Representing Drainage
Water Level & Flood Risk
Management Authorities

Leading the transition to Net Zero across the country and more globally:

A budget policy change is needed to deliver urgent resilience against climate change extremes and reduce the carbon footprint of flood risk management

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Introduction

The warnings delivered by the recent IPCC report on climate change are powerful. We are already experiencing many unprecedented weather "extremes" brought about by climate change. Increased rainfall, droughts and higher temperatures are already being seen across the world. These weather extremes are expected to occur more intensely and more frequently in the coming decades, even if the greatest efforts to reduce carbon emissions to net-zero by 2030 succeed. Our rivers will be put under increasing pressure to convey away excess water to prevent flooding and provide increasing amounts of water during times of water deficits.

So how well is the water level management industry placed to deal with the current and future challenges these weather extremes bring? And are they able to reduce their own carbon emissions quickly and effectively to contribute towards the global net-zero effort? We set out the main challenges to the water level management industry below and the policy changes required to urgently improve their preparedness for climate change.

Policy Ask 1:

1 Funding policy and budget allocations must reflect the importance of river maintenance, not just focus on capital expenditure for new flood defences if resilience and CO2 reductions are to be achieved.

Background

The water level management industry across the country has a number of key players. Internal Drainage Boards (IDBs) manage drainage channels and pumping stations in order to maintain groundwater levels in lowland areas which otherwise would be naturally flooded. The Environment Agency (EA) manage main rivers and Local Authorities (LA's) manage ordinary watercourses. Many smaller watercourses are also privately owned and managed. However the water flowing through this freshwater system does not recognise administrative boundaries. Channels, rivers and streams are all interlinked and the most effective way to manage them therefore is holistically, on a catchment scale.

When left to nature, river beds silt up and natural obstacles occasionally block channels, causing flows wander across wide flood plains carving new channels. The way our country has developed around watercourses now prevents this natural process in many areas. Now, where sediment in river channels is allowed to build up or flow restrictions such as fallen trees are introduced, it reduces the capacity for water and presents a real flood risk to surrounding communities. As such, a robust maintenance regime is needed to keep river channels in good repair and clear of sediment and obstacles, to ensure that there is room for water to flow through them and to minimize flood risk. This **maintenance regime should be considered in terms of the catchment as a whole** and how it impacts the flood risk situation further up and downstream of its application. In other words, if channels are not kept in good repair and clear in some parts of the catchment, it can significantly impact on the flood risk in other areas of the catchment.

Current position

1.1 Budget allocation for maintaining flood defence assets has significantly decreased despite the deteriorating condition of some flood defences.

In recent decades, flood defence maintenance spend appears to have been reduced in favor of capital project budgets, as set out in a recently published report commissioned by ABI and FloodRe[1]. These capital projects have delivered new flood defences which have indeed delivered a greater level of flood protection to many areas. But without the necessary maintenance of connected watercourses, the effectiveness of capital solutions to alleviate flood risk will be gradually and increasingly diminished where the interconnected river system is neglected and deteriorates.

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[1] https://www.abi.org.uk/globalassets/files/publications/public/flooding/modelling-the-impact-of-spending-on-defence-maintenance.pdf

The ABI/FloodRe report stated that in the year 2000, 64% of the Environment Agencie's linear flood defences were in a good or very good condition. By 2021 that figure had reduced to a worrying 33%, meaning **77% are in a fair to very poor condition**. In 2021, the number of assets maintained to a good or very good condition is expected to fall once again to 15%.

The increased spend on capital flood defences exacerbates the revenue budget pressures as it creates more flood defences to maintain. The National Audit Office's November 2020 report[2] on managing flood risk mirrored this concern in its prediction that that the requirement for revenue funding is likely to increase as assets deteriorate more quickly due to climate change and as capital investment growth results in more assets.

Research commissioned by the Environment Agency indicates that sea level rises, increased storm surges and river flows as a result of climate change are all expected to increase pressure on flood defence assets. **The cost for flood defence asset maintenance and repairs could increase by between 20% and 70% a year as a result.**

1.2 Increasing maintenance budget allocation is economically beneficial

The ABI/FloodRe report calculates that £568 million each year is saved each year in flood losses due to linear flood defences "performing as they were designed to do". But it also states that with a reduction in maintenance spend on these defences, deterioration rates increase. This is not comforting knowledge when we are already experienced unprecedented rainfall events which are set to become more severe as climate change progresses.

The report predicts that for every £1 extra that is spent on flood defence maintenance, £7 is saved on capital expenditure, such as reconstruction or replacement.

Again, this message was supported by the findings of the recent NAO report which set out that capital expenditure on maintenance of inland defences, which represents 15% of capital expenditure over the period, has more than doubled from £33 million in 2015-16 to £70 million in 2020-21.

1.3 River maintenance delivers carbon emission reductions

Increasing the current maintenance budget for linear flood defences by 50% is expected to extend their life by 8 years, the ABI-FloodRe report suggests. Recent research has also suggested that construction projects contribute the greatest percentage of all CO2 emissions for the water level management industry, up to 54% in some cases. As such, there are clear CO2 reductions to be made in lengthening the lifespan of flood defence assets and minimizing the need for capital expenditure to reconstruct or replace them.

[2] https://www.nao.org.uk/wp-content/uploads/2020/11/Managing-flood-risk.pdf

Recommendations:

It is clear that revenue budgets need to be significantly increased in order to secure the required level of maintenance of flood defence assets and to improve resilience against predicted weather extremes, reduce CO2 emissions from construction and deliver good economic efficiencies.

Policy Ask 2:

2 Funding policy for flood risk management must support the aspirations of the 25 Year Environment Plan and the carbon emission reduction commitments of the UK Government

Background

Over 1 million hectares of the UK are in low lying areas that would be naturally flooded if it were not for pumping stations removing water from networks of drainage channels to keep ground water levels below the surface. The removed water is transferred to other catchments where it can eventually flow into the sea. Some of the UK's most agriculturally productive land is located within these low lying areas such as the fens. Villages, towns, cities, industry, power stations, transport infrastructure and much more also heavily rely on water level management in these areas.

Pumping stations have traditionally operated diesel pumps but more modern systems operate electric pumps. Some pumping stations operate with both electric and diesel and can use either as the main "duty" pumps with the other pumps acting as "back-ups". Back-up pumps only get switched on when the duty pumps have reached capacity.

The configuration of electric pumps means they can deliver efficiencies in terms of energy consumption over diesel pumps. Diesel pumps tend to have a more horizontal configuration and pump water into the receiving channel at a lower point, often at some depth below the water level such as when the tide is rising or high. The depth of this point below the surface of the water is called the head of water and greater depths are associated with greater pressure of water against which water has to be pumped. Electric pumps tend to have a more vertical configuration and can "lift" water and expel it into a channel from a higher point and therefore against less pressure, often taking advantage of syphonic assistance.

Current Position

2.1 Aging flood defence assets are inefficient CO_2 emitters and are ill-equipped to cope with increased weather extremes.

A well maintained as a river system may be, if the pumping station at the end of the system is ageing and inefficient then it could undermine the effectiveness of the system upstream. To avoid being the weak link in an efficiently managed river network, many pumping stations are in urgent need of improvement to ensure that they remain capable of managing the increasing volumes of water that are conveyed to them, as we expect from predicted weather extremes. Some IDB pumping stations are in this category and are in urgent need of upgrading. Many operate diesel pumps which make obvious contributions to CO_2 emissions.

The figures presented in the table 1 and 2 below are representative of an ageing diesel pump station. To gauge a true picture of the scale, the average of these CO_2 emissions per pump have been multiplied by 44 to reflect the impact of the approximate number of IDB diesel pumps in need of upgrading across the country.

2020 Diesel Pump Records:											
Pumping station	Max pump capacity (cumecs)	Pump number	Total station max capacity (cumecs)	Pump hours per station	Litres of diesel used per hour per pump	Total diesel used in litres	Cost of diesel per litre	Total cost of diesel	KGs of CO2 per litre of diesel	CO2 per pump in tonnes per year	Total station CO2 emissions in tonnes per year
Tydd	3.36	4	13.44	1,545	50	77,250	£ 0.52	£ 40,170.00	2.62	50.60	202.40
Cross Guns	1.6	3	4.8	1,164	30	34,920	£ 0.52	£ 18,158.40	2.62	30.50	91.49
Hobhole	9.43	3	28.29	481	100	48,100	£ 0.52	£ 25,012.00	2.62	42.01	126.02
								£ 83,340.40			**419.91**
									Average CO2 in tonnes:	**41.03**	**139.97**
									Total CO2 in tonnes for all known Diesel pumps (x44 approx.)	**1,805.51**	

Table 1: Diesel usage by pumps at pumping stations in 2020 and the associated CO_2 emissions

2018 Diesel Pump Records:											
Pumping station	Max pump capacity (cumecs)	Pump number	Total station max capacity (cumecs)	Pump hours per station	Litres of diesel used per hour	Total diesel used in litres	Cost of diesel per litre	Total cost of diesel	KGs of CO2 per litre of diesel	CO2 per pump in tonnes per year	Total station CO2 emissions in tonnes per year
Tydd	3.36	4	13.44	1,197	50	59,850	£ 0.61	£ 36,508.50	2.62	39.20	156.81
Cross Guns	1.6	3	4.8	1,098	30	32,940	£ 0.61	£ 20,093.40	2.62	28.77	86.30
Hobhole	9.43	3	28.29	288	100	28,800	£ 0.61	£ 17,568.00	2.62	25.15	75.46
								£ 74,169.90			**318.57**
									Average CO2 in tonnes:	**31.04**	**106.19**
									Total CO2 in tonnes for all known Diesel pumps (x44 approx.)	**1,365.78**	

Table 2: Diesel usage by pumps at pumping stations in 2018 and the associated CO_2 emissions

The capacity of some of these diesel pumps, in terms of volumes of water they can pump, significantly decreases when they are trying pump against a head of water. Capacity can decrease from 100% at ~9.5 cubic meters/second against a 4m head of water to 10% or 1 cubic metre/second against an 8m head of water. As capacity decreases, pumps have to be run for longer in order to evacuate the required volumes of water to avoid flooding, using more fuel and emitting more CO2. As weather extremes increase these instances of having to pump at less efficient times such as against rising tides and higher flows will be more frequent so we can expect that CO2 emissions will increase accordingly. This potential loss of capacity and pressure placed upon aging assets is likely to pose a significantly increased flood risk to many areas. **The failure of these ageing pumps under such pressure would mean that thousands of KM^2 of land would be inundated, causing catastrophic damage.**

Comparing the 2018 figures to the 2020 figures already begins to demonstrate the unprecedented rainfall events we are experiencing as a result of climate change. **An increase of 32% in CO2 emissions** can be seen across a 2 year period as a result of increased pumping. This is a worrying situation when faced with the need to rapidly progress towards net zero CO2 emissions and the ageing systems which are having to deal with increased pumping operations.

Some pumping stations such as these detailed in the examples run electric pumps and diesel pumps and some operate only electric pumps. Electric pumping systems are generally more efficient than diesel pumps due to their configuration and **significantly reduce the carbon emissions** from pumping when compared to diesel pumps. The figures presented in the table 3 and 4 below are representative of average electric pumps (although in need of replacement to newer models). To gauge a true picture of the scale, the average of these CO2 emissions per pump have been multiplied by 44 to help to demonstrate the impact that approximately 44 IDB diesel pumps in need of upgrading across the country would have on CO2 emissions each year.

2020 Electric Pump Records:										
Pumping station	Pump capacity	Pump number	Pump hours	Total KWh used	Total cost of (variable) electric used	Total fixed cost of electric per year	Total electric costs per year	CO2 per KWh	CO2 per pump in tonnes per year	Total CO2 emissions in tonnes per year
Tydd	3.36	2	822	185,549.70	£ 18,780.72	7,284.25	£ **26,064.97**	0.23	21.62	43.23
Cross Guns	1.6	3	869	150,765.40	£ 15,519.13	10,118.79	£ **25,637.92**	0.23	11.71	35.13
Hobhole	2.1	4	5236	895,356.00	£ 116,396.28	-	£ **116,396.28**	0.23	51.48	205.93
				336,315.10						**284.29**
								Average CO2 in tonnes:	**28.27**	**142.15**
			Total CO2 in tonnes if all diesel pumps were replaced with electric (x44 approx.)						**1,243.86**	**6,254.45**

Table 3: Electricity usage by pumps at pumping stations in 2020 and the associated CO2 emissions

2018 Electric Pump Records:										
Pumping station	Pump capacity	Pump number	Pump hours	Total KWh used	Total Cost of Electric Used	cost of electric per year	Total electric costs per year	CO2 per KWh	CO2 per pump in tonnes per year	Total CO2 emissions in tonnes per year
Tydd	3.36	2	266	86,884.50	£ **8,990.18**	7,284.25	£ **16,274.43**	0.23	10.12	20.24
Cross Guns	1.6	3	150	40,105.90	£ **4,203.03**	10,118.79	£ **14,321.81**	0.23	3.11	9.34
Hobhole	2.1	4	5897	1,008,387.00	£ **131,090.31**	-	£ **131,090.31**	0.23	57.98	231.93
										261.52
								Average CO2 in tonnes:	**23.74**	**130.76**
			Total CO2 in tonnes if all diesel pumps were replaced with electric (x44 approx.)						**1,044.55**	**5,753.39**

Table 4: Electricity usage by pumps at pumping stations in 2018 and the associated CO2 emissions

The examples provided demonstrate that electric pumps can **reduce CO2 emissions by 31%** compared to diesel pumps. If accredited "green" energy suppliers are used then these emissions can be **further reduced by 25% to a 48%** CO2 reduction over diesel pumps. If these pumps were also to be replaced with more efficient pumping systems such as variable speed drives (VSD), recent research suggests that **a further reduction of 32.5%** could be made in energy consumption and carbon emissions taking the total **reduction to more than 65%** over diesel pumps.

Recommendations:

These figures demonstrate that some of the most important pumping stations in the UK operate inefficient carbon emitting diesel pumps. Replacing these pumps with more efficient electric pumps with variable speed drive systems could account for a **carbon saving of approximately 65% each year** against diesel pumps. This could make a considerable contribution to the UKs net zero ambitions and improve preparedness for the weather extremes that are predicted of climate change. We recommend that these asset replacement projects are made a priority for funding.

2.2 Funding for the replacement of inefficient carbon-emitting IDB pumping stations is severely restricted

Background

Flood Defence Grant in Aid or FDGiA is the primary funding mechanism available to IDBs to support their capital project portfolios. The current FDGiA "green book" cost benefit analysis scores an application for funding against a number of outcome measures such as number of properties protected (outcome measure 2), amount of habitat created or restored (outcome measure 4), and the value of land protected (outcome measure 1). The higher the score against these outcome measures the more likely that funding will be granted and the higher the contribution of the overall project cost will be made. Where projects do not score highly enough against these outcome measures, then no funding will be granted.

Current Position

For IDBs as public bodies, the funding available to them to upgrade their assets is very limited. Some IDB asset replacement projects would achieve a low FDGiA score or would not qualify at all against the FDGiA outcome measures due to the low "number of properties better protected", low "value of land protected" and lack of habitat created. The IDB diesel pumping station examples used in this response are such projects. As such the low proportion of FDGiA funding offered towards the overall project costs, if any at all, renders the project financially unfeasible for the IDB to progress.

As an example, a typical rural pumping station which services a large but mostly agricultural catchment may have 1300 properties that meet the criteria to be considered "better protected" against outcome measure 2. However this number of properties would result in a low score against the outcome measure. The land in the same catchment could be some of the most productive high grade agricultural land in the country delivering many millions for pounds of agricultural benefit but the FDGiA cost benefits analysis **counts only 6% of the "retail" value of that agricultural land** against outcome measure 1. In the face of a rising global population and concerns over food security and availability, the low value placed on such land makes little sense.

The same application could propose to install new "fish-friendly" electric pumps as required by the Eel Regulations to improve the passage of fish and particularly the critically endangered European Eel. The score achieved by this benefit would depend on the length of watercourse where passage had been improved but would not be sufficient to qualify the project for funding without high scores against the other outcome measures.

CO_2 reductions are a consideration within FDGiA applications. However, while applicants are expected to complete a complex carbon calculation to demonstrate that CO_2 reductions can be made, the result, regardless of how much **CO_2 can be reduced, is not currently a scored element of the application**. Even applications with the highest CO_2 reductions therefore would fail on this basis if other outcome measures scored poorly and priority would be given to applications which scored more highly against other outcome measures even if CO_2 reductions were minimal. **This is contrary to CO_2 reductions being a primary government objective and a legally binding commitment.**

The risk exposure from operating aging flood defence assets has been recognised this year when the EA secured an asset replacement fund of £240 million pounds. Disappointingly, the funding was only available to the EA for improving their own assets that did not qualify for FDGiA funding. As mentioned previously in this response, improving one element of a river system to "gold standard" when all other interlinked elements are sub-standard will only diminish the benefit and effectiveness of the improved element and overall system. However this funding allocation has demonstrated that such asset replacement is feasible and valuable so should be extended to include the consideration of other flood defence assets regardless of their managing authority.

Despite the examples of the benefits to be gained from funding the improvement of ageing IDB assets: protection of our most productive land, biodiversity enhancements, rural communities protected, climate change resilience and the significant CO_2 reductions, many such catchments do not meet the criteria for FDGiA funding. As such, many catchments are at risk from the weather extremes we are already experiencing from climate change and the diesel pumps will continue to contribute towards the UKs carbon footprint until funding opportunities improve.

Recommendations:

The details provided highlight that significant improvements can be made to climate change resilience, biodiversity, food security and CO_2 reductions if some of these IDB asset replacement projects were funded and progressed.

We recommend that the value placed on agricultural land by the FDGiA cost benefits analysis is significantly increased to properly recognise the importance of these areas to our national food security and the rural communities who rely on them.

We also recommend that the FDGiA CBA introduces an outcome measure which scores and prioritises the delivery of carbon reductions if the government is to meet its net zero objectives.

Increasing the “stand-alone” asset replacement fund and/or extending it to cover the upgrade of non-qualifying IDB assets would further support the progression of such projects to the same benefits, particularly if CO2 reductions were included as an objective. This would ensure that assets were considered and prioritised on a catchment basis rather than a management system basis.

Looking further ahead

The recommendations set out in this response would significantly reduce the carbon footprint of the flood risk management industry and make a vital contribution towards net zero commitments both nationally and globally. However more can be done. This response sets out some “quick wins” in terms of replacing parts of existing systems with more carbon and energy efficient parts. Many of these systems would be even more efficient if they underwent a complete system redesign. This has obvious cost implications but such approaches could potentially deliver a net-negative carbon position. For example, many European water-level managers have installed renewable energy systems at their pumping stations. These systems generate “green” energy for the both the pumping operations and supply any surplus to the local communities, often at a discounted rate, or to the national grid. There are examples of some UK pumping stations which have solar array systems but the current performance of such systems is insufficient to meet the energy requirements of the pumping stations at all times therefore traditional energy supplies are still required. While excess power is generated at times at such locations, it cannot be stored for later use by the pumping station because energy storage technologies are currently cost prohibitive. This would mean that the feasibility of replicating such a renewable energy set up across other pumping stations is uneconomic at present.

We recommend that central funding is increased for progressing the development of improved and accessible renewable energy technologies for the benefit of not only the flood risk management sector but undoubtedly other sectors also if the Government is to meet their net-zero commitments.