

TACKLING FLOODING IN THE CALDER VALLEY

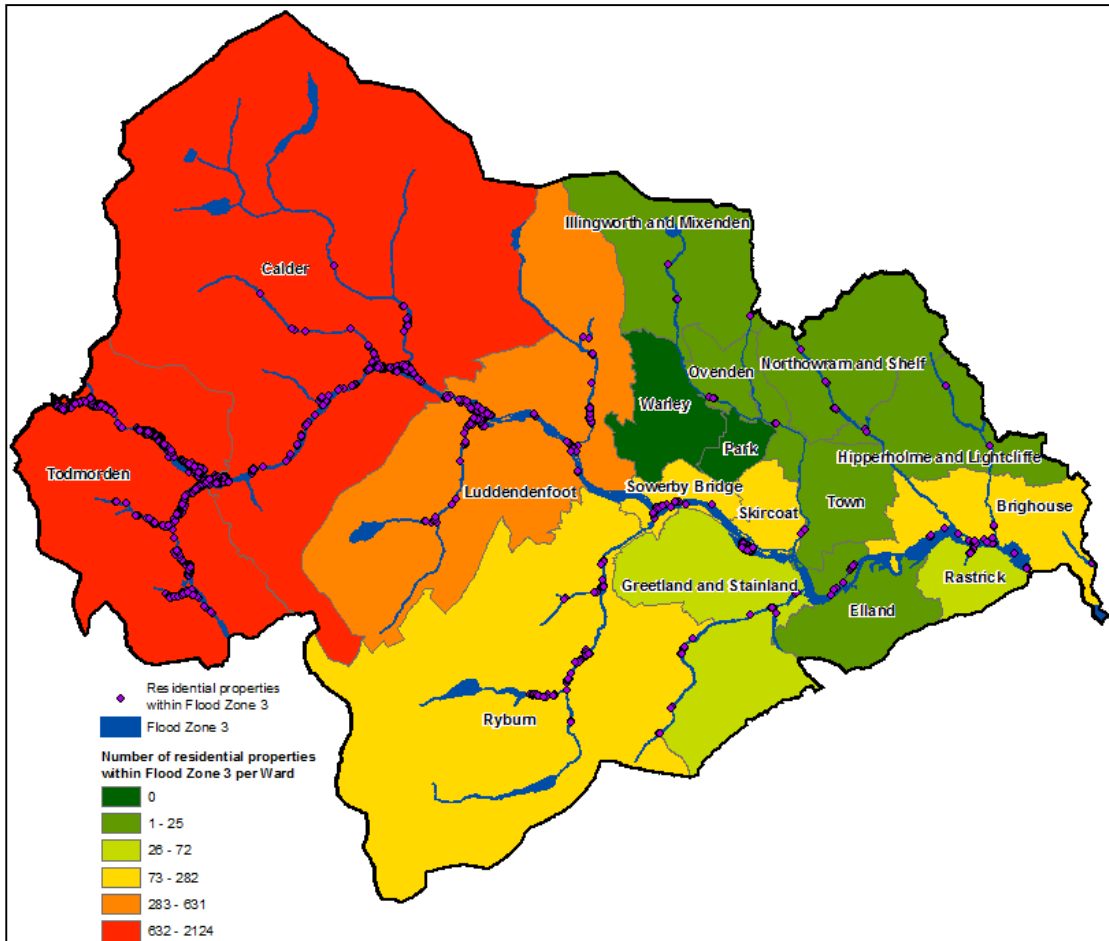
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Introduction

- River Calder catchment in Calderdale.
- History of significant flooding.
- Hydrometric analysis of 26/12/15 flood event.
- Impact of the event.
- Review of response activity.
- Going forward ensuring infrastructure resilience and better land management.

The Catchment



- River Calder catchment.
- 19 main rivers.
- Approximately 7000 OWC.
- Development of the flood plain.
- Steep high gradient valleys.
- Rapid response to rainfall.

History of Significant Flooding

Date	Source
June 2000	Main river & surface water
July 2006	Main river, surface water and OWC
January 2008	Main river
November 2009	Surface water
June – August 2012	Main river, surface water and canal
December 2012	Surface water
July 2013	Surface water and OWC
July 2014	Surface water
December 2014	Surface water
November – December 2015	Surface water, main river and OWC

- 500 calls received on average per year on localised flooding.

Hydrometric Analysis of 26/12/15 Flood Event



Rainfall gauge locations



River level gauge locations

Hydrometric Analysis of 26/12/15 Flood Event

Duration	Walshaw Dean Lodge	Gorple Reservoir	Gorpley Reservoir	Ringstone Reservoir	Great Wolden Edge	Thornton Moor Reservoir	Halifax Ogden Reservoir
15-min	5.0	3.0	4.2	3.6	3.6	3.4	4.2
30-min	7.4	5.6	6.6	5.6	7.2	6.0	5.8
1-hr	10.8	9.4	10.0	8.6	11.6	8.6	8.6
2-hr	16.6	17.0	17.6	13.6	17.8	14.2	13.2
3-hr	22.0	23.2	26.4	18.6	23.0	19.4	17.4
6-hr	43.0	43.2	49.0	32.4	37.4	37.6	32.8
12-hr	64.2	66.2	71.4	43.6	48.0	62.0	55.2
18-hr	80.0	84.0	91.6	59.2	63.2	86.0	79.2
24-hr	99.0	102.8	112.8	71.0	73.8	103.8	99.2
48-hr	113.2	118.8	126.8	81.8	81.0	113.6	108.6
Peak time	07:15	07:30	07:45	08:30	08:15	07:30	16:45 (day before)

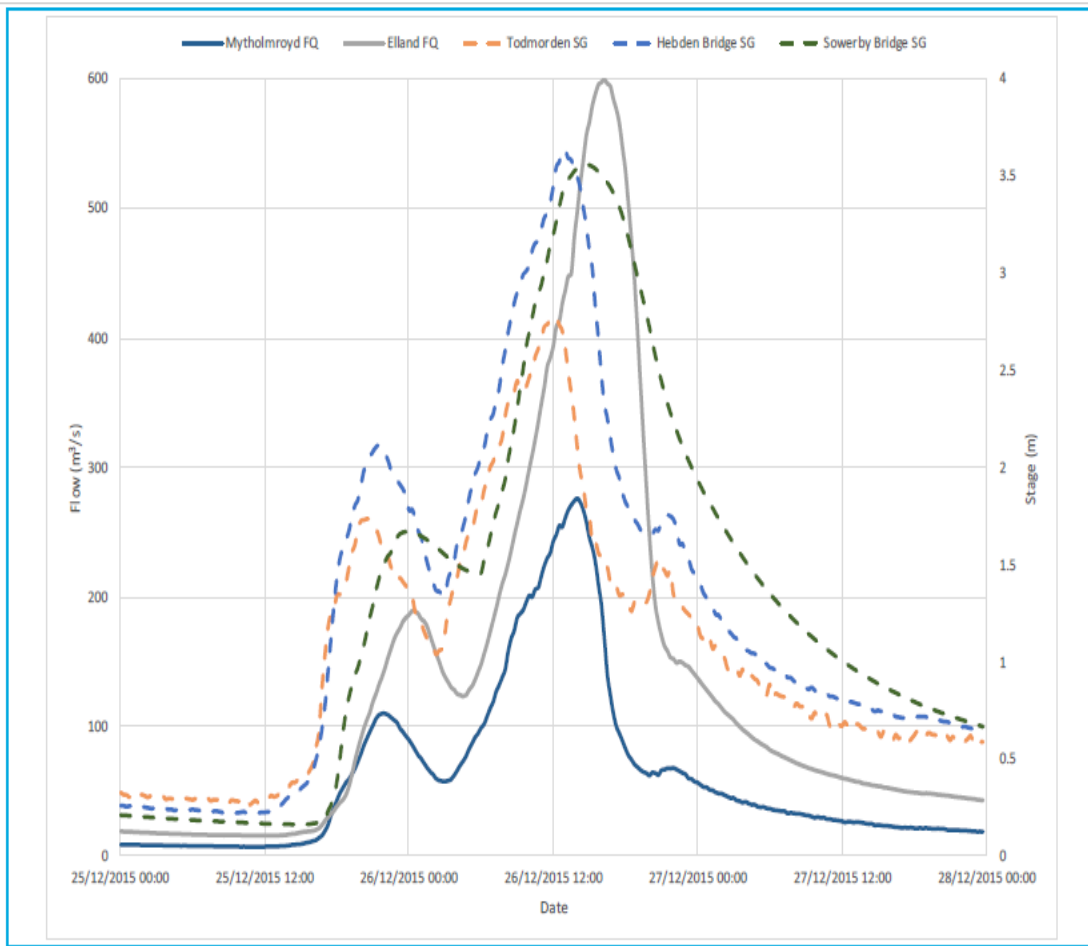
Rain gauge data

Gauging station	Peak level (mALD)	Peak flow (m ³ /s)	Time of peak
Todmorden	2.768	-	12:00
Hebden Bridge	3.628	-	13:00
Mytholmroyd	5.735	276	14:00
Sowerby Bridge	3.554	-	15:00
Elland	2.757	600*	16:45

Gauging station	Peak level (mALD)	Peak flow (m ³ /s)	Time of peak
Walsden Water	0.616	-	07:15
Todmorden Salford	3.091	-	12:30
Portsmouth Lennox Road	1.146	-	12:30
Nutclough	2.615	-	12:45
Ripponden	1.241	33.7	12:00
Colne Bridge	1.986	136	13:15

River level gauge data

Hydrometric Analysis of 26/12/15 Flood Event



River Calder hydrograph

	Mytholmroyd	Elland	Ripponden
Average rainfall (mm)	106.39	95.66	75.82
Catchment average rainfall volume (m ³)	18,416,420	32,592,440	2,593,020
Total flow volume (m ³)	3,389,512	7,172,550	488,144
Baseflow volume (m ³)	14,503,320	31,196,790	1,900,620
Percentage runoff	60.3%	73.7%	54.5%
SPRHOST	47.4%	38.5%	50.6%

Percentage Runoff

- 24 hour storm duration.
- Double peaked storm and hydrograph.
- Greater % runoff than SPRHOST.
- Delay in peaks between catchment extents.

Impact of 26/12/15 Flood Event

Major Infrastructure Affected



Elland Bridge



A646 Falling Royd



Scout Road



Crowther Bridge



Copley Bridge



Midgley Road

- Confirmed numbers of properties flooded are 1,939 flooded homes and 1, 108 flooded businesses.
- Significant damage to highway assets and infrastructure.
- 12 substations affected.
- Utility infrastructure including pump stations affected.
- Numerous landslips.

Preparations Prior to 26/12/15 Flood Event

- FFC and Met Office warnings received from 23/12/15 at 14:53 low likelihood of flooding. Severity updated on Christmas day.
- EA set up incident room. CMBC staff checked on critical areas and infrastructure. Hotspots attended to.
- Extra resource and personnel bought in to carry out maintenance activities on 23rd and 24th December 2015.
- Highway and land drainage critical areas updated and attended to following previous two event.
- Temporary infrastructure installed in areas damaged by recent flood event.
- Time of year and low severity of warning resulted in standard staffing levels being maintained.

Review of Preparatory Activity

What worked well

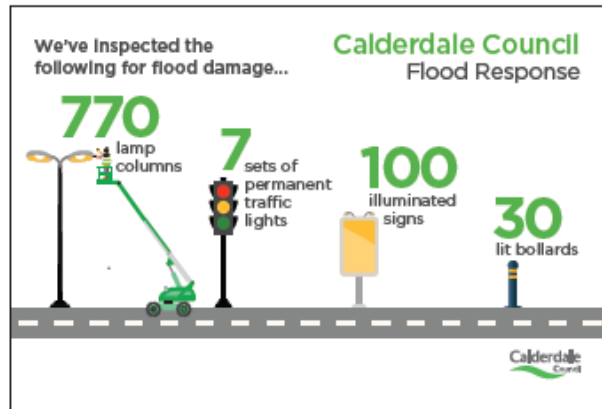
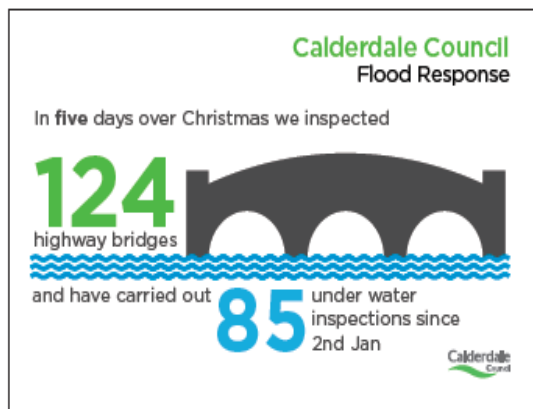
- Communications improved following previous events.
- Vulnerable infrastructure addressed.
- Inspection & maintenance of infrastructure in known hotspots.

Areas for improvement

- Large range of forecasted rainfall total with no confidence attached to upper or lower limits.
- Catchment conditions not taken into consideration and warnings not refined to local topography.
- Impact of a given rainfall total or intensity not analysed specific to Calderdale with a forecasted outline produced.
- Reliance on local knowledge and availability.

Response to 26/12/15 Flood Event

- Multi agency SOR established at 09.25 and hubs opened for public to receive help.
- Major incident declared at 20:47 on 26/12/15.
- Staff numbers increased across RMAs with aid provided from the army.
- Inspection and recovery works of impacted infrastructure.
- Hardship and resilience grants provided.



Review of Response Activity

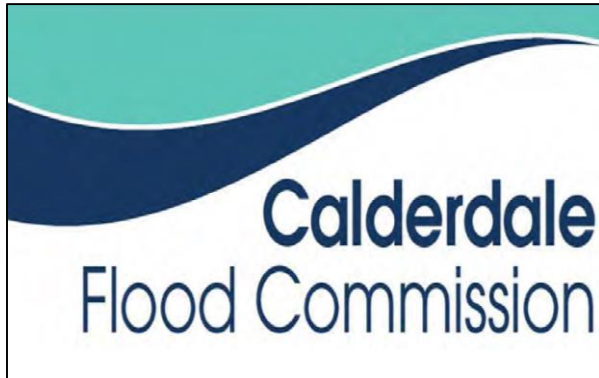
What worked well

- Assistance centres were established in the worst hit areas allowing communication when substations failed.
- Timely inspection of critical infrastructure.
- Over 2000 tons of debris being removed from affected homes and businesses.
- Financial aid provided to both residents and businesses.

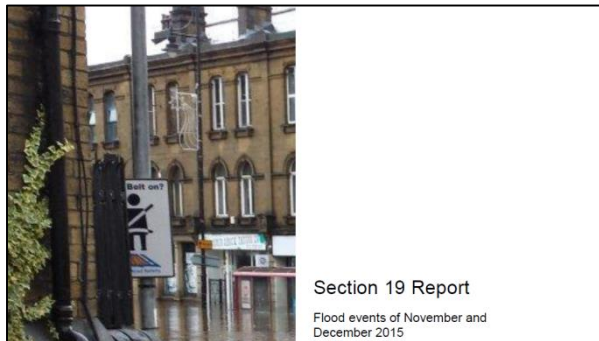
Areas for improvement

- Delay in declaring a major incident.
- Failure of power infrastructure hindered communication.
- Lack of shared knowledge on critical infrastructure.
- Resources strained due to staffing levels.
- Reliance on local knowledge.

Key Investigations & Lessons Learnt



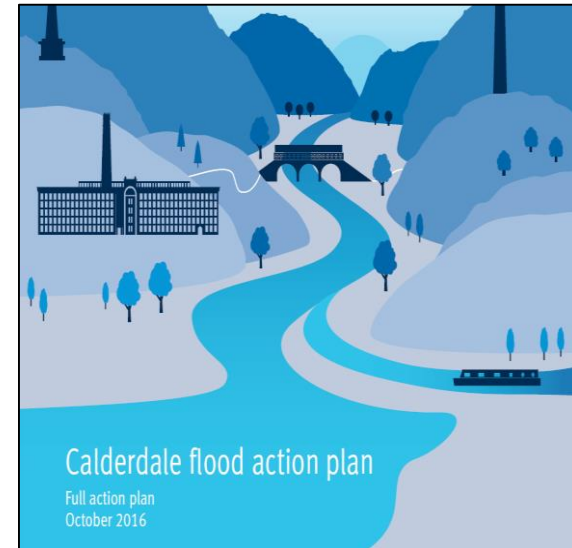
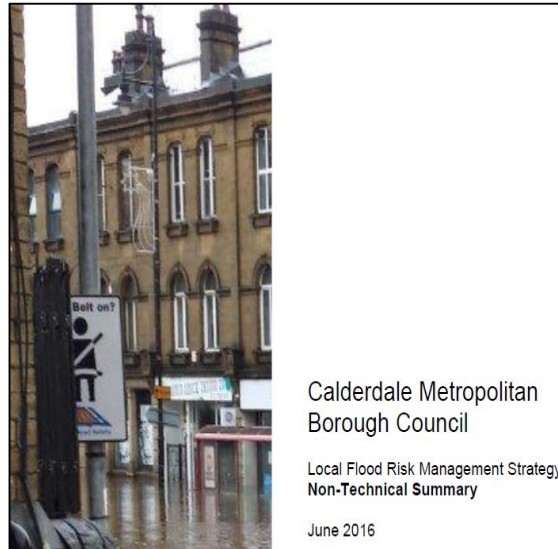
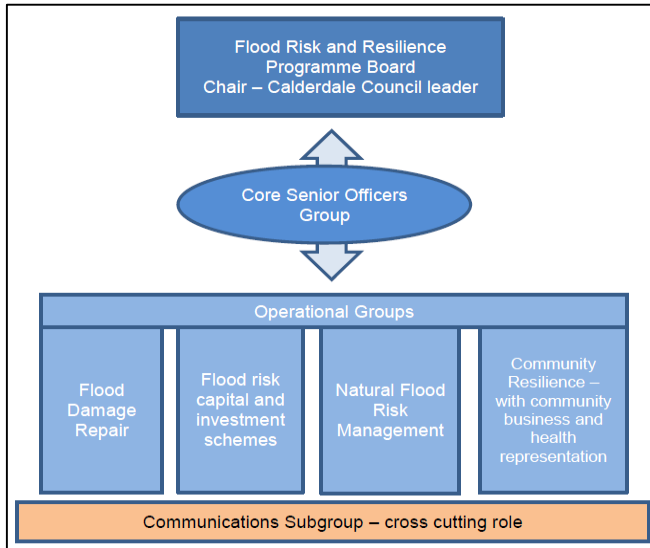
- Develop plan for NFM.
- Develop a programme of works to improve infrastructure resilience.
- Develop a catchment based plan.
- Develop a Flood Programme Board informed by a LFRMS led by CMBC.



- Improve resource arrangements.
- Improve internal and external communications.
- Improve response coordination.
- Improve preparedness to flood events.

Progress To Date

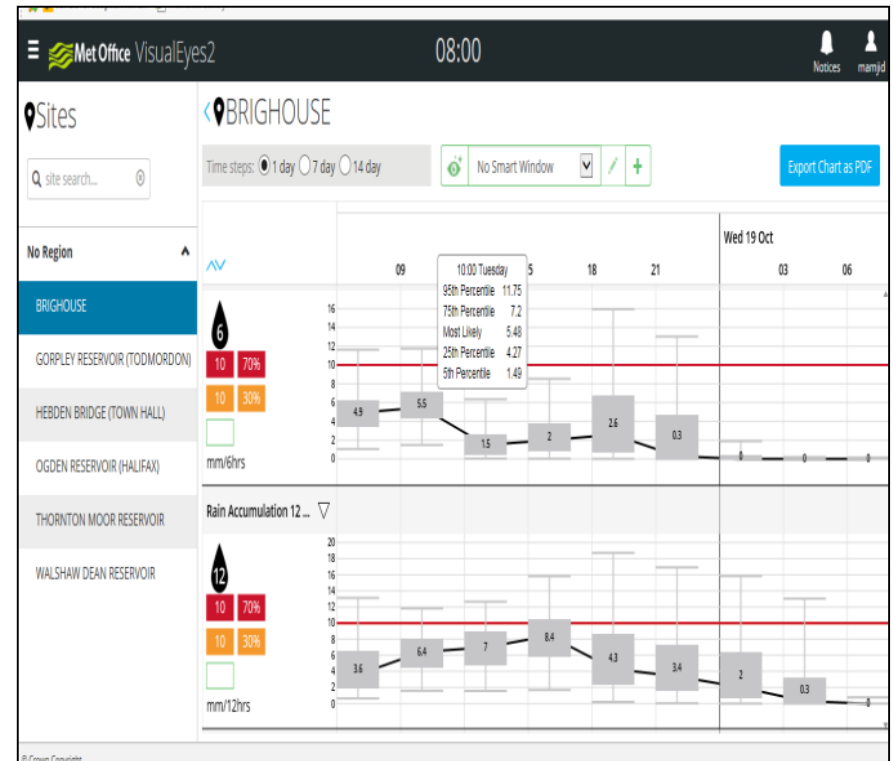
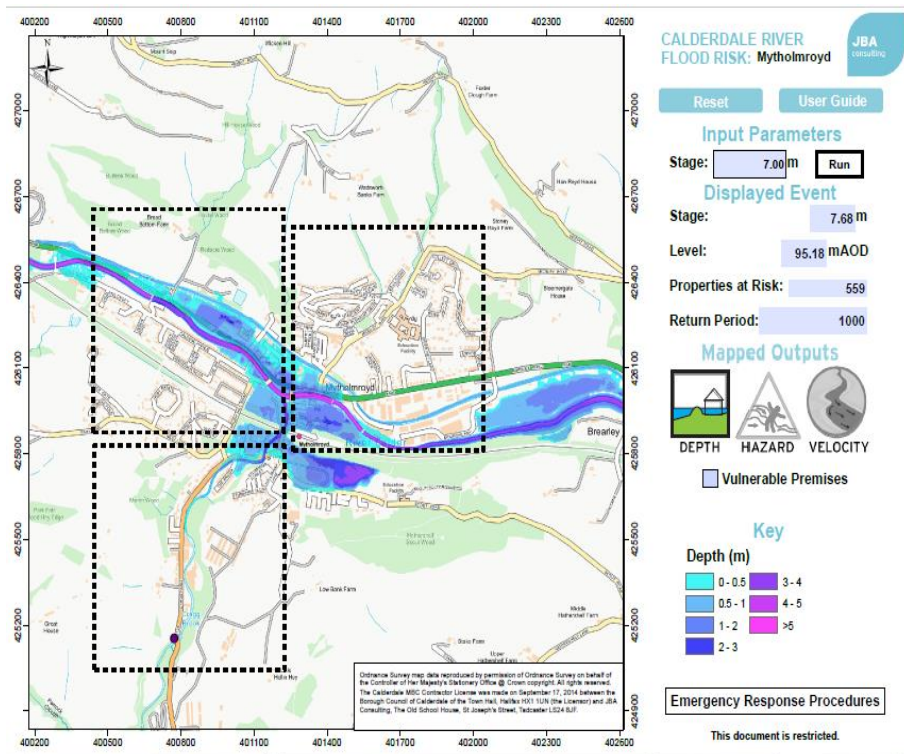
Strategy and policy



- Steering group replaced with multi stakeholder flood programme board established. Meetings open to the public.
- LFRMS adopted in 2016 which provides strategic objectives and measures for the Board to deliver.
- Action Plan published providing specific projects for the operational groups to deliver.

Progress To Date

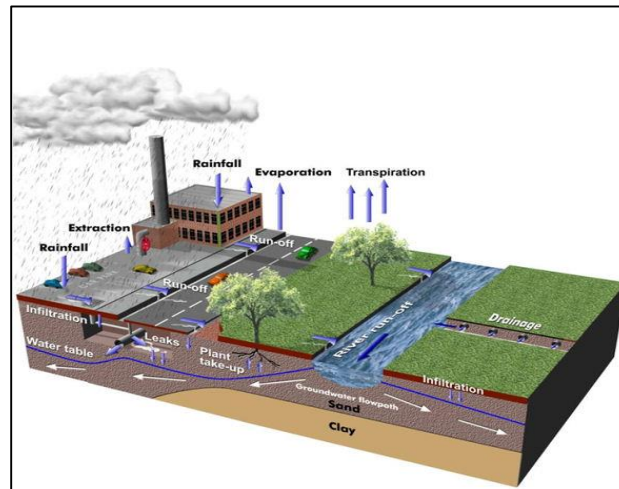
Preparation and operational response.



- Development of GeoPDFs showing visual impact of forecasted hydrology.
- Improved rainfall forecasting systems to aid response and improved resource management.
- Increased provision of flood stores and flood wardens.

Ensuring Infrastructure Resilience and Better Land Management

- Flood risk cannot be eliminated but reduced and impacts mitigated against.
- The need for focus on resilience of local infrastructure.
- Moving towards sustainable flood risk management and drainage systems.



Defending Infrastructure & Ensuring Resilience

- Drafting a flood risk asset register.
- Modelling asset failure and impact.
- Reprioritisation of planned capital schemes.
- T98 inspections of critical flood risk assets.
- Level 1 and level 2 scour risk assessments of bridges for a design flood corresponding with a return period of 1 in 200 years plus a 20% allowance for Climate Change.
- Scour protection and uplift mitigation measures installed for bridges.
- Relocation of substations to less vulnerable locations.
- Feasibility of temporary barriers and safe diversion routes for flood flows.

Better Land Management

- Establishing a focal point and governance structure for NFM.
- NFM actions in the Calderdale Flood Action Plan
- Development of a NFM opportunities map
- The need for improved development control policies.
- Undertaking further surface water management studies and defining critical drainage areas.
- Fulltime NFM Officer appointed.
- Drafting regional and local guidance for developers on SuDS.

“Future flood risk from all sources of flooding and its impacts needs to be addressed, not just to maintain current risk levels. To do this a mosaic of interventions is required, based on evidence and a clear plan of action”. - Calderdale Flood Commission

Sustainable Land Management Challenges



Practical steps to overcome barriers need to be explored further.

In Summary

The event

- Record rainfall, runoff and impact experienced

Preparedness & response

- Lessons learnt and work carried out to improve.
- Measures tested exercises and actual event

Infrastructure resilience and defences

- Improved understanding of infrastructure resilience and suitable mitigation measures.

Sustainable land management

- Working towards NFM and increased uptake of SuDS
- Significant challenges lie ahead.

Thank you



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