Title: Water Company Discharges **IA No:** DEFRA1904 **Lead department or agency:** Department for Environment, Food and Rural Affairs **Other departments or agencies:** The Environment Agency, Welsh Government and, Natural Resources Wales	**Impact Assessment** **Date:** 14/10/2015 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Primary Legislation **Contact for enquiries:** Jackie Sullens

Summary: Intervention and Options

RPC Opinion: GREEN

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB on 2009 prices)	**In scope of One-In, Two-Out?**	**Measure qualifies as**
2.7	2.7	-0.1	Yes	Zero-net-Cost

What is the problem under consideration? Why is government intervention necessary?

Water companies return (discharge) a considerable amount of treated water back into rivers from sewage treatment works. It is often re-abstracted by others downstream for their businesses and hence there are sizable benefits to society from the discharges ('positive externalities'). Current legislation does not require water companies to take into account the impact of any change in discharge patterns on water availability for others. The increasing need to use water more efficiently and achieve higher water quality standards may lead to changes in water company discharges. This may gradually erode the positive externalities. Government intervention is necessary to maintain the water availability benefits to abstractors, which may become more important as pressure on water resources grows.

What are the policy objectives and the intended effects?

The policy objective is to introduce a system that treats both water company dischargers and abstractors fairly and proportionately when water company dischargers seek to change their discharge patterns, enabling the maximum benefits to be achieved. The intended effects are to:

- Facilitate a fair and transparent distribution of the risks and responsibilities between water companies and downstream abstractors in the event of changes; and
- Assure that the maximum economic benefit for the water associated with current discharges can be achieved.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

Option 0 (Do nothing): This would involve no change and water companies can move discharges;
Option1: Water company discharges could be changed with notice to those downstream abstractors reliant on them;
Option 2: Water companies undertake a cost benefit analysis of the change which can only go ahead if the total economic benefit to the water company exceeds the total economic cost of the water to the abstractors. This ensures that the final decision on the discharge change reflects the highest value use. **Option 3**: Water companies perform a narrow cost-benefit assessment and change discharges only if abstractors are compensated for any losses incurred due to any reduced water availability.
Option 4: In a two step approach water companies would first assess the impact of the change on river flows and water availability for abstractors and environment. A 2nd step, only if an impact occurs, is to agree a way of mitigating it (i.e. by providing a compensatory flow) *Option 4 is our preferred option as it offers a proportionate and fair approach for water company discharge management and has the potential to be integrated into the existing discharge permitting regime.*

Will the policy be reviewed? Yes **If applicable, set review date:** 6 years after implementation					
Does implementation go beyond minimum EU requirements?			**No**		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** No	**< 20** No	**Small** No	**Medium** No	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:** 0	**Non-traded:** 0	

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible SELECTED SIGNATORY: Rory Stewart Date: 14 October 2015

Summary: Analysis & Evidence — Policy Option 1

Description: Water Companies can change discharges but must notify abstractors reliant upon them.

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2014	Time Period Years 30	Net Benefit (Present Value (PV)) (£m)		
			Low: -0.1	High: -0.2	Best Estimate: -0.1

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0		0.0	**0.1**
High	0	-	0.0	**0.2**
Best Estimate	0		0.0	**0.1**

Description and scale of key monetised costs by 'main affected groups'

The incremental costs relative to the baseline are administrative costs incurred by water companies from notifying third-party abstractors of their intention to change their discharge pattern.

Central NPV £0.1m ;*Low £0.1m and High £0.2m.*

Other key non-monetised costs by 'main affected groups'

None identified.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		0.0	**0.0**
High	0	-	0.0	**0.0**
Best Estimate	0		0.0	**0.0**

Description and scale of key monetised benefits by 'main affected groups' relative to the base line

There are no monetised benefits under Option 1. The external benefit of discharges to abstractors is not internalised into water companies' planning.

Other key non-monetised benefits by 'main affected groups'

Water company notification provides downstream abstractors sufficient time to address any business impact from changing discharges. The notification improves information about discharges by providing these abstractors with an indication of the scale of benefit they receive from the discharges.

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5%

All currently identified schemes for changing / transferring discharges have the possibility of being implemented during the first 15 years of the appraisal. The headline capacity of all identified schemes is around 594 Ml/day. The value of water to abstractors is around 3pence/Ml (central assumption) and the reduction in water availability for abstractors is around 0.91% of the discharge schems' effective capacity (central assumption).

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: >0.0	Benefits: 0.0	Net: <0.0	Yes	In

Summary: Analysis & Evidence — Policy Option 2

Description: Water Companies can change discharges if benefits to water companies outweigh costs to third party abstractors following the results of a Cost Benefit Analysis (CBA).

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2014	Time Period Years 30	Net Benefit (Present Value (PV)) (£m)		
			Low: -4.1	High: -1.5	Best Estimate: -3.0

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0		0.1	**1.5**
High	0	-	0.2	**4.1**
Best Estimate	0		0.2	**3.0**

Description and scale of key monetised costs by 'main affected groups'

The costs relative to the baseline are driven by administrative costs faced by all three relevant parties (Water companies, the regulator and third-party abstractors) related to the Cost Benefit Analysis and engaging with a potential appeals process.

Water Companies : ***Central NPV £1.8m*** *Low £0.9m High £2.4m.*

The regulator : ***Central NPV £0.2m*** *Low £0.1m High £0.3m.*

Abstractors : ***Central NPV £1.0m*** *Low £0.5m High £1.4m*

Other key non-monetised costs by 'main affected groups'

None identified

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		0.0	**0.0**
High	0	-	0.0	**0.0**
Best Estimate	0		0.0	**0.0**

Description and scale of key monetised benefits by 'main affected groups'

Monetised benefits assessment identical to Option 1. Although water companies assess the costs to abstractors in this option, they are not required to pay for those costs, so the external benefit of discharges to abstractors is still not internalised into water companies' planning.

Other key non-monetised benefits by 'main affected groups'

The CBA makes downstream abstractors aware of possible discharge change and provides sufficient time for them to address any business impact from any change if it occurs. This improves information about the role of discharges by providing abstractors with an indication of the scale of benefit they receive from them.

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5%

As per Option 1. In addition, our evidence base suggests the CBA is likely to indicate that benefits to water companies significantly outweigh the impacts on third-party abstractors at an aggregate level (throughout the year), as opposed to particular periods when discharges can be of great benefit to third-party abstractors (times of low river flow). Hence, change / transfer of water company discharges always takes place in this option.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: 0.1	Benefits: 0.0	Net:0.1	Yes	In

Summary: Analysis & Evidence — Policy Option 3

Description: Water Companies are required to compensate abstractors for any losses as a result of changed discharges.

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2014	Time Period Years 30	Net Benefit (Present Value (PV)) (£m)		
			Low: -1.8	**High: 16.3**	**Best Estimate: 0.9**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0		0.1	**1.9**
High	0	-	0.8	**13.9**
Best Estimate	0		0.3	**5.7**

Description and scale of key monetised costs by 'main affected groups'

All parties face administration costs generated by agreeing compensation payments. There are further administrative costs to all parties if an appeal about compensation is raised. The requirement to pay compensation provides an incentive to water companies to seek more cost effective ways of providing benefit to abstractors and incentivises companies to adjust the operating regimes of the schemes for changing / transferring discharges; companies face cost of adjusting the operating regime of their scheme.

Water Companies : ***Central NPV £4.1m*** *Low £1.1m High £11.7m*
The regulator : ***Central NPV £0.4m*** *Low £0.2m High £0.5m.*
Abstractors : ***Central NPV £1.3m*** *Low £0.6m High £1.7m.*

Other key non-monetised costs by 'main affected groups'

None identified

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		0.0	**0.1**
High	0	-	1.6	**30.2**
Best Estimate	0		0.4	**6.7**

Description and scale of key monetised benefits by 'main affected groups'

The requirement to pay compensation provides an incentive to water companies to adjust operating regimes of discharge transfer schemes. Hence downstream abstractors receive benefit in terms of greater water availability relative to the baseline where the discharge transfer would have meant lower water availability).

Abstractors: ***Central NPV £6.7m*** *Low £0.1m High £30.2m*

Other key non-monetised benefits by 'main affected groups'

Option improves the level of information amongst abstractors about the role of discharges by providing them with an indication of the scale of benefit they receive from them.

Key assumptions/sensitivities/risks — **Discount rate (%)** Key

As per Option 1 and additionally: Any abstractor benefits are assumed constant throughout the appraisal period of 30 years; we do not consider second order impacts, in particular the effect of providing third party abstractors with information about their reliance upon discharges. The wide range in monetised benefits to abstractors in this option stems in part from: the variability in values that abstractors place on the water as derived from the case studies (these range from around £3.50 to around £10 per Ml of water); the extent to which their water availability is reduced; and most significantly the capacity of schemes.These last two factors lead to concurrent high costs and high benefits i.e. that we only observe high costs when there are high benefits.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: 0.3	**Benefits: 0.3**	**Net: >0.0**	Yes	Zero Net Cost

Summary: Analysis & Evidence — Policy Option 4

Description: In a two step approach water companies first assess the impact of the change on river flows and water availability for abstractors and environment. It implements a 2nd step to agree a way of mitigating it only if an impact occurs. There is no obligation for a cost-benefit analysis or to administer compensation payments.

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2014	Time Period Years 30	Net Benefit (Present Value (PV)) (£m)		
			Low: -1.0	**High: 18.7**	**Best Estimate: 2.7**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0		0.1	**1.1**
High	0	-	0.6	**11.5**
Best Estimate	0		0.2	**4.0**

Description and scale of key monetised costs by 'main affected groups' relative to the base line

There are monetised costs in this option relative to the base line. However, the administrative costs incurred by all parties are lower than in Option 3 as the administrative process is less involved.

Water Companies ***Central NPV £3.1m*** *Low £0.6m High £10.4m*
The Regulator ***Central NPV £0.3m*** *Low £0.1m High £0.4m.*
Abstractors ***Central NPV £0.6m*** *Low £0.3m High £0.8m*

Other key non-monetised costs by 'main affected groups'

None Identified

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		0.0	**0.1**
High	0	-	1.6	**30.2**
Best Estimate	0		0.4	**6.7**

Description and scale of key monetised benefits by 'main affected groups'

Monetised Benefits are as per Option 3, since the water companies are incentivised by the discharge management process to adjust their operating regimes, which provides external benefit to abstractors in terms of increased water availability relative to the baseline where the discharge transfer would have meant lower water availavility.

Abstractors ***Central NPV £6.7m*** *Low £0.1m High £30.2m*

Other key non-monetised benefits by 'main affected groups'

Option improves the level of information amongst abstractors about the role of discharges by providing them with an indication of the scale of benefit they receive from them.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5%

As per Option 1 and additionally: Any abstractor benefits are assumed constant throughout the appraisal period of 30 years; we do not consider second order impacts, in particular the effect of providing third party abstractors with information about their reliance upon discharges. The wide range in monetised benefits to abstractors in this option stems in part from the variability in values that abstractors can place on the water as derived from the case studies (these range from around £3.50 to around £10 per Ml of water), the extent to which their water availability is reduced and most significantly the capacity of future schemes.These last two factors lead to concurrent high costs and high benefits i.e. that we only observe high costs when there are high benefits.

BUSINESS ASSESSMENT (Option 4)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: 0.2	**Benefits: 0.3**	**Net: 0.1**	Yes	Zero Net Cost

Executive Summary

1. This Impact Assessment (IA) presents an appraisal of the policy options for addressing the market failure associated with the reduction and/or re-deployment of water company discharges.

2. Water & Sewerage companies (henceforth "water companies") return or "discharge" a considerable amount of treated water into rivers from sewage treatment works. This water is often re-abstracted by others further downstream for their businesses. Currently legislation only requires that discharges take account of impact on water quality. There is no legislation requiring the external benefits of the quantity of discharges to be taken into account.

3. A water company may choose to reduce and/or redeploy a particular discharge if it assessed doing so as cost-beneficial to itself. Increasing pressures from upstream market reforms, EU environmental regulations, reducing water availability due to climate change, and a growing population may lead companies to seek efficiency gains in their operations that involve the stopping or reducing of a discharge and/or relocating the discharge point. Discharges are already an important water resource for river flows, but they can also have a value to the water company if they re-use it; to other water companies if sold to them; and consolidating sewage treatment into larger treatment plants can also save costs. With the potential for these situations to occur more often there may be consequences for downstream abstractors as it could affect the reliability of their water abstractions particularly at times of low river flows. These abstractors are generally unaware of the extent to which they are dependent on water company discharges.

4. The **rationale** for intervening is to ensure the positive external benefit that abstractors receive from discharges is internalised in the decision making process when managing discharges. Our **objective** is to ensure the maximum net economic and social benefit of discharges is achieved, while ensuring that all parties involved are treated fairly and proportionately.

5. The Options under consideration cover a range of different approaches from 'Do Nothing' through to various means of internalising the social cost of altering discharges into the decisions of water companies when they are considering discharge transfer schemes. In practice, this 'internalisation' can be achieved in various ways, such as through a cost benefit analysis to implicitly take into account external costs, and may include compensation.

6. Our preferred option (Option 4) provides a step based approach which requires an initial assessment of the impacts of discharge reduction and/or re-deployment on water availability for abstractors and the environment. Only if this process identifies significant impacts, does this trigger a discharge management process to mitigate them. This assessment can be undertaken as part of the wider commercial viability assessment that water companies always undertake when investigating a change. This additional assessment can therefore be at marginal additional cost.

7. Our detailed analysis of discharges looks at changes in the direct impacts relative to the base-line; this brings together an assessment of the administrative costs and the direct impact of altering discharge flows to the parties impacted. These are analysed by combining results from a comprehensive water company survey about possible / planned future schemes with four real, representative case studies drawn from the survey results and developed collaboratively with water companies and the regulator. The case studies represent 17% of the total population of future discharge change schemes identified through the water company survey for the next 25 years. Together the broad range of evidence compiled allowed us to assess the possible future scale and impact of changes to discharges.

8. The monetised costs of our preferred option are £4 million NPV (best estimate) - around 45% of such costs are incurred by water companies in the form of higher operating costs if an impact is identified and mitigating action is needed, while the rest are incurred by water companies, abstractors and the environmental regulator in the form of administrative costs. Abstractor costs would only occur if they were to appeal against the mitigating action. Monetised benefits (best estimate) are around £6.7 million NPV arising from maintaining water reliability to abstractors.

The net benefits (best estimate) are around £2.7 million NPV over a 30 year appraisal period; the net benefits of the preferred option are higher than under any other option considered.

9. The full monetised costs and benefits across the low, best and high estimates show considerable variation. However, this is explained by the step-based approach which only permits possible scheme costs and abstractor benefits to increase *in proportion* – that is to say these two factors are largely correlated. Hence it is not possible for there to be a high cost scenario without corresponding high benefits.

10. The preferred policy option guides parties towards economically efficient outcomes with a minimum of administrative costs. The formal processes associated with compensation under Option 3 and the associated effort required to fully assess abstractor impacts in advance of implementing a scheme make this approach less attractive than Option 4. Option 2 also requires a high level of precision in assessing abstractor impacts to underpin a full cost-benefit assessment, which can be very costly and thus reduces the net benefits of this option.

11. Option 4 is the most attractive option as it guides towards an approach which flexibly mitigates the impacts on abstractors, without the administrative costs associated with assessing these impacts formally using detailed modelling.

12. Abstractors dependent on discharges receive the majority of benefits while the water companies incur the majority of costs. Abstractors benefit as the positive externalities they derive from discharges become internalised into water company decision making. We also consider this to be fair as there has historically been an implicit assumption that water companies will return discharged water which is reflected in abstraction charges, abstraction licence application determinations and water resources management in catchments.

13. Stakeholders were also broadly supportive of option 4. Consultation and engagement with them took place throughout the option development, evidence gathering and option appraisal stages. Considerable collaborative working with water companies was key to the development of a clear understanding of the current picture of possible schemes over the next 25 years and of the four corresponding representative case studies developed as a result. This work enabled the assessment of the possible future economic impacts of schemes and the effectiveness of the policy options in addressing them. The case studies themselves and the assumptions made based on them were presented to and discussed with water companies and abstractors, including the energy and agricultural sectors.

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1 Problem under consideration

Background

1.1 Water in rivers and aquifers is a common property resource[1] and therefore has a system of regulation to manage its use. This use, called abstraction, is currently managed by an abstraction management system and licences set up in the 1960s. The system regulates how much water is taken from rivers and aquifers.

1.2 The UK Government's 2011 Water White Paper, Water for Life, set out a vision, direction and process to reform the abstraction management system to make it more responsive to future uncertainty and enable us to manage England's water resources more effectively. That vision included that the reformed system should reflect the benefits of discharges to river systems.

1.3 The UK Government is committed to introducing a reformed water abstraction management system able to promote resilient economic growth and protect the environment. By resilient economic growth we mean growth that is not significantly affected by a problem with water availability in the short and/or long-term.

1.4 The Welsh Government has issued a written statement confirming its commitment to a reform of the abstraction management system.

1.5 The UK and Welsh Governments' consultation on the reform of the existing water abstraction management system, 'Making the Most of Every Drop', set out the UK Government's proposals for abstraction reform in England and the Welsh Government's commitment to consider the need for any changes to the system in Wales.

1.6 The UK and Welsh Governments explained in the consultation document that discharging (a process of returning abstracted water after it has been used) can play an important role in the water available for abstractions downstream. Many abstractions downstream in rivers may rely on the water provided through upstream discharges, particularly at low flows during the drier weeks of a typical summer. Discharge patterns can change currently, however drivers are increasing that may lead to water companies reducing and / or redeploying their discharges significantly in the future and current regulation does not provide a mechanism for ensuring impacts on downstream abstractors are considered. (Further details of the consultation are in paragraphs 1.27 – 1.34).

About discharges

1.7 Some abstractors use (consume) all of the water they abstract (for example, spray irrigators). Others only consume some of the water (such as water companies[2] and energy producers) and release or 'discharge' the rest to rivers or seas at discharge points and to specific water quality standards which the regulator[3] specifies. Discharges which meet the definition of "water discharge activity" in the Environmental Permitting Regulations (EPR) must be made under permits which have conditions on them permitting maximum discharge volumes. Broadly, these discharges are water containing polluting or poisonous matter.

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[1] This is a natural resource which is limited, accessible by all and potentially exhaustible if free access is allowed to it.

[2] Some water companies are 'water supply only' companies. This means that they provide water for the Public Water Supply (PWS) only and the sewage produced from this water is treated by other water companies that operate both as water and sewerage companies. Such companies provide water for the PWS as well as provide sewerage services and it is these that would make discharges from sewage treatment works.

[3] The Environment Agency is the regulator for managing water resources in England, while in Wales it is the Natural Resources Wales. The regulator manages water resources through licensing most abstractions with regard to the water available in a catchment and regulates discharges of water also.

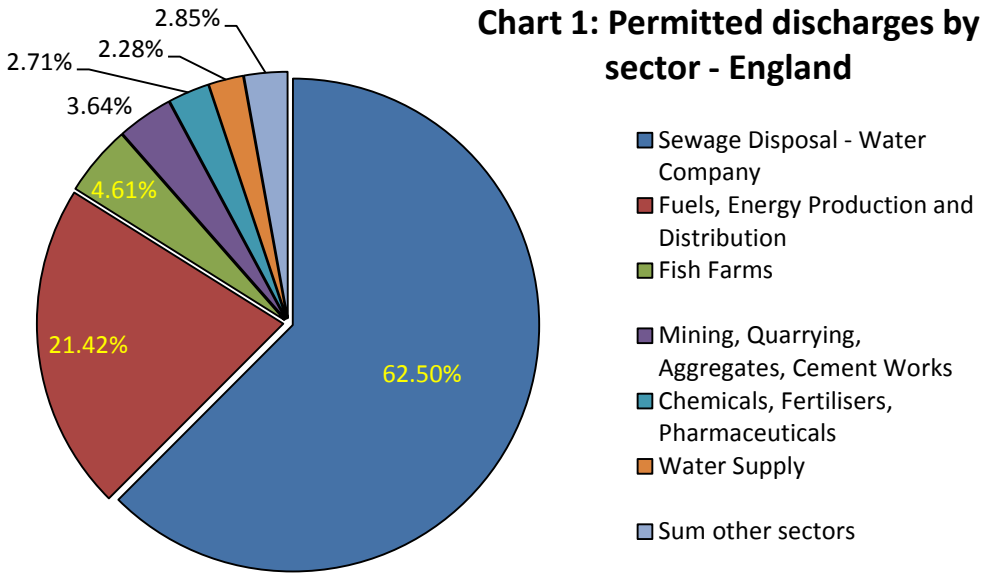
1.8 The current water abstraction charging system is based on a number of factors including broad sector-based assumptions of how much abstracted water is used or 'lost' (the consumptiveness of the activity for which the water is used). This is known as a 'loss factor' - defined as high (1.0), medium (0.6), low (0.3) and very low (0.03). For example, abstractors with a loss factor of 0.6 (60%), including water companies, are assumed to return roughly 40% of the abstracted water.

1.9 Management of water resources in Catchment Abstraction Management Strategies (CAMS) currently take into account discharges in determining water availability, and assessment of applications for abstraction licences consider intended discharges of abstracted water.

1.10 Permitted discharges by sectors, except water companies, are mostly connected with an individual abstraction and are largely made close to the abstraction point. It is therefore possible to identify the individual abstraction from which the discharge originated and to place conditions on that abstraction licence requiring a proportion of the water to be returned. (A limited number of abstraction licences currently have such conditions requiring this).

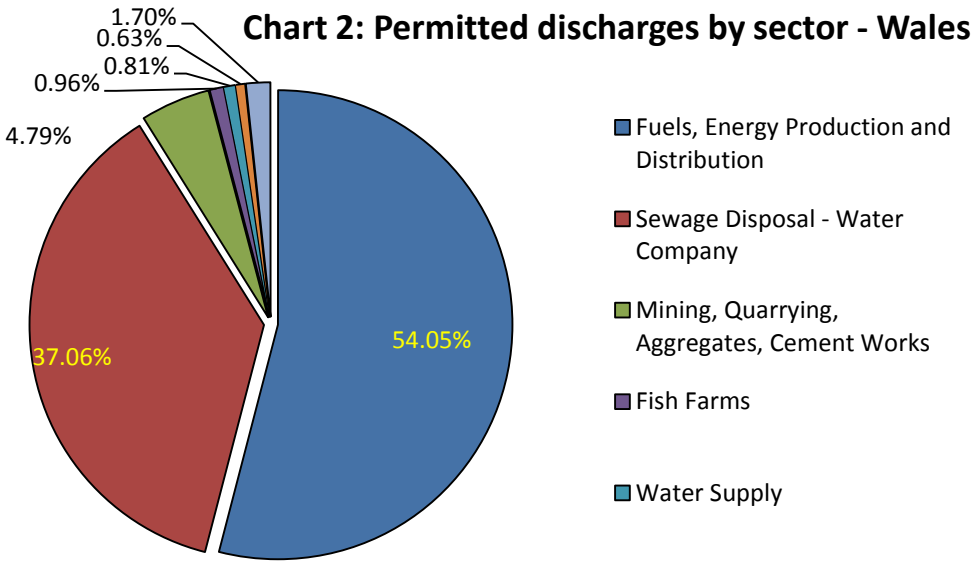
1.11 Water company permitted discharges from sewage treatment works however are made up of water from a number of distant abstraction points brought together via the public water supply. They also include substantial rainwater run-off; their volumes can change throughout the year depending on the weather; and they are often made in different catchments from where the abstractions took place. It is therefore not possible to link the discharge and abstraction or to place conditions on an abstraction licence for water to be returned.

1.12 Charts 1 and 2 below illustrate the maximum permitted discharges made by different sectors under discharge permits which the regulators in England and Wales[4] have issued. Water company discharges (from sewage treatment works (STW)[5]) account for just over 60% of maximum permitted discharges in England and roughly 37% in Wales.



[4] Source: Water Information Management Systems(WIMS) Sept 2014 – Environment Agency/ Natural Resources Wales

[5] 'Sewage Treatment Works' can also be called Waste Water Treatment Works and Water Recycling Centres.



1.13 Water company permitted discharges are made to a number of different water environments, such as rivers, canals, the sea and saline estuaries. In England, approximately 60% is discharged to rivers and freshwater environments like canals and lakes, 26% to saline estuary and 17% is discharged to sea. In Wales, 44% is discharged to rivers and 36% to saline estuary and 15% to sea[6].

1.14 During the drier weeks of a typical summer, treated sewage from these discharges can make up as much as 60% of the flow in some rivers in England[7]. Because of the coastal pattern of settlement in Wales, there are no large rivers within the country where the discharge exceeds 20% of river flows with many discharges being made to sea. Discharges in England are also made to sea or saline estuary where sewage treatment works are located on the coast but to a lesser extent than in Wales. Over time this has meant that a variable value to discharges has developed depending on their geographical location. For those catchments that have no coastal access, river discharges may have developed a greater economic value than those made in coastal areas. See table 1 below which illustrates discharges of treated sewage in a number of rivers in England at times of low summer flows, and the proportion of the low flow it provides at those times on average.

Table 1 **River location**	**Upstream Discharge as % of low summer flow**[1]
Thames near Windsor	39
Kennet near Reading	24
Avon nr Bristol,	>60
Ouse near Milton Keynes	34
Ouse near Bedford	>60
River Avon near Evesham	57
Rivers Severn near Worcester	60
Trent downstream of Nottingham	>60
River Ouse near York	33
River Mersey downstream Manchester	>60

[6] Source: Water Information Management Systems(WIMS) 2010-12 – Environment Agency/ Natural Resources Wales

[7] Source: Water Information Management Systems (WIMS) 2010-12 – Environment Agency/ Natural Resources Wales

1.	Low summer flow is estimated Q95 flow[8] of river at that location. Please note: This analysis only demonstrates the predominance of water company discharges upstream of the river locations.

1.15 In many rivers, abstractors may have minimal dependency on water company discharges because the availability of other water in the river is sufficiently high or there may be no abstractors. In such cases, changes to water company discharges would be unlikely to have a significant impact. However, in some rivers where the discharge makes up a large proportion of the water flow, a large reduction in a discharge could impact significantly on any abstractors in the river and 'Hands off Flow'[9] (HoF) conditions on a licence could be triggered more frequently, reducing abstractors' water reliability.

Current regulation of discharges

1.16 Discharging is a regulated activity and for most discharges a permit is required. Although there is no requirement that a discharge should continue and a permit can be surrendered with 20 working days' notice without penalty.

1.17 The purpose of existing regulations is to limit the potential for pollution in the receiving waters and to ensure that the waters achieve the water quality objectives set by legislation, thereby protecting the environment and human health. While regulators have powers to intervene on environmental grounds if a discharger wishes to move their discharge and applies for a new permit to discharge elsewhere or use the discharge in another way, they do not have any powers to consider the impact of discharges on economic grounds (i.e. impact of reduced water availability for abstractors) or to stop a permit being surrendered.

Drivers for change

1.18 The drivers for change are:

- Future lack of water availability as a result of climate change and population growth and the need to find new approaches to water management which may include redistributing current discharges (see paragraphs 1.19 – 1.22 below); and

- A need to deliver stricter water quality standards through a number of European Directives for example the Water Framework Directive and the Environmental Quality Standards (EQS) Directive (see paragraphs 1.23 – 1.26 below).

<u>Driver 1: About water availability</u>

1.19 Managing our available water resources is likely to become more of a challenge in the future with an increasingly varied climate and increased demand for water from a growing population. The Environment Agency / Natural Resources Wales's refresh of the Case for Change[10] shows that there are significant risks of less water being available in the future than today, and this is unlikely to be limited to the south and east of England. The severity of pressures on water resources may vary across England and Wales, as well as change over time. Therefore, the approach for managing them will need to be adaptive and flexible. Discharges have a part to play in this, as they have the potential to provide water companies with an additional water resource which is currently effectively lost to them after being discharged. Methods for reusing or reselling

[8] Q95 – The flow of a river which is exceeded on average for 95% of the time. This would be typical of a low summer flow.

[9] A HoF is a regulatory condition applied to abstraction licences which requires abstractors to stop abstracting when the flow in a river reduces to a certain point. They are mostly crude, 'on-off', controls which mean that abstraction must be ceased entirely once flows have dropped below a certain level. Hands off levels can be used in the same way but related to levels rather than flows.

[10] Case for change refresh 2013; Addendum to "The Case for Change: current and future water availability" (Dec 2013)

discharges rather than returning them to the environment exist and could be used more frequently in the future.

1.20 Reuse schemes allow water that would previously have been discharged to be re-used, for example to be treated and returned to public water supply. Most reuse schemes are 'indirect', with a discharge being made into a reservoir or river where it is diluted and blended with other sources before re-abstraction. These schemes could reduce the volume of discharges being made and therefore reduce the water available for abstractors downstream. Where downstream abstractors have a 'Hands off Flow' (HoF[11]) condition on their licence this could mean that the condition is triggered more frequently, reducing their water reliability.

1.21 Resale schemes could occur where the cost of using a discharge is lower than providing reliable water from other sources. This could result in a water company or an industrial user in an area of water shortage offering to buy the discharge from a company in another area. For example, Thames Water has investigated possible future options for other water companies selling them bulk supply of raw or treated water at times of possible future reduced water availability. Again this could reduce discharges and water reliability for downstream abstractors, but it could increase availability in another system, which could be more water stressed.

1.22 Upstream competition from around 2020 may also lead to more reuse or resale schemes (see Box 1 below for an explanation of upstream competition).

Box 1: About Upstream Competition

Upstream competition concerns the market for the sale of treated or untreated water into the supply system or the disposal of waste from the sewerage system. The Water Act 2014 contains provisions to encourage more upstream competition, by making it easier for new businesses and other incumbent water companies to provide certain upstream services. For example, they could develop a new water source and sell it to an existing water company. Alternatively, they could develop a more environmentally-friendly way of treating wastewater, re-using it for industrial use or disposing of sewage sludge. Upstream competition will also make it easier for water companies to buy and sell water from each other, to encourage better interconnections in the water supply system.

Upstream reforms will be implemented after 2019, over lapping with Abstraction Reform.

The Welsh Government took the decision not to implement upstream reform for Wales at this time. However, the Welsh Government took a power in the Water Act 2014 to implement upstream reform in the future if evidence suggests that it will provide benefits for the environment, the economy and citizens in Wales.

Driver 2: About stricter water quality standards

1.23 The Water Framework Directive (WFD) for example requires Member States to prevent deterioration in the status of water bodies and aim to achieve good ecological and chemical surface water status and good chemical and quantitative groundwater status by 2015. Good ecological status indicators for surface waters include Environmental Flow Indicators which are used to assess whether the quantity and variation of the flow of water in a river are sufficient to support healthy biodiversity and habitats. No deterioration is the key standard for ongoing management of water, where the ecological status of a water body shouldn't be allowed to go below the status it had reached.

[11] A HoF is a regulatory condition applied to abstraction licences which requires abstractors to stop abstracting when the flow in a river reduces to a certain point. They are mostly crude, 'on-off', controls which mean that abstraction must be ceased entirely once flows have dropped below a certain level. Hands off levels can be used in the same way but related to levels rather than flows.

1.24 This can lead to water companies increasingly considering the relocation of their discharges. The relocation of discharge is where water is still returned to a river but at a different location through the closure and consolidation of small sewage treatment works in favour of larger works that can treat water more efficiently to a higher quality.

1.25 Some of these larger works are now sited in coastal locations where the treated effluent is discharged to sea. As a result, there have been changes to discharge patterns in some rivers. Such changes could occur more frequently in the future as environmental quality standards increase. Larger works could still be making sewage discharges to rivers therefore but in different catchments.

1.26 Environment Agency data from the Northwest of England on historic revocations of water company discharge permits show that there have been approximately 40 closures of small sewage treatment works since 1989. These were predominantly small rural schemes with very small volumes, although this could clearly have an impact for a local abstractor. The data for other parts of the country is inconclusive, with Thames Water reporting fewer closures but of bigger plants.

Consultation on regulation of discharges

1.27 Recognising that drivers for changing discharges may increase, we included questions on discharges in our 2013 '*Making the Most of Every Drop*' consultation document and asked for views on:

a) The proposal to require all abstractors who discharge water close to where they take it from to continue to discharge a proportion in line with their current pattern; and

b) How best to regulate water company [sewage treatment works] discharges to provide reliable water for downstream abstraction without impacting on water quality objectives or constraining flexibility in water management.

1.28 There were 242 responses to question [a] in the consultation. 165 (70%) respondents believed that it was a good idea to require all abstractors who discharge water close to where they take it from to continue to discharge a proportion in line with their current pattern and this proposal is integrated into the final Abstraction Reform Impact Assessment and is not covered further by this Impact Assessment.

1.29 There were 182 responses to question [b]. Approximately half offered some form of detailed response, while others understood why discharges were important to rivers but stated they were unqualified to suggest any specific proposals. 58 respondents from a range of sectors believed that water company discharges needed greater regulation, monitoring and enforcement. 36 of those had specific concerns about ensuring the water quality of discharges and warned of the dangers of not doing so. The majority of water companies who responded agreed that the value of their discharges to river systems should be recognised in a reformed system.

1.30 The UK and Welsh Government's published a summary of consultation responses including those on discharges in July 2014[12]. We reaffirmed in this our consultation commitment to undertake further work to investigate how best to regulate water company discharges.

1.31 The scope of this impact assessment is therefore limited to discharges made by water and sewerage companies from sewage treatment works. However, in order to investigate the options comprehensively we had considerable on-going dialogue not only with water companies (which included a survey of their planned changes to discharges - explained further in section 4) but also

[12] Making the most of every drop consultation on reforming the water abstraction management system: Summary of consultation responses: July 2014

with all groups of abstractors. We did this by establishing a Discharge Management Steering Group comprising representatives from water companies in England and Wales, representatives from the energy sector in England, and representatives from Environment Agency, Welsh Government and Natural Resources Wales. This close working with water companies enabled us to collaborate with them to develop the case studies referred to in paragraph 7 of the Executive Summary and explained in more detail in Section 4, and to validate the costs of these with them.

1.32 We also had on-going dialogue with other abstractors. This included an online discussion with all stakeholders for five weeks during September – October 2014 to seek views on possible principles that could underpin the options for managing water company discharges. Their feedback fed into option development[13]. In summary, 38 comments were posted in the online discussion. There was general feeling that it would not be fair or reasonable for either downstream abstractors to pay water companies for continuation of discharges or for water companies to pay abstractors compensation for changes. The Consumer Council for Water worried that customers' bills would be affected if water companies had to pay abstractors compensation. Energy UK welcomed Defra's proposal to address the issue as they felt that it was of potential importance to society as a whole. In the case of power generation, they felt that it could impact on the sector being able to assure reliable power generation and on electricity costs. They also felt that water companies should get permission from the regulator to change a discharge. There was general agreement from participants that water companies should consider the societal impacts of any possible changes.

1.33 The options were also discussed at a meeting of the Abstraction Reform Advisory Group (ARAG) in November 2014 which comprised representatives from a range of trade associations and stakeholder groups representing abstractors and water companies[14]. We presented the options as well as the analytical methodology, assumptions and outputs. A general discussion with question and answer session about each of the options was held, including our assessment of potential costs. The discussion was supported by a presentation from Vivid Economics explaining this in some detail, including how data from a targeted survey of water companies and water company case studies had been used.

1.34 There was a lot of interest in the case studies; the assessment of the economic impact of discharges; and the corresponding value of water that had been calculated and all we discussed in some detail. Energy representatives, concerned about the impact of reduced future flows on power generation, were not supportive of policy options that might effectively accept current practice and allow the changes without consideration of abstractors. They also had concerns that there was a real possibility that future drivers and commercial pressures could see more changes to discharges. The Country Land and Business Association (CLA) was supportive of options in which compensation was paid to them if changes impacted on their businesses, while CCWater suggested that payment should be made to water companies for effectively increasing flows through discharges. Further discussion concluded with broad agreement that the policy option should incorporate a way of assessing the impact of the discharge change and either agreeing with abstractors how it could be changed fairly or paying compensation to them. Water companies were concerned however about exactly how to engage with abstractors to discuss impacts / compensation.

[13] Online discussion and summary of responses, Defra 2014

[14] ARAG comprises 19 members and includes representatives from a range of trade associations and stakeholder groups representing abstractors including National Farmers Uion, Confederation of Paper Industries, Horticultural Trade Association, Water UK, and Energy UK.

2 Rationale for intervention

2.1 Discharges from water companies can, in some locations and at some times, have a substantial effect on surface water flows and levels. They may also have the potential to impact the volume of water available for abstraction downstream. Increasing pressures from climate change, population growth, EU Environmental regulation, a need to increase efficiency for the benefit of the customer, and upstream competition may lead water companies to seek efficiency gains in their operations that involve changes to future volumes of discharge, or the re-location of discharge points, if doing so was cost beneficial. This could cause the gradual erosion of the positive externalities of discharges.

Information Failure

2.2 Some abstractors have unknowingly developed a reliance on discharges which have become a consistent feature of the river catchment for a considerable period of time. There could be an information failure whereby abstractors are unaware of the potential risks around their water availability. Water has been licensed for abstraction based on the amount of water availability at a particular point which may be downstream from a discharge. While abstractors know that there can be no guarantee that water will always be available, they may have developed their businesses based on a fairly secure assumption that the water licensed to them will largely be there.

2.3 The loss factor (0.6) used for the purposes of water company abstraction charging has also implied an expectation that a portion of the water abstracted will be returned to the environment.

Market failures in water discharges

2.4 While surface water flows can depend on discharges there is no obligation on most operators to maintain discharges in any circumstances. Current water company discharges can therefore be regarded as providing 'positive externalities' where the benefits of a private action are less than the benefits to society (in this case downstream abstractors). This gives rise to the possibility that an operator may divert its discharges to other locations and/or purposes without taking into account the beneficial effect on surface water flows and on other abstractors.

2.5 To take an example, the benefit to a public water company of diverting discharges upstream for re-use in public water supply (PWS) may be lower than the use value of that water to downstream abstractors overall or at particular times when flows are low. If the cost to downstream abstractors is not taken into account in the water company's decision on managing its discharges, the outcome could be a net economic cost to society.

Existing regulation of discharges

2.6 Regulators do not have any powers to consider the impact of discharges on water availability for abstractors.

2.7 The Environmental Permitting Regulations 2010 cover only the 'discharge, or entry to surface waters, which are controlled waters, of any poisonous, noxious or polluting matter; waste matter; trade effluent or sewage effluent'. Its purpose is to limit the potential for pollution in the receiving waters and to ensure that the waters achieve the water quality objectives set by legislation, thereby protecting the environment and human health.

2.8 Hence the externalities above are not addressed by regulation.

3 Policy objective

3.1 In the Water While Paper[15] published in December 2011, the UK Government committed to the reform of the abstraction management system. Included in this commitment was that the new system would be designed to reflect the benefit of discharges to river systems.

3.2 As explained, we have identified how this can be achieved for discharges linked to an abstraction, but an alternative approach is required for water company discharges due to their unique nature of not being linked to individual abstractions.

3.3 We anticipate that future changes to water company discharge patterns are unlikely to occur that often or that quickly (as considerable planning is needed before a discharge can be altered). However, future challenges to water availability, enhanced water quality standards and increased market opportunities from upstream reforms may make such changes more attractive to water companies than at present.

3.4 If water companies were to make such changes without consideration of the benefit of the discharge to the river system, there could be the potential for a future impact on water availability for downstream abstractors in some rivers and therefore to their businesses.

3.5 The policy objective therefore is to introduce a system that:

- Is proportionate in terms of the scale of the possible problem caused by a changing discharge pattern;
- Takes account of the needs of both the water company and abstractors; and
- Maximises the economic (social) benefits of discharges.

[15] Water for Life, Defra 2011

4 Options Analysis

4.1 This section sets out the policy options for appraisal and also the methodology used to assess them. We have considered four options for addressing potential changes in water company discharge patterns.

4.2 As explained in paragraphs 1.27 – 1.33, the process for gathering evidence to develop options for this policy started with stakeholders' views being sought on possible approaches to managing discharges in the formal abstraction reform consultation which closed in March 2014. All stakeholder responses were analysed, summarised and published as part of the formal summary of consultation responses and their suggestions considered as part of the policy option development[16].

4.3 Development of the possible water company discharge policy options was discussed at an early stage with:

- The Abstraction Reform project board comprising of personnel from Defra, Welsh Government, Environment Agency, Natural Resources Wales, Natural England and Ofwat; and

- A Discharge Management Steering Group comprising representatives from water companies, the energy sector in England and Vivid Economics, and representatives from Defra, Environment Agency, Welsh Government and Natural Resources Wales.

4.4 We also held a five week online discussion with stakeholders during September and October 2014 to build on their earlier consultation comments and to help to finalise the principles that could underpin the policy options for managing water company discharges. We received 39 comments from a range of stakeholders including abstractors and water companies. All their comments fed into the further development of the options[17].

4.5 We then extensively discussed the option assumptions and analysis at further meeetings of the project board, the Discharge Management steering group and at a meeting of the Abstraction Reform Advisory Group (ARAG) in November 2014[18]. As explained in parargraph 1.33, at the ARAG meeting we presented the options as well as the analytical methodology, assumptions and outputs; and a general discussion with a question and answer session about each of the options was held. This included a discussion about our assessment of potential costs. The discussion concluded with broad agreement for the policy need and that the preferred option should incorporate a way of assessing the impact of the discharge change and agreeing with abstractors how it could be changed fairly. Some abstractors also suggested that compensation may be an additional option.

[16] Making the most of every drop consultation on reforming the water abstraction management system: Summary of consultation responses: July 2014

[17] Online discussion and summary of responses, Defra 2014

[18] ARAG comprises 19 members and includes representatives from a range of trade associations and stakeholder groups representing abstractors including National Farmers Uion, Confederation of Paper Industries, Horticultural Trade Association, Water UK, and Energy UK.

4.6 The Options

Option 0: **Do nothing:** This would involve no change and is the counterfactual against which policy options have been measured.

Option 1: **Change with notice**: Water company discharges could be changed following notice to those downstream abstractors reliant on them and with regulator agreement regarding environmental impact.

Option 2: **Cost Benefit Analysis**: Water companies undertake a cost benefit analysis of making the change which can only go ahead if the total economic benefit to the water company exceeds the total economic cost to the abstractors. Changes would be subject to agreement from the regulator regarding environmental impact.

Option 3: **Compensation**: Water companies perform a narrow cost-benefit assessment and could change discharges only if abstractors are compensated for any losses incurred due to any reduced water availability. Changes would be subject to agreement from the regulator regarding environmental impact.

Option 4: **Discharge management**: Water companies could change discharges but would need to assess the impact of a significant change on water available for abstractors and environment. If impacts occur, a discharge management arrangement is developed with the regulator to mitigate it.

Option 0: Do nothing

4.7 This is the counterfactual to which the other four options will be compared.

4.8 This option would continue the status quo and, as at present, water companies could change discharges with agreement, if required, from the regulator concerning environmental impacts.

4.9 Water companies wishing to change a discharge could also decide to investigate which downstream abstractors benefited from those discharges, and then offer the sale of reliable discharges to those downstream abstractors for a specified period to enable them to ensure their water availability.

4.10 However, estimating the benefit of the discharge and negotiating its sale would require considerable resource. There would also be logistical complexities in ensuring that the discharge reaches the abstractor once it has been put into a river. Complexities include preventing a different abstractor from abstracting it, because the discharge may supplement the water flow and stop a HoF being triggered for other abstractors that then take the water. So we do not think this is a realistic possibility.

Option 1: Change with notice

4.11 Water companies would be required to provide sufficient notice to downstream abstractors of any proposals involving a significant change (to the volume or location) of a discharge. Notice would include details about the proposed change, whether it was permanent or operational for specific periods of the year.

4.12 However, changes could still only ultimately be made with agreement, as required, from the regulator concerning environmental impacts; existing environmental standards would therefore be maintained.

4.13 The provision of notice would allow any abstractors reliant on the discharge to assess the impact of the change and decide whether and how to take mitigating actions in advance of the change taking place.

4.14 It is likely that water companies could provide a considerable notice period in many cases (up to 5 years) as most changes would be planned as part of Water Resource Management Plans (developed for a 25 year period every 5 years) and do not take place quickly owing to the amount of preparation needed for any change.

Option 2: Cost Benefit Analysis

4.15 This would involve the water company undertaking an economic assessment of the proposed change. If the benefits of the discharge were assessed as greater for the water company than the downstream abstractor, the water company would be able to change the discharge (with agreement, as required, from the regulator concerning environmental impacts).

4.16 The water company would therefore need to investigate and gather evidence to make the assessment. Water companies already undertake considerable planning and assessment of costs in advance of making changes to their operations. This cost benefit analysis could therefore form an additional part of this.

4.17 No compensation would be made to the downstream abstractors to compensate for any losses as a result of any change. However, abstractors could challenge the accuracy of the assessment. Any challenge could be made initially to the water company with the right to request a review by the Planning Inspectorate.

4.18 This option would require a statutory duty to be placed on water companies to have due regard to the impact of significant changes to discharges on abstractors.

4.19 There would be an exemption to undertaking the economic assessment where there was a legal environmental requirement to reduce discharges to protect water ecosystems. For example, a discharge may cause the natural flow level of a river to be exceeded impacting on a water ecosystem that functions more effectively at natural flows.

Option 3: Compensation

4.20 This option would enable water companies to change a discharge (as currently under Option 0) and with agreement, if required, from the regulator concerning environmental impacts. However for any changes which resulted in significant impacts on downstream abstractors, they would be required to compensate them for losses incurred. A ‘significant impact’ would be a loss of significant volume of reliable water abstraction.

4.21 This option would require a statutory duty to be placed on water companies to have due regard to the impact of significant changes to discharges on abstractors and to pay compensation for changes which resulted in a significant impact on the abstractors. Water companies would have to undertake a narrow cost benefit analysis in order to make compensation payments.

4.22 Abstractors would have a maximum period of time in which to apply for compensation. They could challenge the compensation level proposed by the water company but would be required to base their challenge on an alternative compensation assessment calculated by them using actual data from their business. The water company would consider the challenge first with a further appeal route.

4.23 There would be an exemption to providing compensation where there was a legal environmental requirement to reduce discharges to protect water ecosystems. For example, a discharge may cause the natural flow level of a river to be exceeded impacting on a water ecosystem that functions more effectively on natural flows.

Option 4: Discharge management

4.24 This option follows a ‘step-based’ approach to minimise costs (two possible scenarios under this option are set out below) . The step-based approach involves the initial step of water companies

undertaking a proportionate assessment of the impact (on the watercourse and its users, including abstractors and the environment) of significantly changing a discharge. The regulator would provide guidance on how significance is defined.The assessment would be at a minimal, incremental cost to the water company because it can draw on the considerable work it would already have undertaken in assessing the commercial viability of a potential change.

4.25 The regulator would then review the assessment of impact including the water company's evidence. If the impact was significant, water companies would then work collaboratively with the regulator on the second step to develop a method for mitigating the impacts on the abstractors and the environment.

Example 1:Single step needed

The water company undertakes Step 1 of the policy – to assess the impact of the potential discharge change on river flows and abstractors / environment.

On assessing the impact, the water company identifies that there will be no impact on abstractors or the environment as the scheme will only operate in the spring and the flow level patterns of the river at this time of the year will be sufficient for abstractors and the environment, even without the discharge .

The water company submits their assessment to the Regulator for review. The Regulator agrees with the assessment and allows the discharge change to go ahead.

Example 2: Two steps needed

As per example 1, except the discharge change will operate in the spring and summer and there will be an impact on abstractors during the summer because of the lower flow levels in the river and reduced rainfall at that time of year.

The water company therefore moves to Step 2 of the policy and develops mitigating action which will change the operation of the proposed scheme in the summer to avoid the impact. They have two options for doing this and present both, along with the assessment, to the Regulator for review.

The Regulator and water company negotiate on the two options and the water company agrees toa mitigating action that requires them to limit the operation of the scheme in the summer to allow for sufficient water for abstractors.

4.26 The mitiating actions could be developed as a condition within the discharge permit. An example is the continuation of a compensatory flow at specified low flows. If agreement on the permit condition could not be reached, the water company could appeal to the Planning Inspectorate for a final decision. Abstractors could also challenge the permit condition – incurring costs for the abstractors. Or the water company could offer to mitigate the impact by paying compensation to the abstractors after assessing the economic benefit of the water, making this option a proportionate development of Options 2 and 3.

4.27 There would be an exemption on the assessment where there was a legal environmental requirement to reduce discharges to protect water ecosystems. For example, a discharge may cause the natural flow level of a river to be exceeded impacting on a water ecosystem that functions more effectively on natural flows.

Analytical Methodology

4.28 The methodology applied to assess the options is set out in this section.

4.29 An initial scoping exercise to investigate existing literature on the national and international treatment of discharges and schemes for changing them ("discharge transfer schemes") revealed

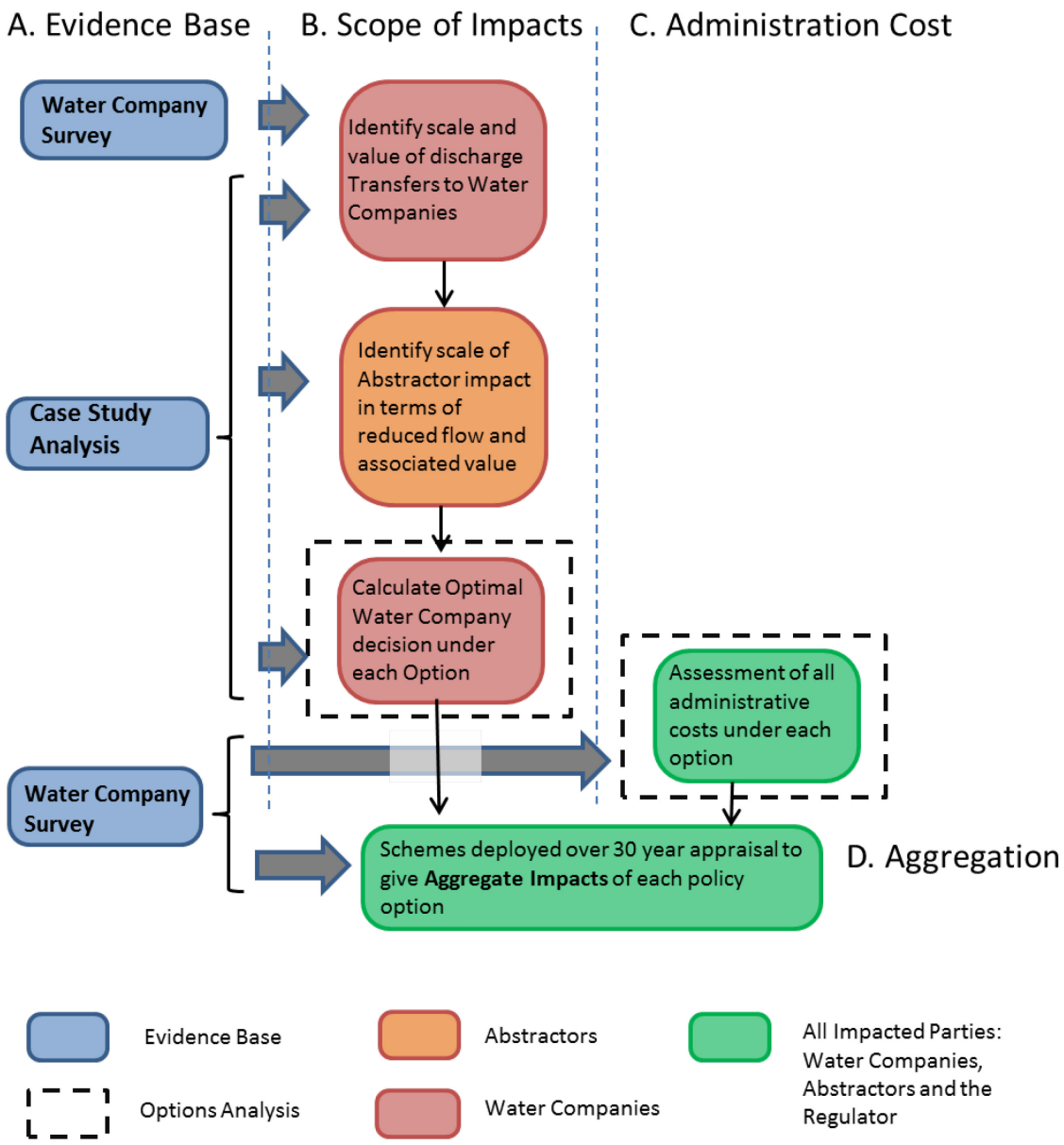
limited current evidence[19]. Hence it was necessary to undertake original analysis of the handling of current discharges in England and Wales and potential future changes.

4.30 We commissioned Vivid Economics to assist with the development of an evidence base to enable us to assess the options. We actively involved key stakeholders in this process, including all water companies in England and Wales[20]. The final methodology therefore reflects contributions from many parties and brings together significant expertise and knowledge. Parties involved included all Water and Sewerage companies within England and Wales, The Environment Agency and Natural Resources Wales. The steering group consisted of Water Companies, the Environment Agency and energy sector representatives. Vivid Economics provided advice and challenge on an ongoing basis during development of the methodology. As a consequence, the analysis contains the most robust information available, consistent with water company business plans and advice. The interpretation of evidence and expert judgement applied by Vivid Economics has been thoroughly discussed, scrutinised and challenged by the project steering group.

4.31 The methodology for the analysis follows the structure set out in the flow-diagram below (Figure 4.1):

[19] The Evidence Review and Assessment is covered in **Annex A**

Figure 4.1: Schematic structure of analysis



A. Evidence Base

The evidence base comprises two key sources, as follows:

i) Water Company Survey: twenty-two out of the twenty-three water companies in England & Wales helped to provide a comprehensive national picture of the potential scope and scale of discharges. The survey therefore represents almost the entire population of potential schemes. The survey revealed no plans for any schemes in Wales. The survey identified the number of discharge transfer schemes either under consideration ("Planned") or seen as viable options in the future ("Possible"). It also unearthed information on the capacity of such schemes, the frequency of their operations and, importantly, what effect (if any) on water flows and abstractors the scheme might have. The responses were cross checked by Vivid Economics with water company Water Resource Management Plans and gaps in submissions were supplemented

through interview with individual companies[21]. The survey identified a total of thirty nine (39) potential water company schemes for changing discharges over the next twenty-five years (2015-2040). Of these, only 24 (62%) were expected to have a potential negative effect on water availability for abstractors, as the other 15 schemes (38%) affected parts of rivers where no abstractors were present, or actually increased surface water flows which may benefit abstractors. More detail on the Water Company survey can be found in **Annex D.**

ii) Case Studies: We made use of the local-level expertise of water companies and Environment Agency staff to collaborate and develop in-depth studies on specific transfer schemes. The studies were carefully selected and analysed using Environment Agency catchment level datasets and water company research; in one instance the case study data fed into a sophisticated hydrological model of abstractor behaviour.

In deciding on the case studies and optimal number required for this evidence base we had to consider:

- the level to which the schemes were representative of the total 24 identified from the water company survey as having a potential impact on water availability for abstractors;
- the insight we anticipated they would provide into the impact of schemes (each study had to have contrasting characteristics to give a range of insights);
- the level of input needed from water companies and the regulator during their development. This included the available evidence held by water companies as some schemes had very limited scoping work done on them and so the costs of assessing them as case studies would have been proportionately high; and
- the level of resources required in proportion to the limited level of regulation the policy would impose and the frequency with which it was likely to be implemented.

Our conclusion, supported by Vivd Economics and water companies, was that these four case studies were representative of the total sample and offered a proportionate approach to developing an assessment of the impact of our policy options.

These case studies also benefitted from being able to draw on comprehensive planning that water companies had / were already undertaking to establish the commercial viability of the schemes. The case studies highlighted that water companies always undertake such planning in advance of pursuing a scheme, and that building on this work to establish the impact on the flow levels at different times of the year, and therefore water availability, is relatively straightforward for them. For the purposes of this evidence base and to reduce the burden on water companies however Vivid Economics undertook the additional work needed to establish the impact on the flow levels in the case studies. Their findings were discussed and agreed with water companies.

The case studies give figures on the size of the discharge transfer, the possible reduction in water availability and the values abstractors place on water (which can vary depending on the nature of the businesses involved). They also provide a valuable insight into the response water companies might take in those case studies under each of the Options, which includes an assessment of alternative means to facilitate the proposed discharge transfer to deliver mitigating action.

[21] Vivid Economics conducted the interviews by telephone with the individual water companies. They involved detailed discussion of the survey returns to verify the information against water companies' Water Resource Management Plans (WRMP), and to establish the likelihood of any other discharge changes. WRMPs had provided only an indication of possible future water re-use schemes. They had not included any information about STW consolidation or re-sale schemes.

The most important insights came from two of the four case studies. They showed, for example, that water had a greater benefit (value) for some abstractors such as farmers with high value crops. The third and fourth case studies were useful in emphasising the low-likelihood of schemes actually impacting on abstractors even if they are present in a river.

In order to reach these conclusions, we had considerable dialogue with water companies and the Environment Agency to discuss the details of each case study including the evidence and the assumptions necessary to assess the situations of abstractors. And as set out in paragraph 1.33 all of this was explained and discussed with a broad range of abstractors at the ARAG meeting.

The case studies represent a substantial investment in terms of stakeholder expertise, time and resource. More detail on the Case Studies is provided in **Annex B.**

B. Scope of Impacts

Our assessment of the scope of the impacts took place in three stages:

- Stage 1: Identify Scale and Valuation of Water Company Discharge Transfers: This involved drawing on the water company survey to estimate the scale of the discharge transfers. In total the survey revealed 39 schemes with the potential to redistribute up to 594Ml/day. One aspect that the four case studies are used to estimate is the value of this transfer to the water companies.

  The total "headline" capacity of 594Ml/day is adjusted to give an "*effective*" capacity. The headline capacity refers to the redistributed volume of water by water companies, while the effective capacity adjustment reflects that not all schemes will be implemented; and that not all have a clear effect on abstractors. For example, many of the largest schemes are located close to the sea and may not reduce flows in a way that affects abstractors. Once these adjustments are made, the schemes only have an "effective" capacity between 13 and 107Ml/day. Using the central estimate of 49Ml/day indicates that the total volume of water which might affect abstractors is only 7% of the "headline" capacity.

- Stage 2: Identify scale and valuation of abstractor impact in terms of reduced flows: This draws upon the case study analysis to calculate the impact of discharge transfer schemes on abstractors. Not all of the "effective" capacity of the schemes results in a direct reduction of water available to abstractors.

  For much of the time currently there is sufficient water available in rivers to abstract. There is insufficient water **only** when the flow level drops below an environmental protection threshold, at which point abstractors are unable to abstract. This can occur most often during drier summer months. The discharge transfer schemes could further reduce the flow level and therefore increase the amount of time an abstractor is unable to abstract if they have a Hand off Flow condition on their licence. We estimate that on average throughout the year only around 0.01%-1.8% of the effective capacity of the discharge transfer schemes would feed through as a reduction in water availability for abstractors[22]. Hence there is an extremely low probability of schemes affecting abstractors.

[22] These estimates were discussed and agreed with stakeholders, including all water companies, the Environment Agency and energy representatives. See *Key Assumptions* section, pages 28-29 for more detail.

The Case Studies also help identify the characteristics of abstractors that have the potential to be impacted and the value they place on the change in water availability. This was established through direct contact with the main abstractors in the case studies – the Energy Sector and the Middle Level Commissionsers[23]. We established their uses for the water, the times at which it was needed, and the impact of insufficient water availability on power generation and on crop types / yields / values.

- Stage 3: Optimal Water Company decision under each Policy Option: This stage brings together the values of: the discharge transfer to water companies; the cost to the water companies of seeking alternative ways to realise the transfer; and the impact on abstractors. The water company is assumed to select the cheapest action to try to achieve the transfer under each policy option. These actions are outlined in the assumptions section (page 26). The action the water company selects (and corresponding cost) will determine whether a scheme goes ahead unadjusted, goes ahead but with some mitigation in place (for example through adjustment to the scheme's operating regime) or whether it is abandoned.

C. Administration Cost

- Assessment of all administrative costs: The associated administrative activities for each case study under each of the options were identified and then costed based on water company and Environment Agency estimates. The costs are adjusted depending on the underlying complexity of the case study's transfer scheme and the probability that an appeal against a decision will take place. Appeals by abstractors are an additional element to the administrative costs.

- The majority of costs are calculated as the amount of administrative time spent performing each activity multiplied by a full-time-equivalent wage rate. They include costs where a party (such as an abstractor) has to employ specialist consultancy advice (such as legal or hydrological modelling) to enable them to make an appeal against the effectiveness of any mitigiating action.

- As would be expected, the administrative costs vary under each option, reflecting the differing level of administrative tasks that each would require from the different parties involved - water companies, the regulator and abstractors.

- Administration costs are detailed further in **Annex C**.

Table 4.1: Total Average Administrative costs per transfer scheme by policy option

Policy option	Cost (£,000)
Option 0	£0
Option 1	£7
Option 2	£170

[23] The Middle Level Area is a network of waterways in England, primarily used for land drainage, which lie in The Fens between the Rivers Nene and Great Ouse, and between the cities of Peterborough and Cambridge. The Commissioners' primary functions comprise the provision of flood defence and water level management to the Middle Level area (including abstractors), and as navigation authority for the navigable waters of the Middle Level system. The Commissioners have also certain conservation duties to fulfil when undertaking their functions. The Middle Level Commissioners consist of representatives from both the agricultural and non-agricultural sectors.

Option 3	£218
Option 4	£118

Source: Environment Agency and Vivid Economics
Note: These estimates represent the average for the central scenario. Amongst other scenarios, and for individual schemes, actual administration cost per scheme will vary depending on the its complexity. Total administration cost will also vary by the number of schemes that are implemented and their capacity.

D. Aggregation

- Aggregating the figures: The final stage is to apportion the yearly impacts of the 39 discharge transfer schemes identified in the water company survey over a 30 year appraisal period (rationale for this period is explained in '*key assumptions'* section below).

- Some schemes may not be taken forward and costs have been adjusted to reflect this;

- Those that are taken forward and implemented are assumed to be deployed over a 15 year period. This sees the effective impact of reduced abstractor flow rise gradually over that first 15 years as more of the surveyed schemes go live. The implementation of schemes has been differentiated according to whether the schemes are "Planned" (to take place in the next 5 years) or "Possible" (to take place in the subsequent 10 years).

Key Assumptions

4.32 The assumptions and any associated uncertainties were discussed and agreed with stakeholders, including water companies, the Environment Agency and energy representatives. They were also discussed with our Abstraction Reform Advisory Group, comprising a broad section of abstractors. The assumptions are as follows:

- We have used an appraisal period of **30 years** in this analysis. This is to reflect the time period over which abstractors are likely to face sustained impact from the discharge schemes implemented in the first 15 years of the appraisal period. Most administrative are incurred around the time of the scheme's implementation, while any economic impact will be delivered once the scheme is in force; a 30 year period allows for the full maturity of impacts for a scheme implemented in the first 15 years. Over time an abstractor may take steps to mitigate any impact (see further down).

- The extremes of the outputs from the case studies provide us with our low inputs (from the Severn Trent transfer case study) and high inputs (from the Anglian Water re-use case study). The central (best) estimates are a straight average of the low and high. This is because we do not have any further evidence needed to say which of the figures from the case studies is most representative.

- We assume that the deployment of 'Planned' schemes takes place evenly over the first five years of the appraisal period, while the deployment of 'Possible' schemes is evenly spread over the subsequent ten years. 'Planned' schemes are those currently under consideration by water companies while 'Possible' schemes are those which remain viable options to water companies in the future. This distinction between scheme type and the profiling of schemes recognises that not all schemes will be implemented, and that those which are will not necessarily be implemented at the same time.

- To reflect that not all schemes identified will necessarily be implemented, a probability weighting has been applied at the aggregation stage. The evidence from water company surveys and detailed discussions with water companies highlighted that some schemes in the early stages of planning are not necessarily guaranteed to proceed. If the scheme is "Planned" then there is a

central figure of 80% for the likelihood it goes ahead; if the scheme is "Possible" then this central figure is 40%.[24] These adjustments apply to all impact categories.

- We have only monetised the first order impacts to abstractors. There are likely to be second order, adaptive impacts that have not been quantified. In particular, it is likely that any changes to the benefit abstractors receive from water company discharges will fall over time as businesses adapt and evolve (e.g. invest in alternative sources of water, move location, become more resilient, some businesses may be transitory and have a limited lifetime) The assessment was limited to direct impacts because they were identified to be small in magnitiude

- Table 4.2 below provides details of other key inputs / assumptions made in the analysis

Table 4.2: Other Key Inputs/ Assumptions

Assumption	Description	Unit	Central	Low	High
Headline Capacity	This is the total potential of discharge transfer that could take place as identified in the survey	*Ml/day*	594	594	594
Effective Capacity	This is the total potential of redeployment once additional factors are considered. These factors are adjustments to account for: the frequency of scheme operation; the likelihood of the scheme going ahead; whether the scheme actually has the potential to impact abstractors, and; whether the scheme affects river flows.	*Ml/day*	47	13	107
Scheme Cost	Total private cost of the discharge transfer scheme to water companies	*£/m^3*	1.20	0.98	1.42
Scale of Lost abstraction	This figure is the proportion of water gained by a company that feeds through to a reduction in water availability to abstractors once river flow constraints are considered.	*%*	0.91%	0.01%	1.80%
Average value of Water to abstractors per unit of net abstraction	This is the value of water to abstractors per the amount of net abstraction (i.e. that consumed)	*£/m^3*	6.75	3.50	10.00
Value of Discharge to Abstractors per unit gained by Water Company	This is the value of lost abstraction per the unit of water that is gained by the water company. i.e. the value of water to the abstractor multiplied by the proportion of discharge transfer that is lost to abstractors. This is also the compensation cost of the scheme.	*£/ m^3*	0.03	0.001	0.06
Incremental cost of next supply scheme	This is the additional cost of the next best alternative (i.e. if a company is forced to abandon its proposed scheme)	*£/ m^3*	0.16	0.09	0.23
Incremental cost of adjusting operating regime	This is the incremental cost to the scheme when adjusting its operating regime so that water can be sourced to ensure abstractors are unaffected	*£/ m^3*	0.01	<0.001	0.02

Source: Vivid Economics, based on engagement with water companies and the Environment Agency. Headline and Effective Capacity estimates derived from the water company survey; remaining assumptions derived from case study analysis of representative schemes.
Note: 1,000 m^3 = 1 Ml

[24] Estimates are derived from a Vivid Economics' analysis of the water company survey responses. Figures shown are 'central' estimates; we use alternatives in the 'high' and 'low' cost assessment to capture their inherent uncertainty. "planned" low and high estimates are 40% and 100% respectively; while the equivalent for "possible" schemes are 20% and 60%

Note: the 'scale of lost abstraction' figures, and in turn the value of Discharge to Abstractors, are on the whole relatively low. These figures show the reduction in net abstraction faced by abstractors as a proportion of the gain in net abstraction to water companies. The low magnitude of estimates largely reflect that most of the time abstractors are unconstrained in their water use – there is no breach of the environmental "Hands-off-Flow" limit – and there is sufficient water capacity for water companies to adjust their discharges without impacting on abstractors.

Key cost and benefit Categories

4.35 The monetised cost and benefit categories used in this analysis are[25]:

- Administration Costs: Applicable to water companies, abstractors and the regulator.
- Cost of adjusting operating regime: Applicable to water companies. Involves adjusting the scheme's operating regime by finding an alternative source(s) of water to complement any reduction in flows that an abstractor might face with the discharge transfer.
- Cost of abandoning scheme: Applicable to water companies. Involves the incremental cost of having to adopt an alternative scheme.
- Continuation of external benefit to abstractors: where a company makes adjustments to its operating regime to protect abstractors, abstractors in turn receive benefits from the discharge (net of the base line where they otherwise are not in receipt of this benefit)
- Compensation: transfer payment from water company to abstractors.

Water company potential actions under different options

4.33 To analyse the impact of the options, we considered a set of potential actions a water company may take given the economic characteristics of its proposed scheme. These potential actions were developed on the basis of telephone interviews with the surveyed water companies which involved detailed discussion of the survey returns to verify the information against water companies' Water Resource Management Plans (WRMP). The potential actions (points i. to iv.) below have distinct cost outcomes and/or distributional consequences, particularly between water companies and abstractors. The four potential actions we consider are:[26]

i. **The scheme is unchanged (compared to current base line discharge transfer arrangements) and no compensation is paid:** this action has no change in economic outcomes relative to Option 0 and has no distributional consequences.

ii. **The scheme is unchanged but compensation is paid in relation to the scheme's external effects**: this action does not change the overall economic outcome but has distributional consequences, with water companies being worse off and abstractors being better off relative to the base line;

iii. **The scheme goes ahead but with a changed operating regime**: this action will reduce the economic costs to abstractors and increase economic costs of water supply to water companies, and therefore has both aggregate economic effects as well as distributional effects; and

iv. **The scheme is abandoned and the next best supply option is implemented**: this action will increase the cost of water supply for water companies, while removing the cost of lost

[25] We also consider wider impacts in the options assessment, such as those on the environment or our natural capital stock (see paragraph 5.6)

[26] Plausible responses were identified by Vivid Economics in discussion with Water Companies.

abstraction faced by abstractors, and therefore has both aggregate economic effects and distributional effects.

4.34 Overall, the water company will select the lowest cost option available based on its private cost in Options 0, 1, 3 and 4; or based on the total social costs of the scheme under Option 2.

Table 4.3: Water Company potential actions available under each policy option

Water company action	Option 0	1	2	3	4
1. Scheme goes ahead unchanged (no compensation)	✓	✓	✓	×	×
2. Scheme goes ahead unchanged with compensation	×	×	×	✓	×
3. Scheme goes ahead with altered operating regime	×	×	×	✓	✓
4. Scheme abandoned	×	×	✓	✓	✓

Source: Vivid Economics, based on water company engagement.

Risks and Limitations

4.36 Our analysis has been tested with a wide range of stakeholders, including the Environment Agency and water companies. We established the total population of schemes from the water company survey to enhance our understanding of the likelihood for change, and we have been able to provide ranges in our key assumptions where we feel uncertainty exists on the basis of our four representative case studies. We do not believe there are limitations around using four case studies to inform the likely decisions of water companies and provide parameter estimates because:

i. the four case studies were investigated in detail. They represent 17% of the total population of schemes with possible impacts on abstractors, although we also collected and compared information on the characteristics of the other 20 schemes that had possible impacts on abstraction through the water company survey. For our case studies, water companies (Anglian Water, Southern Water and Severn Trent/Thames Water) had undertaken detailed planning to establish their commercial viability, and it was possible for us to work with them to build on this work to establish the impact of the schemes on flow levels at different times of the year and therefore their impact on abstractors. This involved considerable discussion with water companies and the Environment Agency. While we considered developing further possible case studies, doing so would have been disproportionately costly for all parties given that the policy is currently unlikely to be implemented frequently. The use and outputs of these four case studies were also tested and agreed with industry stakeholders, including water companies and energy industry representatives.

ii. The two case studies that provided evidence of an impact on abstractors produce two sets of estimates for the value of water use for purposes of abstraction and also the percentage reduction in water availability to abstractors. The range of these estimates is significant and we are confident given the information we collated on all the possible schemes that the range represents the maximum upper and lower bounds.

5 Options Assessment

5.1 This section provides an analysis of the four options.

Option 1: Change with notice (net impacts)

Cost/benefit Category	Party affected	Values in £million NPV Low	Central	High
Costs				
Administration Cost	WaterCompanies	-0.06	-0.12	-0.16
Net Benefit		*-0.06*	*-0.12*	*-0.16*

5.2 Under this option, water companies proceed with the schemes to change discharges without any compensatory adjustments but must provide abstractors sufficient notice of their intention.

Monetised Impacts: Water companies would incur costs related to identifying abstractors affected by their proposed change to discharges; and possibly through advertising the proposed change. Water companies would continue, as under the baseline (Option 0 – Do nothing), to gain maximum benefit from their proposals to change discharges. Abstractors continue, as under the baseline, not to receive any benefit and not to incur direct costs of the option.

Non-Monetised Impacts: We have not monetised any of the associated benefits of abstractors taking actions in light of being notified to mitigate against the effects (if any) of the discharge transfer. These were considered to be second-order in scale and may not materialise until later in the appraisal period. It is likely that increasing abstractor awareness and allowing sufficient time before any plans are enacted would lead to benefits for abstractors in terms of mitigation and adaptation, beyond those adopted in the counterfactual.

Fairness and proportionality: While this option enables abstractors time to take mitigating action, it fails to recognise that there is an explicit assumption that water companies will return discharged water which is reflected in abstraction charges, abstraction licence application determinations and water resource management in catchments. Furthermore water companies stand to make benefits from reducing and/or redeploying discharges.

Note that option is unlikely to lead to any harm to water quality or the environment as base-line environmental protection standards would govern the regulator's approval of any scheme.

Option 2: Cost Benefit Analysis (Net Impacts)

Category	Party	Values in £million NPV Low	Central	High
Costs				
Administration Cost	Water Companies	-0.90	-1.80	-2.42
	Abstractors	-0.52	-1.03	-1.38
	Environment Agency	-0.09	-0.19	-0.25
Net Benefit		*-1.51*	*-3.02*	*-4.05*

Note: Totals may not sum due to rounding

5.3 This Option considers whether the overall discharge scheme should take place as the outcome of a cost benefit analysis involving the water company, the regulator and abstractors. . Our evidence

base strongly suggests that the outcome of the cost benefit analysis would be in support of the water company to continue with their planned discharge adjustment; it does not take into account the detailed management of discharges to maximise benefits.

Monetised Impacts: Through a cost benefit analysis, the water companies, the regulator and abstractors all face administrative costs (for example, the need to scope out and notify the affected abstractors and undertake detailed hydrological modelling). The cost of co-ordinating the assessment of the economic benefit would rest with water companies as the party seeking to change the discharge; but in doing so resource would also be needed from the abstractors estimating the impact and costs of a change on their businesses. The costs to the regulator are considered as a direct cost to water companies as it operates on a cost recovery basis.

There may also be costs incurred by the party for whom the discharge is assessed as having the lesser value. For example, impacts on downstream abstractors could lead to lost production as a result of insufficient water; increased production costs as a result of greater reliance on Public Water Supply; inability to grow their business; or higher product prices and reduced sales.

Non-Monetised Impacts: The non-monetised impacts are the same as those covered in Option 1, whereby abstractors may take mitigating actions in light of being made aware of the proposed discharge transfer.

Fairness and proportionality: It is similar to option 1, as abstractors would have notice of a discharge change if the greater economic benefit for it rested with the water company. However, this would as in option 1, fail to recognise that there is an explicit assumption that water companies will return discharged water which is reflected in abstraction charges, abstraction licence application determinations and water resource management in catchments. However, if economic benefit rested with abstractors, water companies would be unable to make the change which may impact on customer bills.

Note that option is unlikely to lead to any harm to water quality or the environment as base-line environmental protection standards would govern the regulator's approval of any scheme.

Option 3: Compensation (Net Impacts)

Category	Party	*Values in £million NPV* Low	Central	High
Costs				
Administration Cost	WaterCompanies	-1.12	-2.2	-3.00
	Abstractors	-0.64	-1.29	-1.72
	Environment Agency	-0.17	-0.35	-0.47
Higher Scheme Costs[27]	WaterCompanies	-0.01	-1.88	-8.72
Benefits				
Continued receipt of external benefit of discharge	Abstractors	0.10	6.65	30.22
Net Benefit		*-1.8*	*0.9*	*16.3*

Note: Totals may not sum due to rounding

5.4 Under this Option, water companies can only proceed with their discharge transfer scheme if they provide compensation to abstractors. This compensation is assumed to be equal to the benefit

[27] 'Higher Scheme Cost' would comprise of the following categories (as explained in paragraph 4.35 above) where applicable: Cost of adjusting operating regime; Cost of abandoning scheme; Continuation of external benefit to abstractors; and Compensation.

abstractors receive from the water company discharge. However, our analysis suggests that compensation payments incentivise water companies to make adjustments to the operating regime of the discharge scheme. Operating adjustments are usually in the form of providing compensatory flows back to the original discharge location. As such, this option allows the water company to realise the maximum economic benefit from the discharge, subject to the administrative cost of identifying compensation costs and adjusting its operating regime.

Monetised Impacts: The water company, regulator and abstractors would all face administrative costs. The administrative tasks in this Option are considered to be more involved than those in Option 2. This is because parties are anticipated to undertake many of the same scoping tasks as in Option 2, for example through engaging in detailed hydrological modelling. They also need to take part in an assessment of compensation payments. In practice, compensation payments would probably not take place (but are still assessed by the three parties) as water companies find it costs less to adjust the operating regime of their discharge scheme instead. In doing this there would be a reduced impact (net benefit) of a change in discharge on the abstractor.

The results show a significant degree of variation in the net benefit figures. This reflects, in particular the two impact categories of "Higher scheme costs" incurred by water companies, and the "Continued receipt of external benefit of discharge" to abstractors. Both of these categories are driven by two common key factors: the number of discharge schemes that are likely to be implemented and the proportion of the discharge transfer that will actually impact on abstractors. Together these factors vary the 'effective' capacity of the total population of discharge schemes – i.e the total volume of water from all of the schemes that actually impacts abstractors. The total effective capacity of discharge schemes therefore has a significant impact on the variation in net benefits. In the central scenario the effective capacity of all discharge schemes rises to around 47Ml/day; in the low scenario this figure is around 14 Ml/day and in the high scenario it is almost eight times greater at around 107Ml/day.

This change in the 'effective' capacity therefore feeds into both the total scheme costs and abstractor benefits. The higher the 'effective' capacity of the proposed schemes, the more costs are incurred (as it could lead to more schemes being examined in further detail and operating regimes adjusted) and the greater the abstractor benefits that the policy protects. As a result of feeding directly into both the scheme costs and abstractor benefit categories, the effective capacity will change the scheme costs and abstractor benefits *in proportion* – that is to say these two impact categories ('Higher Scheme Costs' and 'Continued receipt of external benefit of discharge' are largely correlated).

There are also some other factors that independently influence the size of these two impact categories. For example, on-going operating costs of making adjustments to schemes, or the value that abstractors place on the discharge (which can vary depending on the abstractor's business). The evidence revealed that the ratio of underlying 'abstractor' benefits to 'higher scheme costs' is substantially positive in each of the low, central and high cases. These ratios are determined by the results from the case studies (see section on *key* assumptions) and are around 11:1 for the low case falling to just over 5:1 for the high case.

Non-Monetised Impacts: As per Option 1, whereby abstractors may take mitigation actions in light of being notified of the proposed discharge transfer.

Fairness and proportionality: While this option would recognise that there is an implicit assumption that water companies will return discharged water which is reflected in abstraction charges, abstraction licence application determinations and water resource management in catchments, it would not be proportionate as it would require extensive negotiation of compensation for all impacts.

Note that this option is unlikely to lead to any harm to water quality or the environment as base-line environmental protection standards would govern the regulator's approval of any scheme.

Option 4: Discharge management (Net Impacts)

Category	Party	Values in £million NPV Low	Central	High
Costs				
Administration Cost	WaterCompanies	-0.63	-1.26	-1.69
	Abstractors	-0.28	-0.56	-0.76
	Environment Agency	-0.13	-0.26	-0.35
Higher Scheme Costs	WaterCompanies	-0.01	-1.88	-8.72
Benefits				
Continued receipt of external benefit of discharge	Abstractors	0.10	6.65	30.22
Net Benefit		*-1.0*	*2.7*	*18.7*

Note: Totals may not sum due to rounding

5.5 Under this option, water companies can only proceed with their discharge scheme if an assessment of the impact on water availability for both the environment and abstractors is undertaken, and where an impact occurs a discharge management condition on the discharge permit is agreed. As with Option 3, water companies find it preferable to adjust their operating regimes rather than, in this case, abandon the scheme in the pursuit of another. This option would allow the water company to change the discharge provided a compensatory flow or other mitigating measure could be made at required times of the year avoiding any negative impact on their businesses.

Monetised Impact: There would be minimal administrative costs to the water companies and the regulator in the first step of the policy option with no further costs if no impact was identified. Further costs for the water company and the regulator could occur in the second step of the option if a significant impact was identified and costs would only occur for abstractors if they wished to challenge the assessment or mitigating action. This is considered to be less complex than under Option 3, since water companies and abstractors purchase less external support, for example with the production of detailed hydrological modelling.

As in Option 3, the results show a significant degree of variation in the net benefit figures. This is again explained by the impact categories of 'Higher scheme costs' and 'Continued receipt of external benefit of discharge' for abstractors which can vary considerably depending on the 'effective' capacity of the schemes as explained in Option 3.

Non-Monetised Impacts: There are non-monetised abstractor benefits as per all the other options, whereby abstractors may take mitigation actions in light of being notified of the proposed discharge transfer.

Fairness and proportionality: This option would recognise that there is an implicit assumption that water companies will return discharged water which is reflected in abstraction charges, abstraction licence application determinations and water resource management in catchments. It is also designed to be proportionate as substantial administration costs should only be required if there are significant impacts on the environment and abstractors due to reductions and/or redeployment of discharges.

Note that the option will explicitly allow for the protection of water quality and the environment as a specific element within the policy.

Wider impacts

5.6 Wider impacts as follows:

- **Economic / Financial**: Any significant additional costs imposed on water companies could pass through in the form of higher bills to consumers. The size of the additional costs are too small to impact water bills.

- **Environmental**: Under all Options, the environment and our natural capital stock will continue to be protected under existing regulatory requirements; changes to discharge patterns could not take place if they were found to violate existing regulations. As such no changes to the environment are anticipated to occur.

Overall assessment

Table 5.2: Net Impacts of each of the four Options under consideration (£m NPV)

		Figures in £million NPV		
Option	**Impact**	**Low**	**Central**	**High**
Option 1	Benefits	0	0	0
	Costs	0.1	0.1	0.2
	Net Benefit	**-0.1**	**-0.1**	**-0.2**
Option 2	Benefits	0	0	0
	Costs	1.5	3.0	4.1
	Net Benefit	**-1.5**	**-3.0**	**-4.1**
Option 3	Benefits	0.1	6.7	30.2
	Costs	1.9	5.8	13.9
	Net Benefit	**-1.8**	**0.9**	**16.3**
Option 4	Benefits	0.1	6.7	30.2
	Costs	1.1	4.0	11.5
	Net Benefit	**-1.0**	**2.7**	**18.7**

Note: totals may not add due to rounding

5.7 These results indicate that administrative costs are an important aspect of the policy impact. As the per unit impacts in the case studies are relatively small, the potential economic benefit of adjusting discharge schemes to avoid external costs on abstractors may only just exceed the administrative costs associated with assessing and agreeing the schemes depending on the option and the 'effective' capacity of the discharge schemes.

5.8 The preferred policy option (Option 4) is able to balance the burden of administrative cost to maintain the greatest economic benefit to abstractors through the use of the step-based assessment approach. This limits the amount of administration to just an initial assessment of impact on flow levels on top of the commercial viability assessments that water companies already undertake. Further costs are only incurred if this assessment identifies an impact. This helps guide parties towards economically efficient outcomes with a minimum of administration costs.

5.9 Both the formal processes associated with compensation under Option 3 and the associated effort required to fully assess individual abstractor impacts in advance of implementing a scheme make this option less attractive than Option 4. Option 2 also requires a level of precision in assessing abstractor impacts to underpin a cost-benefit assessment, which consumes the economic benefits of the option.

5.9 Option 4 is the most attractive option as it guides stakeholders towards an approach which flexibly mitigates the impacts on abstractors, without the administrative costs associated with assessing these impacts formally using detailed modelling. This option provides net benefits of around £2.7million NPV. Net benefits accrue to abstractors, whilst both water companies and the Environment Agency (through administrative costs) face net costs from the policy. We consider water company costs to be fair as there is an implicit assumption that water companies will return discharged water which is reflected in abstraction charges, abstraction licence application determinations and water resources management in catchments. Furthermore, water companies stand to incur benefits from reducing and/or redeploying discharges.

5.10 As noted in section 4 (Analytical Methodology) the modelling of the economic effects used a broad range of evidence to arrive at the absolute impact estimates. There are potentially significant positive net-benefits to implementing the preferred option of up to £18.7million NPV. These occur when we take a number of the underlying asusmptions[28] that influence how likely the transfer schemes will be to affect abstractors in the 'high' scenario which compound to reveal potentially large net benefits. It is however possible that layering all of these input assumptions in their 'low' setting can lead to an outcome where the administrative costs marginally outweigh the net benefits to abstractors leading to an outcome of -£1million NPV over 30 years. Yet, more confidence can be placed in the finding that there are potentially significant economic benefits from managing the impact on abstractors of changing discharges, and it seems clear that these are best obtained through a flexible regulatory step-based arrangement that works with the existing commercial viability that the water companies undertake and minimises administration costs. As explained this preferred option achieves this by requiring water companies to consider the impacts of changes to discharges and, only if an impact is identified, to enter into a discharge management agreement which mitigates it. Hence it should be a proportionate policy option and response to the potential issues of discharge transfer schemes.

Small and Micro Business Assessment

5.11 We have considered three separate groups in our analysis: water companies, the regulator and the third-party abstractors. Neither the regulator nor water companies that are impacted are considered to be small or micro businesses (SMEs).

5.12 While it is likely that a significant number of abstractors are SMEs, the regulation is not being placed on them. In addition, abstractors would largely benefit as the options would ensure a number of possible outcomes including abstractors being made aware of possible changes to discharges and action being taken to mitigate any impact of a change.

[28] There are a number of factors that influence the range of impacts to abstractors.Most of these have been derived from our comprehensive survey of water company discharge schemes and include how frequently the scheme operates, the likelihood it is commissioned, whether there is a net increase in river flows, the presence of abstractors in the catchment and perhaps most significantly whether abstractors are constrained in their access to water (this final factor is derived from the case studies). The ranges for each of these individual factors are small yet when layered the overall uncertainty can be wide.

6 Conclusion

6.1 Our preferred option is Option 4 - managing potential significant changes to discharges through a form of discharge management arrangement within the existing discharge permit. This is preferred as it:

- Has the potential to manage changes to discharges holistically through consideration of the impact of a discharge on a watercourse (including abstractors) and not just the environment;
- Minimises costs by use of a step based policy approach;
- Allows changes to discharges to take place and the economic benefit of these to be realised while at the same time protecting abstractors and the environment;
- Achieves a fair and proportionate outcome allowing an economic benefit of the discharge for abstractors; and
- Would be integrated into the existing discharge permitting regime.

6.2 We expect that the provision for the management of water companies' discharges to be implemented in the early 2020s alongside abstraction reform.

7 One-In, Two-Out Methodology

7.1 All the policy options are in scope as they would involve a regulatory change and water companies would be required to take specific actions which they do not take currently before being able to make a change to a discharge or following the change to a discharge.

7.2 Those actions are however designed to help abstractors and their businesses by either: enabling abstractors to decide whether to mitigate the impact of a future change; to compensate abstractors who have incurred losses as a result of a change; to enable the change to take place only if it has the greatest economic benefit for the water company; or to maintain water availability for the abstractors as needed through an agreement on discharges between the water company and the regulator.

7.3 Our preferred option (option 4 - discharge management) is therefore an 'IN' with 'zero net cost', as is option 3 (compensation).

7.4 The small costs to business of option 4 are administrative arising mainly from activity costs of water companies assessing the impact of a discharge change on water availability for abstractors and the environment, and working with the regulator to reach an agreement on any mitigating action needed if an impact is identified.

7.5 The benefit arises from water reliability being maintained for the abstractors who would otherwise have had reliability impacted by the change to the discharge.

7.6 These costs and benefits are direct and included in the one-in-two-out analysis. Note that the size of the costs and benefits are very small.

7.7 The net benefit to business was calculated using the latest BIS impact assessment calculator to derive the Equivalent Annual net cost to business (EANCB) in 2009 prices. Table 7.1 below shows that business can achieve a cost saving in England under option 4 under the best estimate.

Table 7.1: Direct Impact on Business (Equivalent Annual £m per).

Business Assessment					
Option	Direct Impact on Business (Equivalent Annual) £m			In Scope of OITO?	Measure Qualifies as
	Costs	Benefit	Net		
Option 1	0	0	**<0**	Yes	In
Option 2	0.1	0	**-0.1**	Yes	In
Option 3	0.3	0.3	**>0**	Yes	Zero net Cost
Option 4	0.2	0.3	**0.1**	Yes	Zero net Cost

7.8 The One-in-Two-Out approach to regulation is not the policy of the Welsh Government and applies only in England. However the regulation of water company discharges could enable the future proofing of changes in Wales also and the future protection of any abstractors reliant on discharges.

Annex A: Rapid Evidence Assessment

Prior to conducting our own analysis on the impact of discharge transfer schemes, an assessment of existing evidence was undertaken. This helped to unearth the most likely sources of published work on the topic of discharges and their associated impact on third-party abstractors. It was used to try to identify where further, more detailed evidence assessment may be of use and to see whether evidence of discharge management exists internationally. The review was performed by Vivid Economics.

There were three key elements to this evidence review:

i. Update of previous review*:* Vivid Economics undertook a previous literature review in 2014 for the water Abstraction Reform Impact Assessment. Preparatory work for the project included an examination of relevant literature and the key sources identified through that process were reviewed again for the purpose of this assessment.[29]

ii. Academic Journals search: A comprehensive search for relevant titles and keywords was conducted within academic literature.[30]

iii. Grey Literature: Web resources from Government, 'Google Scholar' and 'Google' were consulted to ensure the most relevant and recent reports (or grey literature) were included in this assessment[31] 'on effluent re-use'; 'waste water consolidation'; and 'abstraction licensing'. Further searches included relevant jurisdictions, such as California and Australia, as additional keywords.

The literature review indicated that there was little or no existing published work that is applicable for our analysis here. It was concluded that several sources do identify the issue without proposing any specific solutions and that most other sources merely examine stakeholder attitudes to water trading, abstraction rights and water value-in-use, without focussing on the role of discharges. As such it was deemed necessary to construct original analysis for our assessment.

Review Outcome

Several sources identified the issue without proposing specific solutions:

A range of academic and policy sources identify the importance of capturing the effect of discharges or 'return flows' in an effective abstraction regime, and discuss the complexity these flows create when trading water entitlements whilst protecting the environment. None of the sources propose specific solutions.

Several United Kingdom sources, including those authored by Defra itself, identify this issue. A joint paper by Ofwat and the Environment Agency (Environment Agency (UK) & Ofwat, 2011) argues that 'there has been little recognition of the fundamental link between discharge and abstraction' with consequences for 'catchment-wide allocation of water resources'. Risk & Policy Analysts (2011) conclude similarly in their analysis for Defra that 'changes to the point of abstraction (and discharge) could have significant impacts on the environment' and that these impacts may have to be investigated by the Environment Agency when regulating trades. The conclusions from these papers are reflected when Defra highlights the issue in the context of Abstraction Reform Impact Assessment.

The debate appears in international literature and in policy discussion in other jurisdictions. Young and Mccoll (2009) argue that Australia's allocation of water entitlements on a gross rather than net basis, that is, gross abstraction rather than abstraction net of discharges, has achieved an increase in

[29] *The Impact of Abstraction Reform: A simple top down water abstraction economic model for England and Wales* (not published). (Vivid Economics, April 2014)

[30] This drew upon the three online libraries of Elsevier, Springer and Wiley, and focussed on six journals: 'Water Resources'; 'Water Resources Research'; ' Water Resources Management'; The Journal of Environmental Economics and Management'; 'The Water and Environmental Journal', and; 'The Journal of the American Water Resources Association'. Keywords included 'water discharges', 'water reform', 'water value-in-use', 'water re-use'; 'effluent re-use'; 'waste water consolidation'; and 'abstraction licencing'. Two types of checks ensured that all appropriate articles were considered. Firstly, results were ordered by relevance and the first 60 results were checked, although in some cases there were less than 60 results. Secondly, the results were ordered by date and all publications for the past three years were checked.

[31] The same search terms as described in the previous footnote with additional keywords for relevant jurisdictions, such as California and Australia.

irrigated area at the expense of reduced return flows. This is because the entitlements, as defined, do not require any water to be returned to the system. Young (2013) concludes that this reduction in return flows has created a 'raft of social, economic and environmental problems'.

Grafton et al. (2011) discuss the existence of 'third party' effects arising from water trades by senior rights holders. The authors argue that at times of drought junior water appropriators are particularly dependent on return flows from senior appropriators. Accordingly, if senior appropriators change the location, nature or timing of their use, this can influence the level of water available to junior appropriators. Although this discussion reflects the particular nature of appropriative water rights in the western US, it highlights that changes to discharges arising from private transactions or decisions can affect the entitlements and interests of third parties, that is, an externality can arise.

Other sources examine stakeholder attitudes to water trading, abstraction rights, and water value in use:

Lumbroso et al. (2014) sought to understand stakeholders' attitudes to water trading through demonstration of two potential water trading platforms in the Bedford Ouse and Upper Ouse catchment in eastern England. This study is primarily of general interest for its investigation of the attitude of small farmers to water trading. The hypothetical water trading demonstrations adopted in the study attempt to address the hydrological effects of moving water use and resulting changes to discharges. Particularly, the authors identify that bilateral water trades where the buyer is downstream of the seller and has an equal or lower level of consumptiveness carry low or negligible probability of environmental damage, whereas trades that do not fit these criteria require closer assessment. This categorisation reflects that trading water upstream to users with equal or higher consumptiveness must reduce surface water flow at some point relative to the pre-trade situation. The authors do not specify what adverse impacts they anticipate from such trades, but in principle it would include breaches of minimum flow conditions and restrictions on downstream abstraction.

Lange and Shepheard (2014) interviewed stakeholders in East Anglia and the North East of England to understand attitudes to water rights, and relate these to theoretical conceptions of property rights. This article is primarily of general interest due to its geographic context and its focus on the attitudes of small abstractors such as farmers. Issues of compensation are discussed in this study, but only in the context of the changing abstraction licences, not in relation to third party effects of changes to discharges or abstraction location.

Vivid Economics also reviewed several sources examining water valuation that were used in its past work for Defra. No more recent sources of relevance have been identified since the literature reported in Vivid Economics' April 2014 report to Defra, *The Impact of Abstraction Reform: A simple top down water abstraction economic model for England and Wales* (not published).

Further sources identified by academic contacts:

To ensure comprehensive coverage of the rapid evidence assessment, a range of academics and researchers were contacted to try to identify further sources relating to discharges and effects on abstractors. These experts were located in the United Kingdom, the United States, France, Australia, the Netherlands, and at the OECD.

None of the additional sources identified by these researchers directly addressed the effect of re-use or changes in discharges on abstractors. One Australian study examined consumer attitudes to water re-use from a sociological perspective, whilst a second assessed consumer willingness to pay to improve the quality of recycled water. A Canadian study examined consumers' willingness to pay to access recycled water and so avoid dry weather restrictions on household use.

Annex B: Case Study Analysis

An analysis of four case studies was carried out to identify the scope of operation and impact on abstractors of potential discharge re-use and re-sale schemes. The case studies included:

i. An analysis of a water re-use scheme by Anglian Water;
ii. A re-sale scheme that would divert discharges from the River Trent to the River Thames;
iii. Diversion scheme 1 under consideration by Southern Water;
iv. Diversion scheme 2 under consideration by Southern Water.

In identifying suitable case studies for our analysis to ensure a representative sample of the types of changes that could occur, we analysed the characteristics of each of the schemes that the survey identified. The case studies were selected by identifying candidate river catchments on the basis of advice from local regulator staff and water companies whom collectively have a deep understanding of individual catchments in England and Wales. Those acquainted with the discharge operating patterns and the configuration of individual schemes, were heavily engaged in the design of the case studies.

A short-list of suitable discharge transfer schemes for each case study catchment area was established. Some of these schemes exist in water company 'Water Resource Management Plans' (WRMPs) and are under consideration (defined as "Planned") or seen as viable options in the future "possible". Companies use WRMPs to outline their further plans for how they intend to balance the supply and demand for water. Typically the schemes that water companies invest in are chosen as least cost, but the environmental regulator would also ensure that they meet minimum regulatory standards on the environment.

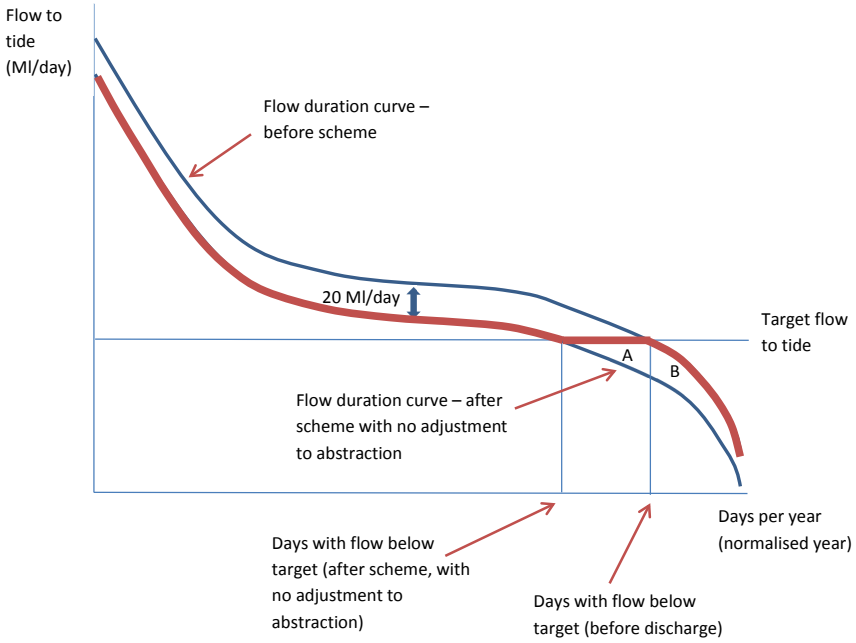
Water companies undertake considerable investigation to assess the commercial viability of such schemes including the impact / benefit on their businesses. Our case studies benefitted considerably from being schemes for which water companies had fully completed such investigations. Given the already considerable amount of work these investigations involved, there was limited further work and cost required to assess the actual impact of the change on flow levels.

Outputs from the Case Studies

- The cost of the discharge schemes to the water company and the incremental cost of implementing an alternative scheme or having to adjust the schemes operating regime. These costs are taken from a water company's WRMP or was submitted in confidence for the assessment.

- The proportion of a discharge scheme transfer that has an effect on water availability to third-party abstractors. This is done through analysis of historic river flow data and, in one case study, the use of a sophisticated hydrological model that accounts for a range of plausible further socio-economic scenarios for future water availability. (The diagram below illustrates how water availability can be affected both with and without a discharge transfer scheme in place.)

- The types of abstractors impacted (if any exist) and the values they place on the water and avoiding the reduction in availability. We use existing evidence produced for the Abstraction Reform Impact Assessment to help contribute to additional evidence from the case studies for assigning values to the value of water flows to third-party abstractors.



This diagram above shows the difference in flow curves that can occur: i. without a discharge transfer scheme in place (the blue line); and ii. with the scheme in place (the red line). It specifically relates to the analysis performed under case study 1 but the general principle is the same amongst all of the case studies.

i. *Case Study 1: The Anglian Water Flag Fen (re-use) scheme -* This scheme looked at the possible re-use of effluent from the 'Flag Fen' Sewage Treatment Works (STW) near Peterborough to top-up a water storage facility in Rutland, where otherwise the effluent would be returned back to the river from which it was sourced (albeit at a different location).

This scheme made use of analysis by the EA's local area hydrologists, in discussion between Anglian Water and Vivid Economics, to discover the effect of discharge diversions on abstractors. It was explored how the changes in flows might translate into changes in the patterns of allowed abstraction for those in the 'Middle Level' (the Middle Level Commissioners being a reliable abstractor and are situated between the abstraction and existing discharge location).

This scheme affected abstractors in a peculiar way: prior to the re-use scheme being implemented, the discharge outlet would return water at the lower reaches of the river, near the sea. Environmental protection dictates that there must be a minimum level of river flow to return to the see. With the scheme in place, in order to maintain this flow, abstractors above stream of the discharge outlet may see their abstraction volumes reduced.

The case study also showed the relative benefit (value) of the water and it had a greater benefit for farmers with high value crops.

ii. *Case Study 2: The Severn to Thames transfer (re-sale) scheme* - Thames Water is seeking a reliable injection of water during summer months and has identified, amongst a list of other schemes, a support transfer of water flows from the River Severn. The transfer may have knock-on consequences for abstractors in the River Trent. This case study benefited from the availability of an agent based catchment model developed for investigation of options for the reform of the water abstraction management system. It enabled the estimation of the effects in the Trent and Derwent catchment of a diversion of the discharge through sale to Thames Water. This work was undertaken in collaboration with Severn Trent Water and the Environment Agency.

iii. *Case study 3: Southern Water diversion (re-use) scheme on Arun and Western Rother* – This scheme included in Southern Water's 2014 WRMP looked at the possible transfer of

water from a small sewerage treatment works at Littlehampton to a point on the West Rother above an existing abstraction point. In discussion with Southern Water After further it became clear due to a number of reasons, including the small distance between the old and new discharge points, that there would be no significant effect on abstractors.

iv. *Case study 4: Southern Water diversion (re-use) scheme on the Medway* – This scheme also in Southern Water's 2014 WRMP involved transferring water upstream from a sewerage treatment works on the lower Medway River to a new discharge point at East Barming. While there are abstractors operating on the stretch of river that would have lower flows, the conclusion was that they would not face a material negative effect from the scheme. These conclusions were tested and agreed with Environment Agency and Southern Water.

The case studies indicate small adverse impacts on water availability for abstractors. Analysis of the Anglian and Severn Thames Transfer case studies indicates that the external costs the schemes imposed on abstractors are between **0.1% – 4.5%** of the total water company scheme costs. This shows that the scale of effects on third party abstractors is not hugely influential to determine decisions whether to proceed with the schemes, at least in an overall economic sense.

Limitations

The four case studies we have analysed represent 17% of the total population. Having collected information however on the total population of possible schemes we are confident that the case studies are broadly representative of the schemes under consideration, the impacts such schemes could have, and the abstractors that could be affected.

Of the case studies, two revealed outputs that feed directly into the Impact Assessment and we believe the two sets of estimates they produce for the value of water use for purposes of abstraction and also the percentage reduction in water availability to abstractors represent the possible maximum and minimum of the possible bounds.

The third and fourth case studies are also useful in that they illustrate that even where there is a discharge transfer scheme it may result in no impacts on abstractors.

This work has significantly strengthened the existing evidence base. We do not believe that additional case studies would add any different evidence or that the costs involved in undertaking additional case studies would be proportionate.

It is worth noting also that there is not a strong probability of the schemes covered in the two case studies being taken forward by the water companies concerned. The full operational or regulatory arrangements for the schemes have not been determined by either of the companies involved or the Environment Agency. Accordingly, it was necessary to make assumptions about how these schemes might be operated that may not fully reflect the commercial or operational intentions of the companies involved, or the potential effects of environmental regulation.

Annex C: Administration Costs

This Annex provides background to the assessment of the administrative costs associated with each of the four proposed options for the management of changes to discharges. These administration costs are applicable to the three parties involved: Water Companies; the Regulator (Environment Agency) and the abstractors. The process for computing the administration costs is as follows:

Stage 1 First, we identified all relevant administration cost categories for each of the three parties involved and to which of the Options they are applicable. This is shown in **Table C.1**.

Stage 2 Next we assigned values to each of the administrative tasks that were identified. This was done in consultation with the Environment Agency and Water Companies. Most of the administration costs applicable to each of the parties are then measured in terms of the amount of *time* spent performing each task valued at a Full-Time-Equivalent wage rate. Where a particular party has to employ specialist help, such as employing legal or technical modelling advice, this was measured as the total cost of contracting the service.[32]

Stage 3 The costs estimates are varied depending on the complexity of the scheme they apply to. The more complex a scheme, the higher its associated administrative costs.[33] A method for allocating schemes to a level of complexity is created from the results of the water company survey.

Stage 4 Cost estimates are also adjusted for the probability that one of the impacted parties might launch an appeal, thus potentially imposing extra administrative cost for those involved. The final estimates are shown in **Table C.6**.

A high-level description of the administrative stages each party would undertake for Options 1 – 4 are provided in **Table C.1** below.

[32] In discussion with the Environment Agency, Vivid Economics and Water Companies, it was felt that a Full Time Equivalent wage rate for Environment Agency and Water Company staff time would be around £66,000 per annum, while an average annual wage rate of around £23,058 was derived from ONS earnings data for abstractors. One FTE workload represents around 45 weeks of work. This is discussed further in Annex C.

[33] Complexity is measured in terms of the degree of assessment involved to the parties in understanding the effect of changes to discharges on abstractors.

Table C.1: Breakdown of Administrative Costs for each Option by party involved

Party	Assessment stage	Activities to be undertaken	Option 1	Option 2	Option 3	Option 4
Water Companies	Initial	Staff time for preliminary assessment of materiality of effects and opportunities to mitigate. Staff time for incorporation of outputs into project costing for future plans.	-	✓	✓	✓
		Detailed hydrological and economic modelling of preferred operational arrangement to assess effects	-	✓	✓	-
		Agreement on and administration of compensation payments to affected parties	-	-	✓	-
		Basic hydrological and economic modelling of preferred operational arrangement to inform discharge management agreement	-	-	-	✓
		Collaborative development of a discharge management arrangement with regulator	-	-	-	✓
		Notification of change to discharge	✓	-	-	-
	Appeal	Staff time to make administrative appeal if assessment rejected by EA, or to respond to appeal by abstractors.	-	✓	✓	✓
		Legal and/or hydrological or economic analysis to support initial assessment of impact in appeal.	-	✓	✓	-
		Legal and/or hydrological or economic analysis to establish that discharge management agreement is adequate	-	-	-	✓
Environment Agency	Initial	Ensuring assessment complies with guidance and sign-off	-	✓	✓	-
		Ensure discharge management agreement established in accordance with requirements for watercourse	-	-	-	✓
		Ensure that notification of change to discharge adequately meets requirements	✓	-	-	-
	Appeal	Support decision and provide advice in appeal process heard through Secretary of State or planning inspectorate.	-	✓	✓	✓
Abstractors	Initial	Stakeholder participation in development of the cost-benefit assessment. Company, private or industry association time to make high-level review of assessment and EA decision to determine whether to appeal. High level hydrological-economic analysis in to assess merits of initial assessment.	-	✓	✓	-
		Agreement on and administration of compensation payments to affected parties	-	-	✓	-
		Company, private or industry association time to make high-level review of discharge management agreement	-	-	-	✓
	Appeal	Company, private or industry association time to support administrative appeal.	-	✓	✓	✓
		Legal and/or hydrological or economic analysis in appeal.	-	✓	✓	-
		Legal and/or hydrological or economic analysis challenge elements of the discharge management agreement	-	-	-	✓

Differentiating between water schemes with varying levels of complexity

The observations above set out the logic of the relative ordering of costs between policy options. We also differentiate the administration cost associated with a transfer scheme to depend on how large and complex it is. The 39 surveyed schemes are separated out into four levels of complexity. This separation was done with advice from water companies and Vivid Economics.

Water quality focused schemes were felt to be the least complex in administrative terms. This is in part because they tend to be smaller in terms of capacity and also because their operating regimes are relatively simple, typically involving permanent closure of small sewage works. It is also because schemes of this type will generally be driven by requirements of, and assessments made under, the Water Quality Standards Directive and/or Water Framework Directive. These assessments will have involved both hydrological analysis and economic assessment of the relative costs of upgrading or consolidating sewage treatment works. Accordingly the incremental level of effort associated with these schemes is assumed to be low, consistent with that of the least complex of the non-water quality schemes.

Non-water quality schemes however are assumed to increase in complexity in line with scheme size, reflecting that larger schemes are more likely to affect more abstractors. Schemes that discharge to surface waters are also assumed to be more complex to assess than those that discharge to the tide or sea, as they are more likely to have effects on abstractors.

Table C.2: Categorisation of Scheme Complexity and number of surveyed schemes

Category	Description of schemes included in category	All schemes	Planned schemes	Possible schemes
1 (less complex)	All water quality schemes All schemes of less than 2 Ml/d capacity Schemes of 2 to 10 Ml/d capacity that discharge to the tide or sea	16	11	5
2	Schemes of 2 to 10 Ml/d capacity that discharge to surface waters Schemes of 10 to 50 Ml/d capacity that discharge to the tide or sea	12	4	8
3	Schemes of 10 to 50 Ml/d capacity that discharge to surface waters Schemes of more than 50 Ml/d capacity that discharge to the tide or sea	9	4	5
4 (most complex)	Schemes of more than 50 Ml/d capacity that discharge to surface waters	2	0	2

Source: Vivid Economics

Estimates of administrative inputs and costs of advice

Here we consider the direct staff time associated with each option as well as (in the case of abstractors) the time of self-employed parties such as farmers and of industry associations. It also sets out assessments of costs of specialist advice sought as part of the assessment process, including legal advice, hydrological modelling and economic modelling. The internal cost estimates for the three parties involved are based on the amount of time spent on each appeal for a worker paid at a Full Time Equivalent (FTE) salary; while the costs for seeking specialist help (e.g. with hydrological modelling) have been estimated directly.

A full-time equivalent (FTE) cost was assumed to be **£66,000 per annum for the Environment Agency and for Water Companies** and that one FTE workload was assumed to represent 45 weeks. This figure is the total annual regulator cost for a G4 Permitting Officer. It would be at this level that the evaluation of water company assessments, the agreement of mitigating actions and appeal sanctions would largely be dealt with. It includes all salary and other costs such as National Insurance, pensions, and Human Resources. Following discussion with water companies on their administration costs, this figure was assessed as being an appropriate evaluation of cost that takes into account the mix of junior and senior staff that might be involved in any assessment.

An average annual wage rate of **£23,058 was assumed for abstractors**. The size and type of abstractors benefitting from discharges may be varied. The detailed water company survey on

discharge schemes did not provide an exhaustive picture of the type of abstractors. Instead we have taken gross annual pay data for each abstraction-sector that is represented at the national level (excluding abstractions relating to public water supply) and formed an average by weighting these figures by the size of each sector in terms of the proportion of abstraction licences held nationally by the sectors. This is shown in Table C.3 below:

Table C.3: Abstraction licences by sector in England and Wales 2011

Sector	Licences held within England & Wales		Assumed Annual Wage Rate (£ 2014)	ONS 'SIC' category
	Number	*%*		
Electricity (including thermal and hydropower)	519	2.6%	40,828	*D - "Electricity, Gas, Steam and Air Conditioning Supply"*
Private Water Supply	1,031	5.2%	32,733	*36 - "Water Collection, Treatment and Supply"*
Other Industry	3,896	19.8%	31,738	*B-F Avg. - "Index of Production Industries"*
Fish Farming, Cress Growing and Amenity Ponds	685	3.5%	23,296	*3 - "Fishing and Aquacultre"*
Spray irrigation	10,330	52.5%	19,000	*1 - "Crop and animal production, hunting and related service activities"*
Agriculture (excl. spray irrigation)	2,992	15.2%	19,000	*1 - "Crop and animal production, hunting and related service activities"*
Other	210	1.1%	27,271	*ALL - All Employees/ Nat Avg.*
Total	**19,663**	**100.0%**	**23,058**	

Note: Total wage rate is an average weighted by the volume of licences held by each abstraction sector excluding public water supply (i.e. water companies).
Source: Environment Agency, ONS Annual Survey of Hours and Earnings 2014 (provisional). Totals may not sum due to rounding.

Environment Agency, Water Company and Abstractor time: The Environment Agency provided estimates of their staffing cost across the four levels of complexity and the four policy options. These resourcing estimates were based on internal consultation within the EA with staff involved in similar administrative assessments. Whereas the internal abstractor and water company costs were produced separately by Vivid Economics through discussion with water companies. All costs are expressed as weeks of staff time per scheme or per appeal.

Table C.4: Costs by policy option and scheme type (£1,000s per scheme)

Policy option	Party Impacted	Cost Element	1 (least complex category)	2	3	4 (most complex category)
Option 1 (Notification)	Water Companies	*Initial internal assessment*	2.9	5.9	11.7	17.6
		Appeals – internal administration	0.0	0.0	0.0	0.0
Option 2 (Cost Benefit Analysis)	EA	*Assessing application and sign off*	2.9	5.9	11.7	17.6
		Appeals	1.5	11.7	23.5	35.2
	Water Companies	*Initial internal assessment*	11.7	23.5	35.2	46.9
		Appeals – internal administration	11.7	14.7	17.6	20.5
		Consultation & initial internal assessment	4.1	8.2	12.3	16.4
	Abstractors	*Appeals – internal administration*	6.1	12.3	18.4	24.6
Option 3 (Compensation)	EA	*Assessing application and sign off*	4.4	8.8	17.6	29.3
		Appeals	2.9	17.6	35.2	58.7

	Water Companies	*Initial internal assessment*	17.6	35.2	52.8	70.4
		Appeals – internal administration	11.7	14.7	17.6	20.5
	Abstractors	*Consultation & initial internal assessment*	4.1	8.2	12.3	16.4
		Appeals – internal administration	8.2	16.4	24.6	32.8
Option 4 (Discharge Management)	EA	*Assessing application and sign off*	4.4	7.3	14.7	22.0
		Appeals	2.9	17.6	35.2	52.8
	Water Companies	*Initial internal assessment*	17.6	35.2	52.8	70.4
		Appeals – internal administration	2.9	5.9	8.8	11.7
	Abstractors	*Initial internal assessment*	1.0	2.0	4.1	6.1
		Appeals – internal administration	4.1	8.2	12.3	16.4

Source: Vivid Economics

Notes:The EA has advised that administrative costs associated with Option 1 (notification) can be absorbed within existing activities; It is unlikely that stakeholders will appeal on the grounds of non-notification, and so appeal costs are assumed to be zero for Option 1

Expertise – Legal help and/or Hydrological and Economic Modelling: These costs are not estimated as a number of weeks, but as a direct service cost associated with purchased advice by the respective parties. These are summarised in the table below

Table C.5: Advice costs by policy option and scheme type (£1,000s per scheme)

Policy option	Party Impacted	Cost Element	1 (least complex category)	2	3	4 (most complex category)
Option 2 (Cost Benefit Analysis)	Water Companies	Initial assessment – modelling	£25	£50	£100	£200
		Appeals – modelling and legal	£25	£50	£75	£100
	Abstractors	Initial assessment – modelling	£20	£30	£40	£50
		Appeals – modelling and legal	£25	£50	£75	£100
Option 3 (Compensation)	Water Companies	Initial assessment – modelling	£25	£50	£100	£200
		Appeals – modelling and legal	£25	£50	£75	£100
	Abstractors	Initial assessment – modelling	£20	£30	£40	£50
		Appeals – modelling and legal	£25	£50	£75	£100
Option 4 (Discharge Management)	Water Companies	Initial assessment – modelling	£10	£20	£40	£80
		Appeals – modelling and legal	£15	£30	£60	£90
	Abstractors	Initial assessment – modelling	£10	£15	£20	£30
		Appeals – modelling and legal	£15	£30	£60	£90

Source: Vivid Economics

Producing aggregate cost estimates

The final stage involves adjusting the cost estimates for the probability of an appeal being launched. It was anticipated that the probability of an appeal under Option 3 will be higher than under Option 2 and Option 4 because of the direct opportunity for monetary gain through compensation. As the costs of an appeal are somewhat fixed while the potential benefits of an appeal will increase dramatically for larger schemes with greater impacts on water flows, we expect that appeals will occur more frequently for larger and more complex schemes than for smaller or less complex schemes. Reflecting this, the assumed probabilities of appeal are set out below:

Table C.6: Probability of an appeal

	Scale of scheme complexity	
	1	4
Policy option	(least complex)	(most complex)

Option 1	0%	0%	0%	0%
Option 2	20%	30%	40%	50%
Option 3	40%	50%	60%	70%
Option 4	20%	30%	40%	50%

Source: Vivid Economics

Combining the assumptions, the total administrative costs for the parties involved covering all of the surveyed schemes are shown below:

Table C.7: Total Average Administrative costs per scheme by policy option (£thousands)

Policy option	All schemes	Water Company	The Regulator	Abstractors
Option 0	£0	£0	£0	£0
Option 1	£7	£7	£0	£0
Option 2	£192	£102	£11	£57
Option 3	£248	£126	£20	£71
Option 4	£127	£71	£15	£32

Note: These figures are not the final NPV figures used in the final assessment; the administrative costs in this table have not been adjusted for the probability of a scheme occurring, or for the timing of their occurrence.

Annex D: Water Company Survey

The water companies across England and Wales were surveyed to assess the prevalence of current, planned and potential discharge transfer schemes ('schemes') that would change discharges from sewage treatment works. Twenty-two out of the twenty-three companies in England and Wales responded to the survey. Respondents provided details of:

- The objective of the scheme to adjust their discharge patterns;
- The capacity of the change in discharge in mega litres per day (Ml/d);
- The operating regime, such as whether it is continuous, seasonal or occasional;
- The effects the scheme would have on surface water flows; and
- What effects it might have on third-party abstractors.

Table 4.4: Composition of Water Company Survey responses

	Total
Total responses	22/23
Survey coverage	96%
Number of Schemes identified	39

The survey was principally used to:

i. Estimate the size and scale of schemes; and

ii. Calculate what impact in terms of reduced access to water flows fed through to third-party abstractors (the "effective" capacity of schemes)

i. The size and scale of schemes

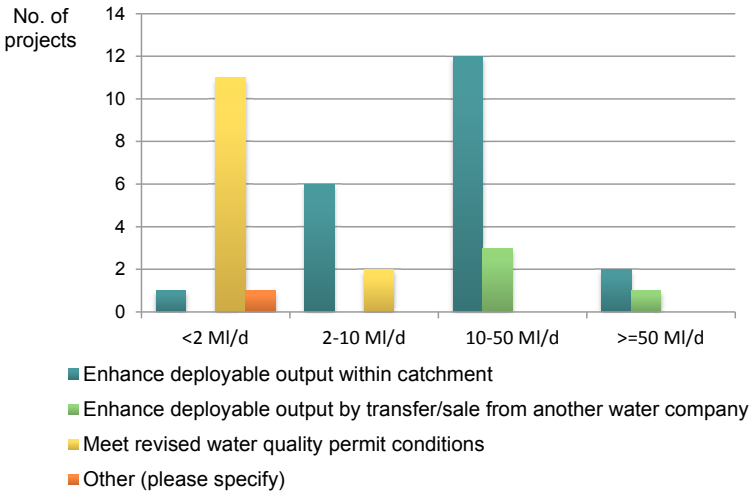
There are 39 schemes in various stages of planning that would involve changes to discharges. All schemes were in England with none being planned in Wales. Of the 39, only 24 (62%) were found to have a potential effect on abstractors.

Discharge schemes vary greatly in scale and most are small. The survey showed that water companies use small schemes to to move effluent to larger treatment works, thus increasing the scale of more advanced treatment and at the same time reducing the costs of meeting water quality obligations.

The larger schemes have a different objective: they move water resources around to increase usable supply ("deployable output").

This pattern in the results is shown in the figure below. The objective of the majority of the changes is to enhance deployable output.

Figure 4.2: Distribution of Scheme Type by capacity (Ml of discharge re-deployed per day)



Over 40 percent of the total capacity is scheduled in the next five years. The schemes are split into whether they are 'planned' or whether they are 'possible'. This separation of schemes is carried through the analysis.

Table 4.5: Likelihood of surveyed schemes going ahead

	Planned Schemes			Possible Schemes			All schemes	
Variable	Number of schemes	Capacity (Ml/d)	Proportion of total capacity	Number of schemes	Capacity (Ml/d)	Proportion of total capacity	Number of schemes	Capacity (Ml/d)
Enhance deployable output within company area	6	204	34%	15	228	38%	21	432
Enhance deployable output through purchase from another company	2	38	6%	2	108	18%	4	146
Meet water quality permit conditions	11	13	2%	2	2	0%	13	15
Other	0	0	0%	1	1	0%	1	1
Total	**19**	**255**	**43%**	**20**	**339**	**57%**	**39**	**594**

Note: Totals may not sum due to rounding

ii. Translating the survey results into effects on abstraction

The headline capacity of the proposed schemes will not directly feed through one-for-one to impacts on third-party abstractors.

There are several factors which can modify the effects of discharges on abstractions. These factors must be taken into account when assessing the potential economic impacts of changes to discharges:

i. The scheme might reduce flows in surface waters but 'hands off flow' conditions may not be binding, and therefore there may be no reduction in abstraction;
ii. the scheme may not operate year round and so its total effect on flows may be reduced;
iii. the scheme may not operate in all years, also reducing its total effect on flows;
iv. the scheme may not be implemented, in which case it would have no effect on flows;
v. the scheme might only decrease flows to the sea or to tide, in which case the prospect of effects on freshwater abstraction is lower; and

vi. The scheme might reduce flows in a segment of river with very limited abstraction.

We have already established information on the first factor: the case studies were analysed to estimate the relationship between reductions in flows and reductions in abstractions (factor i.).This factor is implicit in the unit cost (£/m3) that are output from the case studies and is introduced on the monetisation side of costing the impacts.

The survey is able to inform the remaining five parameters. Notably, we were able to establish suitable parameters surrounding the operating regime (factor ii.) from the survey through interpretation on a scheme by scheme basis using the number of months of operation specified by the water company – the factor is built up of the weighted average of the responses.

The combined application of these factors gives the expected impact of each scheme to give an effective impact on abstraction. i.e.

The effective impact on abstraction (Ml/day) =

Headline impact (Ml/day) *x* factor ii *x* factor iii *x* …… *x* factor vi.

To account for the uncertainties in the scheme impacts and limitations on data available for them, low and high estimates were generated alongside a best estimate.

Table 4.6: Lower and upper bounds on factors that influence impact to abstractors

Factor	Layer	Conditional Scheme Assumption	Central parameter	High parameter	Low parameter
Factor ii.	Frequency of operation	Within year operation	0.68	0.68	0.68
Factor iii.	Frequency of operation	Every year	1	1	1
	Frequency of operation	Dry years only	0.4	0.5	0.3
	Frequency of operation	Drought conditions only	0.2	0.3	0.1
Factor iv.	Planning status	Planned	0.8	1	0.6
	Planning status	Possible	0.4	0.6	0.2
Factor v.	Effect on flows	Increase only	0	0	0
	Effect on flows	Decreases in surface water in part of the catchment	1	1	1
	Effect on flows	Decreases in flows to tide or the sea	0.4	0.6	0.2
	Effect on flows	None	0.2	0.4	0
Factor vi.	Effect on abstractors	Yes	1	1	0.8
	Effect on abstractors	No	0.1	0.2	0
	Effect on abstractors	Not aware	0.75	1	0.5

The cumulative effect of each of the factors is shown in the table below. The first two factors, which address the timing of operation within years and across years, account for a 56 per cent reduction in capacity on a continuous equivalent basis. Location factors, namely the position of the scheme (relative to fresh waters or the sea) and presence or absence of abstractors, account for a further 71 per cent reduction. Likelihood of the scheme contributes to the balance of 41%.

Overall, the headline capacity is reduced by 93 per cent, which means that the total volume which might affect abstractors is only 7 per cent of the headline capacity if the schemes were run continuously in every year. Abstractors will experience reductions in allowed abstraction which is a fraction of that 7 per cent figure, according to the flow conditions in the river.

Table 4.7: Transmitting scheme headline capacity to potential effect on abstractors, effective Ml/day Best Estimate

	Effective Impact on Abstractors of cumulating factors (Ml of flow per day)

Scheme Type	Headline capacity	Allowing for part-year operation	Allowing for years not in operation	Allowing for planning status	Allowing for location of flows	Allowing for absence of abstractors
Enhance deployable output within company area	432	329	196	111	68	37
Enhance deployable output through purchase from another company	146	58	32	14	9	77
Meet water quality permit conditions	15	15	15	11	10	3
Other	1	1	1	0	0	0
Total	**594**	**403**	**244**	**137**	**87**	**47**

The next table shows similar figures using the central, high and low estimates using the factors set out above. The range of final capacity estimates reflect the substantial uncertainty in how many schemes there will be, where they will be, and how they will operate. To allow for the fact that planned schemes are more likely to occur earlier than possible schemes, we also estimated the effective capacities of planned schemes and possible schemes separately.

Table 4.7: Effective Impact on Abstractors – Upper and lower bounds

		Effective Impact on Abstractors of cumulating factors (Ml of flow per day)					
Sensitivity	Scheme planning status	Headline capacity	Allowing for part-year operation	Allowing for years not in operation	Allowing for planning status	Allowing for location of flows	Allowing for absence of abstractors
High estimate	All	594	403	270	207	158	107
	Planned only				113	72	28
	Possible only				94	86	79
Central estimate	All	594	403	244	137	88	47
	Planned only				79	38	10
	Possible only				58	50	37
Low estimate	All	594	403	218	78	38	13
	Planned only				51	16	2
	Possible only				27	22	12

Again, the implication of each of the factors on our headline capacity is split out in the table; as we move from left to right we see the cumulative effect of applying each factor until, on the right side of the table, we reach what is the effective impact on third-party abstractors in terms of mega litres of lost access to water per day.