Ramsey Road Cul de Sac. A blocked culvert at the bottom of Minorca Vale is suggested to be the cause of significant issues to two properties there. This culvert was identified during a drain survey in March 2018, but no action is reported to have been taken. Properties on Quarry Road and Minorca Hill itself are also said to be affected by related issues. Reports state that flooding incidences in 2015, 2016 and 2017 occurred shortly after local gullies made been cleared, indicating issues or inadequacies with the systems.

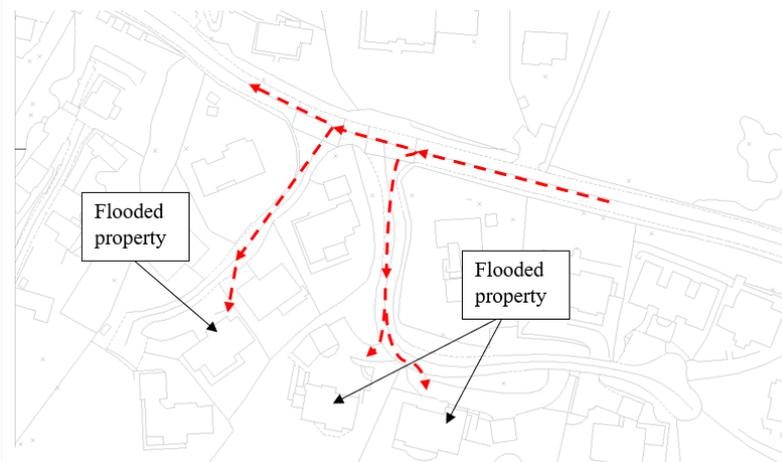


Figure 10 - Image showing flow paths at Upper Cronk Orry and Ramsey Road Cul de Sac

<p>New Road Culvert/Drain</p>	<p>A culvert under the New Road carries a stream from the north. During heavy rainfall the culvert is overwhelmed and causes flow from the stream to instead flow down the road. The runoff's flow path includes diverting down a side street and down the hillside to the Laxey River. On the 1 October this is thought to have caused a landslip above the MER line.</p>  <p>Figure 11 - Image showing flow path on the New Road (left) and photograph of area after heavy rainfall event (right).</p>
<p>Mines Road</p>	<p>The concentration of flow through a concrete culvert under the MER line above Mines Road caused flooding issues to local properties on the 1 October, as well as several times in the past. The flow from the culvert has led to a waterfall, that in heavy rainfall results in a number of tributaries, some of which make their way to residential properties where they have caused flooding issues.</p>  <p>Figure 12 - Image showing flow paths affecting properties on Mines Road.</p>
<p>Ballaragh Road</p>	<p>Similar to Ramsey Road, the Ballaragh Road has long stretches with no drainage, and so the build of runoff as it enters Laxey from the east is substantial.</p>

<p>Flooded bridge outside working men’s institute always an issue</p>	<p>During heavy rainfall, localised flooding of the New Road bridge often causes the closure of the bridge. As the centre of Laxey is often already severely affected in such events, the village becomes effectively impassable. This can have serious effects on both resident’s lives, and the access for responders to flood events.</p>  <p>Photograph 14 - Flooding at the New Road bridge, adjacent to Laxey Working Mens Institute.</p>
---	---

C2 Incident of Debris Build up

Almost certainly a significant contribution to the debris which caught on the MER weir was an upstream ‘tree-jam’ across the Glen Roy River within the Laxey Glen, approximately 1.4 km upstream of the confluence with the Laxey River which became dislodged and washed down on 1 October 2019. This tree-jam was reported to the government authorities almost a year earlier, via the Garff Commissioner, on the 5th of October 2018, with the concern being:

‘the large volume of material that could potentially be washed down and cause issues in the main river and flooding property’

The blockage, reported to be creating a waterfall with 1.5m from upstream to downstream, can be seen in Photograph 6 - Tree-jam in the Glen Roy River in 2018.



Photograph 15 - Tree-jam in the Glen Roy River in 2018.

On the 8th of October 2018, a MUA officer visited the site of the tree-jam.

Two days later, the Garff Commissioner received a message that *‘due to the location of the trees and the difficulty we would have in removing them, they will have to remain.’*

The officer cited reasons of unsafe access to undertake removal off site and low likelihood of the pile to moving, with further expectation that if the debris did move it could be removed from the river at a safe access point at the basin by the Laxey Glen Mill Race and not foreseeing snagging on the further downriver MER weir superstructure as actually seems to have happened.

It is suggested that this tree jam originally deep within Laxey Glen was dislodged during the 1 October flood event and made a significant contribution to the accumulation of debris at the MER weir, where 50 tonnes of timber are said to be removed.

During the October 2018 inspection it was recommended that the tree-jam be marked to track its movement, and accounts suggest that this marked wood could be seen at the MER weir blockage. On the 4th October 2019 an Officer from Garff Commissioners visited the site of the tree-jam in Laxey Glen and found that it no longer existed. Evidence of scour was also observed downstream of the earlier tree blockage location. An MUA officer also is also said to have visited the site following the October 2019 incident and found two large trees still remained in position across the Glen Roy River, but that the smaller deadwood had moved – subsequently a contractor was arranged to chainsaw the large trees into pieces for removal.

C3 Laxey Woollen Mills Weir Works

The Laxey Woollen Mills weir has seen various upgrades over the past years. In 2015 the weir was in very poor structural condition, and work was undertaken to reconstruct its front face and to prevent undermining of the upstream bridge and walls. The works were designed for the passage of fish as to comply with the Fisheries Act 2012. Subsequently over winters scour developed downstream and on the right bank of the weir, which DEFA are said to have considered was causing an issue with fish passage. In 2017, planning applications were submitted by MUA for further repair works to the weir, including reconstruction of the collapsing weir face, and it was agreed with DEFA that improvements to fish passage were also to be included in the scheme. The design of the weir works was therefore awarded to a fisheries specialist the consultancy Fishtek. These additional works did not start on site until Summer 2019. The following considers key aspects of the project related to flood risk.

C3.1 Pre-Construction

According to MUA, at tender stage the project was assessed to be of small enough scale that only Regulation 13 would apply under the Island's Construction Design & Management (CDM) Regulations 2003. However, once the indicative programme was received from the tenderer, the project became further notifiable under CDM regulations. This meant that a Planning Supervisor was required, and this position was appointed to JBA, who prepared and issued a Pre-Tender Health & Safety Plan (PTHSP). After the tender process, Paul Carey & Sons Ltd (PCS) were appointed as the Principal Contractor and were to agree and adhere to the PTHSP before commencing work on site.

The pre-tender Method Statement & Risk Assessment provided from PCS in their tender for the weir works has been made available for this review. The Method Statement only refers to flooding in a single footnote stating 'Note: Risk assessment should be used to identify other site-specific hazards (e.g. Overhead power lines, flooding, impact of changes in ground water conditions)'. However, the associated Risk Assessment does not include any methods for dealing with the risk of flooding although there is one mention of heavy rainfall, which is related to avoiding working in the river rather than reducing flood risk. The risk assessment in this case considers employee onsite safety only, rather than the wider implications of the works. It should be noted that these were pre-tender documents, and site-specific assessments were to be undertaken by PCS before construction began.

Further risk assessments have been reported to have been undertaken and accepted by the client and the Planning Supervisor before the commencement of the works. Copies of these have been requested from MUA and PCS but have not yet been provided for review. The available evidence indicates that the consideration of flood risk was not adequate with regards to these works.

C3.2 Construction Stage

The Laxey Woollen Mill weir works were undertaken by PCS. The project was originally programmed to start in early July 2019 with in-channel works to be completed in late August. The work was planned at this time as in-channel works are only permitted by DEFA Fisheries in the window of July to September. Delays with the contractor's previous job and health and safety documentation issues meant that the start date was deferred to mid-August, leaving them a 6-week programme for completion.

The PCS pre-tender method statement for the project stated 'Access for the site has been planned to knock down the existing wall on the Glen Road, we would agree the position with the Project Manager in the pre-commencement meeting', which was also used during the 2015 works. The pre-commencement meeting happened on the 31st of July, from which brief notes are available. Where the machine was intended to be put in the river was discussed, but no specific reference to the planned location or mitigation of the access hole was made.

On the 19th of August 2019, the contractor began work on site, forging access to the River Laxey by breaking down the highway wall on Glen Road. Outside of site working hours, it was protected with Heras fencing (open wire mesh) and traffic cones. Local residents are said to have made complaints to the government regarding this lack of flood protection, but no action was taken.

Issues were raised with the contractor not attending pre-arranged meetings and concerns as to whether they were providing adequate resources to complete the job within the allowed period. The contractor was also reportedly not providing adequate notice when fisheries were required on site, causing potential further delays. Due to various issues, an updated programme for the completion of the works was released on the 23rd of September, indicating that in-channel works would be completed by the 4th of October and the stone wall would be rebuilt from the 5th. The extension of working in the river past the September window was accepted by MUA and DEFA.

On the 30th of September several Yellow weather warnings were released by the Isle of Man Met Office. PCS were apparently informed by MUA operatives of this weather warning and advised to secure the site. The contractor is not believed to have installed any additional barrier to mitigate the risk of flooding via this hole in the wall. The contractor is also known to have left an excavator and associated temporary works in the river channel on the night of the 30th of September, which affected the flow path of the river. On the 1st of October, the village of Laxey was hit by extensive flooding, where one of the first pathways of flooding was through unprotected the hole in the wall. Subsequent modelling by JBA shows that water would have left the river channel this far upstream without the presence of the hole.

C4 MER Weir Geometry - Further Information

The weir, now known locally as the MER weir, was once part of Laxey Power Station hydroelectric plant, until this form of power was decommissioned in 1934. The concrete superstructure was also subject to severe debris accumulation in 1930, during another major flood in Laxey (13).

MUA are reported to have previously consulted with Manx National Heritage on the removal of the concrete superstructure of the MER weir, but due to concern for historic infrastructure in the Laxey conservation area and the potential for debris to instead snag at the next downstream pinch point, it was decided the superstructure should be retained. However, a social media post from Manx Natural Heritage after the 1 October flood stated that ‘we have not objected to the removal of any of the weirs in the glen’, going on to say ‘the MER weir is not in our ownership nor was it ever in our power to refuse its removal.’ The confusion of ownership and responsibility regarding structures in such a significant part of the river may add to the prelude of questionable river management. Public debating of such matters is also likely to decrease the communities trust in the authorities that govern them.

A pre-survey stability check of structures in Laxey was undertaken in January 2013, during which the MER weir and associated downstream apron were considered at significant risk of structural collapse. No such concerns about the Woollen Mills weir are stated in the report, however this weir has been subject to extensive work since, while the MER had been left untouched until October 2019. The presence of a high-voltage cable running through the crest of the Woollen Mills weir is the likely reason for this. The MER weir and its superstructure are a known risk, both structurally and as a snag point for debris, and the lack of assessment of its presence is questionable. The 1 October post-event T98 surveys also indicates the washer beds just downstream of the MER weir are a high risk and need urgent work.

The presence of the MER is reported to have been considered as a risk to flooding, and that the reason for inaction was the wider catchment modelling that has been ongoing for several years. It seems that the removal of the weir could have been a ‘quick win’ solution to manage flood risk in Laxey, subject to assessment.

C5 Pluvial Flooding Case Law

It has long been established that downstream landowners cannot bring a claim against their upstream neighbour for any flooding caused by the natural occurrence of water running onto the lower land. Liability will only arise from the drainage between adjacent land if the upstream neighbour takes action which is non-natural or deliberate and which causes water to flow onto the downstream neighbour’s land.

So, while landowners have the right to pass on waters to their downstream neighbour, this lower landowner also has the right to receive water in its natural state without alteration. Cases such as *Bybrook Barn Garden Centre v Kent County Council* [2001], ruled against the drainage authority stating that once aware that drainage was not adequate, they were under a duty to do what is reasonable to prevent flooding.

In the case of *John Green v Lord Somerleyton*, it was ruled that the defendant would be liable if flooding was caused by a failure to do what is reasonable in the circumstance, with the scope of the duties for every landowner is to consider:

1. The extent of the risk – whether it is reasonably foreseeable that damage will be caused;
2. The foreseeable extent of any damage;
3. Whether it is practicable to prevent or minimise any damage;
4. If it is practicable, the extent of the works required;
5. The financial resources of the parties (14).

Appendix D

Garff Commissioners Letter

- A1 Methodology
- A2 Government Agencies Roles and Responsibilities
- A3 Independent Community Questionnaire Response Summary
- B1 Flood Risk and Source-Pathway-Receptor Model
- B2 Forecasting and Hazard Response
- B3 Flood History
- C1 Detail of Pluvial Flooding Instances
- C2 Incident of Debris Build up
- C3 Laxey Woollen Mills Weir Works
- C4 MER Weir Geometry - Further Information
- C5 Pluvial Flooding Case Law
- D1 Submission from Garff Commissioners
- E1 2016 National Strategy - Laxey
- E2 2016 National Strategy recommendations and perceived progress
- F1 Flood Risk Management Activities
- G1 David Wilkes Biography



D1 Submission from Garff Commissioners

Report from Garff Commissioners received by the Flood review team on 06/01/2020.

Glen Roy River Blockage

On 5th October 2018 Garff Commissioners officers reported a large dam of trees in the Glen Roy river located approximately 1km upstream from the entrance to the Laxey Glen. The trees were causing a dam effect on the river, with a fall of approx. 1.5m upstream to downstream. Concerns were that if the trees were to be washed down the river they would cause blockages further downstream that could potentially cause flooding to property. An email with photographs attached was sent to Manx Utilities. An officer from Manx Utilities to visited the site on the following Monday. Following the site visit a response was received via email:

“Just about managed to get my breath back from my visit down Glen Roy on Monday. Always nice to explore new places on the Island. Just to confirm that due to the location of the trees and the difficulty we would have removing them, they will have to remain. It would definitely be a job for an excavator and from what I could see there is no safe way to access the watercourse with any machinery and I would not be prepared to instruct a contractor to do so. As there is no infrastructure or properties in the area that would be affected by rising river levels, we feel that there is little justification for removing the pile. The river will be able to find it’s way through and over the trees in high flows. I will arrange to have the large trunks marked so that if/when they find their way downstream, we can identify where they have come from. We suspect if they do move, they will be caught in the basin next to the millrace where the last big pile up was removed. We can then arrange to safely remove them. We will also liaise with forestry over the management of the land in question as I noticed there were a couple fallen trees left in the area which could possibly find their way into the river at some point.”

On the 2nd October 2019 an employee of Paul Carey Ltd informed an officer from Garff Commissioners that 180 tonnes of timber had been removed from the MER sluice gate in the Laxey River on Glen Road. On the afternoon of the 1st October it was observed that significant volumes of timber had been deposited along the high tide line on Laxey beach.

On 4th October an Officer from Garff Commissioners visited the site of the blockage in the Glen Roy river and it was noted there was no trace of any material in the area. It was observed that from the location of the blockage downstream the riverbank showed evidence of scouring. This was not evident upstream of the blockage.

Consideration needs to be given to Manx Utilities and the Governments response to this and whether more could have been done at the time to remove the material

and recommendations can be made for dealing with similar blockages in the future.

Government Response to Reports of issues with Surface water Drainage and flooding

On 3rd December 2015 Laxey suffered a flood event which is well documented. Following this event Manx Utilities engaged JBA to undertake a survey of the Laxey catchment area and update the flood models. Garff Commissioners understand that following completion of this work Manx Utilities would liaise with DEFA and Department Infrastructure to identify works that needed to be carried out to lessen the impact of flooding in the future. This does not seem to have happened. Furthermore, Garff Commissioners have collated correspondence between them and various Government Departments drawing their attention to various issue relating to surface water drainage and flooding. Garff Commissioners would encourage the Government to take a more proactive approach to investigating and resolving these issues. Please see separate emails with attachments.

Survey and mapping of Surface water drainage systems

Historically surface water drainage systems i.e. gully's, culverts and ditches have been maintained by the Department of Infrastructure and prior to that the Isle of Man Highway Board. Over the years significant local knowledge was built up by operatives who, and in some cases still do work in local 'gangs'. This knowledge is held by current and former Government operatives and in some cases by the Local Authority. It was noted that after the 1st October flood event a number of the surface water drainage systems were found to blocked or partially blocked. A recommendation from Garff Commissioners is that all surface water drainage system are recorded and mapped to enable location, inspection and maintenance to be carried out on a regular basis, without the total reliance on the local knowledge. Any surveys and mapping carried out should include the Manx Electric Railway system, including the Snaefell line. Recommendation – Survey and mapping of the surface water drainage systems in the Laxey catchment area. It is noted that the sewage systems are mapped and Garff Commissioners hold drawing produced in 1994.

Access to detailed flood map models

As part of a current planning application it has been noted that the applicant has had access to flood modelling data produced by JBA on behalf of the Isle of Man Government. This data provides detailed information, more that can be obtained from the Isle of Man Governments website. If the data were to be made publicly available, it would give residents more informed information on how to best protect their property from future flood events. Recommendation – Flood model data and information made freely and easily accessible.

Riverbank Management

It was observed that in the weeks following the flood the Manx Utilities put considerable resource into removing trees from both the Laxey and Glen Roy

River Banks. The remit behind this exercise is not fully understood and several seemingly healthy trees were removed. The blockage that was observed in the Glen Roy river in October 2018 was likely to be a result of a number of dead and diseased trees falling into and being washed down the river. If regular tree management were carried out on the river banks and dead, damaged, diseased and overhanging trees were felled and logged into short lengths on site, no further action would be required as the timber would eventually find its way down the river with out risk of blockage downstream. Recommendation – Regular inspection of riverbank to identify, fell and log trees that may become an issue in the future.

North Laxey/Minorca Catchment

Storm waters that ran from north of Laxey caused significant problems on the 1st of October for residents of the following areas (please see attached maps numbered 1, 2 & 3 in the attached file):

1. Ramsey Road cul de sac.
The property ‘Regent House’ (currently empty) was flooded on October 1st and the neighbouring property ‘Iverna House’ had its garage flooded and the house came close to flooding. The storm waters ran down from Ramsey road and from the fields above.
2. Upper Cronk Orry
The property ‘Arisag’ was catastrophically flooded. The storm waters ran down from Ramsey road and from the fields above (resident statement Appendix A in attached file).
3. Minorca Vale cul de sac
The property ‘Hollydene’ was catastrophically flooded and the property ‘Primrose Cottage’ which is being renovated had a stream of water running through and seemingly under it. The storm waters entered the north end of the cul de sac from Ramsey Road direction. The problem is greatly exacerbated by a large culvert under Minorca Vale road that Manx Utilities have identified as blocked. It would appear that due to this blockage water is backing up and emerging through the gullies higher up and actually breaking through the road surface thus allowing water to flow into the two named properties. Neither Manx Utilities or DoI have as yet proposed a solution to clear the culvert (please see resident statement Appendix B in attached file).
4. Minorca Hill
Storm waters from Ramsey Road, Ballaragh Road and the fields above north Laxey tend to make passage through the above named areas and come down Minorca Hill.
5. Quarry Road
These storm waters also make into Quarry Road threatening several properties close to the junction.
6. Glen Road (particularly Rosedene Cottage, the Cranleigh Ville Site, the adjacent properties to the east of these, the Laundry business, La Mona Lisa restaurant).

The storm waters that ran down Minorca Hill were reportedly 8 – 10 inches deep for a time on October the 1st across the carriageway and pavement. These waters

entered the drive to the flats behind 'La Mona Lisa Restaurant' and flooded the basement of the restaurant and also catastrophically flooded 'Rosedeane Cottage' on Glen road from the rear. The Laundry business on Glen Road was only saved by pre-planned infrastructure at the site and by the determined efforts of the owner. Other properties in the immediate vicinity are also in potential danger from storm waters coming down Minorca Hill (please see resident statement at Appendix C in regard to a planning application in the vicinity and to flooding problems caused by storm water flow down Minorca Hill).

Additional information: A flood modelling map of Lower Minorca Hill is attached at Appendix D in the attached file which was produced by JBA consultants and has been provided as part of a live planning application at Cranleigh Ville. This does not give a fully accurate picture of what occurs on the ground. In short the flow of water from Minorca Hill to the rear of the Glen Road properties actually enters lower down the road along the access drive to the flats behind Glen Road (indication of this has been added by this office to Appendix D). The properties on Glen Road named at item 6 above are all under much greater flood risk than Appendix A suggests – all should be marked in red perhaps.

Mines Road Catchment

Storm waters running off the hills behind properties on Mines Road flooded several properties on October the 1st 2019 as indicated on Map 4 attached. The problems with flow of storm water from these hills appears to have been exacerbated by the construction of a concrete culvert to collect water along the Manx Electric Railway track and channel it under the rails and down the bank leading to the properties identified on Mines Road. This storm water flow enters the Laxey River and runs down through Laxey Valley Gardens to Glen road (Resident statement Appendix E in attached file).

Appendix E

National Strategy

- A1 Methodology
- A2 Government Agencies Roles and Responsibilities
- A3 Independent Community Questionnaire Response Summary
- B1 Flood Risk and Source-Pathway-Receptor Model
- B2 Forecasting and Hazard Response
- B3 Flood History
- C1 Detail of Pluvial Flooding Instances
- C2 Incident of Debris Build up
- C3 Laxey Woollen Mills Weir Works
- C4 MER Weir Geometry - Further Information
- C5 Pluvial Flooding Case Law
- D1 Submission from Garff Commissioners
- E1 2016 National Strategy - Laxey
- E2 2016 National Strategy recommendations and perceived progress
- F1 Flood Risk Management Activities
- G1 David Wilkes Biography



E1 2016 National Strategy - Laxey

Table 4 - Extract from the 2016 National Strategy on Sea Defences, Flooding and Coastal Erosion (Table 5.2 of the Evidence Report - Action Area Analysis for Laxey)

<p>Assessment of Risk</p>	<p>High hazard flooding location, rapid response, fast flowing streams into Laxey. Main flood risk is fluvial/surface water not tidal. Severe surface water flooding in 2015 exacerbated by debris and blockages plus overtopping of River Laxey. Although works to Laxey Harbour are proposed in years 1-3, the evidence is questionable to justify this in the short term, fluvial/surface water flooding appears to be a greater risk. Very sensitive to climate change impacts.</p>
<p>Recommendations</p>	<p>Coastal scheme planned by DoI in the next 3 years to manage coastal flood risk. Manx Utilities is commissioning a study of fluvial flooding looking at the river catchment. However there is a need to better understand the causes and potential measures to limit surface water flooding. In addition to a study and potential scheme, flood awareness should form part of the response due to the high flood hazard, it can be difficult to provide timely flood warnings due to the rapid response catchments. Natural flood management measures further upstream could help slow the flow.</p>

E2 2016 National Strategy Recommendations and Perceived Progress

Table 5 - Recommendations made in Section 7 of the 2016 National Strategy's Evidence Report, with the Review's perceived progress.

<p>Recommendations Made</p>	<p>Perceived Actions</p>
<p>Strategy should be used to inform future investment and planning decisions at all scales.</p>	<p>Arup initial comment: These developments of policy seem to have been slow progress, until the 1 October event after which several policy updates have been passed through Tynwald.</p> <p>MUA comment: The strategy and the flood information derived from detailed studies is being used as envisaged, e.g. to inform investment decisions such as the proposed sewage treatment solution for Laxey; to inform local development planning decisions; land use allocation: for example the Eastern Area plan.</p> <p>DOI comment: Investment and planning has been done using the strategy document. The flood risk priority list is an example of this. At a lower scale</p>

	<p>maintenance work and minor improvement schemes are consistent of the priority list, but they also address issues that are road safety and political in nature</p> <p>DEFA comment: The Planning system is undergoing review, many aspects of the plan having been dealt with already. The Strategic Plan is due for review shortly. Following the completion of the Douglas Model, the MUA are in conversation with Treasury about appropriate capital funding.</p>
<p>DEFA, DoI and Manx Utilities should take forward the analysis of prioritised risk locations and develop an Action Plan for public consultation (ongoing monitoring, community resilience and awareness-raising, further studies and investigations and potential schemes).</p>	<p>Arup initial comment: Evidence of implementation has not been found.</p> <p>Laxey residents, while aware of possible schemes such as the sea-defence wall and sewage treatment plant, did not seem to have been informed about the wider catchment modelling being undertaken. There is no evidence of awareness-raising or community resilience activities.</p> <p>MUA comment: FRIDAY 16 MARCH 2018 https://www.energyfm.net/cms/news_story_520184.html</p> <p>A meeting was held with Garff commissioners to inform them of the wider catchment modelling and feasibility studies underway. They released a press release to inform residents.</p> <p>For the Laxey Flood Alleviation Scheme it was (and still is) intended to carry out public engagement when a short list of mitigation options is proposed. A little premature to discuss mitigation options with residents given business case / economics / cost benefit not yet defined. However, we now intend to write a 'newsletter' to Laxey residents informing them of the study and where it is up to.</p> <p>DEFA comment: The Flooding Advisory Group (FAG) therefore works from a spreadsheet summarising the work on the 24 sites, in line with this Administration's policy statement in Programme for Government ('we will continue to invest in sea defences and in reducing flooding and coastal erosion risks for those areas identified as high risk in our national strategy') which is submitted within an annual report to the Environment and Infrastructure Subcommittee, and was adapted for public consumption prior to circulating it to Tynwald Members late last year. A National Indicator states, 'Reduce built infrastructure at risk from flooding' and this is quoted in the Department Plans of the Departments of Infrastructure and of Environment Food and Agriculture (DEFA).</p>

	<p>These high risk sites are being addressed, initially with modelling, to enable subsequent action. We understand that the Douglas model is completed and conversations have commenced between MUA and Treasury to fund and commence the work. We understand that the Laxey Model is drafted and currently being tested. So we would argue there is clear evidence of implementation of the plan, however, as the modelling takes time and we have agreed a model-led action plan, we have not yet been able to undertake the commencement and delivery of major developments.</p> <p>With regard to community engagement, we understand the MUA met Garff Commissioners in March 2018 to brief them regarding their approach to the catchment modelling and clarify the main engagement would commence once the model was available.</p> <p>Since the event, the MUA have had meetings with Garff Commissioners, including a meeting specifically about the development of the catchment model (DoI also present, 28 November 2019). See 8 for other activities.</p> <p>A quick search brought up a press release for Douglas relating to plans for a flood alleviation scheme (20 December 2018), though we realise that there are people who do not read any local news media and are therefore harder to reach.</p> <p>Some other press releases include: 24/4/2017 Castletown Flood Scheme, 11/12/2015 on work to repair Glens from flood damage, 7/10/19 on concerted action to ease flood victims' plight and prevent further floods, and 8/1/14 Minister praises flood response.</p> <p>Therefore, there is evidence of awareness and community resilience activities.</p>
<p>A Working Group should be set up with representation from various Government departments and Manx Utilities to manage the Action Plan development and Strategy and Action Plan implementation.</p>	<p>The Flood and Coastal Advisory Group (FCAG) was established in September 2017 and met 5 times between this and October 2019. Development and implementation of an Action Plan is questionable, but updates of specific projects were being tracked by the FCAG.</p> <p>DoI Comments: A plan was developed based on the priority risk areas. This was an officer level working document and may not have been accessible to others however it has since been improved to make it more accessible and better explain the state of the action plans.</p> <p>DEFA comment: The FAG was formed to take forward the National Strategy (GD No. 2016/0044) of July 2016. Initially, work was held up due to the</p>

	<p>elections and the determination of government priorities, via the development of the Programme for Government, which was approved on 17 January 2017 (GD 2017/0002). This included the National Strategy under Sustainable Island; Outcome – ‘we have a natural and built environment which we conserve and cherish and which is adapted to cope with the threats from climate change’; Policy Statement – ‘we will continue to invest in sea defences and in reducing flooding and coastal erosion risks for those areas identified as high risk in our national strategy’. This thereby defined which sites would be under consideration by the FAG (‘high risk’ sites, which are defined in the Evidence Report as the 24 high risk sites) and allowed the work to move forward, though some projects were already underway by the DoI as a recognised need, for instance Castletown.</p>
<p>Manx Utilities should take account of the Strategy in discharging its drainage authority duties and implementing the Regional Sewage Treatment Strategy.</p>	<p>The Regional Sewage Treatment Strategy - Phase 2 is in implementation. Works are being progressed in several locations, including Laxey, but some delays are being experienced.</p> <p>DEFA comment: The Programme for Government includes, ‘Complete the regional sewerage infrastructure’. The aim is to do so by the end of this administration, subject to obtaining the necessary planning approvals and site acquisitions. We understand the MUA are working on this basis.</p>
<p>The Action Plan and responses developed to manage the evident risks should be undertaken through a catchment management approach.</p>	<p>Until summer 2019, DoI and MUA were pursuing different projects within the Laxey catchment with potential negatives impacts on each other. More recently this catchment management approach is being better developed.</p> <p>Decisions to take the catchment management approach were made in Spring / May 2019 – It was agreed MUA to run with Laxey inner harbour defence as part of the Flood Alleviation scheme</p> <p>DoI comments: MUA and DOI were aware of each other’s work, through their close working relationship and later through the FAG, but that they were progressing at different speeds. It was known that they may impact on each other. Once the design for the harbour wall was completed an assessment was made of the changed risks because work on the catchment had not yet progressed. It was then a fine balance of the risks of doing nothing on the harbour side now and the risk of it causing a problem in some pluvial events. Harbour flooding from still water sea levels does happen (2012) as does coastal over topping on an even more frequent basis (last week).</p> <p>DEFA comment: A holistic catchment management approach is indeed being taken, with studies</p>

	<p>undertaken by the MUA on the Douglas catchment, then on Laxey, and a third study currently underway by DEFA on the Neb system, with specific interest in natural flood risk management and the reduction of river pollution. The Laxey modelling project was underway with a project briefing before the recent flooding occurred. This catchment approach is in line with the National Strategy (GD No. 2016/0044), ‘How we will deliver the Strategy’, paragraph 4, which states that ‘The Action Plan and responses developed to manage the evident risks should be undertaken through a catchment management approach avoiding piecemeal intervention and ensuring that the management of risk in one location does not increase risk elsewhere’. Actions should therefore be considered and informed by the planned catchment modelling, and not the other way around.</p>
<p>Low cost solutions working with nature through natural flood management measures should be adopted wherever possible.</p>	<p>This has been pursued by DEFA and MUA, through site visits and studies by post-graduate students regarding natural flood risk management. We can see little evidence of practical implementation yet.</p> <p>MUA comment: Implementation will be considered holistically as an element of the package of flood alleviation solutions under consideration at present.</p> <p>DEFA comment: It is important that any natural flood risk management developments are undertaken after consideration of their effects, which can be positive (slowing the flow) or negative (if they result in flows meeting in a surge from different areas), therefore these should be considered after completion of catchment studies.</p> <p>We understand that the effects of individual projects are relatively small in comparison with the major works required in some areas and in the project studied in the UK the NFRM techniques were believed to contribute around 5% of the combined flood management contribution.</p> <p>We are also aware that the wooden and debris type dams may actually add to the flood debris which emphasises the importance of modelling in advance.</p>
<p>An Investment Planning Tool has been developed to assist Government and Manx Utilities in deciding where public money is best invested. DEFA, DoI and Manx Utilities, working with the Cabinet Office and Treasury, should develop policy</p>	<p>No evidence of this seems to have been developed yet.</p> <p>MUA comment: The suggested minimum criteria for investment is 1:1 benefit: cost ratio by default, which gives the best prospect of taking forward schemes for approval.</p>

<p>guidance and funding criteria including a required Return on Investment.</p>	<p>DOI comment: This was discussed in FAG and development of a draft was actioned. The Castletown harbour flood defence scheme was assessed and had a payback of around 4:1</p> <p>DEFA comment: Minute 7.2 of the FAG of 11/11/19 states, ‘The team discussed the ratios of investment schemes to work to along with likely financial costs associated to the ratios. The group concluded that at this time it is too early to identify a ratio and that they should continue to work on a scheme by scheme basis as they have been. It was agreed that it should be reviewed again in approximately one year down the line. It was also agreed that Treasury should attend the meetings so that they are aware of any schemes well in advance. ACTION: CM to invite Andrew Sidebottom, Director of Strategic Asset Management and Valuations from Treasury in future meetings.’ Andrew attended the next meeting.</p> <p>Currently a 1:1 ration of damage against cost is used in order to determine whether projects might be of community benefit. This is therefore the bottom line, default position. A higher ratio may rule out most projects. The actual costs and benefits are then considered in each situation.</p> <p>Therefore there is evidence of progress on this initiative.</p>
<p>Once the analysis of Action Areas and Outliers has been completed and an Action Plan is developed, it is recommended that a programme of community awareness raising and resilience is developed and implemented.</p>	<p>We have seen no evidence of this being carried out.</p> <p>MUA comment: The analysis of action areas was to be completed in the period 2016-21 under the Tynwald approved national strategy. We are on target to do this. Community awareness raising and potential funding of resilience measures (where a reasonable standard of defence cannot be provided or justified) would follow from the evaluation of defence options. We already have a list of schemes for the River Douglas which are estimated to cost more than £25M.</p> <p>DOI comment: This was discussed in FAG and development of a draft was actioned.</p> <p>DEFA comment: Reviewing community awareness-raising and resilience is an area that is currently under discussion within the FAG. There is already some advice on the gov.im website (Floodwatch, including MET tidal warning system) and on the MUA website (flood maps, advice and a flood reporting system). The MUA pages were originally on the Department of Transport website, until the flood responsibility was transferred to the Water and Sewerage Authority in</p>

	<p>2010 and then Manx Utilities in 2014. It has been regularly updated, there is a Be Flood Prepared page https://www.manxutilities.im/your-home/watercourses-and-flooding/be-flood-prepared/ and at the last FAG meeting the MUA reported that a new member of staff will be reviewing the website information again. The Floodwatch pages and also the Floodline recorded telephone service were instituted following the floods of 2002 and both are updated daily. There has also been discussion at the FAG regarding how best to help/encourage homeowners to flood-proof their residences in terms of awareness and the provision of equipment and a press release was sent out in 2014 with advice on clearing up after a flood (3/1/2014).</p> <p>Evidence of work on this topic has already been identified at point 2 above.</p>
<p>The Risk Assessment that underpins the Evidence Report should be sustained as a ‘living’ database and updated on a regular basis bringing in more robust datasets as these are generated.</p>	<p>The need for this was discussed in a FCAG meeting, but unknown whether it has been actioned.</p> <p>MUA comment: The detailed analysis (for example the Laxey FAS) is the source of updated information.</p> <p>DOI comment: The risks are regularly reviewed and updated on the Progress on Priority Action Areas Working Document.</p> <p>DEFA comment: The MUA took the lead in the FAG for updating the evidence base, where and when appropriate. Evidence has been added via 3 models created in much greater detail than available to JBA in the National Strategy Evidence Report and these make use of further data available, for instance up to date flow rates and detailed damage assessments. Updates with regard to each high risk site are reviewed at each meeting of the FAG.</p>
<p>Consider developing an approach in which Government investment for flood and coastal erosion risk management can be supplemented by contributions from other partners.</p>	<p>This option was discussed in a FCAG meeting in December 2017, and ideas to learn from relevant UK actions were raised. No evidence of further progress of this matter.</p> <p>DoI comment: This is being pursued, to some extent, by the Cabinet Office which is preparing a community infrastructure levy regime as part of planning legislation.</p> <p>DEFA comment: There is a flood fund available for capital works, but the work must be prioritised, which was done through the National Strategy. If projects need to be brought forward then funding must be discussed with Treasury and discussions are indeed underway, for instance with regard to coastal protection, for which the DoI are looking at efficiencies via the development of multiple sites, as east coast and</p>

	<p>west coast projects. Treasury have been brought into the Flood Advisory Group in order to be aware of funding requirements early on. The Department of Infrastructure and the MUA are in discussion with Treasury currently, regarding the funding. Treasury have stated that if there is a good case, then they may support it, and they are looking at Douglas and Laxey requirements together, just now.</p> <p>The aspect of private land or building owner contributions has not yet been addressed.</p>
--	--

Appendix F

Flood Risk Management Act 2013

- A1 Methodology
- A2 Government Agencies Roles and Responsibilities
- A3 Independent Community Questionnaire Response Summary
- B1 Flood Risk and Source-Pathway-Receptor Model
- B2 Forecasting and Hazard Response
- B3 Flood History
- C1 Detail of Pluvial Flooding Instances
- C2 Incident of Debris Build up
- C3 Laxey Woollen Mills Weir Works
- C4 MER Weir Geometry - Further Information
- C5 Pluvial Flooding Case Law
- D1 Submission from Garff Commissioners
- E1 2016 National Strategy - Laxey
- E2 2016 National Strategy recommendations and perceived progress
- F1 Flood Risk Management Activities
- G1 David Wilkes Biography



F1 Flood Risk Management Activities

Table 6 - Suggested activities to fulfil functions from the Flood Risk Management Act 2013, with assessment of relevant actions.

Functions (note these are examples of possible functions, they are not requirements, nor are they exhaustive)	Assessment of Action
(a) prepare and publish FRM strategies;	While the 2016 National Strategy is concerned with 24 high risk flood sites where new infrastructure is probably desirable, it is not believed to address all the operational inspection and regulatory enforcement activities to achieve good practice flood risk management.
(b) carry out surveys to identify what FRM works are required;	<p>Annual T98 inspections and project specific surveys are completed, but these relate to specific assets (walls, sluices etc). More general surveys and inspections of the states of catchments are lacking.</p> <p>MUA Comment: There are many examples of more general surveys. The detailed studies carried out in relation to the National Strategy priority areas are intended to identify what FRM works are required.</p> <p>Extensive topographical surveys have been carried out for most watercourses and the collection of whole island LiDAR data.</p> <p>Topographical surveying of gravel bars and river channel cross sections is often carried out and used alongside computer modelling methods to establish whether the area will benefit from gravel removal from a flood risk perspective.</p>
(c) prepare and publish FRM plans stating FRM works that the Authority proposes to carry out;	<p>We have not seen the Authority's public engagement in this way. The independent public questionnaire suggests the community knew little about potential works.</p> <p>MUA comment: The works are in the process of being identified.</p> <p>For the Laxey Flood Alleviation Scheme it was (and still is) intended to carry out public engagement when a short list of mitigation options is proposed. Perhaps premature to discuss mitigation options with residents given business case / economics / cost benefit not yet defined. We are</p>

	<p>starting to develop a newsletter to Laxey residents informing them of the alleviation study and progress.</p>
<p>(d) provide and operate flood warning systems;</p>	<p>Through the DoI's Met Office, weather warnings are released and transmitted to relevant bodies. No further flood warning systems are in place. Unlike many other jurisdictions, on the Isle of Man there is an absence of river flood forecasting, and potentially tidal flood forecasts..</p> <p>MUA comment: An effective tidal storm surge flood warning system is in place.</p> <p>Flood warning for rural, small and rapid response catchments is an inherently difficult problem. MUA have looked into the feasibility of introducing a flood warning system for the Douglas catchment. The island is at a disadvantage with the gap in radar coverage which significantly hampers the ability to forecast and provide flood warnings. With minimal rainfall-stage data and no available rainfall forecasts, recent investigations have shown that we theoretically could generate river level forecasts for up to 1 hour and 30 minutes ahead. Lead times beyond this would require forecast rainfall information. MUA will consider how to progress forward with feasibility studies into flood warning for the Island's catchments but there are many hurdles to overcome and additional resource required. As part of the Laxey Flood Alleviation scheme, JBA are considering the feasibility of a flood warning system for Laxey.</p> <p>DOI comment: Our Met Office does, in fact, provide an effective quantitative & deterministic tidal flooding forecast / warnings service for the DoI, multi-agency partners, local authorities and the public. This service was developed as a significant part of the 'Flood Group' work following the flooding events on the island in 2002. The information is also made available on the 'Flood Line' telephone service and on our 'Flood Watch' page online at gov.im with links from the weather page. The river flooding aspect of 'Flood Watch' is only a subjective risk category, albeit with an awareness of the antecedent conditions and a knowledge of the rainfall forecast (duration, intensity and quantity) because there's no operational fluvial flood risk model available to us.</p>
<p>(e) protect the Island from flood risks by providing, maintaining, improving or extending FRM works and watercourses;</p>	<p>Major projects are underway from the National Strategy, and some other inspection and maintenance is sometimes carried out in line with available budget.</p>

<p>(f) monitor both FRM works and watercourses and systems for them;</p>	<p>There is an apparent lack of monitoring on a catchment wide scale, specifically in areas connected to high flood risk where there is greater requirement.</p>
<p>(g) provide, install, operate and maintain apparatus required for the monitoring of systems;</p>	<p>Work to replace/maintain gauges has been carried out.</p> <p>MUA comment: Currently, there are approximately 42 monitoring stations that have been deployed around the island by the Isle of Man Government measuring:</p> <ul style="list-style-type: none"> • tide levels in harbours • reservoir and river levels • air and ground temperatures • visibility • wind speed and direction • rainfall <p>MUA have recently invested in upgrading the Island’s hydrometric data management software package to improve data access, analysis and quality control. Maintenance reports are developed quarterly on river gauges and a member of staff is employed by the DoI to maintain rain gauges.</p> <p>MUA have recently put in effort to improve stage discharge relationship curves / understanding of flow values by carrying out periodic spot gauging’s. The rain gauge coverage in terms of daily gauges and a recording gauges is compliant with industry recommendations this said we are regularly reviewing the gauges on the island both rainfall and river gauges. Manx Utilities plan to install more river gauges this year and (possibly) a new automatic rain gauge in Douglas.</p>
<p>(h) prepare, gather and publish other information it considers relevant concerning FRM; or</p>	<p>Beside from the publication of flood risk maps and the National Strategy little has been done in this regard.</p> <p>MUA comment: We have prepared and released National Flood Risk Maps for Planning as evidenced on the MUA website</p> <p>The aim is that the maps are updated and released on a biannual basis or when something significantly changes. However, MUA are currently reviewing the UK’s flood maps and associated policies to determine the appropriateness of aligning the island to this.</p> <p>MUA have prepared and published the watercourse management guidance offering advice to riparian owners.</p> <p>MUA website has further information and guidance published on our website. Including Frequently Asked Questions generally and on specific topics such as information about the flood maps.</p> <p>https://www.manxutilities.im/your-home/watercourses-and-flooding/flooding/</p>

	<p>DEFA comment: The comment seems dismissive of the Strategy, which has introduced a clear prioritisation for the work and has guided progress to date.</p> <p>The report was published and has Tynwald approval, it was the subject of considerable press coverage.</p> <p>With hindsight, knowing which order rain events have actually taken place, the priority of number 5 for Laxey catchment was not ideal, however the independent assessment was undertaken in a coherent, rigorous and considered way. This is why the higher numbered priorities have been actioned first.</p>
<p>(i) carry out research and provide education and guidance concerning FRM.</p>	<p>Research has been undertaken into Natural FRM and staff have attended relevant conferences/site visits, but little else.</p> <p>MUA comment: FRM team provide guidance almost on a daily basis to members of the public, other government departments, developers, planners etc. This is not published but guidance all the same.</p> <p>Much research outside of the National Strategy has been carried out for example on:</p> <ul style="list-style-type: none"> - Flood warning - Flow conveyance - Gravel maintenance - Catchment management <p>DEFA comment: The National Strategy states that:- <i>“Low cost solutions working with nature through natural flood management measures should be adopted wherever possible as these have the potential to reduce flood risk elsewhere and can achieve biodiversity and carbon benefits as well as helping to adapt to climate change”.</i> Following discussions with MUA which commenced in July 2019, a catchment study for the River Neb, focussing on NFRM techniques was commissioned in October 2019. This is due to report in March 2020.</p>

Appendix G

David Wilkes Biography

- A1 Methodology
- A2 Government Agencies Roles and Responsibilities
- A3 Independent Community Questionnaire Response Summary
- B1 Flood Risk and Source-Pathway-Receptor Model
- B2 Forecasting and Hazard Response
- B3 Flood History
- C1 Detail of Pluvial Flooding Instances
- C2 Incident of Debris Build up
- C3 Laxey Woollen Mills Weir Works
- C4 MER Weir Geometry - Further Information
- C5 Pluvial Flooding Case Law
- D1 Submission from Garff Commissioners
- E1 2016 National Strategy - Laxey
- E2 2016 National Strategy recommendations and perceived progress
- F1 Flood Risk Management Activities
- G1 David Wilkes Biography



G1 David Wilkes – C.Eng, CWEM, BSc, HonFellow CIWEM, MICE



Photograph 16 - David speaking in the House of Commons.

David Wilkes is an Honorary Fellow of CIWEM, a chartered civil engineer, and Global Flood Resilience Leader for Arup. He is Project Director working on river, coastal and integrated catchment management projects within Europe and across the globe.

David has specialised in coastal, tidal and inland flood risk management for almost 40 years. The first 30 years with the public sector, and the last 10 with Arup as director on a multitude of

projects. With the Environment Agency he was responsible for all operations at the Thames Barrier and the 120 miles network of defences which protect London from the storm tides. During this time he set up the TE2100 study to develop plans to protect London against sea level rise to 2100.

His present responsibilities include reviewing and supporting Arup's flood resilience services globally and being Project Director for the Leeds Flood Alleviation Scheme, a portfolio of schemes for Sheffield City Council, and for 4 projects associated with the Humber Estuary Strategy. He was Project Director for developing the practice guide to accompany PPS25 – Development and Flood Risk, and for the Cabinet Office report on Flood Resilience of National Infrastructure.

Before joining Arup, David was a Flood Risk Manager with the Environment Agency and their predecessors, most recently for Yorkshire from 2000 to 2006 and from 1994 to 2000 as Manager of the Thames Barrier in London. During his time with the Environment Agency, David handled several operational and emergency events including the 2000 floods in Yorkshire and water resource protection during the Foot and Mouth epidemic.

Shaping a better world

CONTACT

david.wilkes@arup.com

ARUP