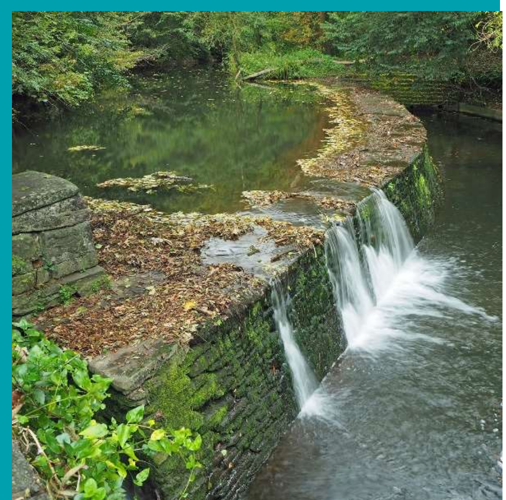
West Country Water Resources Group

Environmental Destination

Annex B: Poole Harbour Rivers pilot catchment plan to increase future water supply and low flow environmental resilience



Wood Group UK Limited – February 2022

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Doc Ref. 807434-WOOD-WRG-PH-RP-OW-0001_S0_P01.1

https://woodplc.sharepoint.com/teams/environmentalambition-wood/shared documents/wood/trial catchments/deliver/reporting/draft/annex b poole harbour rivers/807434-wood-wrg-ph-rp-ow-0001_s0_p01.1.docx

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Document revisions

No.	Details	Date
i1	Draft for review	February 2022

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Contents

1. Overview

This document is one of five technical annexes that lay out plans for holistic measures that may be implemented in five West Country Water Resources (WCWR) pilot catchments to increase water supply and environmental low flow resilience. These set out steps towards an Environmental Destination for 2050 in each catchment, in response to the water resources-related 'Environmental Ambition' challenge set by the Environment Agency as part of its National Framework for Water Resources (March 2020).

1.1 This pilot catchment plan

This trial catchment plan sets out the measures best suited to achieve future water resources resilience and environmental improvement in the **Poole Harbour Rivers Catchment**, in response to the challenge to meet environmental flow objectives, even as flows are expected to fall due to climate change.

Full details of the project context, scope, data sources and stakeholder engagement are given in the main report.

1.2 Contents of this annex

After this introduction,

- **Section 2** provides a summary of the catchment and the pressures on it.
- **Section 3** details the EA-suggested Environmental Ambition abstraction reductions that may be needed to improve river flows. It also provides an indication of how the flow regime is projected to change as the climate shifts into the future.
- **Section 4** describes the current projects underway in the catchment and summarises the strategic action plan of water company measures that could be implemented in a phased approach to increase water supply resilience. Projects currently focused on land management, habitat creation, restoration, re-wilding and diffuse water quality improvements are also included because these should improve ecological resilience through droughts, even though they will not make much difference to the flow regime.
- References are given in **Section 5.**

Figures are provided as a slide pack and at the back of this Annex in **Section** Error! Reference source not found.**.**

2. Catchment summary

The Poole Harbour Rivers catchment is mostly underlain by the Chalk aquifer which is important both for public water supply and also for supporting internationally renowned chalk streams with rare and diverse aquatic ecology. The Chalk is confined by the London Clay in the lower part of the catchment around Poole Harbour itself. This section describes the catchment as it is now - the rivers that drain it (the Frome, Piddle and other tributaries – see **Figure B2.1**), the interaction of surface water with groundwater, the pressures from abstraction, as well as from diffuse and point sources of pollution.

2.1 Why the Poole Harbour Rivers pilot?

The WCWR scoring and consultation process for pilot catchment selection is presented in the main report.

For the **Poole Harbour Rivers catchment**, the Environment Agency's Environmental Ambition calculations consider tightening river flow standards of several chalk stream tributaries and along the SSSI designated reaches of the River Frome and Bere Stream. This would reduce the allowable impacts of Chalk groundwater abstraction, further compounding the squeeze on resource availability expected as the climate warms and low flows fall. Many of the winterbourne tributaries (e.g. the Piddle, Devil's Brook and Bere Stream) have been the subject of detailed WINEP investigations in order to review appropriate levels of abstraction and introduce low flow support mitigations such as groundwater to river support schemes. The Environmental Ambition and climate change challenge means these water bodies will remain under scrutiny, and the extent of potential abstraction impact reduction needs may spread more widely across the catchment.

Poole Harbour is vulnerable to eutrophication risks, so work is ongoing to reduce phosphate and nitrate nutrient inputs from the catchment. Poole sewage treatment works discharges may be re-located northward to support the River Stour in an effort to reduce low flow abstraction pressures on the Lower Hampshire Avon Special Area of Conservation (SAC). This should help reduce nitrate pressures on the Harbour but removes a potential effluent re-cycling future flow resource from the catchment.

There is therefore a need for more creative thinking, planning and investigations to understand what potential options might be available to maintain public supplies whilst improving the resilience of catchment and local habitat management as low flows fall to 2050 and beyond.

The catchment is home to a number of active stakeholder groups, there is good public access to and interest in the Frome around Dorchester, and there is a long history of river habitat and hydro-ecological investigation associated with the research centre on the river.

2.2 The current state of the catchment

Geography, geology, rivers and environmental designations

The Poole Harbour Rivers catchment is largely drained by the Rivers Frome and Piddle (and their winterbourne tributaries) which flow south and then eastwards to discharge into the Poole Harbour transitional water body (**Figure B2.1**). It also includes the other smaller streams that flow directly into Poole Harbour, e.g. the Corfe River and Sherford River.

The catchment area is predominantly rural including agricultural pasture and arable land uses, although areas of urban development characterise the north of the Harbour around Poole and towns such as Wareham and Dorchester (**Figure B2.2**).

The Frome and Piddle are both classic chalk rivers, with catchments underlain and fed by the large area of Chalk that outcrops across the Dorset Downs. As such, the rivers support rare chalk stream ecological assemblages including salmon and sea trout with accretion of clear, cool, good quality groundwater-dominated baseflow.

The headwaters of the River Frome rise from springs that issue from the Upper Greensand at Evershot, and into the Hooke Stream headwater tributary. Here the geology is mixed with other minor tributaries flowing off of mudstone, clay and Upper Greensand to join the main river. As the river flows south it passes onto the permeable Chalk outcrop at Maiden Newton. It is then joined by other Chalk-fed winterbourne tributaries including the River Hooke, Sydling Water, the River Cerne, South Winterbourne, Tadnoll Brook and River Win. Steep topography and incised valleys in the upper reaches of the river lead to higher energy localised runoff responses, but as the river flows past Dorchester the valley becomes typically wide and flat with meanders, and a smoother response is seen due to the influence of the Chalk groundwater flow and storage between recharge and river baseflow (Environment Agency, 2012).

The River Piddle drains the northern part of the Poole Harbour catchment, flowing approximately parallel to the River Frome. It rises on the Chalk outcrop at Alton Pancras and flows south and east, being joined by the Chalk-fed Devils Brook and Bere Stream winterbournes. It joins the River Frome at Wareham where the two rivers discharge into Poole Harbour via the Wareham Channel.

In lower part of the catchment, the Rivers Frome and Piddle both flow onto Tertiary sands, gravels and the London Clay of the Thames Group and Bracklesham Group, which overly and confine the Chalk here. Historically this area was very marshy, and large wetland areas still remain around Poole Harbour.

The channel and habitat around both of the Rivers Frome and Piddle have historically been extensively modified, and this is an important issue for the catchment in terms of the impact on flooding and alteration of natural river flow connectivity and habitats (PHCI, 2014). A large number of structures control the split of flow between channels and extensive ditches drain the river floodplain (Environment Agency, 2010). Modification works have included dredging, deepening and straightening, construction of drainage ditches, artificial channels, installation of in-channel structures, cutting of in-channel vegetation and removal of bankside trees. Initially, this was to supply a network of floodplain water meadows in the 1600’s and water mills. The water meadows were largely drained and converted to agricultural land by 1940 (Environment Agency, 2010).

River restoration to the channel throughout the River Frome SSSI has been ongoing under the Defra/Environment Agency River Frome Rehabilitation Plan 2010-2020 (discussed further in **Section** Error! Reference source not found.).

The lower section of the Bere Stream is more natural in character with braided channels and good examples of riparian wetland and woodland (PHCI, 2014).

Designated sites in the catchment include Special Areas of Conservation (SAC), Special Sites of Scientific Interest (SSSI) and Ramsar sites (**Figure B2.2**). The upper catchment to the Frome contains the Sydling Downs and Cerne SAC, and the West Dorset Alder Woods SAC. The River Frome itself and a section of the Bere Stream are designated as riverine SSSIs for their rare, species-rich chalk stream communities (Natural England, 1998, Natural England, 1984). Along the lower reaches of the Rivers Frome and Piddle the frequently waterlogged grassland of the Wareham Meadows is also designated as a SSSI, important for birds (Natural England, 1987). The soft sand and clay pockets of Bagshot Beds (Bracklesham Group) around Poole Harbour are associated with the Dorset Heaths SAC which support a diverse and rare range of dry and wet heathland communities and peat bog pools (JNCC[1], Natural England, 2014).

Poole Harbour is protected by SPA and SSSI designations and as a Ramsar site due to the ecological value of its extensive marshes, mudflats and sandflats.

There is the potential for the Frome to become a compensatory SAC in relation to impacts on the Hampshire Avon SAC, which could further raise the level of environmental ambition in this catchment.

Abstraction pressures

There is a long history of abstraction impact investigation in the Poole Harbour catchment, both around the River Frome and the River Piddle. Most of the 'consumptive' pumping is for public water supply which returns re-cycled water to the catchment downstream of towns and villages after treatment. There are also large abstraction licences for non-consumptive agricultural purposes such as fish farms and water cress beds – typically supported by springs or boreholes which return the water locally to the catchment and have little impact on downstream resource availability. Non-public water supply water users in the agricultural, industrial or private supply sectors therefore represent a relatively small component of consumptive water demand. However, they still need to be aware of the changes in resource availability expected due to climate change, as set out in **Section 3** so that they can plan and adapt.

Groundwater abstraction is predominantly from the Chalk, licensed to Wessex Water for public supply (**Figures B2.3** and **B2.4b**). In addition, surface water abstraction is licensed for public supply from Wessex Water's Hooke Springs which issue from the Chalk in the west of the catchment. (**Figures B2.3** and **B2.4a**).

The groundwater from within the Poole Harbour surface water catchment also flows south to support spring and borehole public supply sources in the headwaters of the Rivers Wey (Sutton Poyntz, Friar Waddon) and Bride (Litton Cheney), as well as around Lulworth, as labelled in **Figure B2.3**.

[1] https://sac.jncc.gov.uk/site/UK0019857

There are a number of groundwater to river support schemes that Wessex Water operate in the catchment, including **(Figure B2.3**):

- Low flow support to the Upper Piddle at Alton Mills.
- Low flow support to the River Piddle at Briantspuddle on the Piddle (included in the Briantspuddle PWS Licence).
- Low flow support to the Devils Brook at Dewlish (included in the Dewlish PWS Licence).
- Full time flow support to the Tadnoll Brook at Watergates and Warmwell to offset the impact of Empool PWS.
- Schemes are also in place although not in current use for stream support at West Lulworth (related to West Lulworth abstraction) and Poorlot (related to the Poorlot abstraction), but as the sources are rarely used, neither is the stream support.

Groundwater abstraction intercepts flow in the aquifer that would otherwise contribute to river baseflow and therefore affects surface water flows particularly where the river flows over the Chalk outcrop. Lowered groundwater levels can also affect springs and winterbourne tributaries causing the dry period to be longer, particularly under drought conditions, although the impacts of abstractions which draw on groundwater storage are partly delayed until the next recharge season when the aquifer is re-filling and flows are higher.

In 1991 the National Rivers Authority identified the River Piddle (together with other chalk streams) as suffering from acute low flows as a result of local abstraction. Subsequent significant reductions in abstraction have contributed to the river's current good ecological status (CaBA, 2021). Wessex Water has also previously investigated the environmental impact of abstraction on river flows in the Bere Stream, the Devils Brook and River Hooke[2]. The operational effectiveness of the groundwater to river support schemes has been a focus of these investigations.

The Wessex Basin regional groundwater and river flow model has been built by the Environment Agency and Wessex Water covering the Stour, Avon and Poole Harbour catchments. This has been extensively used by both water companies and the regulator to inform abstraction licence decision making for over 10 years.

The latest 2020 Dorset abstraction licensing strategy assesses groundwater availability across the catchment as 'Restricted water available' noting that there is very little scope for any additional consumptive abstraction in low flow summer months (Environment Agency, 2020a).

Drinking water safeguard zones associated with **nitrate** pressures have been designated associated with eleven of Wessex Water's public water supply sources (Hooke Springs, Winterbourne Abas, Friar Waddon, Empool, Sutton Poyntz Springs, Forston, Eagle Lodge, Alton Pancras, Briantspuddle, Belhuish and Milbourne St Andrew) (**Figure A2.2)**. Measures are in place, including water company work with landowners promoting catchment management approaches to reverse rising nitrate trends.

ARUP are also conducting a study to enhance the understanding of the current and future needs of non-PWS abstractions for agriculture, private water supplies, and mineral abstraction. As part of this assessment, ARUP have calculated the non-public water supply demands of the catchment, including generating figures for the number of animals in the catchment which have water

[2] https://www.wessexwater.co.uk/environment/protecting-and-enhancing-the-environment/investigations

demands. The preliminary results from the ARUP 2022 study are shown in Figure B2.4a and indicates non-public water supply demands from the catchment are approximately 9 Ml/d.

Water resource availability

Environment Agency maps of water resource availability in the catchment at a range of flows are shown in **Figure A2.5** (Cycle 2, Environment Agency 2021[3]).

At high flows above Q30, water is assessed as being available across the entire catchment (that is, there is more water that is required to meet the needs of the environment, even if abstraction increased to Fully Licensed rates).

At moderate (Q50) and low flows (Q70) this picture changes, with flows falling below the Environmental Flow Indicator (EFI) in the upper Piddle, Devils Brook and also in the South Winterbourne at Q70, such that restricted water is available for licensing.

At the lowest flows (Q95) most of the upper catchment is assessed as 'Water Not Available', with flows falling below the Environmental Flow Indicator (EFI). The lower River Piddle and South Winterbourne is assessed as restricted water available at Q95.

Flood risks

The Poole Harbour Rivers have a history of flood risk, from surface water flooding, groundwater flooding and tidal flooding.

The sources of flood risk vary across the catchment. In the steeper topography catchment headwaters, flashy peaky surface runoff is typical. In the Chalk downlands, surface water, river and groundwater flooding may occur in incised valleys; for example, river flooding from the River Frome has occurred in Maiden Newton and Dorchester. Groundwater flooding has also been documented in the Piddle Valley (for example at Piddlehinton and Piddletrenthide), Milborne St Andrew on the Bere Stream, Cerne Abbas on the River Cerne, and Dorchester on the River Frome. In the lower catchment where the rivers flow onto the Tertiary sands, clays and gravels, a more mixed response is typical, and tidal flooding may occur in the lower reaches around Wareham (Environment Agency, 2012).

Waste water treatment works discharges and water quality pressures

Wessex Water operates the waste water treatment works which return mains water to the rivers and Poole Harbour. There are treatment works for many small villages and towns (e.g. Dorchester, Wareham, Swanage), with the largest discharges returned from the Poole works into the Harbour. This is labelled on **Figure B2.3** together with the Weymouth works to the south of the catchment because these both represent potential opportunities for re-cycling or re-use to reduce the loss of reliable flows to the sea. An option to relocate the Poole works discharge northward into the River Stour is already under consideration to support higher rates of summer abstraction in order to

[3] https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/WaterResource AvailabilityAndAbstractionReliabilityCycle2&Mode=spatial

reduce pressures on the Lower River Avon. This would also reduce nutrient pressures on Poole Harbour.

These discharges are consented and regulated by the Environment Agency. Considerable improvements in discharge water quality have been achieved over the past 30 years and investment is ongoing as clean-up standards continue to be tightened. As the sewer systems often combine household effluent with urban drainage runoff, occasional storm overflow of untreated water remains a focus for improvement.

Nutrient pollution pressure, specifically relating to **nitrate** and **phosphate**, is a key issue for Poole Harbour itself. Much of the nutrient load is derived from diffuse agricultural sources (fertilisers) running off to watercourses or being leached to groundwater into the Chalk aquifer. A smaller proportion is related to water company WwTW discharge. Urban pollution around Poole also affects the river water quality. The sources of phosphate have been the subject of much research, in particular in the headwaters of the Frome considering to the contribution from natural sources in the Upper Greensand, the effects of higher rates of runoff from mixed soils, agricultural practices and poorly managed septic tanks (CaBA, 2021).

The shallow basin of Poole Harbour is particularly susceptible to eutrophication with excess nutrients (nitrogen and phosphorus) leading to algal and seaweed growth and impacting the ecology. Reduction of nutrients is being managed by the Poole Harbour Nutrient Management Scheme, led by farmers in the catchment in partnership with Wessex Water, the Environment Agency, Natural England, Catchment Sensitive Farming and others (DCP, 2020).

High nitrate levels have also caused SSSI wetland habitats in the catchment to deteriorate due to vigorous growth of vegetation such as nettles. High ortho-phosphate levels during summer low flow periods have been associated with excess algal growth in the Fiver Frome and Bere SSSIs (PHCI, 2014).

Excess **sediment** from silt-laden runoff has also been identified as a key issue which is impacting fish and aquatic ecosystems, and also contributing to elevated phosphorus and algal blooms in rivers in the catchment. Excess sediment may originate from ploughing on steep slopes, damaged road verges and tracks, river channel banks eroded by livestock, cultivated surface soil and pasture with high stock levels (PHCI, 2014).

Future population pressures

In the Poole Harbour catchment, a 10% rise in population is forecast by 2035, representing a further 25,000 people (PHCI, 2014). Summer tourists to the area are also projected to increase in the future, adding further pressure.

Water Framework Directive (WFD) status

A map of the overall WFD (Cycle 2, 2019) status of water bodies across the catchment is shown on **Figure B2.6**. This combines both the chemical and ecological status reported by the Environment Agency for the water bodies. The recent recognition of new types of pervasive pollutants which affect many rivers across the country is tending to dominate overall WFD status. So when focusing on water resources, abstractions and river flows it is more helpful to consider ecological status.

River flow and morphological condition (i.e. the naturalness of channel profiles, the existence of weirs and barriers etc.) are considered as supporting elements in the assessment of ecological status - which is primarily based on monitoring the health, diversity and abundance of plants, bugs and fish in rivers, lakes and estuaries. The WFD water body ecological status of Poole Harbour Rivers water bodies (Cycle 2, 2019) is mapped on **Figure B2.7.**

There are several key reasons for the failure to achieve good status mapped in both **Figures B2.6** and **B2.7** some of which have nothing to do with abstraction pressures (e.g. agricultural management). These are listed below:

- In the Frome headwaters, WFD issues are noted with phosphate related to diffuse agricultural runoff. For the upper Piddle and Devils Brook, the main WFD issues impacting on fish and other aquatic life are due to physical modification of the channel and its banks and diffuse agricultural runoff (as well as the flow regime impacts of groundwater abstraction).
- In the middle reaches of the Frome water quality impacts from natural mineralisation, water company WwTW discharge and diffuse agricultural runoff add to the flow risks associated with groundwater abstraction pressures.
- The lower reaches of the Frome are under pressure from contaminated urban, industrial and diffuse agricultural runoff. In the lower reaches of the Piddle physical modification of the channel, industrial pollution, diffuse agricultural runoff and flows below the EFI are all highlighted as potentially impacting fish and aquatic ecosystems.

Environment Agency catchment data[4] are summarised in Error! Reference source not found. and **Table 2.2** for selected water bodies of particular interest to this plan which is focused on future water resource and environmental low flow resilience. In these water bodies the Environment Agency's Environmental Ambition modelling has predicted river flows could fall further below regulatory thresholds by 2050 unless the impacts of public water supply abstraction are reduced. These calculations incorporate projections of future changes in river flows expected due to climate change, plus the potential impacts of fully licensed abstraction, as discussed further in **Section 3**). These focus water body locations are labelled on **Figures B2.6** and **B2.7.**

Table 2.1 2019 (Cycle 2) EA Catchment Data for water bodies of particular water resources interest in the Frome catchment[4]

Water body	Ecological status	Biological quality	Physico-chemical quality	Hydrological Regime	Chemical substances	RNAG
1 Hooke **GB108044009800**	Moderate	Good	Moderate (phosphate flagged as moderate)	Does not support good	Fail (Mercury and Its Compounds and PDBE)	Diffuse and point sources (phosphate), flow (Flow is below the EFI but not causing an ecological failure)

[4] https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3140 accessed 09/11/21

Water body	Ecological status	Biological quality	Physico-chemical quality	Hydrological Regime	Chemical substances	RNAG
2 Frome Dorset (Lower) u/s Louds Mill Dorchester **GB108044009691**	Poor	Poor (Macrophytes and Phytobenthos Combined)	Good	Supports good	Fail (Mercury and Its Compounds and PDBE)	Groundwater abstraction (Hydrological Regime). Natural, point and diffuse sources (Macrophytes and Phytobenthos Combined)
3 South Winterbourne **GB108044010060**	Moderate	Moderate (Fish)	High	Supports good	Fail (Mercury and Its Compounds and PDBE)	Natural conditions – other (Hydrological Regime)
4 Frome Dorset Trib (River Win) **GB108044009650**	Good	Good	Good	Supports good	Fail (Mercury and Its Compounds and PDBE)	NA
5 Frome Dorset (Lower) d/s Louds Mill Dorchester **GB108044009692**	Moderate	Moderate (Macrophytes and Phytobenthos Combined)	Good	Supports good	Fail (Mercury and Its Compounds and PDBE)	Diffuse and point sources, urban sources (Macrophytes and Phytobenthos Combined)

RNAG Reasons for not achieving good; PDBE Polybrominated diphenyl ethers

Table 2.2 2019 (Cycle 2) EA Catchment Data for water bodies of particular water resources interest in the Piddle catchment[4]

Water body	Ecological status	Biological quality	Physico-chemical quality	Hydrological Regime	Chemical substances	RNAG
6 Piddle (Upper) **GB108044010120**	Poor	Poor (Fish)	Good	Supports good	Fail (Mercury and Its Compounds and PDBE)	Flow (Groundwater abstraction), Physical modification – land use (Macrophytes and Phytobenthos Combined)
7 Devils Brook **GB108044010130**	Bad	Bad (Fish)	Good	Does not support good	Fail (Mercury and Its Compounds and PDBE)	Flow (Groundwater abstraction), Physical modification (Fish, Macrophytes and Phytobenthos

Water body	Ecological status	Biological quality	Physico-chemical quality	Hydrological Regime	Chemical substances	RNAG
						Combined) Diffuse source (fish)
8 Bere Stream **GB108044009630**	Good	Good	High	Supports good	Fail (Mercury and Its Compounds and PDBE)	NA
9 Piddle (Lower) **GB108044010080**	Moderate	Moderate (Fish and Macrophytes and Phytobenthos Combined)	High	Supports good	Fail (Mercury and Its Compounds and PDBE)	Point/diffuse source (Macrophytes and Phytobenthos Combined, fish), Flow (Flow is below the EFI but NOT causing an ecological failure) Physical modification (Fish)

RNAG Reasons for not achieving good; PDBE Polybrominated diphenyl ethers

Whilst **Figure B2.5** shows there is currently restricted water available at Baggs Mill on the lower River Piddle, recent actual environmental low flow deficits are relatively small and short lived in comparison with higher flow surpluses (**Figure B2.8**). This means that there is already a need for more low flow support during dry summers which will grow and become more frequent as natural flows fall in the warming climate (see **Section 3**). It also indicates the potential benefits of options which develop storage to store winter water for summer supply. A phased plan of ideas to be explored is sketched out in **Section 4.** This includes abstraction reductions, the optimisation of existing groundwater to river support schemes, the potential development of an Aquifer Storage and Recovery scheme in the confined chalk at Wareham, investigation of recycling possibilities for the Weymouth WwTW discharge, and the feasibility of a new surface reservoir in the lower catchment to store winter spring flow from the Tadnoll Brook.

2.3 Existing water company water resource management planning (WRMP) options in the Poole Harbour catchment

Wessex Water's previously published strategy centres on demand management, focused on reductions in per capita consumption rates, as presented in the Water Resource Management Plan (Wessex Water, 2019). This includes the management of leakage (15% reduction in 5 years), enhancing metering and providing water efficiency services.

Preferred options are detailed in **Table 2.3**.

Table 2.3 Wessex Water (2019) WRMP preferred options relevant to the Poole Harbour rivers catchment

Option	Code	Type of option	Earliest potential start date	WAFU Ml/d	Detail
Final Planning Scenario - 15% leakage reduction by 2025	ALY	Other leakage control	2020-21	18.6	Infrastructure renewal, active leakage control, pressure management, improved data analysis, and DMA improvements
Met uplift optional	M1a	Metering optants	2020-21	0.4	Enhanced metering
Home Check	WE1	Household water audit	2020-21	3.7	Home advice and device fitting visits
Dashboard	WE2	Customer education / awareness	2020-21	1.3	Customer engagement dashboard

WAFU – Water available for use

A number of feasible **supply-side options** have also been explored by Wessex Water for this catchment, including the construction of desalination plants and bringing back mothballed sources into supply, as detailed in **Table 2.4**. None of these have been taken forward as preferred options at this stage.

Table 2.4 Supply-side options reviewed (but not preferred) in the development of the Wessex Water (2019) WRMP, relevant to Poole Harbour rivers catchment

Option	Code	Type of option	Earliest potential start date	WAFU Ml/d	Detail
Desalination (30 Ml/d)	R1a	Desalination	2025-26	30	A large desalination development on the south coast with the water transferred across the Wessex Water supply system
Desalination (10 Ml/d)	R1b	Desalination	2025-26	10	Small desalination development on the south coast with water used locally
Mothballed sources refurbished and brought back into supply - South	R5a	GW enhancement	2022-23	2.6	Treatment processes upgraded enabling groundwater and spring sources in the south to be brought back into use that have been mothballed.

WAFU – Water available for use

Other feasible **demand-side options** have also been explored by Wessex Water, including options to further reduce leakage and options to reduce demand for water, as detailed in **Table 2.5**. None of these have been taken forward as preferred options at this stage.

Table 2.5 Demand-side options reviewed (but not preferred) in the development of the Wessex Water (2019) WRMP

Option	Code	Type of option	Earliest potential start date	WAFU Ml/d	Detail
Options to reduce distribution losses (leakage)	-	10 further options to manage and control leakage	2020-21	32.5	Active leakage management, mains replacement (not trunk mains), pressure management etc
Options to reduce the demand for water	-	3 metering options	2020-21	19.8	Reduction in demand through improved metering

It is important to note that leakage from the public water supply system represents a return of water to the catchment. Leakage is often associated with household connections rather than large events from main supply pipes which are more easily identified and quickly fixed. Leakage rates tend to be higher in winter when pressures are higher and temperatures lower than in summer. Where housing density is high such as in Dorchester, rates of leakage are accounted for in the Wessex Basin groundwater and river flow model because much of the water is expected to end up back in the River Frome. It follows that reductions in leakage, whilst reducing the rates of abstraction required for supply, may make less difference to river flows downstream of urban areas, particularly during summer months.

Similarly, reductions in per capita consumption will be more difficult to realise during warmer summers when demand usually increases, rather than during winter periods. And if demand reductions are achieved, they will be associated with lower rates of treated wastewater discharge which would reduce low flow resilience downstream of cities and towns.

3. Environmental Ambition challenge

This section summarises the predicted 2050 flow deficits and surpluses in the catchment and the potential future reductions in public water supply abstraction impacts highlighted by the Environment Agency's Environmental Ambition screening modelling, as set out in the National Framework for Water Resources (March 2020).

The Environment Agency's modelling indicates the additional water that may be needed by 2050 to meet:

- environmental river flow targets based on existing (Business as Usual, BAU) or enhanced (ENH) thresholds;
- predicted future predicted (FP) demands for public water supply and other water uses, and also worst-case, fully licensed (FL) demand assumptions; and
- in the context of natural Q95 low flow conditions which have been simply factored down from current estimates for 2050 based on a climate change projection.

The Environment Agency provided the WCWRG with WFD river water body scale National Framework estimates of 2050 environmental flow surpluses or deficits to highlight the water bodies of concern (as summarised in **Section 2** and presented in more detail below). An indication of the individual abstraction reductions which might be needed to meet the 2050 existing or enhanced environmental flows was also tabulated for the regional water resources groups and water companies to consider.

Whilst the main theme of the Environmental Ambition challenge is therefore framed in terms of 'potential abstraction reductions needed to meet river flow targets' and improve environmental low flow resilience, this implies that alternative sources of water will need to be found from elsewhere to maintain public supply resilience. At the same time, water companies must demonstrate that their demand suppression and supply systems are robust enough for a 1 in 500-year drought event. So smarter management options which allow existing drought-resilient abstractions to continue whilst protecting the environment - such the existing groundwater to river low flow support schemes - must also remain on the table.

Section 3.1 presents mapped and tabulated summaries of the water bodies with Environment Agency projected flow deficits. The climate change assumptions made in these projections are reviewed based on the latest suite of UKCP18 modelling data in **Section 3.2** which suggests that significant low and median flow reductions should be expected throughout the century. The potential licence reductions being scrutinised according to the Agency's analysis are listed in **Section 3.3**, and compared with published water company WRMP options in **Section 3.4.**

3.1 Predicted 2050 flow deficits and surpluses

Environmental Flow Indicator (EFI) targets are defined by the Environment Agency to indicate the river flow required to support Good Ecological Status under the EU Water Framework Directive

(WFD). The EFI allows a percentage deviation from natural flows at a specific location, defined based on the Abstraction Sensitivity Band (ASB) of the site – a nationally consistent abstraction pressure screening approach intended to highlight areas where further ecological impact investigations should be carried out.

The predicted fully licensed 2050 flow surpluses and flow deficits for the Poole Harbour Rivers catchment waterbodies under Q95 low flow conditions are mapped in **Figure B3.1**, under the EA's **enhanced** 2050 scenario, which is 'worst case' for planning purposes.

In the enhanced scenario, increased environmental protection (i.e., a more stringent flow target) is assigned to protected areas, principal salmon and chalk rivers, SSSI rivers and wetlands.

For the Poole Harbour catchments, the Lower River Frome SSSI, Bere Stream SSSI and River Piddle chalk stream reaches and winterbourne tributaries have been assigned Common Standards Monitoring Guidelines (CSMG) environmental flows ('river' ASB4) for the Enhanced Environmental Ambition scenario. Under Q95 low flow conditions, CSMG standards allow abstraction impacts up to 10% of natural flows. This is the same as the EFI ASB3 pressure thresholds which already apply as a default to many of the water bodies in the catchment so there would be no material difference to the degree of low flow protection. However, a moderate sensitivity EFI ASB2 (allowing impacts up to 15% of Q95) is currently assigned to the Lower Frome, Win, Cerne, Sherford and Corfe Rivers so the application of CSMG thresholds represents a tightening of the environmental flow standards in those water bodies.

It can be seen from **Figure B3.1** that whilst some headwater streams are predicted to have low flow surpluses in relation to Enhanced environmental flows in 2050 (e.g. the Tadnoll Brook mapped green), the majority of the water bodies within the Poole Harbour catchment are predicted to have flows close to (white) or below (yellow) flow targets. The Ml/d predicted deficits labelled on Figure B3.1 are largely because of the impact of consumptive public water supply groundwater abstractions. It is important to note that in water bodies with existing groundwater to river low flow support schemes (e.g. the Piddle, Devils Brook and South Winterbourne), the deficits may be over-estimated because the Environment Agency's Water Resources GIS projection calculations have not allowed for the increased frequency and duration of support which would be triggered as the climate shifts.

For the River Frome catchment, 2050 flow deficits are predicted in the following water bodies (with the associated public water supply abstractions in brackets):

- Hooke (Hooke Springs and Maiden Newton Borehole)
- Frome Dorset (Lower) u/s Louds Mill Dorchester (Eagle Lodge Boreholes and Bridport Road Well)
- South Winterbourne (Poorlot Borehole)
- Frome Dorset Trib (River Win)
- Frome Dorset (Lower) d/s Louds Mill Dorchester (Belhuish Borehole).

For the River Piddle catchment, 2050 flow deficits are predicted in the following water bodies:

- Piddle (Upper) (Alton Pancras Boreholes)
- Devils Brook (Dewlish Boreholes)

- Bere Stream (Milbourne St Andrew Boreholes)
- Piddle (Lower) (Briantspuddle Borehole).

Groundwater abstraction impacts accrete down the catchment and are greater than rates of treated waste water discharge returns so the deficits are largest at the furthest downstream points on the Rivers Frome and Piddle. Further detail regarding those critical water body flow deficits linked to PWS abstraction is given in **Table** 3.1 below. This provides the surpluses and deficits at different flow percentiles, and also compares with the same outputs for the less stringent '**Business as Usual'** (BAU) scenario in which the current default EFI flow targets would apply.

A summary of their current ecological status catchment data has been presented in **Tables 2.1 and 2.2**.

Table 3.1 Poole Harbour Rivers Predicted Fully Licensed 2050 Environmental Flow Surplus or Deficit (Water body outflow, Ml/d), for the furthest downstream water bodies on the Rivers Frome and Piddle where potential PWS abstraction reductions are highlighted by the Environment Agency

	Frome Dorset (Lower) d/s Louds Mill Dorchester GB108044009692		Piddle (Lower) GB108044010080	
Flow condition	**BAU (Ml/d)**	**ENH (Ml/d)**	**BAU (Ml/d)**	**ENH (Ml/d)**
Q30	116.13	12.84	31.85	-8.10
Q50	45.71	30.76	6.81	0.51
Q70	11.96	-0.10	-2.36	-7.49
Q95	0.24	-8.64	-9.80	-13.35

BAU - Business as Usual; ENH – Enhanced Scenario
Waterbody Surplus or Deficit numbers are Ml/d based on EA natural flow, abstraction and environmental flow target assumptions for 2050

3.2 How do the Environment Agency's estimates of flow reductions due to climate change compare with updated UKCP18 for the Poole Harbour Rivers?

The Environment Agency's National Framework predictions of natural flows for 2050 were based on one of the eleven UKCP09 Future Flows projections known as 'afixK', as available at the time. This projected relatively more marked falls in flow over time compared with the remaining 10 'equally likely' suite of UKCP09 models. At the end of 2021, CEH and a consortium of associates working with the Meteorological Office have delivered the UKCP18 successor to the Future Flows data which includes 12 possible projections of river flows and groundwater levels from 1982 to 2080 using a variety of alternative modelling approaches. These Enhanced future Flows and

Groundwater (eFlaG) data are available online[5] and have been used to compare against the Environment Agency's assumptions for the Poole Harbour catchment and provide stakeholders with a clear picture of how flows are expected to change to 2050 and beyond.

Figures B3.2 and B3.3 plot rolling 18 year flow percentile statistics in Ml/d derived from modelled daily flow projections for the Piddle at Baggs Mill. Plots are included to show how high (Q1 'floods'), median (Q50), low (Q95) and very low (Q99 'droughts') flows are predicted to change through the 21st century. There are lines for each of the 12 possible UKCP18 regional climate models (RCM) provided from eFlaG compared with the projection for the same location from UKCP09 Future Flows, as included in the Environment Agency's calculations.

On the right of each percentile time series, an area plot indicates how many of the 12 UKCP218 eFlaG models show increases or decreases in flow, how big that projected change is relative to the start of the century (2000), and how the differences evolve past 2050 and on to 2080.

These plots indicate that highest flood event flows (Q1 and above) are expected to be steady or perhaps increase with time according to most of the projection models. These increases are modest – perhaps over 10% by 2050, but this still represents a very large increase in highest flood flows. It indicates that flooding risks in the Poole Harbour Rivers are likely to get worse, but also emphasises the value of surface or groundwater storage options designed to capture high flows to support drier period supplies.

Figure B3.2 flow predictions are based on the most reliable of the eFlaG gauge-calibrated river flow models (the Probability Density Model, PDM) and indicate how flows calibrated against the historical gauged record (i.e. including the influence of upstream abstractions and discharges) may change due to climate shifts in rainfall and potential evaporation. Projected falls in median (Q50), low (Q95) and very low (Q99) flows are similar to or greater than the UKCP09 afixK dashed black line. i.e. the Future Flows scenario which was considered worst case now appears reasonable or perhaps even optimistic compared with the updated UKSP18 projections. By 2050, most of the eFlaG models are predicting more than 10% reductions in median flows, with falls of 20 or 30% predicted by several models under drier conditions.

The **Figure B3.3** plots are based on the natural flow projections of the national 'Grid to Grid' (G2G) model using the same RCM climate inputs, but no gauged record calibration. Although less well adapted to the gauged local flow responses and probably less reliable, these projections are included for comparative purposes because they ignore any abstraction or discharge influences on the gauged record, Highest flood flow projected changes are similar, but median and lower flow falls are much steeper.

In order to more confidently understand future flow shifts in all the water bodies across the Poole Harbour catchment it is recommended that the UKCP18 climate projections are run through the Wessex Basin regional groundwater and river flow model – to distinguish the different hydrological responses across the catchments. However, **Figures B3.2 and B3.3** confirm that low flows are expected to fall significantly to 2050. The Environment Agency will therefore need to allow EFI regulatory flow thresholds to evolve downwards with time, and the proportion allowed for abstraction will be squeezed.

This forward look adds real urgency to the need to consider options which will boost storage and low flows support on the supply side, beyond the current demand-side and leakage focus of

[5] https://eidc.ac.uk/

WRMP options. It also highlights the need for riverine and wetland habitat restoration and active management to enhance ecological refuge resilience to dry periods which are becoming and will continue to become more frequent and longer. Broader re-wilding, soil and environmentally sensitive farm land management initiatives are also vital to improve water quality but they will not change the projected decline in low flows. As the climate warms, the higher temperatures will result in more evapotranspiration and less water in our rivers regardless of any 'nature-based solutions' implemented upstream.

3.3 Licences highlighted by the Environment Agency for potential abstraction reductions (or other low flow support)

If it is required to fully address the flow deficits identified in the Environment Agency's 2050 Environmental Ambition projections, licence reductions may be required for eight Wessex Water groundwater licences around the River Frome, and four Wessex Water groundwater licences around the River Piddle. Alternatively, for non-SSSI river reaches where Natural England's 'natural Functioning' objectives do not apply, other options to support low flows can be considered to offset abstraction impacts, such as optimisation of existing groundwater to river support schemes.

License details for these abstractions which are 'at risk' are given in **Table 3.2**.

Table 3.2 Details of Wessex Water PWS abstractions for which potential abstraction impact reductions have been flagged by the EA

Abstraction Information	Hooke Springs	Maiden Newton	Cattistock	Eagle Lodge	Belhuish	Bridport Road Well	Poorlot BH	Forston	Dewlish BHs	Milborne St Andrew	Alton Pancras	Briant
Licence Number	13/44/052/S /001	13/44/051/G /027	13/44/051/G /001	13/44/055/G /105	13/44/059/G /106	13/44/055/G /105	13/44/056/G /103	13/44/055/G /021	13/44/042/G/10 1	13/44/044/G /100	13/44/041/G /005	13/44/
River	Frome	Frome	Frome	Frome	Frome	Frome	Frome	Frome	Piddle	Piddle	Piddle	Piddle
Fully Licensed	2.92	0.64	1.3	6.99	8	0	1.71	3	6.48	5.6	2.44 (PWS only)	9.09 (P
Recent Actual	2.29	0.31	0.76	5.63	0.4	0	0	2.44	4.1	3.30	2.08 (PWS only)	6.25 (P
Surface water/ Groundwater	SW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
WFD Waterbody	GB10804400 9800	GB10804400 9780	GB10804400 9780	GB10804400 9691	GB10804400 9692	GB10804400 9691	GB10804401 0060	GB10804400 9710	GB10804401013 0	GB10804400 9630	GB10804401 0120	GB108
Previous Investigations	None	None	None	None	None	None	None	None	AMP6: monitor flow & ecol. to understand impact. WINEP3: reduce by - 3Ml/d?	AMP5 Abstraction impact not significant – no change	AMP3/ AMP4 (2000-2010)	AMP6: unders reduce

The EA's suggested potential 2050 abstraction reductions are as follows:

River Frome catchment abstractions

- **Hooke Springs, Maiden Newton Borehole, Cattistock Boreholes, Eagle Lodge Boreholes, Belhuish Borehole, Bridport Road Well, Poorlot Borehole: 30% reduction in licence.** Or, options could be developed to reduce this, including surface water abstraction with a low flow HOF or low flow groundwater augmentation.
- **Forston Boreholes – cessation of licence.** Since impact is focused on higher flows, low flow recovery would require a significant reduction in licence quantity.
- **Empool and Watergates Boreholes – no change.** Local catchment is in surplus due to groundwater support.

River Piddle catchment abstractions:

- **Dewlish Boreholes, Milborne St Andrew Boreholes, Alton Pancras Boreholes, Briantspuddle Borehole: 55% reduction in licence.** A deficit is identified at the majority of flow conditions and therefore alternative stream support options are limited, though this could be explored, such as a reservoir that captures very high flows, if feasible.

Wessex Water's total licence reductions across the catchment flagged by the Environment Agency therefore potentially amount to **around 22 Ml/d**, although this ignores the optimisation of existing river low flow support schemes.

3.4 Potential 2050 supply loss compared to published WRMP options

Options explored in Wessex Water's 2019 WRMP include demand reductions and leakage savings to reduce the future supply required (see **Section 2.3**). In this catchment, no options are currently being taken forward to boost supply.

Table 3.3 puts into context the scale and magnitude of the potential 2050 abstraction reductions against the current licensed and recent actual abstraction from the catchment, and WRMP options.

If the EA's 2050 abstraction reductions were implemented, then, even taking into account the WRMP 2045 demand reductions and leakage savings, this would represent **73% of Wessex Water's abstraction from the Poole Harbour catchment (20.8 M/d).**

It is clear that these are huge Environmental Ambition challenges which demand measures well beyond the options published in existing WRMPs. Potential solutions will be associated with large financial and carbon costs and will take around 25 years to complete. The Environmental Destination plan needs to be phased so that incremental benefits can be realised along the way – as set out in **Section 4**.

Table 3.3 Poole Harbour rivers catchment: context of potential 2050 supply loss

	Wessex Water	Unit
Annual PWS licensed abstraction (catchment total)	46.8	Ml/d
Annual PWS RA abstraction (catchment total)	28.6	Ml/d
WRMP baseline water company total water into supply (WAFU) Base Year 2017/18	408.9	Ml/d
WRMP baseline WAFU 2045	384.3	Ml/d
Catchment PWS RA as % of water company WAFU (Base Year 2017-18)	7.0%	%
Total WRMP projected 2045 demand-side and leakage savings	23.8	Ml/d
2045 demand reductions and leakage savings as % of current total water into supply	5.8%	%
WRMP preferred additional supply-side options (catchment total)	0.0	Ml/d
EA 2050 potential abstraction reductions (catchment total)	-22.5	Ml/d
Potential 2050 catchment supply loss, reduced by the effect of proportional 2045 demand reductions and leakage savings	**-20.8**	**Ml/d**
Potential 2050 catchment supply loss (% of abstraction)	**-72.6%**	**%**

Data sources:
Wessex Water (2019). Final water resources management plan.

4. Environmental Destination catchment plan to increase future water supply and low flow environmental resilience

The core Environmental Destination work has highlighted the potential constraints to water resource availability in the 2050s. Adapting to the future twin pressures of climate change and demographic change will require holistic approaches to sustainable environmental improvement.

This section sets the context of the relevant projects already underway or soon to be implemented in the Poole Harbour catchment, that include measures which will improve the resilience of the water resource for both public supplies and the environment. It also summarises wider catchment soil, land management, drainage restoration and nature-based initiatives which are important for the real biodiversity and water quality benefits they can deliver but are not expected to significantly change the decline in river low flows as temperatures warm.

A catchment plan then sets out and prioritises the water company measures best suited to achieve future flow and supply resilience as part of improving biodiversity outcomes in the catchment.

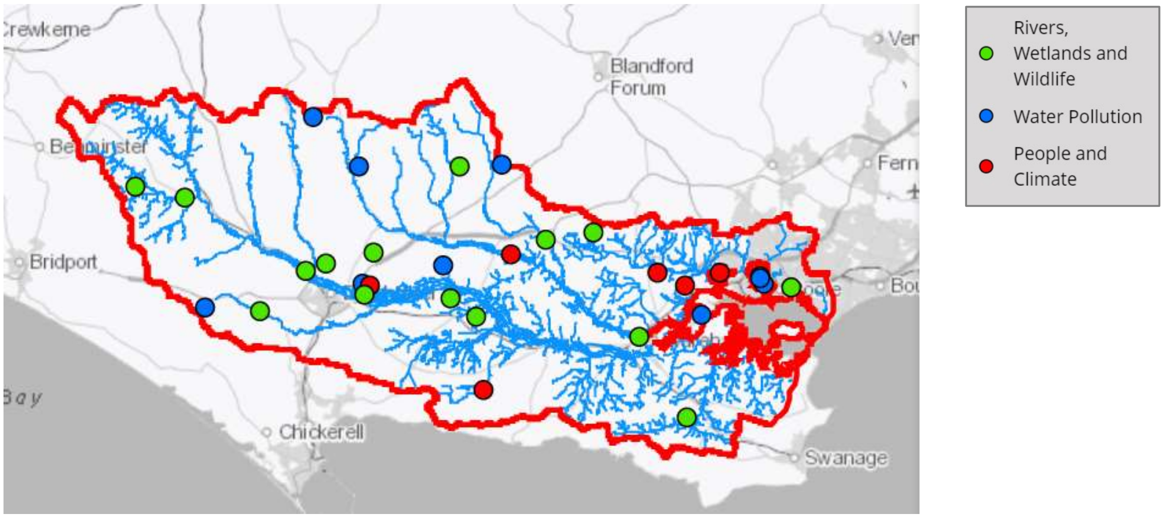
4.1 Current projects in the catchment

The Dorset catchment partnerships set up to promote the catchment based approach (CaBA) include the **Poole Harbour Catchment Initiative**[6] (PHCI), which is hosted by Wessex Water in conjunction with Dorset Wildlife Trust.

The PHCI is a collaborative partnership of a range of groups, aiming to use a catchment based approach to improve the water environment of the Poole Harbour Catchment. Members also include Natural England, Environment Agency, National Farmers Union, FWAG SW, the PHCI agricultural and land management group, the CLA and other local farmers and groups. Project locations to date are shown on **Graphic 4.1**.

[6] https://www.wessexwater.co.uk/environment/catchment-partnerships/poole-harbour-catchment-partnership

Graphic 4.1 Poole Harbour Catchment Initiative projects[7]



Projects currently being implemented, or recently completed in the Poole Harbour catchment have focussed on addressing the key issues of nitrate, phosphate, sediment, historic channel/habitat alterations, and water quantity (low and high flows), as summarised in the 2014 Catchment Plan (PHCI, 2014). Current / recent projects include:

- Dorset Wild Rivers **River Frome restoration** work (2010-2020): restoration of 19km of the channel and re-connection of the floodplain as per the River Frome Rehabilitation Plan (Environment Agency, 2010). Work has included removal / lowering of embankments, removal of structures, replacement of river gravels, and tree planting with the aim of achieving WFD good ecological status and also providing Natural Flood Management (NFM) benefits.
- Ongoing **Catchment Sensitive Farming** (CSF) work with farmers across the catchment, including NFM techniques and improvement of tracks in the upper Piddle Valley so that they do not act as pathways carrying sediment entrained runoff.
- Ongoing reduction of diffuse pollution and excess nutrients in Poole Harbour (nitrate and phosphate), being managed by the **Poole Harbour Nutrient Management Scheme**, led by farmers in the catchment in partnership with Wessex Water, the Environment Agency, Natural England, CSF and others (DCP, 2020).
- Launch of Wessex Water's **EnTrade nutrient trading platform:** a catchment nitrogen offsetting scheme to reduce nitrogen inputs to Poole Harbour through on-farm projects to improve land management practises.
- Wessex Water projects to improve wastewater discharge quality through installation of **phosphorus removal** at water recycling centres (formerly known as sewage or wastewater treatment works) at Maiden Newton, Wool and Dorchester.

[7] interactive project map at https://wessexwater.maps.arcgis.com/apps/MapSeries/index.html?appid=c8c98ac32cde4575a8da2246b0a8715d

- The Wessex **'Stage Zero' floodplain reconnection** opportunity mapping project has recently been completed (EA and Dorset Wildlife Trust, 2021). This has included mapping of the Frome, Piddle, Stour and Corfe rivers to define the unconstrained bottom of the valley floor including areas outside the current floodplain, of importance in designing future Natural Flood Management (NFM) measures in the catchment.

4.2 Future planned projects

Future projects soon to be implemented in the catchment by Wessex Water (2020-2025) include:

- Further infrastructure investments to improve wastewater discharge quality:
    - Additional phosphorus removal at Cerne Abbas, Corfe Castle, Piddlehinton and Dorchester WRCs.
    - Construction of a new nitrogen removal plant at Wareham WRC.
- Abstraction licence change to reduce abstraction in the Devils Brook, improving low flow resilience.
- Appraisal of options for the Poole WRC discharge, regarding improvements for discharge quality (reductions to nitrate and phosphate as per the 2021 Environment Agency recent review of the Consent Order); or outfall re-location to the sea; or to the Stour catchment to solve low flow issues, potentially to a wetland in the Stour Valley Park (with additional treatment of water quality).
- Poole Harbour catchment biodiversity project – which aims to improve 72 hectares of habitat to reduce nutrients to rivers and enhance biodiversity.
- Biodiversity opportunity investigation and catchment nitrate reduction measures at Briantspuddle and Litton Cheney DrWPA.

Other future work of relevance in the Poole Harbours Rivers catchment also includes:

- The potential future **beaver reintroduction** and management in England, which is currently under consultation (Defra, 2021). Initial trials elsewhere have shown overall benefits in terms of their role as 'ecosystem engineers', where dam building and burrowing can redirect water flows and create wetland habitats. Two beavers were released in an enclosed trial site in the Frome headwaters in February 2021 by Dorset Wildlife Trust and are currently being monitored (PHCI, February 2021).

Two other projects may also happen, subject to funding and further consultation:

- A large 'catchment scale project on the River Frome (GWCT Game and Wildlife Conservation Trust). Potential focus areas include nutrient and sediment reduction, fisheries management, river restoration, case studies, monitoring and research to assess the benefits of any work done.
- A 5 year plan for the Hooke catchment as part of Wessex Water's contribution to Chalk Streams restoration research.

4.3 CaBA opportunity mapping: a resource for future projects

CaBA's opportunity maps from the '**Working with Natural Processes - Evidence Base'** project[8] identify the types of measure that may be effective in flood and coastal risk management (FCRM) and wider ecosystem service benefits (Environment Agency, 2018). These maps can be used to inform and prioritise future catchment measures.

Figure B4.1 shows the opportunity mapping across the Poole Harbour catchment for:

- Floodplain reconnection (for example, in the middle reaches of both the Rivers Frome and Piddle).
- Tree planting in riparian areas (identified everywhere along the river network).
- Countryside stewardship options (for example, buffer strips, wildlife strips, regeneration of habitats, livestock fencing, coppicing of bankside trees, hedgerows).
- Priority habitat creation projects (at individual locations to create or restore habitats, for example the Dorset Ponds project in the River Hooke and other minor watercourses, gravel cleaning on the Frome, restoration of habitat on the Corfe River).

Wider scale implementation of these CaBA opportunities will help to deliver biodiversity and water quality benefits. Local channel, drainage and floodplain habitat restoration projects will also provide a vital role in improving the ecological resilience to droughts and dry periods. However, neither catchment-wide nor local habitat initiatives are expected to make much difference to river low flows, or to change the projected environmental flow deficits in the water bodies with abstraction pressures highlighted by the Environmental Ambition challenge.

4.4 WCWR Poole Harbour catchment action plan

Good work is clearly already underway and planned by catchment stakeholders in the Poole Harbour catchment to improve its biodiversity resilience from multiple angles. Consultation with WCWR during this project has contributed to the development of a **strategic action plan of water company measures that could be implemented in a phased approach,** tabulated in **Table 4.1**. These water resources measures would work in synergy and holistically with the wider catchment projects, all building resilience. A phased implementation should deliver incremental benefits along the way and would require step-wise changes in abstraction regulation.

Schematic maps are shown in **Figures A4.2** to **A4.4**, to show how the water company measures may be implemented over the short, medium, and long term. These show how these link to the different environmental issues in the headwaters, main Chalk outcrop and lower catchment, and also how measures may contribute to improvements in the areas of potential 2050 flow deficits identified by the Environment Agency's Environmental Destination modelling.

The plan sketched out builds on current actions to tackle water quality (nitrate and phosphate) to explore medium term options for optimising low flow support in order to allow some drought resilient, low carbon groundwater abstraction to continue, and longer term consideration of the potential for increasing available storage (in the confined aquifer or on the surface) or the re-cycling of water discharged to the sea.

[8] https://catchmentbasedapproach.org/learn/working-with-natural-processes-evidence-base/

If the plan sketched out is realised, it should avoid a significant shift in the balance between the volumes of Chalk groundwater and surface water currently put into the supply network. However, if a more fundamental switch away from groundwater to other sources is required, the consequences for drinking water quality and the integrity of the supply network and service pipes could be significant, particularly if there is seasonal variability in the sources of supply.

Alongside the need to improve water quality and explore options to boost supplies (which will help reduce winterbourne groundwater abstraction impacts), river and floodplain habitat restoration and creation works should be targeted at improving ecological resilience to the longer periods of lower groundwater levels, lower flows and higher temperatures expected with climate change. Stakeholders and river restoration hydro-ecologists need to collaborate to create habitats with built-in low flow refuges and a variety of shaded and open connected river reaches, side channels, pools and floodplain wetlands which are designed to cope with hotter drier summers.

It is also anticipated that as the climate shifts, patterns of agricultural land management and water use will change as farmers adapt, regardless of anything set out in this plan. As water becomes scarcer in the summer months (and probably more expensive), crop and livestock practices may change and efforts to conserve, store and use water more carefully will be ramped up. This will not in itself free-up more water for others to use, but will be increasingly important for farming to thrive. This climate challenge should also combine with recent changes to the targeting of farming grants to generate opportunities for nature-based re-wilding and land stewardship which creates broader-scale biodiversity benefits.

Table 4.1 Phased water resources resilience action plan to 2050: Pool Harbour Rivers catchment

Category	Option category	Measure	Additional supply	Location	Issues being targeted	Short term	Medium term	Long term
AMP7/8 Investments	Planned water treatment works enhancements Reduce Devils Brook abstraction. Optimise current river support.	Additional phosphorus removal plants Additional nitrate removal plant Catchment interventions to reduce N and P (EnTrade) Abstraction licence change		WRCs Headwaters Devils Brook	Water quality (Nitrate, Phosphate) Improved low flows, habitats			
Nature based solutions	Gap analysis of CaBA opportunity maps vs. EnTrade / Wessex Headwater Projects	Feed into Hooke Springs 5 year catchment plan?		Hooke Springs?	Flood risk, water quality & sediment, fisheries & biodiversity, floodplain connectivity			
Local sources of water	Effluent reuse at Poole WwTW	Relocation of the Poole Harbour WwTW discharge to the River Stour		River Stour	Improved low flows in the River Stour, improved water quality of discharge & Pool Harbour			
	GW-river support	New or enhanced schemes		Bere? Win? S Winterb.	Improve low flow resilience and maintain some GW abstraction			
	Re-investigate Aquifer Storage Recovery (ASR)	Increase dry period supply through storage of high Chalk flows in confined aquifer for later use in dry periods	5 Ml/d?	Confined Chalk	Increased storage, flood risk reduction replace lost Chalk abstraction in winterbourne headwaters.			
Larger scale solutions	New storage reservoir on Tertiaries in lower catchment Weymouth WwTW? (Desalination	Increase dry period supply making use of good quality excess Chalk spring water from Tadnoll Brook during winter months Consider recycling options Not preferred)	10 Ml/d? 15 Ml/d?	Tadnoll Brook Wey	Replace lost Chalk abstraction if EA Environmental Ambition is implemented through licence reductions. Also flood risk reduction, habitat creation.			

5. References

Catchment Based Approach CaBA (2021). Chalk Stream Restoration Strategy.

Dorset Council (July 2021) Water. Detailed Technical Paper

Dorset Catchment Partnerships DCP (2020). Summer Newsletter 2020.

Environment Agency (October 2010). Rehabilitating the River Frome SSSI. Draft technical report produced by Royal Haskoning.

Environment Agency (2012). Frome and Piddle Catchment Flood Management Plan.

Environment Agency (2018). Working with Natural Processes – Evidence Directory. SC150005.

Environment Agency (May 2019). Middle and Lower Stour: Reach by Reach Restoration Plan.

Environment Agency (May 2019). Moors River System: Reach by Reach Restoration Plan.

Environment Agency (2020a). Dorset: abstraction licensing strategy.

Environment Agency (March 2020b). Meeting our future water needs: a national framework for water resources. Version 1.

Environment Agency and Natural England (February 2021). Poole Harbour Consent Order Technical Investigation and Recommendations.

Natural England (2014). Citation for Special Area of Conservation (SAC): Dorset Heaths.

Natural England (1984). Citation for Site of Special Scientific Interest (SSSI): Bere Stream.

Natural England (1987). Citation for Site of Special Scientific Interest (SSSI): Wareham Meadows

Natural England (1998). Citation for Site of Special Scientific Interest (SSSI): River Frome.

Poole Harbour Catchment Initiative PHCI (2014). Catchment Plan. Update – May 2014.

Poole Harbour Catchment Initiative PHCI (2020). Beavers and Poole Harbour.

Wessex Water (2019). Final Water Resource Management Plan.

Wessex Water (2020). Poole Harbour Catchment: The Facts.

6. Figures

wood.

Environmental Destination

Figures accompanying Annex B: Poole Harbour Rivers Pilot Catchment Plan to increase future water supply and environmental low flow resilience

Figure B2.1 Poole Harbour catchment: rivers and geology

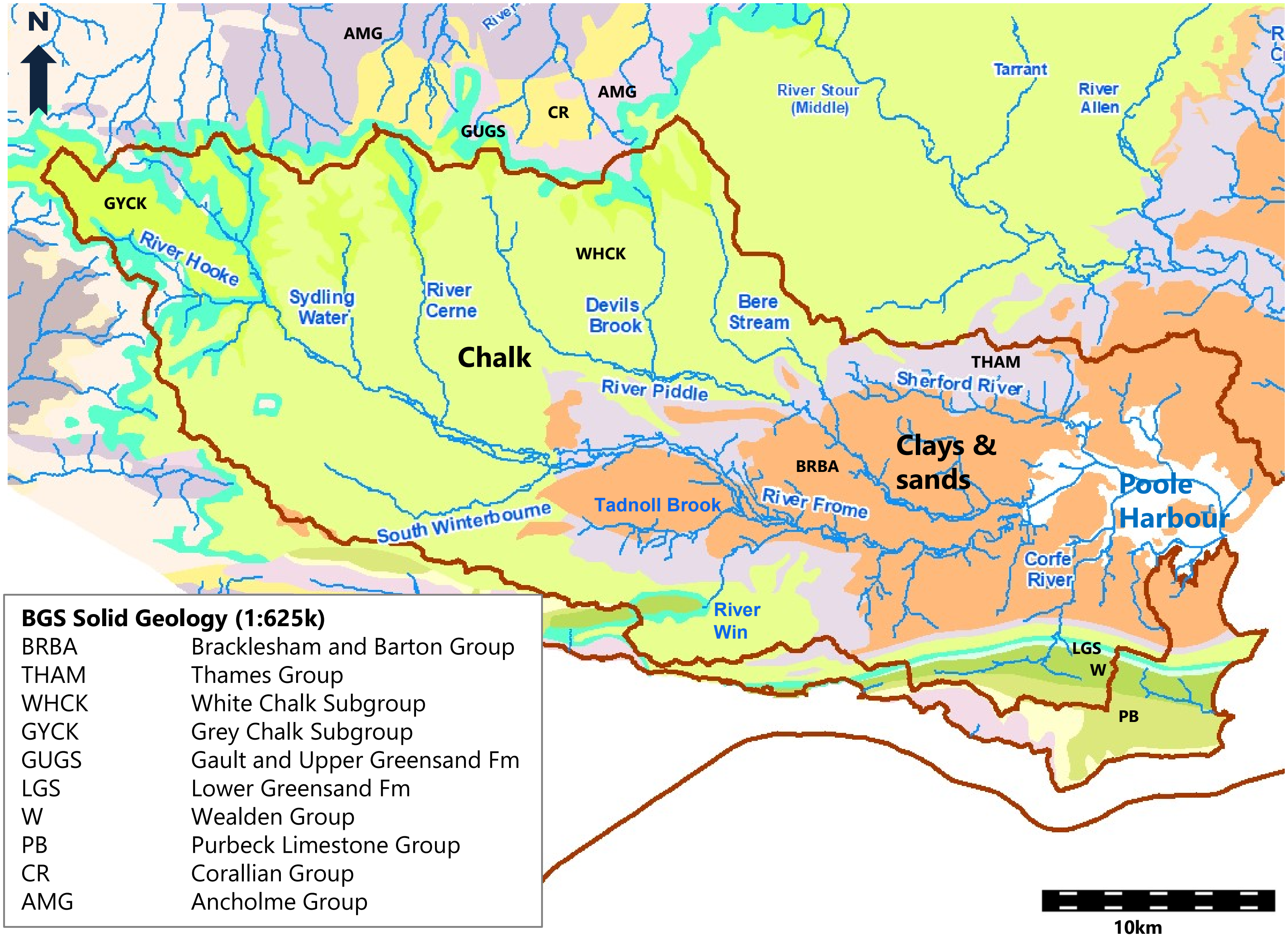


Figure B2.2 Poole Harbour Rivers: Designated sites and Drinking Water Safeguard Zones

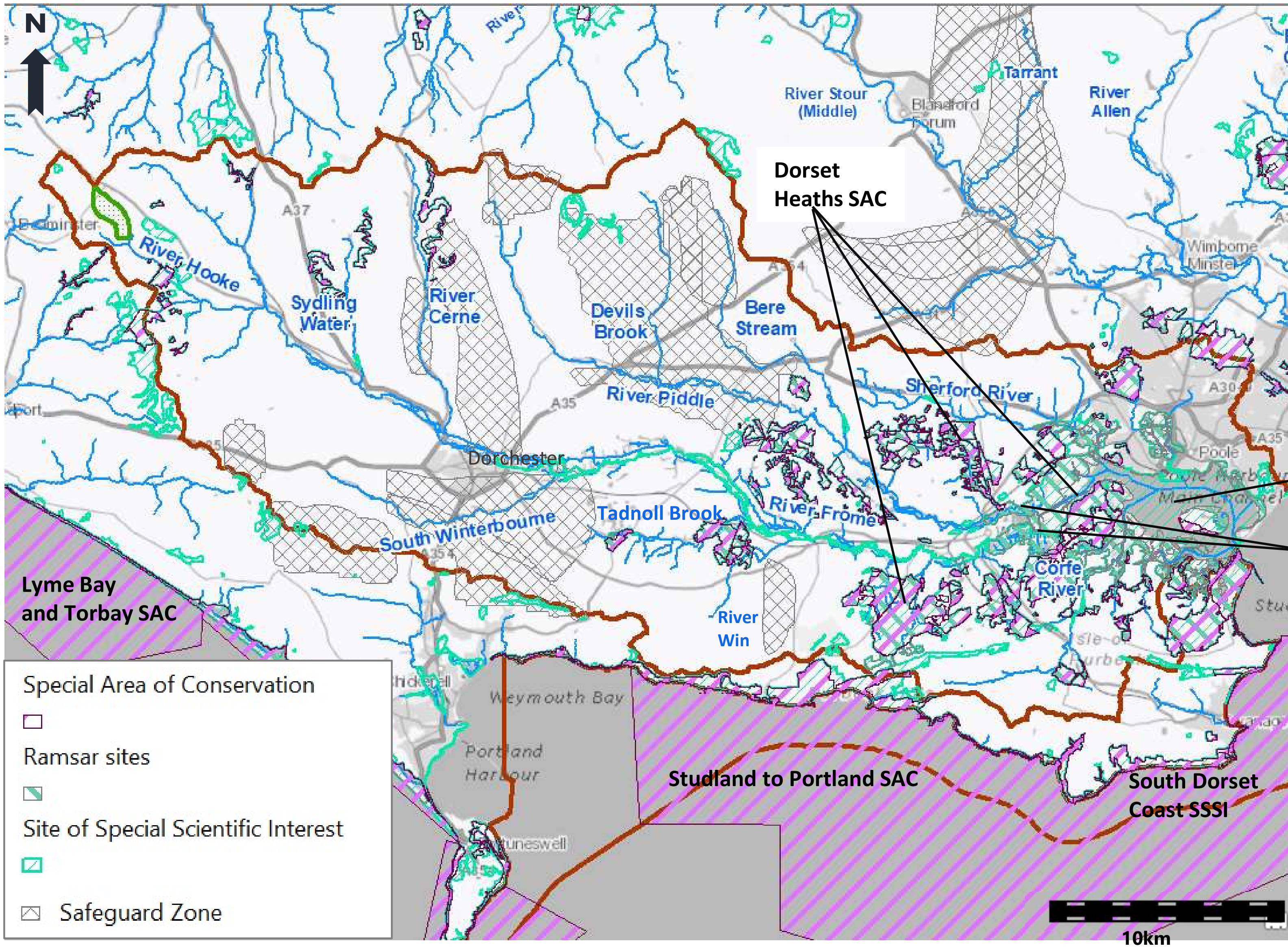
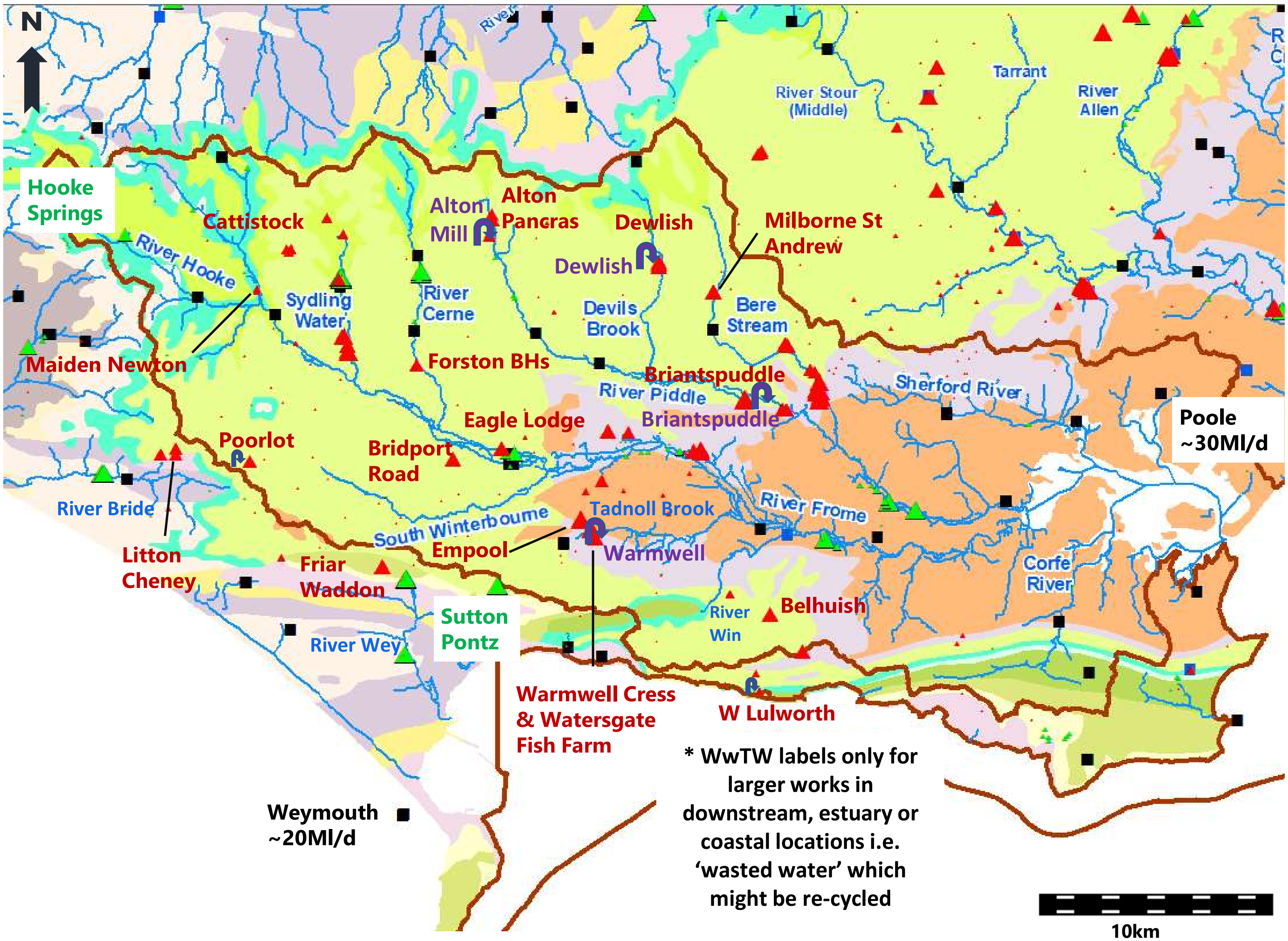
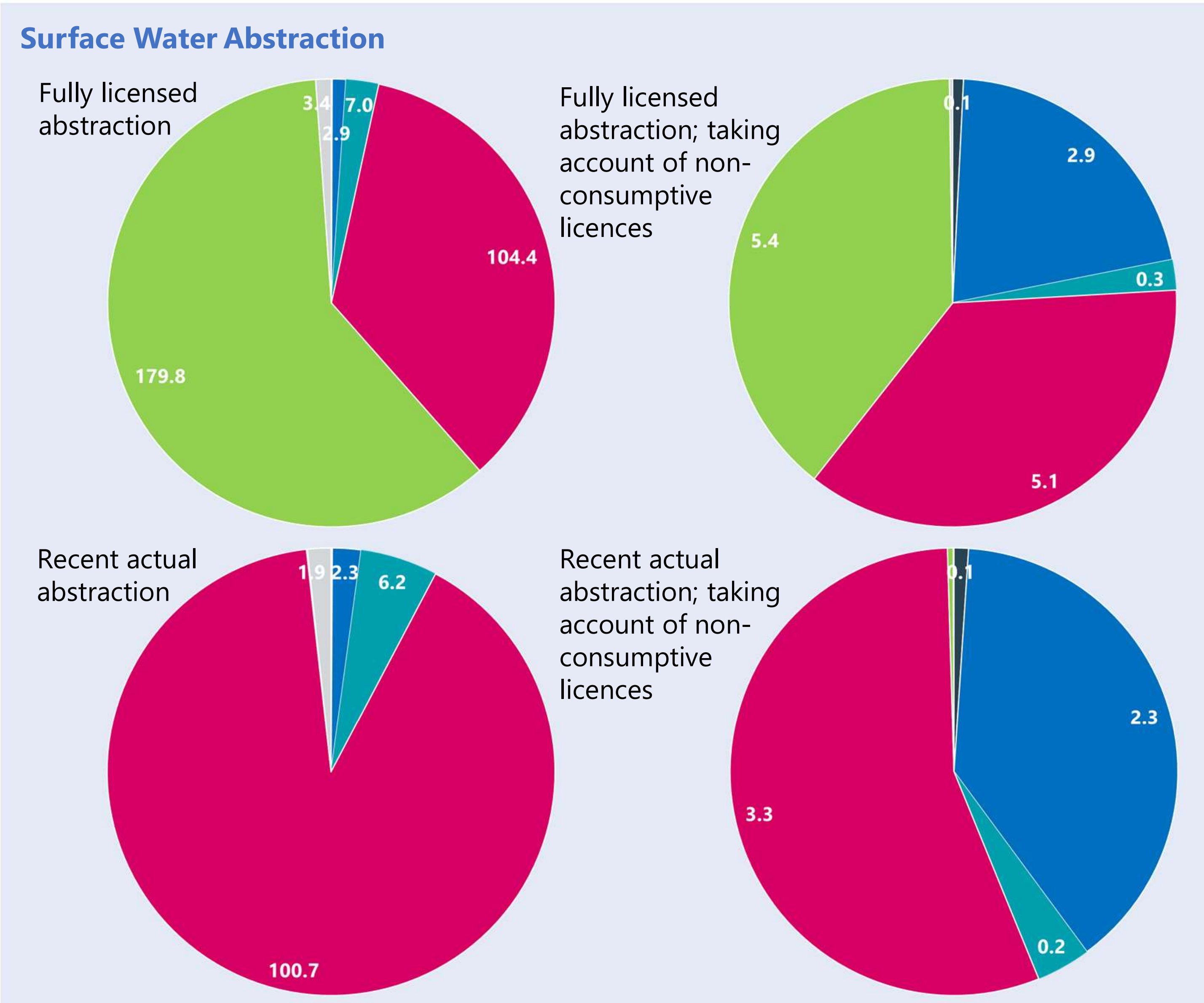


Figure B2.3 Poole Harbour Rivers : PWS groundwater abstractions, surface water abstractions, WwTW surface water discharges* & river support schemes



Abstraction data downloaded June 2021 from Catchment Based Approach Data Hub website

Figure B2.4a Poole Harbour catchment: Surface Water Abstraction by Sector (total, Ml/d)



Non PWS supplies
(ARUP 2022 assessment output)

	Number	Ml/d Usage
Private Water Supplies	225	0.6
Number of unregistered residential address points	2,510	0.9
Dairy	25,835	2.8
Beef	13,005	0.5
Total Cattle	49,804	3.7
Total Sheep	64,932	0.4
Total Pigs	43,736	0.4
Total Poultry	161,903	0.1

Surface Water Abs Key

- Other water supply
- PWS
- Industrial and other
- Agriculture
- Energy Production
- Environmental
- Amenity
- Transfer Between Sources

Figure B2.4b Poole Harbour catchment: Groundwater Abstraction by Sector (total, Ml/d)

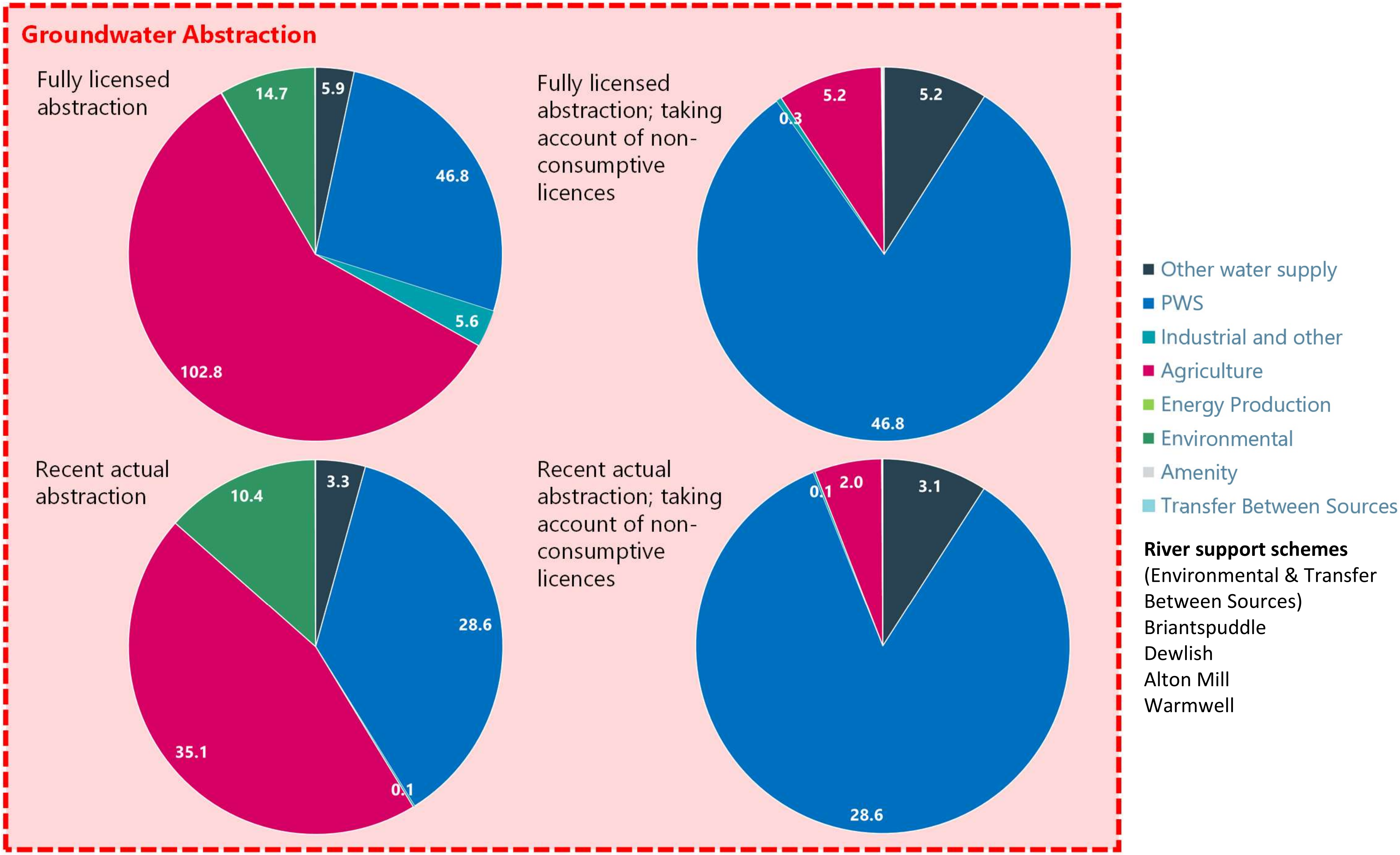


Figure B2.5 Environment Agency water resource availability at Q30, 50, 70, 95 (Cycle 2, last updated 16 April 2021)

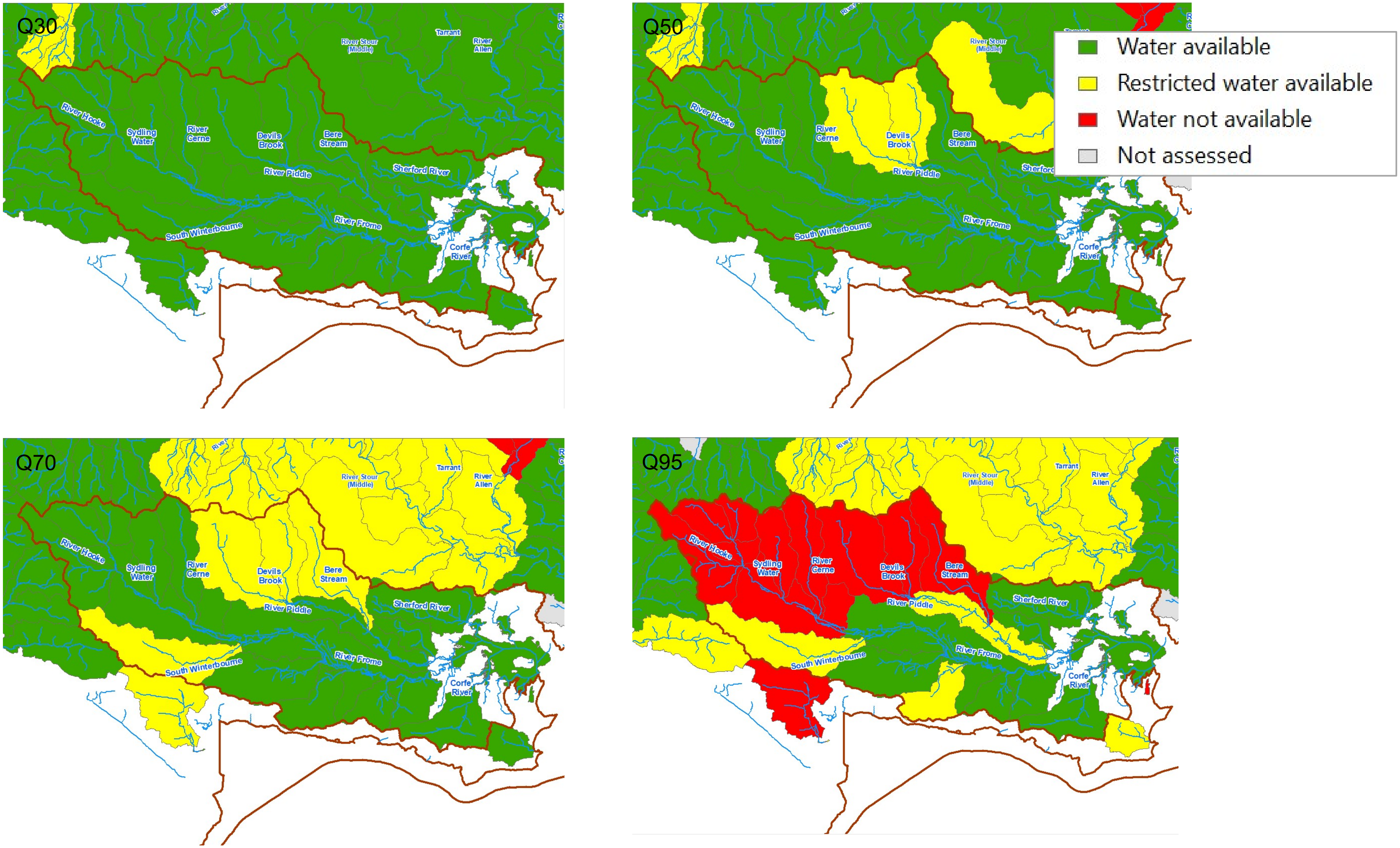


Figure B2.6 WFD water body overall status (Cycle 2, 2019)

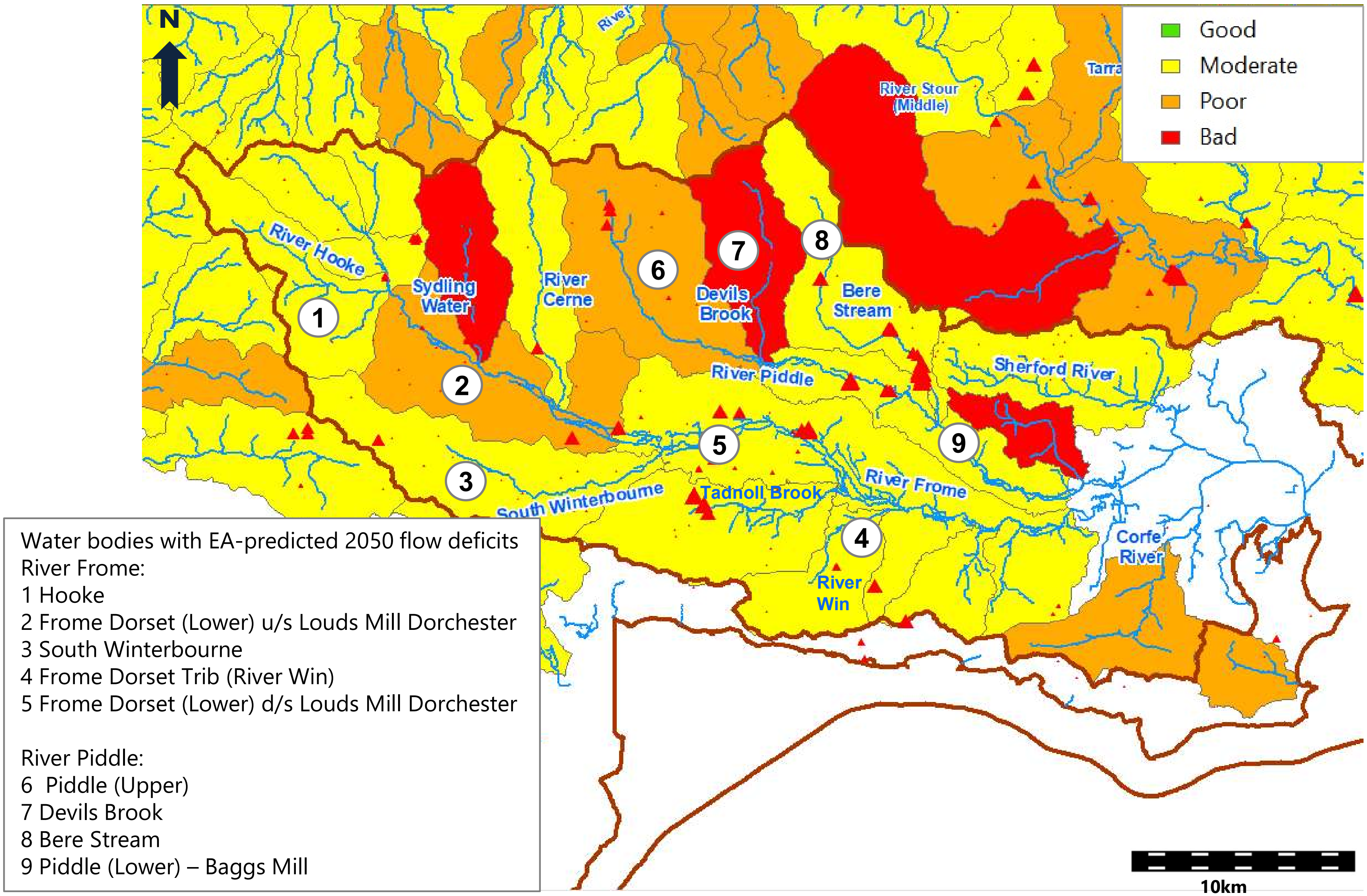


Figure B2.7 WFD water body ecological status (Cycle 2, 2019)

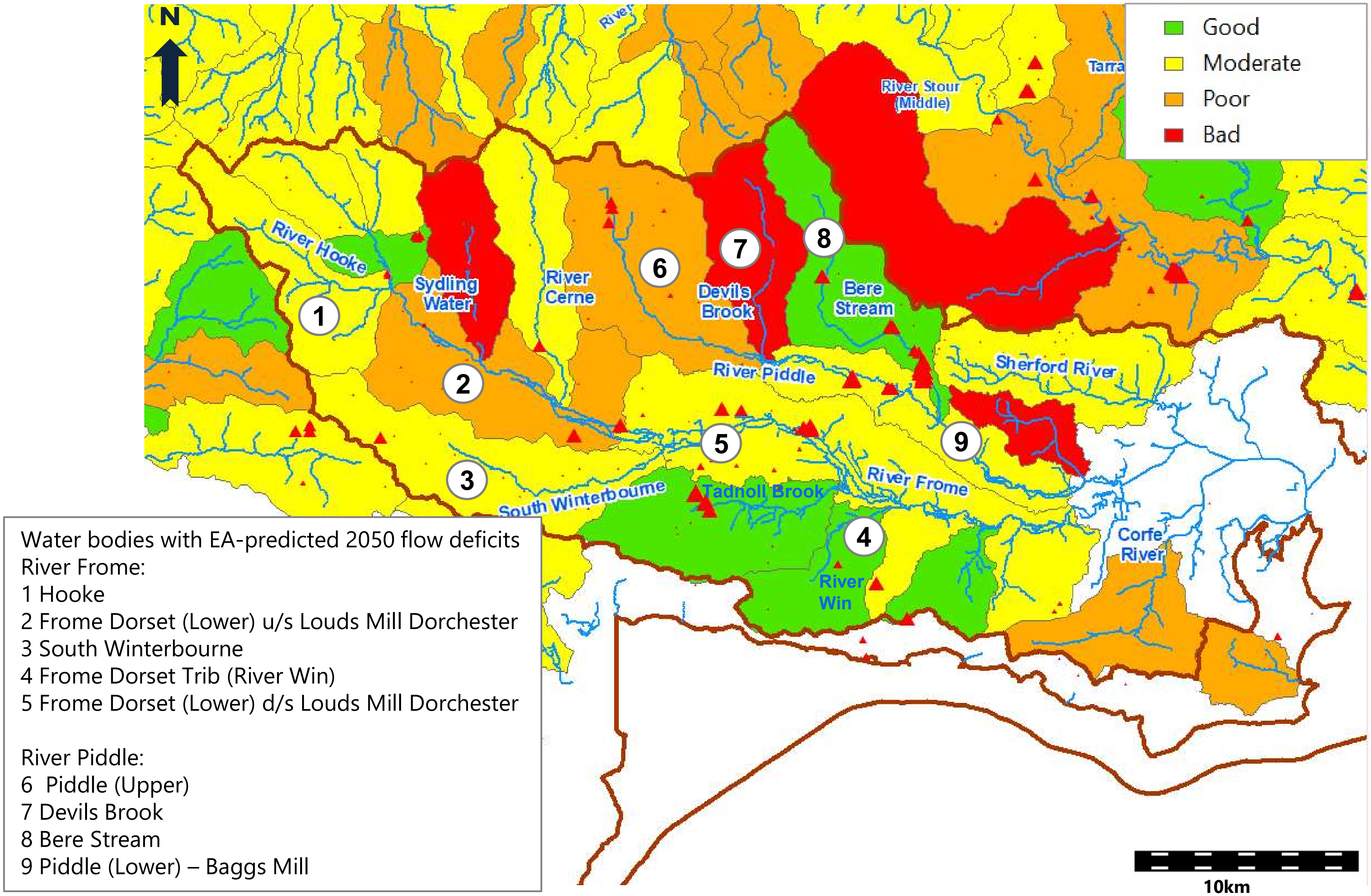


Figure B2.8 Recent Actual environmental flow surpluses & deficits at Baggs Mill (Piddle) through 1976 drought showing need for low flow support or storage

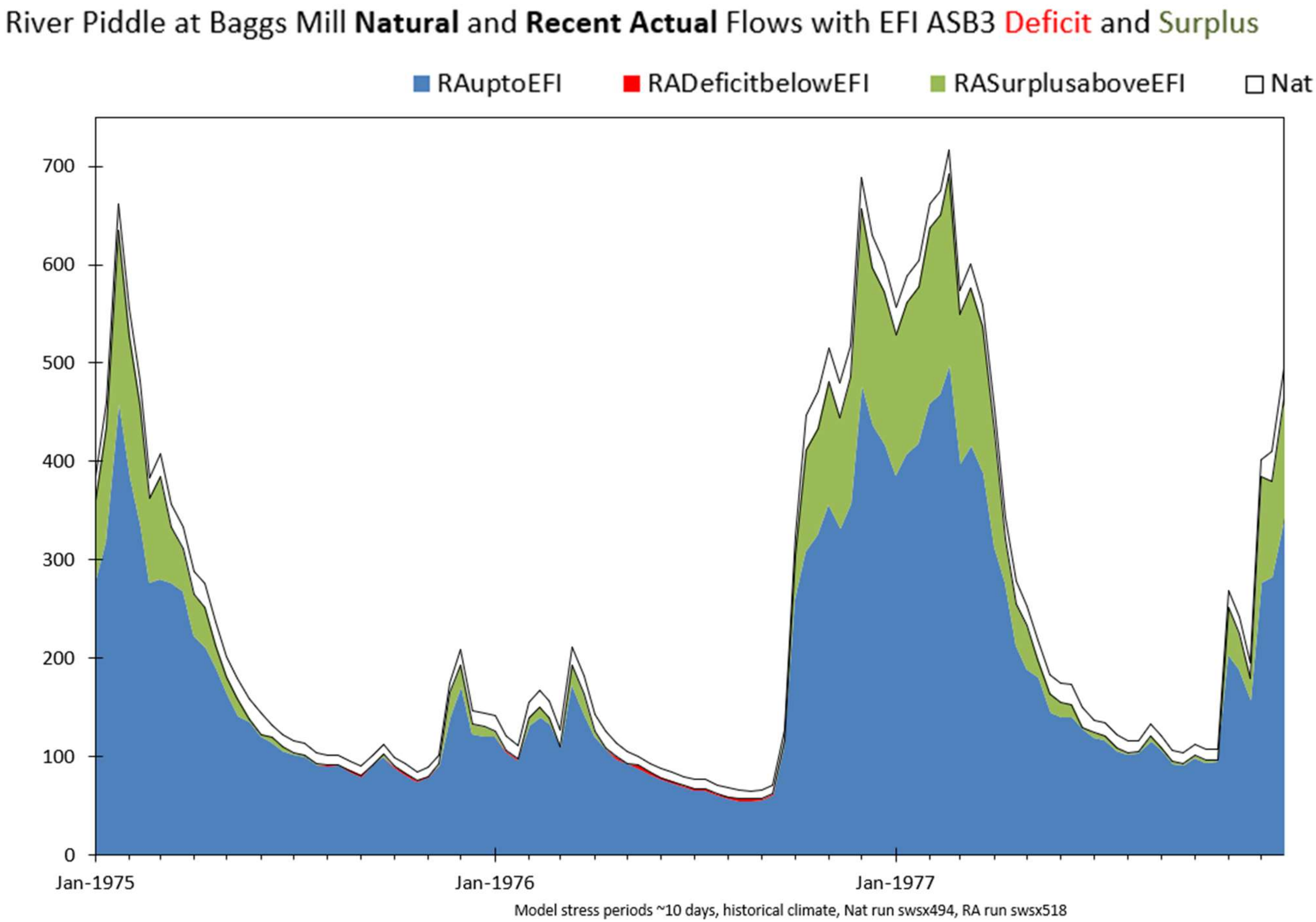
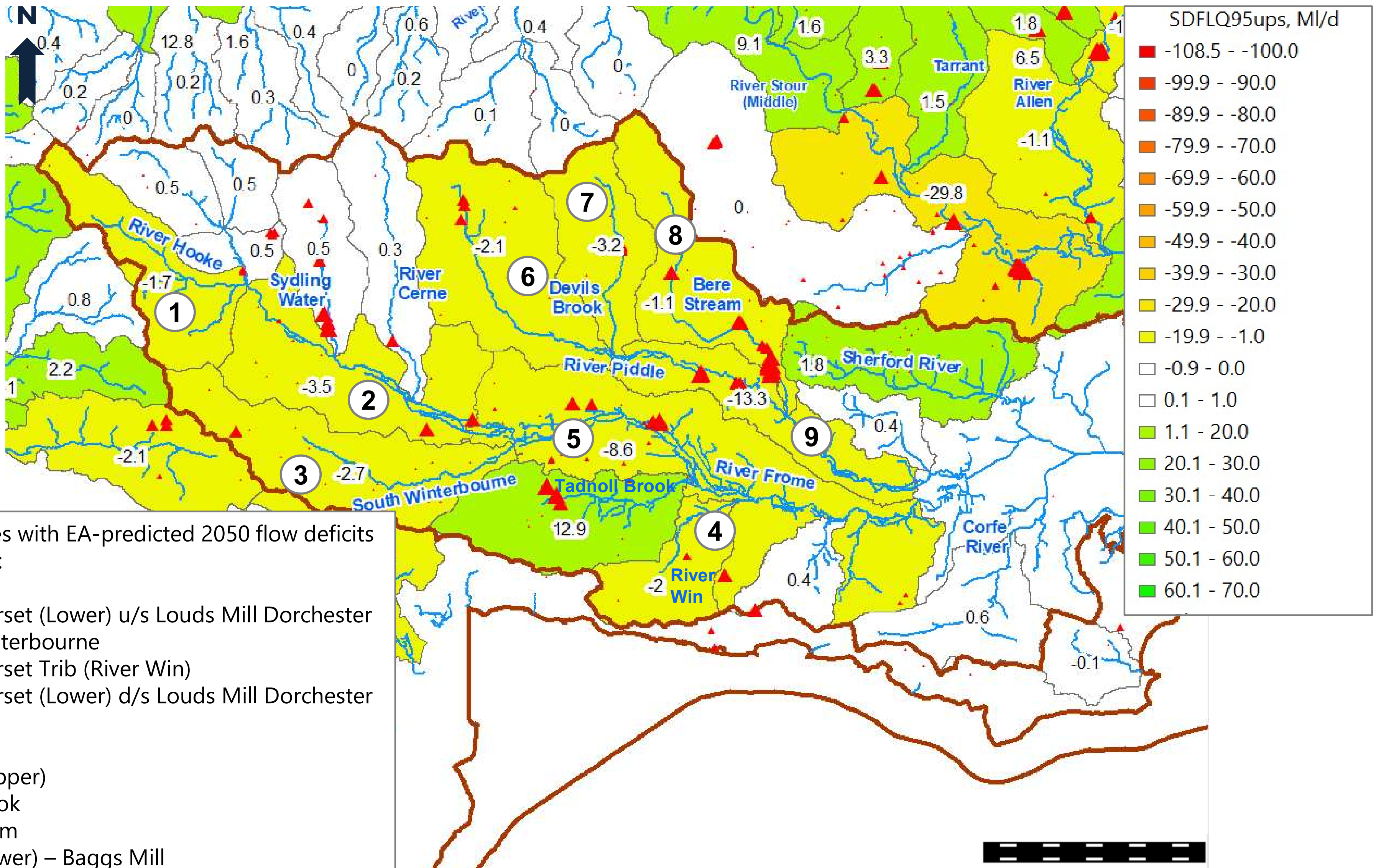


Figure B3.1 EA predicted fully licensed 2050 flow surpluses and flow deficits (Ml/d) for water bodies under Q95 low flow conditions (enhanced scenario)



Water bodies with EA-predicted 2050 flow deficits

River Frome:

1 Hooke
2 Frome Dorset (Lower) u/s Louds Mill Dorchester
3 South Winterbourne
4 Frome Dorset Trib (River Win)
5 Frome Dorset (Lower) d/s Louds Mill Dorchester

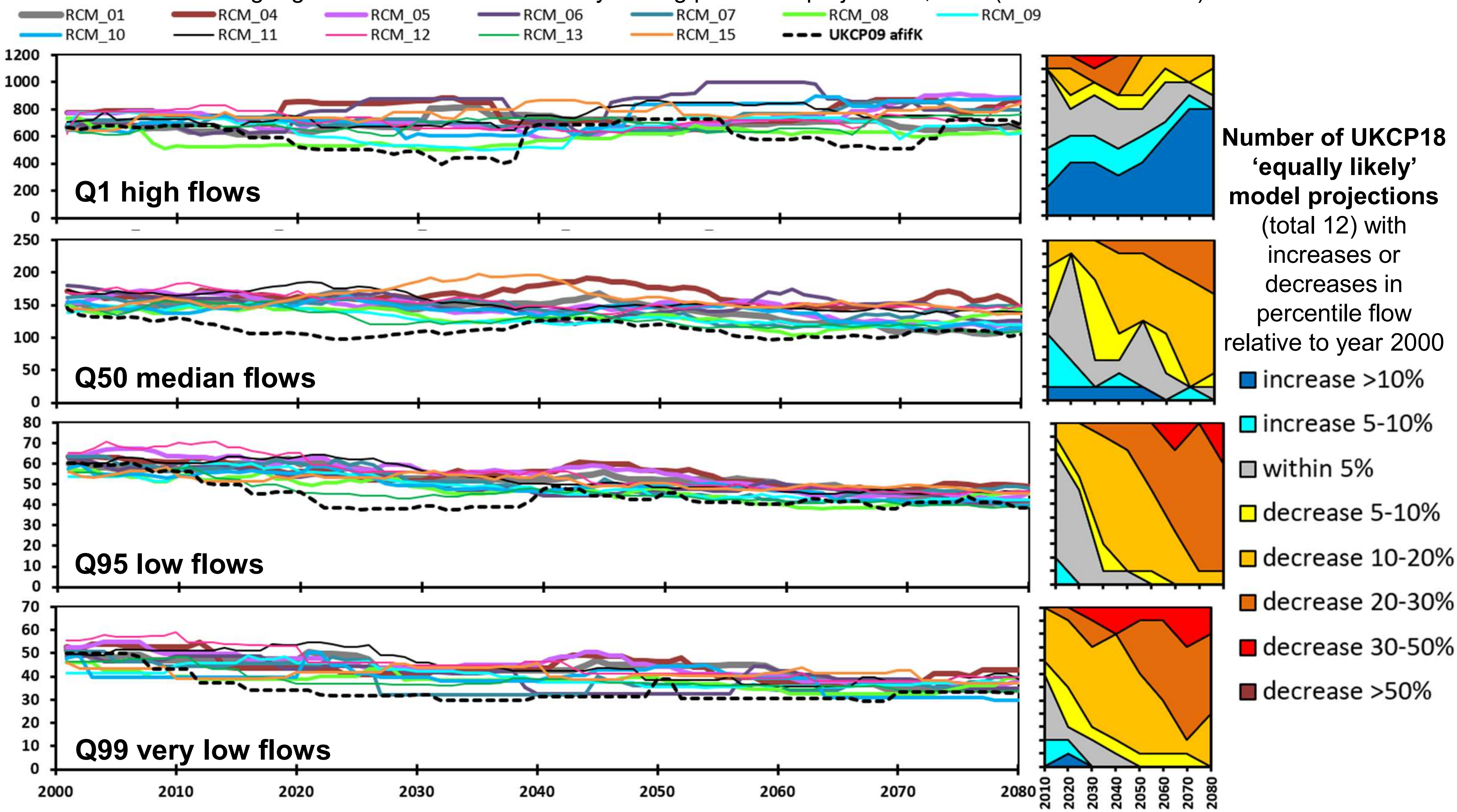
River Piddle:

6 Piddle (Upper)
7 Devils Brook
8 Bere Stream
9 Piddle (Lower) – Baggs Mill

Data from EA's National Framework modelling in 2020

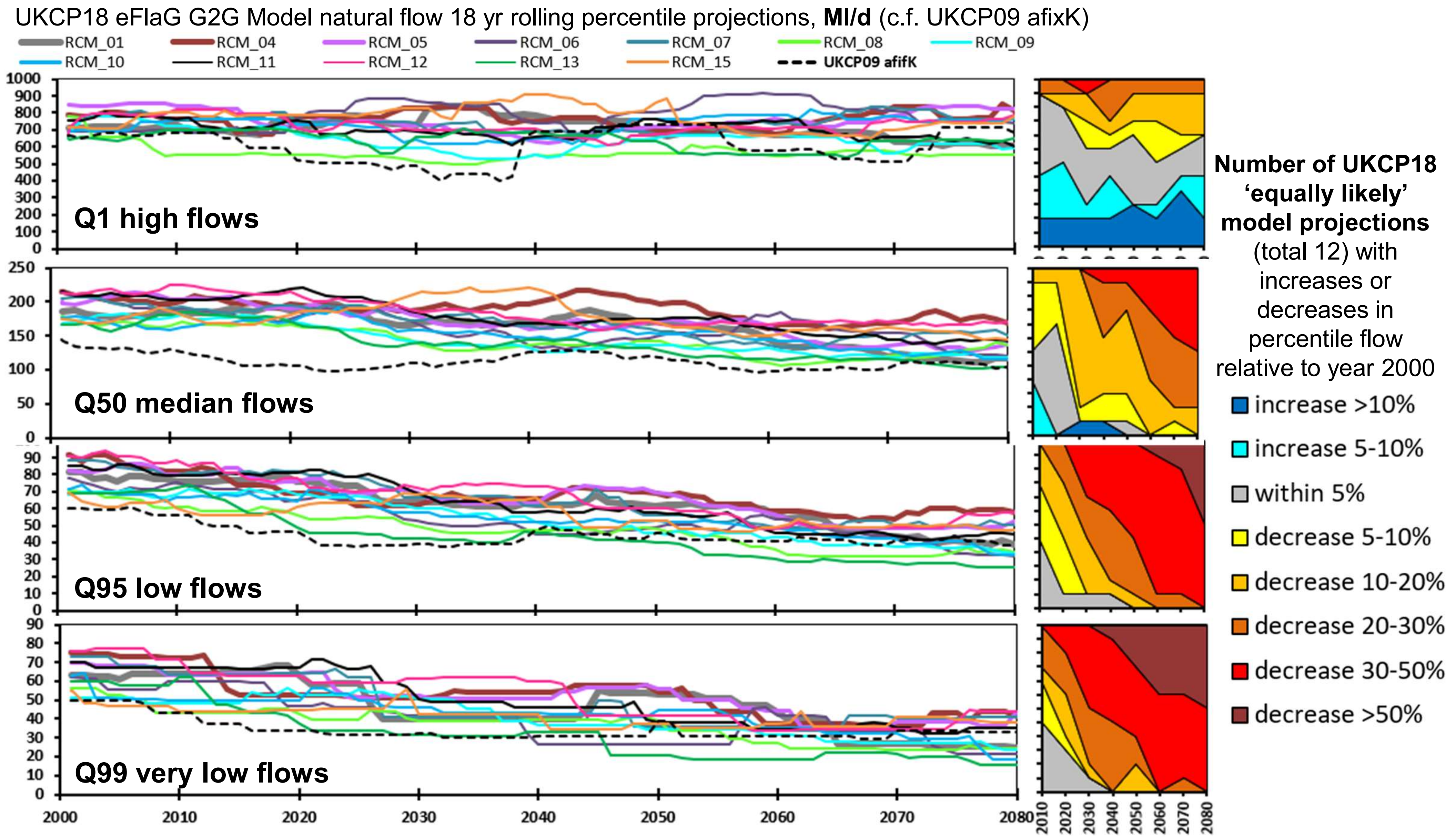
Figure B3.2 Flow changes expected due to climate (Piddle at Baggs Mill): Projections from UKCP18 climate & PDM gauge-calibrated river flow models

UKCP18 eFlaG PDM gauge-calibrated model flow 18 yr rolling percentile projections, **Ml/d** (c.f. UKCP09 afixK)



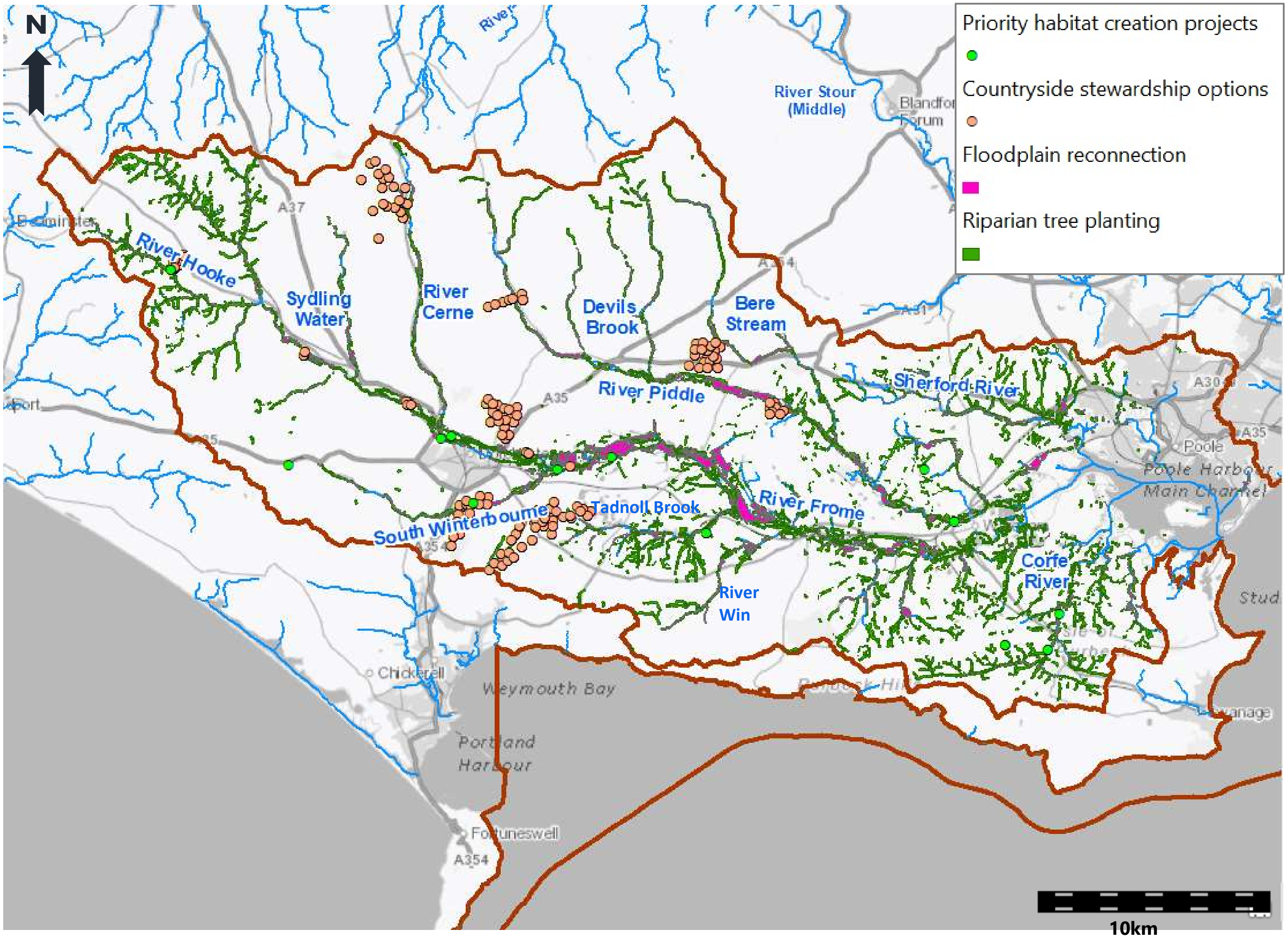
Data source: flows from 12 possible UKCP18 regional climate models (with UKCP09 afixK natural projection for comparison): https://eidc.ac.uk/

Figure B3.3 Flow changes expected due to climate (Piddle at Baggs Mill): Projections from UKCP18 climate & G2G national natural river flow models



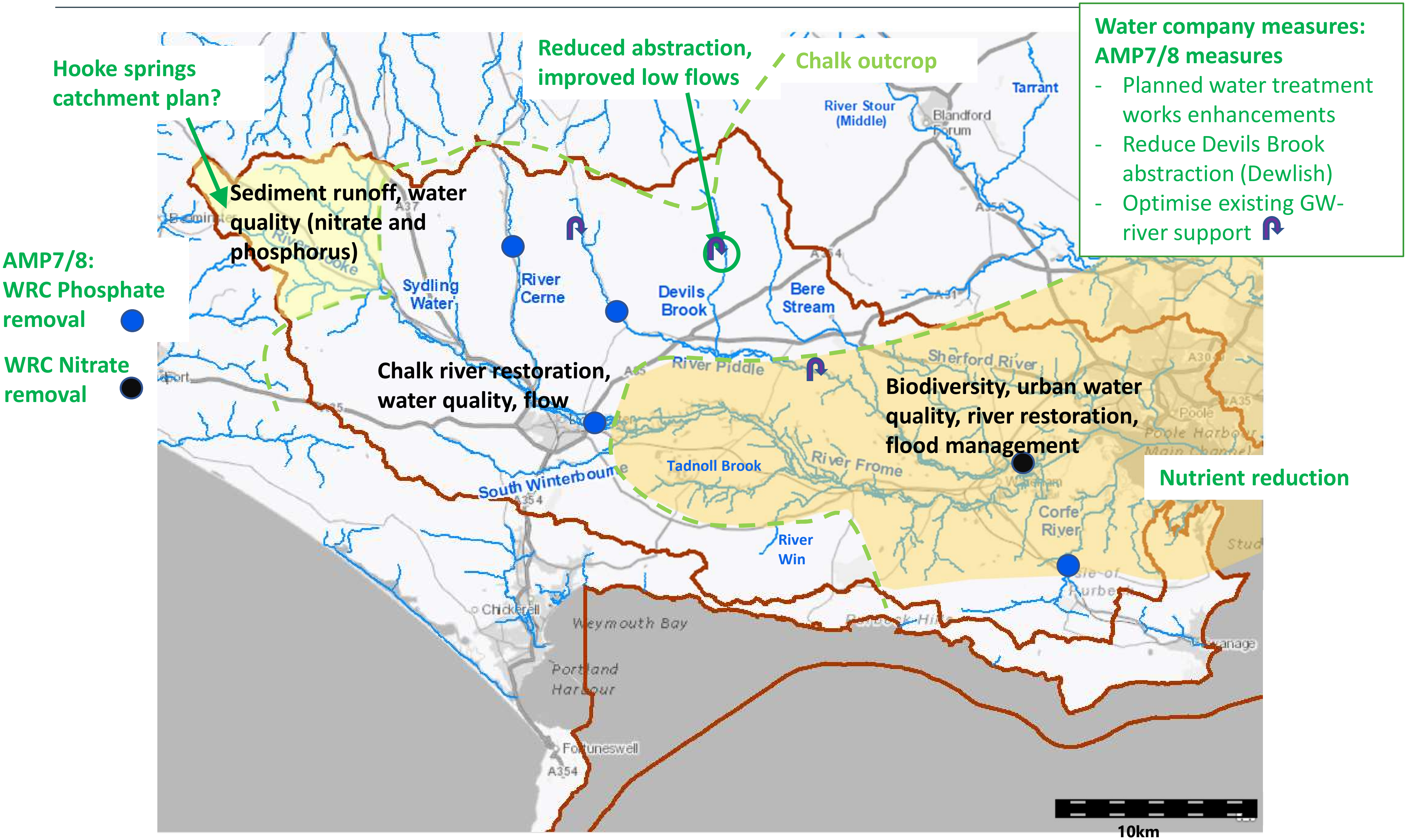
Data source: natural flows from 12 possible UKCP18 regional climate models (with UKCP09 afixK natural projection for comparison): https://eidc.ac.uk/

Figure B4.1 Poole Harbour Rivers catchment CaBA opportunity mapping



Data downloaded June 2021 from Catchment Based Approach Data Hub website

Figure B4.2 Short term 2030 catchment measures: Poole Harbour Rivers catchment



wood.

Figure B4.3 Medium term 2040 catchment measures: Poole Harbour Rivers catchment

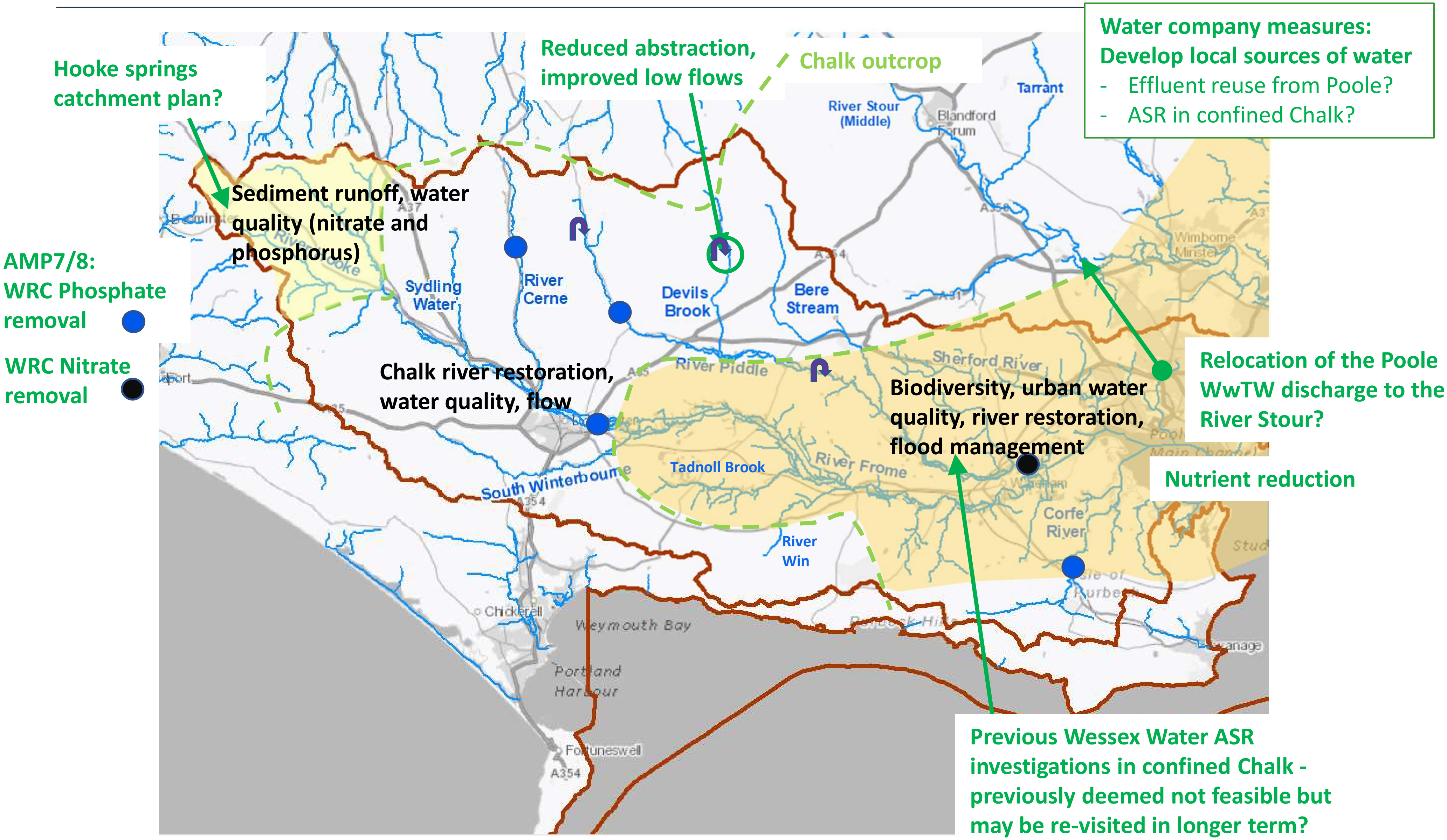


Figure B4.4 Longer term 2050 catchment measures: Poole Harbour Rivers catchment