

Title: Removing water abstraction licence exemptions IA No: DEFRA0046 RPC Reference No: RPC-3028(2)-DEFRA 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 (IA)			
	Date: 07/06/2017			
	Stage: Final			
	Source of intervention: EU			
	Type of measure: Secondary legislation			
Contact for enquiries: Adrian Brookes Adrian.Brookes@defra.gsi.gov.uk				
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 (EANDCB in 2014 prices)	One-In, Three-Out	Business Impact Target Status
£-59.01m	£-57.62m	£3.0m	Not in scope	Non qualifying provision

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

Many areas of the country are experiencing water stress as a result of competing demand for the available water for human uses and flora and fauna in the environment. Population growth and climate change are expected to increase that pressure. Abstraction is the process of extracting water from a source. An abstraction licensing regime has been in place for several decades but abstraction for a number of purposes has remained outside licensing control, allowing some users to take water irrespective of the needs of other users or the environment. The Water Act 2003 was passed with provisions to end these exemptions by awarding them "New Authorisations" to enable effective management of water resources.

What are the policy objectives and the intended effects?

(1) To enable better management of water resources: that is consistent and fair for all water users, to tackle serious environmental damage caused by unlicensed abstractions and it is an important part of our plans to reform abstraction management;

(2) To extend the licensing regime in a way that is cost effective and equitable;

(3) To meet statutory obligations under the EU Water Framework Directive.

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

Option 0: Business as Usual: do not bring exempt abstractors into licensing but rely on existing regulations on environmental protection to improve management of over-abstracted water bodies.

Option 1: Commence new authorisations without the inclusion of a transitional arrangement;

Option 2: Commence new authorisations with the inclusion of a transitional period for pre-existing abstractions;

Option 2 is our final preferred option as it treats exempt abstractions on an equal footing with those already licensed and gives a reasonable transitional period for applications for new licences to be prepared, submitted and processed and for new licensees to adapt. While this option delays benefits to other abstractors and the environment, this option achieves a fair balance with the costs to new authorisation abstractors by including a reasonable implementation timeframe.

Will the policy be reviewed? It will be reviewed. If applicable, set review date: 01/2025						
Does implementation go beyond minimum EU requirements?			No			
Are any of these organisations in scope?			Micro Yes	Small Yes	Medium Yes	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 (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) that the benefits justify the costs.

Signed by the responsible Minister: Thérèse Coffey **Date:** 30.10.17

Summary: Analysis & Evidence

Policy Option 1

Description: Commence the licensing requirement for currently exempt abstractions with no transitional period

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2018	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: -218.94	High: -43.17	Best Estimate: -74.27

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0.1	2.8	63.1
High	26.9	8.6	229.7
Best Estimate	1.9	3.8	89.6

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

Compliance and administration costs for licensing (total all sectors £19.1m) and loss of output (total all sectors £70.5m) for currently unlicensed water users in the following sectors: quarries and mines £36.3m; trickle irrigation farming £33.9m; canals £6.3m; ports £0.6m; water meadows £6.1; drainage boards £0.8m; road and rail £0.8m; Royal Parks and MoD £2.4m; exempt geographical areas £2.5m. All figures in present value terms. Most lost output is due to restricting abstraction causing serious environmental damage.

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

No transitional arrangements may limit applicants' time to adapt their businesses, leading to less than optimal responses, however the policy has been expected since 2003. Small indirect costs via supply chain links, e.g. canal boat operators; cement works. Possible logistical problems – significant difficulty for the regulators to assess all licence applications within the usual determination period.

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0	0.5	10.7
High	0	0.9	19.9
Best Estimate	0	0.7	15.3

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

As trickle irrigators are brought into the licensing system, this "levels the playing field" for existing licensed abstractors in agriculture and horticulture. At times of high demand, the restrictions on trickle irrigators will increase the volume of water available for existing abstractors leading to a monetised benefit estimated at £15.3m (in present value terms). It has not been possible to monetise other more important benefits (see below).

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

Environmental benefit through preventing damage to the ecosystem by over-abstraction especially in key dry periods when these benefits would be substantial.
Levelling the playing field through reducing unfairness arising from over consumption by exempt abstractors will also benefit other categories of non-agricultural abstractors in drought periods, including water companies abstracting for household and business supplies.

Key assumptions/sensitivities/risks	Discount rate (%)	3.5
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There is no transitional period available to those seeking new authorisations. Abstractors take up cost effective/feasible mitigation options when faced with restrictions to their abstraction activities providing they are cost-beneficial. Regulator does not licence abstraction causing serious environmental damage or when river flows are very low.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m:
Costs: 4.5	Benefits: 0.8	Net: -3.7	
			N/A

Summary: Analysis & Evidence

Policy Option 2

Description: Commence the licensing requirement with two years for transitional arrangements

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2018	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: -174.61	High: -33.92	Best Estimate: -59.01

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0.1	2.2	50.1
High	26.9	6.6	183.3
Best Estimate	1.9	3.1	71.4

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

The transitional period that allows for a further two years of exempt abstraction and so defers the impacts. Compliance and administration costs for licensing (total all sectors £15.7m) and loss of output (total all sectors £55.7m) for currently unlicensed water users in the following sectors: quarries and mines £29.3m; trickle irrigation farming £26.5m; canals £4.9m; ports £0.4m; water meadows £5.2; drainage boards £0.6m; road and rail £0.6m; Royal Parks and MoD £1.9m; exempt geographical areas £2.1m.

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

As for Option 1, although the transitional period would ease logistical problems for the regulator and allow more optimal adjustments for newly licensed abstractors.

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0	0.4	8.7
High	0	0.8	16.1
Best Estimate	0	0.6	12.4

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

As for Option 1, additional water available to existing licensed abstractors in agriculture and horticulture leading to additional crop output. It has not been possible to monetise other more important benefits (see below).

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

As for Option 1, benefits from preventing environmental damage and avoiding/reducing restrictions to other licensed abstractors in dry periods. As with business costs, benefits to other abstractors and the environment would be deferred and therefore lower than in Option 1.

Key assumptions/sensitivities/risks

Similar to Option 1.

Discount rate (%) 3.5

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m:
Costs: 3.7	Benefits: 0.9	Net: -2.8	
			N/A

Evidence Base (for summary sheets)

Contents

1. Overview	5
2. Policy background	7
3. Objectives.....	12
4. Rationale for Intervention	13
5. Options Appraisal	15
6. Options Assessment.....	23
7. Conclusion.....	43
8. One-In, Three Out	44
Annex A: Policy Background.....	46
Annex B: Profile of Currently Exempt Abstractors	47
Annex C: Agent Based Modelling	51
Annex D: Top-Down Assessment	52
Annex E: Compliance and Administration Costs.....	53
Annex F: England and Wales Impact Disaggregation	54

1. Overview

- 1.1. This Impact Assessment (IA) presents an appraisal of the lead options for implementing the provisions of the Water Act 2003 to widen water abstraction licensing to cover currently unlicensed water abstraction activities within England and Wales. Implementing these provisions will meet an EU requirement. This policy is known as “New Authorisations”. The IA provides the analytical justification for our approach¹.
- 1.2. Currently around 5,000 significant abstractions are exempt from abstraction licensing. This compares with around 20,000 abstractors that are licensed. These exemptions create an unfair playing field, allowing some abstractors to put pressure on the environment without any controls, while requiring others to take the burden of addressing risks to the environment. This unfairness can be strongly felt, for example, farmers that use spray irrigation are required to have an abstraction licence while those that use trickle irrigation are not.
- 1.3. We would remove exemptions for abstractions that can have significant impacts on the environment by commencing remaining provisions from the Water Act 2003. Several thousands of abstractions that have insignificant environmental costs will remain exempt. Doing so meets a Water Framework Directive (WFD) requirement. This policy is also an important part of our plan to reform abstraction management.
- 1.4. Our policy is to take a light touch approach to licensing. This means:
 - Only removing exemptions for water use activities that have or might have significant environmental impacts. Types of abstraction where licensing cost are disproportionate to the environmental benefits will remain exempt.
 - Most abstractors would be granted licences reflecting the volumes they have previously abstracted. Licences may include conditions to protect rivers at very low flows.
 - A reasonable five-year transitional period from the date we end the exemptions. Abstractors would have two years to prepare and submit applications. The regulator would have up to three years to consider, determine and grant the licence. Abstractors can continue to take water during this period.²
- 1.5. Our policy for implementation will enable almost all abstractors to operate as they do currently, unless the environmental impact of the abstraction is causing serious environmental damage or abstraction is taking place when river flows are very low.
- 1.6. As a result of feedback in the 2016 consultation, we plan to improve the regulatory approach further in places, including:
 - Allowing abstractors to provide additional evidence of previous abstraction during the dry period in 2011 so licensed volumes reflect dry weather needs; and
 - Removing most monitoring and reporting requirements for licences required for water transfers, where there is no intervening use of the water.
- 1.7. This impact assessment uses two pieces of analysis that Defra commissioned to provide key evidence for this appraisal. The analysis collates existing data from a variety of sources and gathered new information through interviews with representatives of the abstractors. This analysis is supplemented by further discussions with abstractors and the evidence provided in the 2009 and

¹ The Water Act 2003 IA “Water Bill-Regulatory Impact Assessment, Environmental and Equal Treatment Appraisals’ provided an initial assessment of the impact of the proposal for debate of the WA2003 in Parliament. This latest IA updates that earlier IA.

² We have balanced the length of transitional period and related costs to exempt abstractors of licensing with the delayed benefits to other abstractors and the environment.

2016 consultation responses, more detailed evidence from the regulator and the improvements to the policy.

- 1.8. The estimated monetised costs of our final preferred option are £71 million Net Present Value (NPV) of which around 20% is due to the administration and compliance costs of licensing, while 80% is due to impact on economic output mainly due to abstraction restrictions to prevent serious environmental damage. Monetised benefits to existing licensed abstractors from levelling the playing field for water resources access are around £18 million NPV. We expect there to be further non-monetised benefits to other abstractors (existing licensed abstractors and insignificant abstractors who will remain exempt). There will also be important non-monetised environmental benefits associated with reducing over-abstraction of water, a problem likely to grow given the increasing pressures from climate change and population growth, particularly when it is dry or there is a drought.

2. Policy background

The Problem under Consideration

- 2.1. Water is a precious resource for many human uses (public water supply, agriculture, energy production, business or industrial processes, amenity and leisure) and for flora and fauna in the environment. Areas of England and Wales are already experiencing water stress as a result of competing demands for access to the water available. Increasing demand for water by those outside of the current regulatory framework for licensing that water is exacerbating these pressures. Climate change along with population and economic growth is expected to increase that pressure further.
- 2.2. Water abstraction is the process of taking water from the environment (e.g. river or groundwater). Some existing water abstractions, both licensed and unlicensed, are having a damaging effect on the environment.
- 2.3. An abstraction licensing system to regulate water abstraction has been in place since the 1960s. The system is operated in England by Environment Agency and in Wales by Natural Resources Wales (both referred to as “the regulator”).
- 2.4. However, abstraction for a number of purposes has remained outside licensing. These have historically been considered low risk activities, but the risk assessment for many of these activities has now increased. Exemptions also create an unfair playing field, as they allow some groups to take water irrespective of the needs of other users or the environment, while those that are currently licensed take the burden of addressing risks to the environment. For example, farmers that use spray irrigation are required to have an abstraction licence, to have a limit on the amount of water they can take, to pay for the water they take and to reduce their water use at specific times of pressures on the environment, while none of these conditions applies to those that use trickle irrigation and they can also increase their abstractions.
- 2.5. Alongside the development of the policy that became the Water Act 2003, the Water Framework Directive (WFD) was also set up in 2000 to manage water resources. The WFD requires each Member State to have in place a programme of measures designed to deliver “Good” water body status. One of the basic requirements to help deliver “Good” status is to have in place a system of prior authorisation and control of water abstraction and impoundments. The Water Act 2003 included the provisions to remove remaining licensing exemptions in England and Wales and help us meet this requirement. Annex A contains further background about the development of the Water Act 2003 and the Water Framework Directive requirements.
- 2.6. On 23 June 2016, the EU referendum took place and the people of the United Kingdom voted to leave the European Union. Until exit negotiations are concluded, the UK remains a full member of the European Union and all the rights and obligations of EU membership remain in force. During this period the Government will continue to negotiate, implement and apply EU legislation. The outcome of these negotiations will determine what arrangements apply in relation to EU legislation in future once the UK has left the EU.
- 2.7. In 2016³ and 2009⁴ we consulted on bringing these exempt abstractors under licensing control. There has also been ongoing dialogue with stakeholders and the regulator about the balance of rights and responsibilities for creating a sustainable water abstraction licensing regime.

³ <https://www.gov.uk/government/consultations/water-abstraction-licensing-changes-to-exemptions-in-england-and-wales>

2.8. Both Governments consulted in December 2013 on reform of the water abstraction licensing system. Their respective responses to the consultation were published in January 2016⁵ ⁶. In particular supporting abstractors to manage the risks from future pressure on water. If the currently exempt abstractors (approximately 20% of all those abstracting) were to remain outside of licensing control and continued to abstract without regard to other licensed abstractors or the environment, we would not be able to maximise the available water and the possible financial benefits available.⁷ The impact of further reform is outside the scope of this IA.

The Current Abstraction Licensing System

2.9. Water abstraction licensing in England and Wales has developed over many decades. The first licences were granted in the 1960s. They were issued without regard to the environment, sharing out the water in a catchment amongst those that wanted to use it, effectively in perpetuity. They also gave abstractors compensation rights against derogation of the licensed water. This results in restricted access to water for new abstractors in stressed catchments, even if the existing licences are now unused or under used. Over recent years the licensing system has evolved where possible to take more regard of the environment and provide greater protection. This has also sought to ensure water use is efficient and adequately valued to reflect water scarcity and competing demands.

2.10. The current licensing system uses a range of tools to help maintain environmental protection and the rights of downstream abstractors. These may include both daily and annual abstraction limits. Water abstraction licences for rivers issued since 2003 also incorporate 'Hands-off-Flow' (HoF) restrictions, whereby, upon notice, all licensed abstractors with a HoF within a given catchment must stop abstracting when the river flow drops below a defined threshold. A similar condition applies to groundwater abstraction that instead refers to the levels of water - a 'Hands-off-Level' condition.

2.11. There are three types of abstraction licence:

- a full licence for abstractions lasting more than 28 days;
- a temporary licence for abstractions lasting less than 28 days; and
- a transfer licence where water is abstracted for more than 28 days to be moved from one source to another with no intervening use for example where a water company moves water to another company to abstract for the public water supply.

2.12. A transfer licence has a higher up front cost to the abstractor but has no annual charge from the regulator and usually has little or no abstraction volume reporting conditions. Most (>95%) existing licences are full licences. This will be different for New Authorisations because of the type of activity being licensed. We estimate that overall about 80 per cent of New Authorisations in England will require a transfer licence, however in Wales we expect most will be full licences (75-80%).

2.13. All licence holders pay a licence application fee and associated costs for example advertising or environmental reports. Full licence holders also pay an annual charge.

⁴ <http://webarchive.nationalarchives.gov.uk/20091205011114/http://www.defra.gov.uk/corporate/consult/water-act/index.htm>

⁵ <https://consult.defra.gov.uk/water/abstraction-reform>

⁶ <http://gov.wales/betaconsultations/environmentandcountryside/making-the-most-of-every-drop/?lang=en>

⁷ The case for reforming the abstraction system was originally set out in the Water White Paper – Water for Life: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228861/8230.pdf

2.14. Full and transfer licences have been issued on a time limited basis as a matter of policy since 2001, and as a legal requirement since 2003, typically for 12 years after which renewal is required. If a licensed abstractor requires more water it applies to the regulator for a new licence or to vary the terms of an existing licence.

Table 1.1: Number of Abstraction Licences in force by type in England & Wales as at 2014

	Public water supply	Spray irrigation	Agriculture (excl. spray irrigation)	Electricity supply industry	Other industry	Fish farming, cress growing, amenity ponds	Private water supply	Other	Total
Wales	160	583	168	253	334	49	50	9	1606
England	1425	9484	2745	476	3368	591	973	192	19254
England & Wales	1585	10067	2913	729	3702	640	1023	201	20860

Source: Environment Agency / Natural Resources Wales 2014

Approach to removing exemptions

2.15. The approach to removing abstraction exemptions will be light-touch and risk-based, taking account of responses from the 2009 and 2016 consultations.

2.16. In the 2016 consultation, we proposed a light touch approach. This means:

- Only removing exemptions for water use activities that have or might have significant environmental impacts. Types of abstraction with no significant environmental impacts will remain exempt as environmental benefits will be disproportionate to licensing costs.
- Most abstractors would be granted licences reflecting the volumes they have previously abstracted. Licences may however include conditions to protect rivers at very low flows.
- A generous five-year transitional period from the date we end the exemptions. Abstractors would have two years to prepare and submit applications. The regulator would have up to three years to consider, determine and grant the licence. Abstractors can continue to take water during this period.

2.17. These transitional arrangements will help ensure that currently exempt abstractors are treated as equitably as possible with other abstractors that are already the subject of licence control.

2.18. As these abstractions are already taking place, the act of licensing them will not cause an environmental impact. In circumstances where there is no risk of serious environmental damage taking place, the licence that will be granted would be based on the volume of water abstracted in the previous six⁸ years. Licences may also be issued with HoF conditions to protect the environment when flows are very low in catchments. The intended effect is to help minimise the regulatory impact while providing some basic environmental protection.

2.19. The WFD allows that abstractions which have insignificant impact on water body status to remain exempt. Therefore, abstractions considered to be insignificant will remain exempt from licensing (for example, abstractions of less than 20 cubic metres per day). Deregulation measures in the Water Act 2003 removed around 24,000 abstractors from the abstraction licensing regime, reducing licensed abstractors to their current level of around 21,000. We have carefully considered the impacts of types of abstraction and we will introduce further exemptions, which will ensure

⁸ Increased from four years as a result of feedback to the 2016 consultation. This may change depending on a final implementation date to take account of the dry weather in 2011.

several thousand abstractions will continue to benefit from being exempt from abstraction licensing.

- 2.20. Where it is considered that there is a risk of serious damage to the environment from a currently exempt abstraction, the regulator will issue a licence curtailing the amount of water that can be abstracted to remove the risk. In limited circumstances a licence may be refused. The impact of an abstraction on the environment depends on a combination of factors that include the type/rarity of habitat or species affected the scale and longevity of the impact and how easily it can be rectified.⁹
- 2.21. Under this light-touch approach, we anticipate that most exempt abstractors will receive licences. Any applications refused or restricted due to serious environmental damage would not receive compensation¹⁰.
- 2.22. Upon commencement, we propose that each applicant will have a two year window in which to make a licence application. This will involve them gathering, recording and submitting information to the regulator to support their application. Afterwards there will be a three year period for the regulator to assess and determine each application. Up until the point a decision has been made on the application, each abstractor will be able to continue their current abstraction activities without interruption, provided they have submitted a valid application. Should an abstractor want to increase abstraction or have plans for a new abstraction they should also apply to the regulator, these applications will be considered under the standard abstraction licence application process.

Who does it apply to?

2.23. The abstraction activities that will have their exempt status removed are:

- **Dewatering of engineering-works** (such as ongoing road and rail activities), quarries and mines.
- **Trickle Irrigation**: All forms of irrigation (other than spray irrigation, which is already licensed).
- The use of land drainage systems in reverse to maintain field water systems and; abstraction of water containing silt for deposit onto agricultural land where the silt acts as fertiliser (a process known as warping). Collectively the issues relate to **Managed Wetland Systems**.
- The transfer of water from one inland water system to another in the course of, or as the result of, operations carried out by conservancy authority, **navigation or ports**.
- Abstraction of water into **Internal Drainage Districts**.
- The majority of abstractions covered by **Crown Estate** exemption.
- Abstractions within currently **exempt geographical areas**.

2.24. A breakdown of the estimated number of abstractors by activity that we expect to bring into the licensing regime is provided in Table 6.2 (Section 6). The environmental and hydrological issues for each of these currently exempt activities are discussed in Annex B of this Impact Assessment.

2.25. We will retain some exemptions for insignificant abstractions that will not require a licence. These activities are:

⁹ The principles by which the regulator will assess serious damage are set out in guidance available at: <https://www.gov.uk/government/consultations/the-water-act-2003-withdrawal-of-compensation-on-the-grounds-of-serious-damage>

¹⁰ In exceptional circumstances, applications based on water use in the previous six years may be refused or restricted for reasons other than serious damage or to protect the environment during low flows. In these circumstances, abstractors would be able to apply for compensation if there is an impact on their business. As we expect this to be exceptional we have not analysed this policy in the impact assessment.

- The abstraction of saline water for ports and harbours, in connection with dredging systems and into internal drainage districts.
- The abstraction of water with a high saline content from underground strata in the Cheshire basin. This is part of an existing exemption given to the former Mersey and Weaver River Authority in 1968.
- The abstraction of water and impounding work solely for the management, operation or maintenance of water within managed wetland systems.
- Impounding works constructed by or on behalf of internal drainage boards in exercise of their appointed area functions.
- Small scale dewatering used in construction activity.
- Third-party operated dry docks that transfer water within a navigation authority's system.
- Some additional abstraction and impounding works when needed to maintain safety or in an emergency.

3. Objectives

3.1. The aim is to bring the exempt abstractions posing most significant risk of environmental impact into the water abstraction licensing system. The objectives are to:

- i) Enable better future management of water resources in England and Wales: doing so in a way that is consistent and fair for all water users, that tackles the serious environmental damage caused by unlicensed abstractions, and that supports further reform of the abstraction licensing system;
- ii) To widen the licensing regime in a way that is cost effective and equitable: for instance through allowing activities that pose a low-risk to the water environment to remain out of scope, ensuring all abstractions are managed on an equal footing, and giving sufficient transitional period for abstractors to assess their strategic options and calculate their required volumes; and
- iii) To meet statutory obligations under the EU Water Framework Directive.

4. Rationale for Intervention

- 4.1. This section explores the economic and wider political rationale for bringing exempt abstractions under licence control.

Future Pressures on Water

- 4.2. Water resources are already under pressure in many areas of England and Wales. Water supply is highly seasonal and inherently uncertain. In the future, emerging climate pressures and the demands of an increasing population will affect the volumes and certainty of water availability at different times of the year. Short duration droughts (12-18 months) are likely to become more frequent, while by the 2030s, those areas already experiencing water stress¹¹ face having a potentially increased population of over 40 per cent (particularly the river basin of the Thames and South East England).¹² This all points to a risk of less resilient water resources and a need to be more effective at managing them.
- 4.3. The UK and Welsh Governments reforms of the abstraction licensing system will create a system that is fairer and more resilient to future pressures, whilst being able to promote economic growth and protect the environment. This will bring benefits to abstractors by increasing water availability. However, while some significant abstractors remain outside of the current licensing system benefits of reform cannot be fully realised.

Levelling the Playing Field

- 4.4. A key rationale for intervention is to seek equity amongst all water abstractors.
- 4.5. Exempt abstractors are able to remove as much water as they want without needing to have regard to the environment or the other licensed abstractors. Where action is taken to balance the needs of abstractors and the environment, the burden falls only on those that are regulated through the licensing regime. This leads to responsibility and costs being imposed only on licensed abstractors as well as undermining efforts to manage water resources. This also leads to negative externalities to other licensed abstractors, as their rights over their access to water are uncertain.
- 4.6. Licensing all abstraction activities, other than those where it would be disproportionately costly to licence because the impacts on the environment or water resources are insignificant, will help create a level playing field across abstractors and deliver water resources and environmental policy.

Existing UK Legislation

- 4.7. The existing abstraction licensing system with its current extent of exemptions is neither fully effective at securing the proper use of our water resources, nor does it achieve control of environmental impacts caused by those exemptions. It also provides insufficient protection for existing licensed abstractors' water needs, yet places an unfair burden on them.
- 4.8. Although there are existing regulatory measures which could be used to control abstraction outside of licensing, in practice they are ineffective because they are inflexible and not designed for abstraction as they do not allow the regulator to control when and how water may be taken.

¹¹ Water stressed areas – final classification

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

¹² Environment Agency's *The case for change – current and future water availability*

<http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/research/planning/135501.aspx>

Market Failures in water abstraction

- 4.9. The main economic rationale behind bringing exempt abstractors under licence control is that fresh water in the environment is generally a “common pool resource”. It rains, flows and dissipates without regard to any geographic boundary. Water is, to a great extent, non-excludable and is rival in so far as if one abstractor takes water that water cannot be used by another abstractor. This means its use is not readily restricted to those who want access. It is difficult to assign property rights to water.
- 4.10. As a common pool resource, access to a finite amount of water is available to many users across a wide geographic area. Without the assignment of property rights to all users of the water, individuals may not take into account the effects on others of their own abstraction activities or on the environment. This leads to issues of over-abstraction, such as reduced volumes available to other, licensed abstractors and how best to allocate the long-term available resource of water for future generations. This overuse can put serious environmental pressure on water bodies and on the ecosystems dependent upon them, leading to adverse effects described as “negative externalities” for others not involved in the decision to abstract when the regulator needs to make abstraction changes to protect the environment.
- 4.11. A licensing system that includes all significant abstractions is essential for effective management of this common pool resource and is a necessary step to tackling these market failures.

5. Options Appraisal

5.1. This section sets out the options which were appraised and also the methodology used to assess them. The appraisal considered three core options for New Authorisations relative to the baseline of continuing the current system:

Option 0: **Business as Usual:** the baseline, where we do not bring exempt abstractors into licensing but rely on existing legislation to meet our statutory requirements on water bodies.

Option 1: Commence the new licensing requirement for currently exempt abstractors **without the inclusion of transitional arrangements** for currently pre-existing exempt abstractors.

Option 2: Commence the new licensing requirement for currently exempt abstractors with the **inclusion of transitional arrangements** for pre-existing abstractions.
(This is the option selected)

5.2. In the 2016 consultation, we included the option to commence the new licensing requirement for currently exempt abstractors with the inclusion of transitional arrangements as in option 2, and also to award **compensation for the loss of future planned increases in abstraction**. However following the consultation response we have not considered this option further as we have concluded this option unfairly allocates water rights to exempt abstractors compared to licensed abstractors who have no compensation rights for planned abstraction.

5.3. The core analysis focused on a set of light-touch options. This is because the environmental protection threshold (i.e. curtailing abstractions at risk of causing serious environmental damage) is anticipated to only apply in extreme instances. Most exempt abstractors will receive licences through a 'light touch' review requiring minimal scrutiny that limits the burden on both exempt abstractors and the regulator. The options are set out in more detail below, with further information on assumptions and methodology in Section 6.

Option 0: Business as Usual (this option would not meet EU requirements)

5.4. This is the baseline that the other three options will be compared to. The baseline is the use of existing legislation to tackle environmental damaging exempt abstraction. Under this option, regulator will have limited enforcement options to address unsustainable abstractions.

5.5. Actions to tackle environmental damaging abstraction would be severely constrained by incomplete information on exempt abstractions, regulator's resources, cost impacts on the regulator and licensed abstractors and the associated uncertainty around the time taken to achieve an environmental outcome. To reflect this difficulty for the regulator, the actions were assumed to operate at a much slower pace than can be achieved by licensing – we estimate it would take on average an additional ten years to fully capture the effect of exempt abstractors causing serious damage to the environment. We therefore assume that all impacts surrounding changes to economic output are incurred from appraisal year 10 in the baseline. This also delays the benefits to licensed abstractors and to the environment.

Option 1: No Transitional Arrangements

5.6. Under this option the policy will commence immediately at the start of the appraisal period. Without transitional arrangements all licence exempt abstractions would become unlawful and would have to cease once the provisions are commenced unless, that is, a licence was granted. Therefore the costs would fall on exempt abstractors immediately. This would also create significant regulatory uncertainty and potentially create costly disruptions to businesses where licence decisions could

only be made in time with significant effort by the regulator. Furthermore, businesses may not have the time to comply with abstraction licence restrictions.

5.7. This option would meet the EU WFD statutory obligations on prior authorisation and control of abstractions, as well as treat exempt abstractions equitably to those already licensed. It would also bring benefits to the environment and other abstractors immediately.

Option 2: Two Year Transitional Arrangement

5.8. This is the selected option whereby we begin the new licensing requirement after a two-year transitional application period and determine all applications in a three-year period following the application period. It would help to meet our environmental obligations for prior authorisation and control of all significant abstractions. Apart from allowing for the transitional period, it would help to treat previously exempt abstractions on an equal footing with those already licensed and also to tackle the market failures outlined in the previous section.

5.9. The Water Act 2003 gave the Secretary of State and Welsh Ministers powers to make regulations that provide transitional arrangements for those abstracting lawfully prior to removal of their exemption. This option proposes transitional arrangements that give a two year application period for abstractors to make an application. It would allow abstraction to continue until decisions were made on the licence application up to three years after the application period closes.

5.10. This option would implement the Water Act 2003 and Water Framework Directive requirements by licensing abstractors who might pose a significant risk to the environment; while treating them equitably with those already subject to licence control. However the transitional period would delay the benefits to other abstractors and the environment compared with option 1.

Analytical Methodology

5.11. Here we describe the methodology used to analyse the options.

5.12. Our approach uses two pieces of analysis Defra commissioned to provide key evidence for this appraisal. This analysis is supplemented by further discussions with abstractors and the evidence provided in the 2009 and 2016 consultation responses, more detailed evidence from the regulator and revisions to the detail of the policy.

Sources of Evidence

5.13. At the outset, evidence on exempt abstractions was seriously limited. Defra commissioned an evidence study to scope and understand the impact of ending the exemptions on affected sectors in England and Wales. The study was carried out by consultants HR Wallingford and Vivid Economics¹³.

5.14. The evidence report analysed:

- The scale of current exempt abstraction activities and associated costs and benefits;
- Likelihood of abstractors receiving curtailments or restrictions placed on their licence;
- What impact both curtailing abstraction volumes and imposing Hands-off-Flow licence restrictions (if applicable) will have on each activity.

¹³ HR Wallingford (2013) "The Impact of New Authorisations on water abstractions", published by Defra <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18618>

5.15. The approach was to collate existing data from a variety of sources and to gather new information through interviews with representatives of the exempt abstractors.¹⁴ In particular, the interviewees provided information on volumes of water abstracted, on the value of this abstracted water to their activities and on the likely mitigating options exempt abstractors may choose to take. Based on this evidence, aggregate abstraction volumes for each of the exempt sectors were estimated.

5.16. The appraisal methodology is constructed as follows:

- Identify mitigation options for maintaining output levels together with their associated costs;
- Develop a model to assess the impact of restricting or refusing future licences.

5.17. In this assessment, the three options were considered against three separate licence scenarios. In the licensing scenarios a cautious view was taken over the level of what constitutes 'serious damage' to the environment. In itself, curtailing abstractions that cause serious damage will not be enough to meet all of our environmental targets. The licence scenarios under consideration range from setting environmental criteria designed to prevent abstractions causing serious damage, to environmental criteria that will not meet all our environmental objectives. More explicitly, the three licensing scenarios considered are:

Scenario A - is a precautionary scenario under which all licence applications would be refused if the activity contributes to a water body not meeting any of its environmental objectives (much more precautionary than our proposal to refuse or curtail licences that may cause serious damage), or where catchments are over-abstracted or over-licensed. This would also include licence refusal for all seriously damaging abstractions, and Hands-off-Flow restrictions where applicable.

Scenario B - covers a situation where approximately half of licence applications would be refused where the activity contributed most towards a water body not meeting any of its environmental objectives, or where catchments are over-abstracted or over-licensed. This would also include licence refusal for all seriously damaging abstractions, and Hands-off-Flow restrictions where applicable.

Scenario C - covers the least severe licensing restrictions and only looks at licence refusal for all seriously damaging abstractions, and Hands-off-Flow restrictions where applicable. This is light-touch approach for exempt abstractors while meeting our environmental objectives in a phased and consistent way as set out in the 2015 WFD River Basin Management Plans¹⁵. Any future abstraction licence changes that may be needed can be made to all consistently to all abstractors. This is the option we selected and is adopted in all of the core option analysis.

5.18. More background on this top-down assessment is in Annex D.

5.19. The evidence report estimates the numbers of abstraction activities that are potentially at risk of causing serious damage to the environment and what the impact of a Hands-off-Flow restriction on licences might be.

The Agent Based Model

5.20. The first assessment gives us an estimate of the impact on production and changes to abstraction volumes for an individual activity in isolation from other abstractors. However this approach does not take full account of the dynamic interaction effects on the decision making process such as

¹⁴ Interviews were carried out to gather information on how the exempt sectors were using their exempt abstractors. The interviewees were asked for data on volumes of water abstracted and the value of this abstracted water to their activities. Not all were able to provide the information. As such the information in the top-down assessment is based on the available existing data and supplemented by the information gathered in interview.

¹⁵ <https://www.gov.uk/government/collections/river-basin-management-plans-2015>

seasonal rainfall patterns or the impact of one abstractor's activity on water flows on another abstractor. Instead it uses expert judgements to suggest what the optimal choices individual abstractors will take. Usually these are judgements made for the average abstractor.

- 5.21. To help further our understanding of the dynamic effects, the analysis also considers a model of the choices that exempt abstractors may make in the face of New Authorisations. This is an Agent Based Model (or the 'ABM').
- 5.22. The ABM underpins all of the analysis in Defra's separate abstraction reform impact assessment and was adapted by the contractors to test and therefore inform this assessment.
- 5.23. However not many of the currently exempt sectors can be modelled using the ABM: The model does not incorporate ports, exempt geographical areas or most Crown abstraction. The ABM coverage of canals, internal drainage boards and Ministry of Defence abstractions is too limited to be useable in the assessment. Even where the model incorporated an exempt abstractor, for example irrigators, without the quality of information we have about licensed abstractors the results of the model varied significantly depending on the assumptions made about the abstraction particularly the exact location of abstractions. The ABM results were therefore judged less reliable than the top down assessment.

Assessing options

- 5.24. The methodology used in this appraisal is summarised here:
- We first developed new evidence on licence exempt abstractors where none existed previously. This evidence base has evolved and is informed by the 2016 consultation responses, engagement with abstractors during and post the consultation and refinement to our final implementation policy as a result (such as moving away from universal volume conditions on transfer licences). This evidence helped to formulate the base line through scoping the total numbers of exempt abstractors, the scale of their operations, the likelihood and implications of bringing them into the licensing regime and also what strategies they are likely to adopt upon policy commencement;
 - The ABM was used to test the analysis where it could be applied;
 - We assume that in the base line (option 0) exempt abstractors would face economic impacts similar to option 1 and 2, where the predominant driver in differences between the options will be the point at which environmental action is taken and licensing costs. For this we choose to set out the approach for each sector alongside the impacts for the base line (option 0) against which options 1 and 2 are then assessed.
 - We assess each of the core options 1 and 2 within a range of high and low estimates of the cost of financing optimal mitigation strategies pursued by licence exempt sectors. This is because our evidence typically provides us with central estimates that are appropriate for the average abstraction activity; flexing inputs within a range helps us to account for any uncertainty in cost assumptions and also variation in the average size of abstraction operations.
- 5.25. As discussed we also develop a base line that assumes existing legislation will eventually force action with regard to detrimental water abstraction. This is to reflect that a lot of the costs incurred by current licence exempt abstractors will happen at some point in time (assumed to be ten years). The predominant driver in the differences in cost estimates between options is due to differences in when action is taken – we are mostly delaying the point at which costs of tackling detrimental

exempt abstractions are incurred. As such we provide detail for analysis for the sectors in the base line and note that the approach is replicated across all options.

5.26. The cost and benefit categories under consideration are outlined in the table below:

Table 5.1: Business Cost and Benefit categories

Impact	Description
Compliance & Administration	Costs to currently licence exempt abstractors from having to apply for and comply with the licensing system.
Economic Output	Changes to output that arise from one or a combination of a) having to invest in technology to mitigate against the impact of reductions in allowed abstraction volumes b) reductions in profits directly as a consequence of reduction in allowed water abstraction volume c) having to switch to a new activity, location or perhaps close operations.
Levelling the playing field	This is an extension to the economic output but relates to existing licence holders. Improvements to the availability and level of water flows may help existing licence holders to expand their output.
Environmental Benefits	The associated environmental (natural capital) benefit from improving flows in water bodies.

Compliance and Administration costs

5.27. All exempt abstractors will face the cost of complying with the abstraction licensing regime as they are brought into it. These are split into those occurring as a one-off, those occurring annually (for full licences only) and those expected to recur every 12 years at the point of licence renewal (or 3 times over our 25 year appraisal period).

5.28. The range of impacts was set out in the 2009 consultation Impact Assessment, which in turn built on the 2003 assessment around the commencement of the Water Act. The impacts are based on data collection and local knowledge.¹⁶ The various cost categories have remained the same but the estimates have been revised for this analysis. These business costs are categorised:

One-off costs:

- Advertising (costs to the regulator and to place in a local newspaper/online);
- Providing an environmental report;
- Seeking professional advice;

Annual costs:

- Annual licence charge (applicable to full licences only);
- Record keeping, reporting and making payments (applicable to full licences and small proportion of transfer licences);

Every 12 years:

- Metering/measurement of required water volumes;
- Time spent gathering data and completing the licence application
- The application fee.

¹⁶ See Sections 3 and 4 of the 2009 consultation impact assessment for more detail.

5.29. It is unlikely that all these costs categories will apply on an individual abstractor and those which do are likely to vary for each abstractor. We have identified a range of cost estimates and also a likelihood of the coverage of the costs to generate an 'expected' unit cost for each of these charges. It is also assumed that, with the exception of two categories ('professional advice' and 'abstraction charges'), the average unit cost for each of these categories will be identical for all abstractors; any variation in sector compliance cost is driven by the number of abstractions needing licences in each sector.

5.30. We use these average figures and their associated ranges to calculate the NPV impact of licence compliance for each sector. In all of our assessment none of these costs are expected to be sufficiently large on their own to influence the behaviour of currently exempt abstractors. So for those activities (most of them) which do not face licence restrictions or curtailment to their abstraction volumes, we do not expect any adjustment to their behaviour when facing the cost of licensing and compliance alone.

5.31. In our option analysis we assume that all of the one-off costs occur at the end of the transitional period. In practice, if there is a transitional period, it may be the case that some of the abstractors may decide to incur the one-off costs earlier in the transition; our assumption on the timing of these costs may be to underestimate the overall NPV impact of licensing and compliance cost.

5.32. An overview of the compliance and administration costs is in Annex E.

Assumptions

5.33. Key assumptions are set out in the table below:

Table 5.2 - Key assumptions

Input	Description	Assumption
Transitional Arrangements / Period	This refers to the process to bring exempt abstractors into the licensing regime. It includes both the period of time allocated to allow currently exempt abstractors to apply for a licence and also time for the regulator to make a decision on whether to award a licence.	Application and Determination period modelled as one. We assume policy impacts incur from the end of the application period. Abstractors to carry on activities as normal until then. Various lengths of time considered. We assume abstractors do not change their abstraction behaviours leading up to licensing and that abstractors will be comply with the licensing requirements ¹⁷ .
Compensation	Compensation could be payable unless the licence is refused or constrained due to association with an activity causing serious environmental damage or to protect rivers at very low flows. As such, we would expect only minimal compensation claims.	We assume no compensation will be payable under any option.

¹⁷ We believe it will be in abstractors' interest to comply rather than risk not being able to take advantage of the light touch approach.

Hands-off-Flow	Regulatory control applied to licences that require holders to stop abstracting when the flow of surface water in a river drops below a particular depth. Occurs from licence commencement.	Treated differently depending upon analytical approach. For the studies have taken evidence to determine likely impact; for ABM we analysed a HoF restriction to a Q-level of 70% and 95% ¹⁸
Licence Costs	New Authorisations face fees associated with licensing. These are a mixture of: fixed charges towards regulator costs; an annual charge for the management of abstraction and the cost of compensating abstractions associated with revocation of licences. Around 80% of New Authorisations will be transfer licences.	All New Authorisations would incur these costs. The New Authorisations receiving transfer licences will not pay an annual charge.
Curtailement	Abstractors at risk of causing serious damage to the environment may face curtailment to their activities. In the extreme a licence may be refused outright. Occurs at the licence determination stage.	We used a relatively strict view of what constitutes serious damage (based on the definition consulted on in 2012) underpins the evidence assessment that feeds into the analysis. Impacts assumed to take place at the end of the Transitional Period.
Mitigation	What currently exempt abstractors could do to mitigate the impact of New Authorisations.	We consider the [combination of] mitigation options that were deemed most suitable or cost-effective when scoping out the evidence. The ABM lets us compare the choice of mitigation which emerges dynamically.
Licence Review Period	New Authorisations are time limited for a period of around twelve years.	We do not model explicitly in the top-down approach, but this is accounted for in the Agent Based Modelling.
Compliance	Separate to administration cost and refers to the direct costs faced by currently exempt abstractors in complying with licence arrangements.	All New Authorisations incur these costs.

5.34. Common to all options is the decision making process each modelled abstractor is assumed to take:

- Prior to commencement abstractors can carry on abstracting without a license and without any potentially associated conditions, in line with volumes abstracted within the qualifying period.
- This unlicensed and unconstrained use will continue until the end of the transitional period¹⁹. Abstractors will react to any licence restrictions immediately after this period. This modelling simplification keeps the analysis tractable and, although abstractors may receive licences with restrictions at various points during the transitional period, this is impossible to predict in advance and has a negligible impact on the cost-benefit profile.

¹⁸ For a HoF condition of Q(x): x refers to level of river flow that is exceeded for x% of the year - the HoF restriction will kick in when the flow drops below this level. We chose a level of Q70 for our Agent Based Modelling as this was felt best to mimic the impact of the HoF on trickle irrigators in the evidence report suggested by HR Wallingford. This level of HoF is substantially more restrictive than abstractors should normally expect when licences are issued. Other than in serious damage cases, our proposal is that in almost all catchments that are already over abstracted will be issued with Q95, in all other catchments 75% of Q99.

¹⁹ Once the transitional regulations come into force, any increases in abstraction will need to be applied for through the usual licensing application route, but a licence will need to have been secured before any change in abstraction practice may occur.

5.35. Throughout the transitional period an abstractor assesses strategically how they might respond to possible curtailments or restrictions to their abstraction when licensing commences; they will have a reasonable expectation of the likely scale of restrictions given their knowledge of their own abstraction/activity.²⁰ The abstractor will consider:

- Administration and compliance costs associated with licensing. This will be incurred by all abstractors;
- An assessment of the impact of having their activities curtailed where they are at risk of causing serious damage to the environment. This is an impact that would occur at the point of receiving a licence. In the extreme curtailment may lead to outright refusal of an abstraction licence;
- An assessment of the impact that Hands-off-Flow restrictions on licences might have on their future activity. This is an impact that may have an effect throughout owning a licence and is based on water availability within a catchment.

5.36. In most instances a likely response will be to carry on as normal but incur cost of complying with the licensing regime. Yet for some where the restrictions at the point of licensing or due to the Hands-off-Flow condition on the licence are strong, the abstractor may choose one or a combination of the following:

- Invest in technology to mitigate against the impact of reductions in allowed abstraction volumes;
- Accept a reduction in abstraction volume and face a reduction in profits/ output volume of the end product;
- Switch to an alternative activity or location;
- In the extreme the abstractor may decline the offer of a licence and prefer to close down its activity.
- Improve efficiency of production²¹

5.37. Each of the decisions an abstractor will choose to take will depend on the activity associated with it. The most cost-effective choice(s) for each abstractor are taken from the scoping analysis done by HR Wallingford/ Vivid Economics.²² In our base line assessment we consider each of the impacted sectors in turn and have summarised at the beginning of each section the types of decision abstractors in the sector will make.

5.38. Our choice of appraisal period is **25 years** to effectively represent admin costs and the benefits to licensed abstractors. This is in consideration that many significant impacts typically materialise over this time frame using our modelling approach. For example, the decision making to invest in assets such as reservoirs are based on a 20 year lifetime, while the licence review period takes place approximately every 12 years. Importantly, the baseline (current policy) includes costs to business in years 11 to 25 that would be brought forward or altered in the other options (see section 6 following).

²⁰ In practice abstractors will use part of the transition arrangement period to gather information to submit to the regulator. They are likely to have a reasonably accurate expectation of the restrictions they may face. Only when the regulator has assessed the application will the abstractor know precisely what implications, if any, they might face.

²¹ This is not a direct response to restrictions on water use but is the results of an up-front capital investment that leads to greater efficiency in water use. For example, a trickle irrigation farm might choose to invest in rainwater harvesting which requires a sizeable upfront cost but in turn leads to a lower marginal cost of water use.

The scope for improvements in productive efficiency – the ability to carry out existing tasks with fewer inputs – was examined in our Evidence Study produced by HR Wallingford. For all of our sectors under considering none the scope for improvements in productive efficiency is considered minimal as mismanagement of water directly leads to greater operating costs in all sectors. See HR Wallingford (2013), page 68.

²² These were in turn based on interviews with current licence exempt sectors, expert judgement and economic theory.

6. Options Assessment

- 6.1. This section shows our assessment of the options. It begins with an assessment of the baseline option 0, taking each impacted sector in turn, and then looks at the aggregate impacts of the remaining options.
- 6.2. At a high-level we expect the main driver in the variation in net impacts between options to be the compliance and administration costs faced by currently licence-exempt abstractors and the point at which licensing commences – the way we calculate the impacts in the base line and across our three options is the same, but the point in time at which the cost-benefit impacts commence will differ between them.

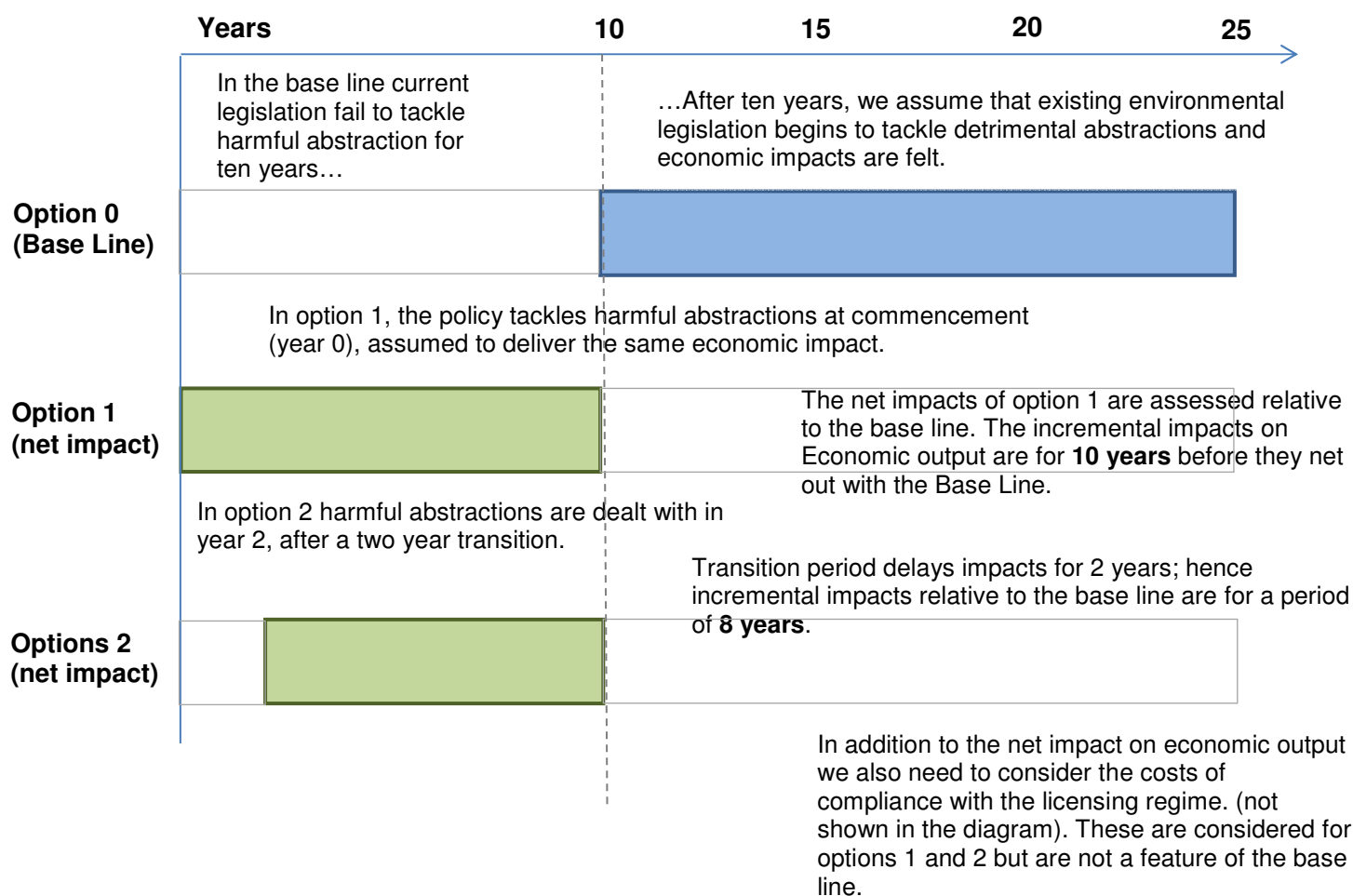
Table 6.1: Timing of impacts for options 1 and 2 and the Base Line

Option	Period in which impacts occur (over 25 year appraisal period)	Key Assumption	Compliance and Administration Costs?
Option 0 - The Base Line	Ten years of no impacts followed by 15 years of impact on economic output and benefits from tackling detrimental abstraction to the environment and other abstractors	Existing legislation begins to tackle detrimental abstractions from appraisal year ten. This is assessed in the same way we assess the impacts of other options.	There would be substantial effort tackling this in an ad hoc case basis).
Option 1 - No Transition	Assessment is relative to the base line. Incremental impacts are for a ten year period which incur from appraisal year 1 to year 10 inclusive.	From appraisal year ten, the incremental impacts on economic output are zero relative to the base line and begin to net out.	Yes – starting from the beginning of the appraisal (year 0)
Option 2 - Two Year Transition (The option selected)	Assessment is relative to the base line. Incremental impacts are for an 8 year period and are incurred from appraisal year 3 to year 10 inclusive.	From appraisal year ten the incremental impacts on economic output are zero relative to the base line and begin to net out.	Yes – starting from appraisal year 2

- 6.3. The approach set out in the table above gives a high-level representation of when impacts are incurred in each affected sector.²³ This high-level representation is also explained in figure 6.1:

²³ Regarding sectors analysed by the ABM: the incremental impacts of new authorisations evolve over time in ways that are dependent on the socio-economic, investor and hydrological conditions at the time the policy is commenced. As these vary year by year, the incremental impacts when comparing, Option 1 and 2 will not exactly net out with the base line from year ten. Similarly for quarries the length of the transitional period and the commencement date of the policy plays a role in determining the scale and persistence of the impact, to the extent that they do not net out precisely with the base line from appraisal year ten

Figure 6.1: Illustrative timing of impacts for options 1 and 2 and the Base Line



Option 0: Base Line Assessment

- 6.4. In the base line it is assumed that existing legislation will eventually have its intended effect. This assumption is a simplification aimed at achieving a coherent methodological structure for the analysis. In practice this is unlikely to be the case, existing legislation is likely to take a gradual effect and tackle detrimental abstractions earlier or later than ten years into the appraisal period. This assumption does not affect the relative attractiveness of options 1 and 2.
- 6.5. The assessment considers nine licence exempt abstraction sectors, as well as the impact on existing licence holders and the environment. Numbers of exempt abstractors are given below by sector.

Table 6.2: Expected Numbers of Exempt Abstractions by activity.

Sector	Number of Abstractions Exempt from Licensing
Quarries and Mining	790
Trickle Irrigation Farms	990
Ports	12
Navigation (Canals)	350
Managed wetland systems	1500
Internal Drainage Boards	200
Ministry of Defence / Crown	150
Road and rail	200
Exempt Geographical Areas	600

Source: Environment Agency and Natural Resources Wales

Quarries and Mining

- 6.6. It is estimated there are around 790 quarries and mines in England and Wales that are currently exempt from abstraction licensing. The economic importance of this type of site is sizeable with an approximate turnover of £2.9billion²⁴. These activities are also regulated through reviewable planning permits which in the majority of cases will be informed by Environmental Impact Assessments balanced with other interests. Expected impacts on the water environment have thus already been taken into account as far as possible prior to operation, so it is thought that only a very small number of the abstractions for dewatering used in quarrying and mining sector may cause serious damage to the environment. Here it is assumed that around half a dozen cases (less than 1% of all operations) may occur. This assumption was discussed with the sector who agreed it seemed a reasonable estimate for use in an impact assessment.
- 6.7. Abstractions by quarries and mines are for the purposes of dewatering – the process of removing groundwater, which is necessary to prevent interference with their activities. There are no Hands-off-Flow restrictions for dewatering licences.
- 6.8. Mitigation measures to maintain output are likely to be implemented by operators when facing curtailment or restriction of their current levels of water abstraction. The range of plausible mitigation options identified were:
- *Prevention* measures to avoid the need for drawing water from below the water table (the act of drawdown);
 - *Control* measures to restrict the depth, extent or duration of the need to drawdown;
 - *Compensation* measures to ameliorate the impacts of drawdown, such as return water to the aquifer.
- 6.9. All of these measures are characterised by high associated costs.²⁵ Interviews carried out for the evidence study suggested that a quarry or mining site was very unlikely to remain commercially viable if it must undertake high cost mitigation strategies; therefore sites facing curtailment are assumed to find closing down the site (and opening another site) preferable over mitigation strategies. We believe this is a reasonable assumption given the small scale of restrictions we estimate (affecting around 0.7% of 790 quarries) and the relative availability of alternative sources of minerals, although we note the sector's concerns about assuming that operators could switch readily to alternative sites and that the impacts could be significant on the operators affected.
- 6.10. The ABM results support the view that quarries and mines may prefer to close their operations early when facing a restriction to their abstraction activity (dewatering).
- 6.11. This is plausible as mitigation options may only be feasible for quarries that have considerably longer operating lives than average. However, as it has been the intention to commence the Water Act 2003 provisions for 14 years, it would be expected that any site opened since this date will have been chosen commercially to avoid risk of harm to water bodies and, as noted above, the industry is regulated through reviewable planning permits which the industry suggests will have adequately addressed significant environmental concerns through the planning Environmental Impact Assessment process.

²⁴ Aggregate Minerals Survey 2009; UK Minerals Yearbook 2011. Turnover figures relate to relevant subdivision: 'quarrying of stone, sand and clay'.

²⁵ HR Wallingford Report (2013)

6.12. Our options assessment thus looks at the impact of bringing forward the expected closure date of a quarry or mine. We present the impacts of a quarry or mine deciding to close down in light of restrictions to dewatering on lost output/revenue. The approach we have taken is as follows:

- First, we take the assumption that quarries and mines are equally likely to be at any point in their life horizon, such that on average a quarry's or mine's remaining life is half of its typical life.
- At the point exempt abstractions are ended quarries/mines decide to stop any resource extraction that involves dewatering. Some of the extraction can be done without dewatering so that each site will not necessarily close immediately but will continue to exhaust all resources above the water table before closing. An assumption over how much resource above or below the water table is needed.
- We assume that quarries/mines deplete the resource available to them at a fixed rate over time. Throughout the lifetime of the site, the operator's return will be used in part to finance the next site; this notional amount is accrued evenly over the site's lifetime.
- We then look at the cost of the next available site that will be opened and calculate what the required annuity value will be over the remainder of its life, assuming dewatering is still exempt from licensing. This factors that some of the cost will have been recovered as in expectation the site will be half way through its lifetime at the start of the appraisal period.
- Then the same exercise is repeated but this time we look at the annuity value of having to pay for the next available site over a shorter time frame- that of the remaining life assuming the operator will discontinue with extraction that makes use of dewatering.
- These values are annuitised over the 25 year appraisal period. This difference in annuity value reflects the cost of lost production to a quarry/mine.

6.13. In doing this we have made the following assumptions on the following figures, drawing on figures provided jointly by HR Wallingford and Vivid Economics for the *average* quarry or mine:

- The financing cost is **7%** (pre-tax, real).
We apply a sensitivity test for alternative rates at 6% and at 9%. This is to reflect any potential uncertainty around our central estimate due to our small sample of operators and possible variation to an individual operator's financing costs
- Only a proportion of each site requires dewatering for mineral extraction to take place. Any resource to be extracted that is above the water table will not be impacted by restrictions on dewatering. It is assumed that **50%** of the remaining resource is above the water table based on interview evidence that suggested this proportion of resource extraction is currently dependent upon dewatering.
We also examine what if 25% of the remaining resource is above the water table to capture any potential uncertainty in our central estimate, given that it is based on a small sample of operators.
- The economic life of a quarry or mine is around **40 years**.²⁶ For the purposes of this analysis it is thus assumed that the average quarry has been in operation for 20 years (it is at its mid-point) expected remaining lifetime for our average quarry or mine will be 20 years. If a quarry chooses to stop its dewatering activities it will close earlier than anticipated but not right away –

²⁶ HR Wallingford (2013)

it will continue to extract resources above the water table at the same rate. For instance, at 50% of resource above the water table our average quarry could continue for another 10 years. For the base line the quarry will continue to finance the next site as normal for ten years and then, from the point environmental action commences, it will only have five (ten x 50%) further years of its life remaining whereby it is restricted to extracting resources without dewatering – the quarry is assumed the spread the remaining financing cost over this period.

- The overall resource available to be extracted in each quarry or mine is around **20million tonnes**²⁷ (so on average we would expect about 10million tonnes to remain). The rate which resource is extracted is around **500,000 tonnes per year**²⁸.
- The cost of replacing production capacity/ moving to a new site is around **£35million**²⁹. For simplicity and in the absence of further evidence, we also are implicitly assuming that abstractors are evenly distributed across groundwater sites 'at risk of serious damage' and that any Hands-off-Level restriction will have little-to-no effect on operations. It is expected that quarries or mines are able to use the lowest cost methods to mitigate for the effects of temporary water restrictions. There is a mark-up of 2% on the cost of the next quarry.³⁰

6.14. To further test uncertainties associated with the cost of replacing production capacity/ moving to a new site which could vary within a range of 30% higher or lower, we have applied sensitivity testing within this range of 30% more or less than the central average value. The mark-up is tested also at 0% and 4% for the low and high ranges respectively.

6.15. These estimates are for an *average* quarry/mine. Clearly there will be some variation around this for an individual quarry or mine. As such we have looked at high and low estimates based on plausible combinations of the assumptions listed above. These scenarios layer a number of benign or stricter assumptions (relative to the average) to give a cautious, but extreme range of the costs around the average.

- **Central costs:** all of our central assumptions listed above;
- **Low cost:** as central estimate yet with a lower financing cost of 6%, and a replacement cost figure 30% lower than the central figure (to capture unknown variation around the average and uncertainty in our assumptions). There is no mark-up on financing the next quarry;
- **High cost:** as central estimate yet with a higher financing cost of 9%, none of the remaining resource is above the water table (i.e. site has to close immediately) and a replacement cost figure 30% higher than the central figure. There is a mark-up of 4% on financing the next quarry.

6.16. Addressing abstractions causing serious environmental damage in the mining and quarrying sector may yield sizeable benefit, not limited to those just from abstraction.

²⁷ HR Wallingford (2013)

²⁸ HR Wallingford (2013)

²⁹ HR Wallingford (2013)

³⁰ It is assumed that the expected market value of the natural resource is captured in these financing assumptions (notably the financing cost) of the quarry, and each operator finances the next site over the life-time of the current site. In addition, evidence from HR Wallingford suggests there are a significant number of potential sites for a quarry operator to move to indicating that supply is relatively elastic. Together this suggests there is low opportunity cost of not-extracting the full potential resource from a site; the imposition of water restrictions to a quarry raises the marginal cost of resource extraction, such that it becomes more cost effective to move to an alternative site with little disruption in output – we do assume the operator pays a mark-up on the next available quarry, yet the value paid captures the anticipated return over the total cost of the site. What is lost is the anticipated return over the forgone resource. Crucially the remaining resource from the original site is still available and can be extracted at a future time should it become profitable to do so.

- 6.17. The table below shows the impact of preventing harmful abstractions relating to the Quarries and Mining sector in the base line. The quantified cost reflects that quarries will choose to close when faced with curtailments to their output that is causing serious damage to the environment.
- 6.18. There are likely to be environmental benefits (not quantified) from curtailing abstractions here as it is estimated that this sector contributes a small proportion of the 40% of groundwater bodies at risk of failing to meet its environmental objectives (basically more water is taken out of the groundwater than is going in over the longer term ie a negative mass balance). In addition, curtailments may lead to the relocation to sites in low-risk areas, and perhaps with the take up of more efficient technology.

Impact on business of preventing harmful abstractions relating to Quarries and Mining in the Base Line (met by existing policies) PV £million		
<i>High cost</i>	Central	<i>Low cost</i>
-94.1	-38.7	-25.0

Trickle Irrigation Farming

- 6.19. Trickle or drip irrigation is a specialised technique that delivers precise quantities of water through tubes to the soil close to the roots of plants. It requires specialised and relatively expensive equipment that is expensive to move around. In the UK it is therefore used mainly for small areas of high value crops that depend on steady supplies of water under controlled conditions. Examples are soft fruit, orchard fruit, runner beans, hops and ornamental horticulture. Many of these operations have rainwater storage to maintain their own supply in periods of low rainfall. About 20% of trickle irrigators use only mains water, leaving 80% that may use unlicensed abstraction from surface or groundwaters to feed their systems.
- 6.20. Drawing on several different sources of data, HR Wallingford estimated that there are 990 farmers and growers in England and Wales using exempt abstractions for trickle irrigation. A regional breakdown is shown in table 6.3.

Table 6.3 - Estimated number of exempt abstractors using trickle irrigation, England & Wales

Region	Number of exempt abstractors
North East	7
North West	67
Yorkshire and the Humber	99
East Midlands	84
West Midland	124
East of England	262
South East & London	187
South West	144
England	974
Wales	16
Total (England and Wales)	990

Source: HR Wallingford estimates

- 6.21. Because of the type of crops involved, restriction of access to water supplies could have major implications on crop yields and quality and therefore it will impact the revenue and profitability of the business. In the extreme, restrictions could force growers of high value crops to switch to lower

value crops that do not depend on the same highly controlled regular supply of water and can be rain-fed. The economic impact of this situation can be estimated by considering a typical horticultural unit. Averaging the two most recent years' data from the Defra Farm Business Survey shows that an average horticulture business produced £331,000 output from 27 hectares of agricultural land, giving a farm business income (a measure of profit) of £33,000. This compares with the average cereal farm, producing £276,000 output from 198 hectares at a profit of £40,000. If the horticulture unit were forced to switch to cereals on the same relatively small farm holding, it would effectively be scaling down its business in monetary terms, achieving a far lower output from the same area, although saving some costs too. Specifically the assumption is that the output (£1,045) and variable cost (£516) per hectare of the unit would fall to those of the cereal farm, as would fixed costs (£1,642) with the exception of unpaid labour (£1,039). Costs and revenues relating to other cost centres of the business (non-agricultural operations and payments from public policy schemes) would remain as they were for an average horticultural unit. The result would be a drop in profit from £33,000 to a loss of £13,000, a net reduction of £46,000. This assumes that the farm would continue but would not be able to cut all its fixed costs down to the level per hectare that is possible for a typical larger cereal farm because of its economies of scale. This position would not apply in the real world because the business would become unviable but the assumption is used here in the context of an impact assessment to demonstrate the scale of first round cost to business that this could involve.

6.22. Because of the very high cost of losing trickle irrigated enterprises, businesses that might be affected by restrictions would anticipate the situation by adopting mitigation strategies. HR Wallingford identified and costed four main mitigation options that might be considered: on-farm reservoir storage, rainwater harvesting, greywater recycling and more efficient water use. Further information is available in the Annex B.

6.23. It is not possible to know the exact strategies under different types of restriction for different businesses but HR Wallingford suggested that several possible packages of options might be used. These are set out with HR Wallingford's estimate of the annual costs to the business in Table 6.4. For comparison, the option of applying all four of the above strategies would cost over £140,000 a year and can be ruled out as a realistic approach for any business.

Table 6.4 – Mitigation packages for trickle irrigators applied in HRW analysis

Situation	Description	% of annual water usage supplied	Annualised cost
Major restriction	Farms invest in one high cost measure (reservoir storage) and one low cost measure (rainwater harvesting). This package yields highest volume of water at lowest cost.	100%	£41,000

Minor restriction	Farms invest in two low cost measures – rainwater harvesting and improving water efficiency (both at £1,150). This package yields the required amount of water (30% of annual usage) to mitigate the HoF condition. This package has been used in the HoF cost calculations.	35%	£2,300
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Source HRW model, accompanying HRW report.

6.24. The current best estimate is that major restrictions on water use might apply to 50 (5%)³¹ of the 990 unlicensed trickle irrigators involved in unsustainable abstraction, typically larger operations than the average considered above. Of these 50, it is possible that 80%³² would find it worthwhile to invest in reservoir storage with rainwater harvesting at an annualised cost of £41,000. The remainder would have no option but to switch to crops requiring less water, taking the full loss in farm business income considered above, expecting major structural change to follow (e.g. amalgamation with other businesses). In addition, around 60%³³ of the 990 trickle irrigators might experience hands off flow restrictions at an annual equivalent cost of £2,300. As mentioned above, many trickle irrigators already have rainwater collection systems that would be used to mitigate the impact of restrictions. Table 6.5 shows the combined total of these impacts.

Table 6.5 – Combined impacts on trickle irrigators

		Number	Cost per business per year	Total cost per year
Total trickle irrigators		990		
Major restrictions apply	5%	50	£42,000	£2.1m
Of which:				
Reservoir + rainwater harvesting	80%	40	£41,000	£1.6m
Switch cropping	20%	10	£46,000	£0.5m
HoF restrictions only	60%	594	£2,300	£1.4m
Total restricted	65%	644		£3.5m
Unrestricted	35%	346		

Source Defra from HRW report.

6.25. The table below shows the impact of preventing harmful abstractions relating to the trickle irrigation farm sector in the base line. The estimates show the combined impact of tackling harmful abstraction by either curtailing output at the point of commencement or placing restrictions on abstraction use (equivalent to receiving a HoF condition on an abstraction licence), which is substantial at a cost of around £20 million over the 25 years.

Impact on business of preventing harmful abstractions relating to Trickle Irrigation in the Base Line (met by existing policies) PV £million		
<i>High cost</i>	<i>Central</i>	<i>Low cost</i>
-26.1	-20.1	-14.0

³¹ HRW report licensing scenario

³² HRW report (based on expert judgement and consultation feedback)

³³ Estimated proportion abstracting from surface waters

Navigation (Canals)

- 6.26. There are around 350 abstractions made by canals currently exempt from licensing. Navigable canals are artificial constructions that connect to natural waterways and improve the efficiency of passenger and freight transport. An estimated 250 abstractions are made by the Canal and River Trust (CRT) for navigation in England and Wales, whom are responsible for around 75% of the canal network (this number has been appropriately scaled to give the overall figure).
- 6.27. Overall we estimate that 10% of the 350 may face a more restrictive HoF than their current operations while possibly 1% may be refused a licence on the grounds of risk of causing serious environmental damage. These estimates are based on discussions with CRT and the Association of Inland Navigation Authorities.
- 6.28. The following cost estimates are derived from HR Wallingford/ Vivid Economics (2013) and based on information provided by the Canal and River Trust.
- 6.29. Canals facing either HoF restrictions or curtailments are assumed to use a combination of low-cost mitigation methods. These include: system optimisation; the development of new surface water sources, and; back pumping. Only once these are explored will the canal operator respond by investing in higher cost options such as developing new groundwater sources or extending reservoirs where it is viable to do so.
- 6.30. Typically canals are expected to prioritise service levels and will attempt to maintain the integrity of the network (if they can) prior to restricting usage. With these service obligations in mind, it has been assumed that canal operators will invest to manage the risk of temporary HoF restrictions in the same way as they would for other licence restrictions: through a combination of mitigation options, using the lower costs option more extensively than higher cost options.
- 6.31. The approach to assessing canals is as follows:
- We assume that the nearly all canal operators take to the same combination of low cost mitigation methods. These include the development of new surface water sources, leakage reduction and back pumping. It is estimated that the average mitigation cost per MI of Water per year is around £263. This is an average figure based on judgement over the appropriate choice of mitigation measures. To reflect the underlying uncertainty, the estimate is flexed by 30% for the high and low.
 - The average combined impact of HoF restrictions and licence curtailment will lead to a loss in abstraction activity of around 9,800 MI per year for the sector as a whole (compared to around 455,000 MI abstracted in total per year). Again this assumption is flexed by 30% for the high and low ranges.
 - Canal operators have a duty to maintain their water levels and as such are required to mitigate all losses in abstraction volumes. Thus the central estimate of the capital cost needed to maintain water levels is around £2.6 million (i.e. yearly loss in abstraction volume multiplied by yearly mitigation cost of water loss or 9,800MI x £263/MI). An assumed financing cost 6% and a payback period of 25 years are used to calculate the central estimate of the annualised cost of mitigation. The financing cost is varied by +/- 2% for the high and low ranges.
 - In addition to the capital costs there are recurrent operating costs estimated to be around £38 per MI of water pumped. Combining the annualised capital costs and the operating cost gives a yearly cost of mitigation around **£574,000 per year**.

6.32. The table below shows the impact of preventing harmful abstractions relating to the Navigation sector in the base line. The assessment by the regulator that around 10% of abstractions harm the environment and would lead to some environmental enforcement action (equivalent to a HoF restriction on a licence). In addition, an estimated 1% could potentially face curtailment due to serious damage. The combined impact of restrictions and serious damage curtailment are quantified below.

Impact on business of preventing harmful abstractions relating to canals in the base line (met by existing policies) PV £million		
<i>High cost</i>	Central	<i>Low cost</i>
-7.5	-4.9	-2.9

Ports

6.33. There are an estimated 116 ports in England and Wales that are currently exempt from licensing. The majority of these ports are or can be maintained by saline water and will not become licensable. This is because most ports and harbours are also covered by a proposed exemption for abstractions from saline waters.

6.34. An estimated 12 of the 116 ports and harbours in England and Wales instead require the use of abstracted fresh-water to replenish depleting water in their enclosed docks. It also is not anticipated that these fresh-water abstractions will be refused licences. There was also little evidence to suggest that fresh-water abstraction use by Port authorities is causing environmental deterioration. As such no ports are expected to face licence refusal but freshwater ports are assumed to face issue with low flow restrictions that is assumed to prevent 1.5% of freshwater abstractions.

6.35. A licence refusal would necessitate ports to purchase an ‘impounding pump’ (used to import saline water into the port to maintain water level) should the port not have one in place already. However a Hands-off-Flow restriction, one that leads to a temporary reduction in output, would be unlikely to result in operators investing in impounding pumps. Only under substantial, permanent restrictions might a port operator find this mitigating investment commercially viable.

6.36. From the evidence available to us, we would expect the operator to respond to the Hands-off-Flow restriction by a combination of temporarily reducing the level of water in docks, or through restricting the size of ships that could dock (this is assuming the port does not already have an impounding pump installed). Even an assumed revenue loss of 15% due to Hands-off-Flow restrictions in our high case scenario, this loss would not be sufficient for an operator to prefer investment in an impounding pump.

6.37. In our analysis we assume that 4 of a total of 12 may stand to lose revenue due to the HoF restrictions. The remaining 8 ports own impounding pumps already. Key assumptions in our approach are as follows:

- We examine the cost of installing an impounding pump and also the impact of reductions in revenue associated with the Hands-off-Flow restriction.
- An impounding pump is assumed to cost the operator around £15m and will have a central expected lifetime of 25 years. The financing cost associated with the pump is 10%. The yearly maintenance costs are 10% of the initial value of the asset and the operating cost is estimated to be £200k/year. The cost estimates are estimated within a range of 10% above

and below for our high and low estimates. The lifetime of the pump is 25 years in all scenarios. Financing cost is varied +/- 3%.

- Data for ports has come from the Association of British Ports, which owns around 25% of all ports. The figures are scaled up by a factor of four to obtain a national estimate – with the remaining exempt licences all covered by harbours. Only ports that make use of freshwater abstractions and without impounding pumps are affected by HoF restrictions. There are an estimated 4 freshwater ports without impounding pumps.
- From this we assume that the 4 ports without freshwater pumps will be unable to abstract for 1.5% of the time, leading to a loss of 1.5% of their average annual revenue.

6.38. The table below shows the impact of preventing harmful abstractions relating to the Port in the base line. The freshwater abstractions made by ports are not anticipated to be causing environmental problems but a small proportion of ports may face small reductions in revenue as the environmental enforcement (equivalent to imposing a HoF condition on a licence) will prevent ports from abstracting water for around 1.5% of the year.

Impact on business of preventing harmful abstractions relating to ports in the Base Line (met by existing policies) PV £million		
<i>High cost</i>	Central	<i>Low cost</i>
-0.3	-0.2	-0.1

Further Exempt Sectors

6.39. The remaining sectors/ activities currently exempt from licensing:

- Managed wetland systems;
- Internal Drainage Boards;
- Road and rail
- Ministry of Defence / The Royal Parks; and
- Exempt Geographical Areas.

6.40. Our research into these areas indicates there is no or a very small current risk of serious environmental water issues associated with each activity. As such, somewhat trivially in the options analysis there is expected to be no impact on IDBs either due to curtailment associated with serious damage or due to the imposition of a Hands-off-Flow condition placed on the licence. Nonetheless, there will be administration and licensing costs for each of these sectors to bear in the options analysis.

6.41. Managed wetland systems: There are approximately 190 water meadows and up to 4,000 wet grassland systems within England and Wales. Of these it is estimated that **1,500** activities (entirely located in England) may need water control in order to function.

6.42. The evidence research assumes that no water meadow are in breach of serious damage to the environment and will not be impacted by HoF conditions that maybe incorporated in their licence. We estimate that there are no discernible impacts on business activity or environmental stewardship schemes.

6.43. Internal Drainage Boards: The Land Drainage sector covers the Internal Drainage Boards (IDBs) within England and Wales, covering 123 in total. In Wales, the functions of IDBs are carried out by Natural Resources Wales. In England, the Environment Agency estimate that around 200 abstractions made by IDBs are under exempt status. These are typically located in areas with

special drainage requirements, such as floodplains of rivers or broad open areas. IDBs indirectly support farming. IDBs typically raise income from levies on farmers, other occupiers and Local Authorities - our research base from the evidence study was unable to reliably estimate this indirect impact on income.

- 6.44. We are in ongoing discussion with IDBs about their abstraction and none of these discussions has led us to believe that there will be curtailment of IDB abstraction for serious environmental damage. However there is still some uncertainty due to the legal and technical complexity of quantifying which abstraction will need to be licensed. We have not attempted to expand upon this as we feel it would command a disproportionate amount of effort to the overall analysis.
- 6.45. Nonetheless impacts of any potential curtailment have been identified but we have not been able to take any further steps towards quantification. We feel the impacts would be indirect and limited to IDBs with extensive agriculture: the crop production of farms could be impacted as water is being abstracted on their behalf. Reductions in water use would perhaps be manageable as IDBs take an active role in moving water to where it is most needed. In any event the regulator can already intervene if agricultural abstraction is causing environmental damage and is licensed.
- 6.46. Road and rail: through discussions with regulators during the consultation we have estimated that road and rail operators currently dewater tunnels at approximately 200 sites to maintain road and rail networks. Based on the current evidence we are not expecting abstractions to be curtailed because of serious environmental damage.
- 6.47. Ministry of Defence: it is estimated the Ministry of Defence (MoD) occupies around 1% of UK land areas. This estate provides accommodation and training for employees, the armed services, civil servants and industry partners all to help enable military operations. It abstracts water for a number of uses, particularly for domestic use (88% of water use) such as drinking water for housing and barracks, but also for operational purposes (remaining 12% of water use) such as vehicle washing, cleaning and fire-fighting.
- 6.48. Most of water is supplied from water companies but, for around 30% of supply, some water is abstracted where there is no mains supply available. Much of the information on abstraction activities, costs and volumes are not publically available. However, through interview, it was determined that potential reductions in water use could affect the ability to deliver their services which could impact on whether the MoD was able to support its personnel in domestic military duty.
- 6.49. Based on the evidence available we do not expect that abstractions will be curtailed or restricted due to risk of serious environmental damage.
- 6.50. The Royal Parks manage nine parks located within Greater London consisting of around 5,000 acres of historic parkland. During the 2009 consultation it was indicated that the largest abstraction volumes take place during dry summers when other water sources, such as lakes, become unavailable. An estimated 63 abstractions take place (although this number highly contingent on weather patterns).
- 6.51. None of these abstractions are likely to be curtailed as there is no current identified risk of serious damage to the environment. Yet there are likely to be Hands-off-Flow licence restrictions placed on abstractions during period of drought where the Parks will be unable to irrigate. Mitigation measures (such as rainwater harvesting) might reduce any impact of a potential constraint but it was not clear whether Royal Parks would choose to invest in these.

6.52. To capture the effect of Hands-off-Flow restrictions on revenue we have assumed a modest reduction in yearly annual income in the central scenario of 1%.³⁴ The low scenario assumes a 0% and the high scenario 2%. In addition, the cost estimates have been flexed within a range of 30% above and below the central figure. Our central figure is based on the average of the last three reported years of data available in annual accounts. The average total income for the Royal Parks over the three financial years from 2010 to 2013 was **£20.8million**.

6.53. The table below shows the impact of preventing harmful abstractions relating to the Royal Parks in the base line.

Impact on business of preventing harmful abstractions relating to Royal Parks in the Base Line (met by existing policies) PV £million		
<i>Low</i>	<i>Central</i>	<i>High</i>
-4.6	-1.8	0

6.54. Exempt Geographical Areas: there are estimated to be around 600 abstractions in geographical areas in England and Wales that are exempt from licence control. Abstractions activities in these areas are in general expected to be small and as such individual abstractions are unlikely to have an environmental impact. However we are also aware that there is some larger abstraction taking place in exempt areas, where the bottled water industry has developed, and there are concerns about effective regulation to protect access to water particularly in some Welsh exempt areas.

6.55. In our discussions with the bottled water industry, representatives suggested that their abstractions were sustainably managed in the interests of their businesses. We nevertheless acknowledge the possibility that some such abstractions in these areas may be impacting the environment, or other abstractors' access to water, even in cases where the impact is such that serious damage provisions are not likely to apply. It is not however possible to assess these impacts without knowing the precise locations, associated activities and volumes abstracted. We therefore are unable to comment and determine the costs to the environment and other abstractors, although we would anticipate that they are likely to be localised to specific sites.

Impact on Existing Licence Holders

6.56. Here we use the ABM to quantify some of the direct benefit to abstractors that are already within the licensing system – those that are considered to be *levelling the playing field* in allowing more efficient use of water amongst all abstractors. This is only a partial analysis as it mainly encapsulates **benefits to the agricultural sector only**. These benefits effectively arise from transferring some of the restriction between previously unlicensed and licensed abstractors. Higher costs to the newly licensed are partly reflected in benefits (reduced costs) to existing licence-holders. In order to eliminate random fluctuations between model runs, we took an average ratio of modelled benefits to modelled costs (roughly 0.2) and applied it to the top-down agricultural cost estimate for each of the policy options appraised to derive the monetised benefit estimate.

6.57. The HoF restrictions and licence curtailments imposed on those entering the licensing system will make more water available in the catchment to the benefit of the environment and/or existing licensed abstractors, particularly at low flows.

6.58. High and Low estimates for existing licence holders are based on the variation in the national level results from looking at the ABM's constituent catchment models.

³⁴ This figure was proposed by engineering consultants HR Wallingford and Vivid Economics in their research into Royal Parks.

6.59. The table below shows the impact of preventing harmful abstractions relating to the existing licence holders in the base line. There are clear economic benefits to existing licensed abstractors due to maintaining or improvements in access to, and reliability of water flows from curtailing harmful abstractions.

6.60. The benefits to licensed abstractors are likely to be higher than quantified here as the ABM estimated only the benefit of ceasing harmful abstractions from trickle irrigators to the rest of the agriculture and horticulture sector. Including all New Authorisations and including a complete set of all abstractors would increase the overall benefit.

Impact to Existing Licence Holders in the Base Line (met by existing policies) <i>NPV £million</i>		
<i>Low</i>	Central	<i>High</i>
+2.9	+4.1	+5.3

Base Line Summary

6.61. The following table 6.6 shows the aggregate impact of tackling detrimental abstractions under the base line, summarising the above sector analysis. Costs are shown as negative impacts.

Table 6.6 - Summary of impacts in the Base Line (NPV £m 2014)

Sector	Low	Central	High
Quarries and Mining	-94.1	-38.7	-25.0
Trickle Irrigation Farming	-26.1	-20.1	-14.0
Navigation	-7.5	-4.9	-2.9
Ports	-0.3	-0.2	-0.1
Royal Parks	-4.6	-1.8	0
Managed Wetland Systems	0	0	0
Internal Drainage Boards	0	0	0
Ministry of Defence	0	0	0
Exempt Geographical Areas	0	0	0
Existing Licence Holders	+2.9	+4.1	+5.3
Total	-129.7	-61.5	-36.7

Options 1 and 2: Overview

6.62. Here we set out the aggregate impacts of options 1 and 2 *relative to the Base Line (option 0)* as covered above. The methodology for calculating the costs for each of these sectors is the same as for the Base Line; yet the key driver of difference in the results will be that they fall earlier in the appraisal period as we choose to take environmental protection earlier.³⁵ In addition, they will also include licence compliance and administration costs as environmental protection will be achieved through licensing.

Option 1: No Transition

6.63. Without Transitional Arrangements, abstractions would become unlawful and have to cease once provisions are commenced, unless and until a licence were granted.

6.64. The key driver of the difference in these costs relative to the base line is that New Authorisations under option 1 deliver immediate reductions (at the point of commencement) in abstractions

³⁵ Paragraphs 5.2 and 5.3 earlier in this section outline the difference in the timing of New Authorisations amongst the options considered.

causing serious damage.³⁶ The costs to the exempt abstractors incurred in either having to maintain or reduce output and the benefits to the environment and other abstractors are felt throughout the entire 25 year appraisal period – by contrast with the base line where the impacts are felt after ten years and option 2 where they are felt after two years.

6.65. Immediate commencement may limit the time available to abstractors to respond by implementing mitigation measures and cause the regulator resourcing issues. We assume this is unlikely to have notable bearing on costs for the following reasons nethertheless there is likely to be non-monetised costs:

- Exempt abstractors and the regulator have been aware of potential commencement of licensing provisions since the Water Act 2003. In addition, curtailments and restrictions are also possible under the base line environmental protection regulations. Given the size of the main sectors affected it is highly likely these risks are already reflected in business planning. Evidence from sector interviews³⁷ support this;
- The mitigation options identified in the evidence report used in assessment are considered to be the most plausible in terms of their cost effectiveness and time-intensity.

6.66. The table 6.7 shows the range of impacts incremental to the base line for implementing option 1. Figures are NPV £m.

³⁶ Exempt abstractors would be curtailed or restricted as soon as being brought into the regime.

³⁷ These were carried out by HR Wallingford and Vivid Economics.

Table 6.7 – Summary of option 1 net impacts (NPV £m 2014)

Sector	Impact	Low	Central	High
Quarries and Mining	Economic Output	-81.4	-33.3	-23.5
	Administration and Compliance	-5.1	-3.0	-2.5
	Total	-86.5	-36.3	-26.1
Trickle Irrigation Farming	Economic Output	-38.8	-29.8	-20.9
	Administration and Compliance	-26.4	-4.1	-3.2
	Total	-65.1	-33.9	-24.1
Navigation	Economic Output	-7.6	-5.0	-3.0
	Administration and Compliance	-2.3	-1.3	-1.1
	Total	-9.9	-6.3	-4.1
Ports	Economic Output	-0.9	-0.5	-0.2
	Administration and Compliance	-0.1	-0.0	-0.0
	Total	-1.0	-0.6	-0.3
Royal Parks	Economic Output	-4.7	-1.8	0
	Administration and Compliance	-1.7	-0.3	-0.2
	Total	-6.3	-2.0	-0.2
Water Meadows	Economic Output	0	0	0
	Administration and Compliance	-39.9	-6.1	-4.9
	Total	-39.9	-6.1	-4.9
Internal Drainage Boards	Economic Output	0	0	0
	Administration and Compliance	-1.3	-0.8	-0.6
	Total	-1.3	-0.8	-0.6
Ministry of Defence	Economic Output	0	0	0
	Administration and Compliance	-2.3	-0.4	-0.3
	Total	-2.3	-0.4	-0.3
Road and Rail	Economic Output	0	0	0
	Administration and Compliance	-1.3	-0.8	-0.6
	Total	-1.3	-0.8	-0.6
Exempt Geographical Areas	Economic Output	0	0	0
	Administration and Compliance	-16.0	-2.5	-1.9
	Total	-16.0	-2.5	-1.9
Existing Licence Holders	Economic Output	+10.7	+15.3	+19.9
	Administration and Compliance	0	0	0
	Total	+10.7	+15.3	+19.9
Total all sectors	Economic Output	-122.6	-55.1	-27.7
	Administration and Compliance	-96.3	-19.1	-15.5
	Total	-218.9	-74.3	-43.2

6.67. Under our central analysis the net impact of option 1 will be an NPV cost of £74 million. Of this, £55 million is due to net costs on abstractors having to either maintain their abstraction volumes

due to business need or facing reductions in output. These costs arise to protect the environment from serious damage and rivers at low flows. The remaining £19 million reflects the cost of having to comply with the licensing system. Quarries and Mining, and Trickle Irrigation Farms are the largest impacted sectors, making up respectively around 40% and 38% of the cost to all new authorisations.

6.68. However it is worth noting that licensing is a more efficient mechanism for the prevention of serious environmental damage and will deliver environmental benefits at a faster pace relative to the base line and option 2. As well as the biggest environmental benefits it will have the most benefits to other existing licensed abstractors in terms of 'levelling the playing field' on top of those we've been able to quantify here. The ABM analysis gives indication of the types of benefit to existing licence holders.

Option 2: Two Year Transitional Period

6.69. This option allows for a two year transitional period whereby licence exempt abstractors can continue their activities as usual until licensing is enforced. This will delay the benefits from preventing serious environmental damage and other abstractors but also delays the point at which exempt abstractors are impacted from New Authorisations.

Table 6.8: Summary of option 2 net Impacts (NPV £m 2014)

Sector	Impact	Low	Central	High
Quarries and Mining	Economic Output	-65.6	-27.0	-18.9
	Administration and Compliance	-4.0	-2.3	-1.9
	Total	-69.6	-29.3	-20.8
Trickle Irrigation Farming	Economic Output	-29.9	-23.0	-16.1
	Administration and Compliance	-21.3	-3.4	-2.7
	Total	-51.2	-26.5	-18.8
Navigation	Economic Output	-5.9	-3.9	-2.3
	Administration and Compliance	-1.8	-1.0	-0.8
	Total	-7.7	-4.9	-3.1
Ports	Economic Output	-0.7	-0.4	-0.2
	Administration and Compliance	-0.1	-0.0	-0.0
	Total	-0.7	-0.4	-0.2
Royal Parks	Economic Output	-3.6	-1.4	0
	Administration and Compliance	-1.4	-0.2	-0.2
	Total	-4.9	-1.6	-0.2
Water Meadows	Economic Output	0	0	0
	Administration and Compliance	-32.3	-5.2	-4.1
	Total	-32.3	-5.2	-4.1
Internal Drainage Boards	Economic Output	0	0	0
	Administration and Compliance	-1.0	-0.6	-0.5
	Total	-1.0	-0.6	-0.5
Ministry of Defence	Economic Output	0	0	0
	Administration and Compliance	-1.9	-0.3	-0.2
	Total	-1.9	-0.3	-0.2
Road and Rail	Economic Output	0	0	0
	Administration and Compliance	-1.0	-0.6	-0.5
	Total	-1.0	-0.6	-0.5
Exempt Geographical Areas	Economic Output	0	0	0
	Administration and Compliance	-12.9	-2.1	-1.6
	Total	-12.9	-2.1	-1.6
Existing Licence Holders	Economic Output	+8.7	+12.4	+16.1
	Administration and Compliance	0	0	0
	Total	+8.7	+12.4	+16.1
Total all sectors	Economic Output	-97.0	-43.3	-21.4
	Administration and Compliance	-77.6	-15.7	-12.6
	Total	-174.6	-59.0	-33.9

6.70. Under our central analysis the net incremental impact of option 2 will be an NPV cost of £59 million. Of this, £43 million is due to net costs on abstractors having to either maintain their output

or facing reductions in output to prevent serious environmental damage or protect rivers at low flows. The remainder reflects the cost of complying with the licensing system. The net impacts here are lower than those under option 1 as the policy is launched after a two year delay. Similarly as under option 1, the majority of the costs fall on the two sectors Quarries & Mining and Trickle Irrigation farms.

- 6.71. Licensing will deliver greater environmental and economic benefit compared to the base line but this will be delivered later than compared with option 1.
- 6.72. Despite commissioning work and seeking stakeholder advice we have not monetised the benefits to the environment and all the benefits to other abstractors to demonstrate conclusively this should be the preferred option. However, we consulted on the transitional timeframes to provide further evidence – stakeholders found this option to be the most acceptable. We therefore concluded this option provides the best balance between a reasonable implementation timeframe for exempt abstractors and the regulator and delayed environmental and other abstractor benefits. We also believe this option will meet our EU obligations noting it does not fully mitigate risks as option 1 would. We believe a period for much longer than 2 years would be difficult to justify as being a reasonable period to delay implementation of the benefits.

Non-Monetised Impacts

- 6.73. As previously mentioned the current abstraction licensing system is being reviewed as the Government works to reform abstraction management. Control of water resources across a catchment will be essential for the reform of abstraction licensing to work effectively. As discussed we sought evidence to inform our decision on the length of the transitional period through consultation and have made a policy decision trading off between a reasonable transitional period for exempt abstractors versus delaying the benefits to other abstractors and the environment.
- 6.74. Three other types of benefit from New Authorisations have been identified but cannot be quantified or monetised. They are discussed qualitatively here.
- 6.75. Environmental and Natural Capital Benefits: a major part of the rationale for New Authorisations is to help maintain and improve the environmental status of water bodies. There will be benefit to curtailing abstractions at risk of causing serious damage to the environment, and also benefit from putting restrictions on water usage (through Hands-off-Flow conditions) that prevent environmental damage taking place at times of water scarcity.
- 6.76. The abstraction licensing system aims to ensure that groundwater and surface water resources are managed sustainably and with minimal impact on the environment. In order to maintain the biodiversity and ecosystem services associated with groundwater and freshwater systems, at least a minimum requirement of water must remain within these systems. Groundwater and surface water bodies that are over-abstracted do not meet their environmental flow requirements and thus the environmental quality may decline. This may be characterised by impacts on water quality and ecology.
- 6.77. There may be a number of ecosystem services affected through the impact of exempt abstractions on the environment. The total value of these ecosystem service is substantial for instance the annual value of ecosystem service flows related to water abstracted for public use is estimated to be £1.2billion/yr³⁸. However it is difficult to monetise the environmental benefits here. The site-specific abstraction data necessary to assess the scale of damage and improvement in

³⁸ UK natural capital: monetary estimates,2016:

<https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/monetaryestimates2016#asset-value-estimates>

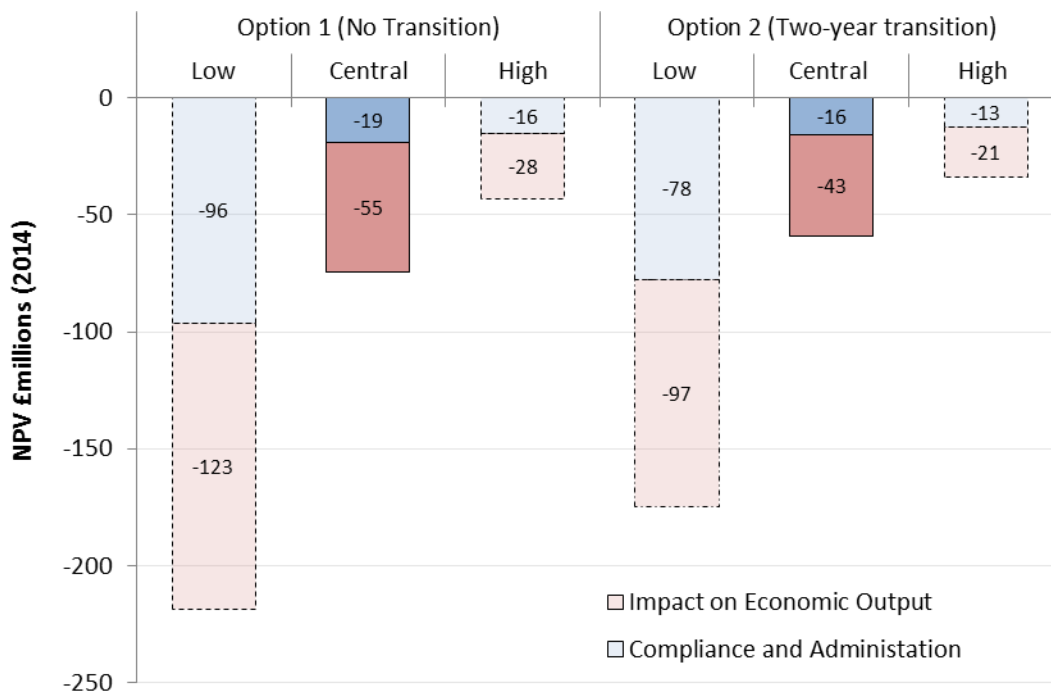
environmental flows or ecological status is limited. for instance, groundwater abstraction has very complex interactions with surface flow levels. Any estimates of environmental benefit would need to link to specific water bodies on a case-by-case basis and substantial further evidence would be needed about specific exempt abstraction for which data is limited.

- 6.78. Levelling the playing field: Over-abstraction can reduce the availability of water for existing licence holders. The incentives faced by licence exempt abstractors are different to those of their licensed counterparts: the social cost of their actions diverges from their private cost.
- 6.79. Unlicensed abstractions that deplete water flows over a sustained period are deteriorating the water availability in water bodies. Gradually the existing baseline licensing system would reflect this with stronger abstraction restrictions imposed on abstractors in the licensing system but, relative to unlicensed abstractors, those that are licensed will incur higher associated costs. Bringing abstractions into licensing control will correct for this.
- 6.80. The monetised analysis includes an estimate of the benefit for existing licence holders in the agricultural sector from availability of additional water as unlicensed abstraction is controlled. There could also be some similar gains in other sectors and potentially overall a more efficient allocation of water amongst abstractors once all activities are brought within licence control. Finally there is an intangible benefit through the perception of greater even-handedness or fairness.
- 6.81. Costs of not having a transition period: The transitional arrangements are designed to let exempt abstractors gather information, to assess strategically their response to New Authorisations and to carry out any necessary investments; a longer transition would be associated with a more efficient long term outcome.
- 6.82. It has not been possible to model the benefit to abstractors of knowing in advance when restrictions will happen. In the ABM, it is possible that a small part of the differences in the results between the different transition periods could have arisen from aspects of the model that incorporate some element of these transitional gains:
- Modelled abstractors will observe more years of emerging climate with a longer transition period, so they can compare their production growth plans against the availability of water over a longer period (reservoir investment decisions for example are based over several years), and;
 - The optimum adaptation strategy can change depending on when the restrictions bite due to the modelling circumstances in that particular year.
- 6.83. In practice we might expect abstractors to be able to plan for and mitigate against the impacts of potential water restrictions. The other benefit of a longer transition is the delay to cost impacts on the affected sectors which have been captured in the analysis.

7. Conclusion

- 7.1. The overall costs of options 1 and 2 relative to the Base Line are illustrated in *figure 7.1*. It is worth noting that in all options most costs fall to the quarry and mining and the agriculture sectors because of the potential risk of serious environmental damage. Although we do not believe many abstractors are causing serious damage, however where they are, costs can be high. The agriculture sector would also face the costs due to hands off flow restrictions but these costs are distributed more evenly.
- 7.2. The costs of option 1 are the greatest mostly due to the immediate commencement date of environmental protection and the subsequent impact on business. Whereas for option 2, the transitional arrangements allow for two years of avoided costs to business and similarly delay delivery of environmental benefits from curtailing and restricting harmful abstractions and economic benefits to other abstractors. For both options, the combination of non-monetised benefits and requirements of EU law provide the justification for the monetised net costs. The choice between options 1 and 2 is a judgement made based on stakeholders views about practicality. Option 2 provides a reasonable transitional period that allows the regulator to carry out the new licensing and currently exempt abstractors to adapt their operations to comply with the licensing arrangements, while not unreasonably delaying benefits to the environment and other abstractors.

Figure 7.1: Summary of monetised net impacts of New Authorisations for options 1 and 2



8. One-In, Three Out and other regulatory impact considerations

- 8.1. This policy is out of scope because it is an EU requirement.
- 8.2. New Authorisations will meet the requirements of the European Union Water Framework Directive (WFD). WFD requires Member States to have: “controls over the abstraction of fresh surface water and groundwater, and impoundment of fresh surface water, including a register or registers of water abstractions and a requirement of prior authorisation for abstraction and impoundment. These controls shall be periodically reviewed and, where necessary, updated. Member States can exempt from these controls, abstractions or impoundments which have no significant impact on water status.”

Small and medium sized business

- 8.3. Small and medium sized business that abstract water at rates of less than 20 cubic metres a day have already been removed from licence control by provisions in the Water Act 2003. This has been particularly beneficial to the agricultural sector and other small to medium size enterprises. This will not change as a result of the proposal to remove exempt area designations. Only those who abstract more than 20 cubic metres of water a day will need to apply for a licence.
- 8.4. The current exemptions may be perceived as being unfair to those small and medium sized business who do not benefit from them. Removing the exemptions will ensure fair and equal treatment to all business sectors and abstractors of the same category or class. This policy will remove exemptions that may previously have provided a competitive advantage.

Minimum EU requirements

- 8.5. This proposal is the minimum required under WFD and involves no “gold plating”:
- The date proposed for implementation is beyond the deadline for the measure to be in place (which was December 2012);
 - The licensing system is considered the least-cost and most efficient way to help meet the WFD requirement on water abstraction. This was set out in the Cave review of competition and innovation in the water markets³⁹, and is also set out in the abstraction reform impact assessment.
 - Defra and Welsh Government will direct that the level at which the regulator refuses to issue licences is at ‘serious damage’. Only targeting abstractions that are causing serious damage is seen as a cautious but necessary initial step to improving the status of water bodies. In addition, abstractors considered to be of low environmental impact will continue to remain exempt under the Water Act 2003.
 - The licences will be issued based on historic rates of abstraction to ensure currently exempt abstractors are given their fair allocation.
 - The scheme will also grant a transitional period that allows currently exempt abstractors sufficient time to submit their licence application. During this application and determination period, applicants will be able to continue abstracting water. Once brought into the licensing regime, all abstractors will be treated on the same-level playing field.

³⁹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69462/cave-review-final-report.pdf

- We are providing additional further licence exemptions in accordance with Better Regulation principles.

Option	Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as...
	Costs	Benefits	Net		
Option 1	4.5	0.8	-3.7	No	N/A
Option 2	3.7	0.7	-3.0	No	N/A

Annex A: Policy Background

Understanding of environmental issues has developed significantly since the Water Resources Act 1963 created the current framework for abstraction licensing.

The debate about these and other abstraction licensing improvements began at a Water Summit in May 1997. This resulted in a review of the abstraction licensing system in place at the time. Following consultation, the then Government's decisions on abstraction licensing were published in Taking Water Responsibly in March 1999.

In November 2000, the then Government published a draft Water Bill for public consultation.

The then Government's response to the consultation was published in May 2002 and considered the questions and concerns raised by respondents on the proposals set out in the draft Bill. The Water Act 2003 contained those changes to improve the existing abstraction licensing system set out in the Water Resources Act 1991.

In parallel to the Water Act 2003 abstraction improvements, the European Union Water Framework Directive (WFD) was set up to help Member States manage their water resources effectively. The WFD requires each Member State to have in place a programme of measures designed to deliver "Good" water body status. To meet the objectives of the WFD, Government goes through an iterative process of first identifying issues within each of the water bodies, and then drawing up a programme of measures designed to tackle the identified environmental issues within each water body. One of the basic requirements in the initial tranche of programme of measures is to have in place prior authorisation and control of water abstraction and impoundments, except for those that have no significant impact on water status.

The Water Act 2003 included the provisions to remove remaining abstraction exemptions in England and Wales. These exempt abstractors may cause significant impacts on the environment and therefore jeopardise our ability to meet WFD requirements. The act allows us to retain or introduce new exemptions for abstractions which are low risk to the environment, eg abstractions of less than 20 cubic metres per day.

The removal of these exemptions were planned to be implemented as part of a wider package of measures introduced under the Water Act 2003. Significant benefits have been achieved through the commenced parts of this legislation, for example, the deregulation of over 20,000 low risk abstraction licences (compared to the 5,000 we expect to bring into the licensing system) and reduced advertising costs as part of the administrative process.

The Water Act 2003 allows us to make the transitional regulations that will govern the creation and determination of licence applications to bring exempt abstractions under licence control. Secondary legislation is also required to create low risk exemptions.

Annex B: Profile of Currently Exempt Abstractors

- 1 Here we set out both the hydrological and environmental characteristics for each of the groups currently exempt from licensed abstraction. The following groups are currently exempt:
 - i) Quarries and Mining
 - ii) Trickle Irrigation
 - iii) Managed Wetland Systems
 - iv) Navigation and Ports
 - v) Land Drainage
 - vi) The Crown
 - vii) Exempt Geographical Areas.
- 2 In setting out hydrological and environmental characteristics for each group, it is worth considering the some of the differences in characteristics of abstraction source type: surface-water and ground-water.¹
- 3 Surface-water is that consisted in rivers, lakes or wetlands. It is to a large extent renewable, mostly by the rainfall from the clouds, but also with waste-water resulting from the consumption of water by individuals and industry. Ground-water is water held underground in the soil or in pores and crevices in rock. By contrast ground-water holds more characteristics of being a non-renewable resource: while its stock is replenished the rate of renewal is considerable low.
- 4 Surface-water is considerably easier to obtain than ground-water but is in general of a lower quality. The quality problem is exacerbated by pollution from agricultural, urban and industrial waste. The supply of surface water is highly uncertain and may drop below subsistence levels during periods of drought.
- 5 All of these characteristics affect the decisions exempt abstractors take and the source of abstraction will have differing degrees of environmental and hydrological impact for each sector. Much of the information here has been sourced from an evidence project commissioned by Defra and produced by consultants HR Wallingford.²

Quarries and Mining

- 6 The abstraction activities of Quarries and Mines relate to the process of dewatering – the process of removing water from a resource. It is necessary to remove water because hard rock quarries must be worked dry to allow stone to be cut. Sand and Gravel quarries are usually worked dry also; in this context dewatering acts to reduce operating costs as more of the extracted resource can be recovered if the material is worked dry. However these soft compounds can be worked wet if necessary; some are worked wet out of choice where dewatering is impractical or costly.
- 7 Dewatering applies to the access (or ingress) of ground-water, either locally or from a neighbouring watercourse, or from rainfall collected in quarries and mines.
- 8 Abstractions for the purpose of dewatering are anticipated to lower the stock of ground-water in the local vicinity; the abstracted water is typically discharged to surface-water systems. Subsequently these activities are unusually deemed to be non-consumptive overall, i.e. the abstracted water is discharged back to the water environment, usually to the most convenient watercourse. This

¹ See J. Dalhuisen (1999) for a more complete discussion on the characteristics of water.

² <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18618>

practice however, usually results in a loss to the groundwater resource. There is some consumptiveness in that a small amount may be lost to evaporation.

- 9 Both surface-water and ground-water can be affected by this drawdown of water. It has the potential to influence water resources, surface water features and a number of environmental designations.³
- 10 Dewatering can affect water resources and subsequently its quality through working below the water table as well as the silting of watercourses from discharges. Where fragile ecosystems are concerned (e.g. wetlands), even small scale dewatering operations may have an impact.⁴
- 11 Finally, dewatering tends to run counter-seasonal to water shortages. For instance, in winter months or at times of high rainfall, it is common to observe higher dewatering volumes as both rainfall and groundwater volumes are higher. This seasonal pattern is site-specific and depends on factors such as geology, local climate and weather.

Trickle Irrigation

- 12 Trickle irrigation is where water falls by drop from a pipe near to the roots of plants. It is used mainly for horticulture (i.e. the cultivation of fruit and vegetables), particularly in glasshouse production, and in some cases for pot plants by farms for arable crops. The greatest proportion of water use is in the cultivation of soft fruits; water management here has a direct and sensitive impact on the quality of a high value product.
- 13 Constant abstractions can place pressure on the environment in water stressed locations. The timing and volume of water abstracted for trickle irrigation tends to be driven by the seasons – it is linked to specific crop growing seasons as well as local weather conditions. Crops grown in glass houses tends to be less seasonal and require more constant irrigation.
- 14 Unsustainable abstractions from agriculture can affect groundwater as well as surface water flows. This can be to prolong or worsen low flows that in turn may affect the ecological status of water bodies and have impact on licensed abstractors. Irrigation from groundwater pumping may reduce the flows from springs and impact on overall water levels. This can have a detrimental impact on groundwater fed wetlands in regions such as East Anglia.
- 15 For the agriculture and horticulture sector as a whole, where trickle irrigation is licensed but become constrained, a small reduction in water would lead to a large loss in crop value. A number of mitigation options may be available to the farm businesses (each with an associated cost). These mitigation options are highlighted in the report.

Managed Wetland Systems

- 16 Water meadows are areas of land either periodically inundated with water or areas over which water flows; these flows help to insulate from frost and act to deposit of nutrients and silt which encourage grass growth. More broadly most other managed wetland systems are in place to enhance the conservation of a local environmental feature.

³ Smith, R.J., Johnson, K., and Stewart, R. (2009) the relationship between aggregate extraction, the hydrology of the surrounding landscape and Sites of Special Scientific Interest in England. Unpublished Report to Natural England for the Department of the Environment, Food and Rural Affairs. The Centre for Construction Innovation Northwest, University of Salford, Manchester

⁴ Wheeler, B.D, Gowing, D.J.G, Shaw, S.C., Mountford, I.O. and Money, I.P. (2004) Ecohydrological Guidelines for Lowland Plant Communities (eds.) Brooks, A.W., José, P.V. and Whiteman, M.I. Environment Agency (Anglian Region), Peterborough.

- 17 The management of water flows to managed wetland systems for growing grass was historically a widespread agricultural practice but has declined due to changes in practice. Managed wetland systems are now recognised as an important habitat with high levels of biodiversity. Grants exist for managing wetland systems under the Countryside Stewardship scheme in England and Glastir in Wales. The removal of exemption from licensing will mean land managers must seek a licence for the abstraction of water from a river to a managed wetland system.
- 18 The abstraction from a donor river for feeding a managed wetland system may result in depleted reaches and associated environmental impacts on the donor river. The managed wetland systems provide many services to ecosystems with regard to valuable habitat, water quality and value of natural landscape. There is considered to be a minimal loss of water resource.

Navigation and Ports

- 19 Ports, harbours and navigable canals are artificial constructions that connect to natural waterways, typically to improve the efficiency of passenger and freight transport. The water levels in impounding docks and canals have to be maintained for the assets to operate effectively; a consistent supply of water is required to maintain water levels. In most cases water is supplied from surface water, although is sometimes drawn from groundwater abstraction or water impounded in reservoirs as typically occurs in the case of canals.
- 20 In some cases the relevant authority may have an operating agreement for individual abstraction with the environmental regulator. This is an agreement to reduce water abstraction when the river flow is low. Canals may need greater amounts of water to maintain levels during dry years when evaporation increases. Water levels are typically only topped up during the summer boating season. The canal network requires water abstractions in order to maintain function. If an abstraction licence was not granted then a combination of demand management and mitigation would be needed (such as the repair of leakages on the network).
- 21 Harbours and Ports will be covered by a proposed exemption for saline abstractions below fixed tidal limits (i.e. that abstractions from saline waters will be exempt). There is no evidence that the freshwater abstraction used by port authorities is causing environmental problems. The risk of licence refusal is considered to be very low and is assumed in our analysis that no operators are refused a licence. It is expected that under hands-off-flow conditions, ports and harbours can respond to the reduction in freshwater abstraction by substituting for saline abstractions where economically viable. More extreme measures would be to impose temporary or permanent restrictions on ship size using impounded docks, or even the suspension/ cessation of dock services.

Internal Drainage Boards

- 22 Here we refer to the Internal Drainage Boards (IDBs) of England and Wales. An IDB is a local public authority that manages water levels and are located in areas with special drainage requirements either within the floodplains or in broad open areas (eg the fenlands). They are typically concentrated mainly in Cambridgeshire, Kent, Lincolnshire, Norfolk, Nottinghamshire, Somerset and Yorkshire. IDB's typically abstract water to redistribute to drainage channels. This for example includes activities such as irrigation, wet fencing and warping. In Wales, the functions of IDBs are carried out by Natural Resources Wales.
- 23 Each IDB has a Biodiversity Action Plan and holds a duty to further the conservation and enhancement of all designated environmental sites within their districts.
- 24 While of low-risk, any curtailment of abstractions by IDBs may affect third parties that are dependent on this activity. For instance, in IDBs with extensive agriculture, farms would be affected

as water is currently being abstracted on their behalf. Large reductions in volumes abstracted would mostly impact on crop production (both quality and type of crop), reducing farm revenues.

The Crown

- 25 The current exemptions for the Crown extends to land owned by the Ministry of Defence (MoD) and the Royal Parks.
- 26 The MoD abstracts water, generally in areas where there is no mains supply, for a number of uses that include drinking water for housing and barracks accommodation (domestic demand, making up 88% of water use), and for operational water (12%), e.g. for vehicle washing, cleaning and water for emergency fire-fighting supplies. The majority of these abstractions come from groundwater sources, with minimal abstractions from surface water. A number of abstractions are located in or adjacent to sensitive aquatic habitats with no readily available alternative water source. Licensing may have economic impacts for specific sites but is unlikely to result in large scale disruption of operations. Since the MoD abstractions support drinking water and sanitation uses, this high priority water use would be taken into account in licensing decisions and hence is felt likely that only a small number of licences (if any) would be refused.
- 27 The Royal Parks manages nine parks located in the London area, consisting of 5,000 acres of historic parkland. The largest volumes of water are abstracted during dry summers when other water sources, such as lakes, become unavailable. The Royal Parks is actively looking to increase sustainable development in the management of the parks and monitors their water usage. Our analysis assumes that under licensing, environmental regulators may issue hands off flow conditions. If there is the risk of serious environmental damage the Parks to be unable to irrigate during dry periods. There are likely to be mitigation measures (such as rainwater harvesting) that reduce any impacts of this constraint.

Exempt geographical areas

- 28 Exempt areas are those geographical areas where a general exemption has been given from the need for abstractions to be licensed. Abstractions in exempt areas are expected to be small and therefore individual abstractions are unlikely to have an environmental impact, although it is recognised that a number of these activities in the exempt areas may have a cumulative impact on the environment or impacts on the accessibility of nearby abstractors to water. Therefore, it is assumed for the purposes of this analysis that almost all of these abstractors are likely to be granted licences, although hands off flow conditions could be implemented if there is a risk of serious damage.
- 29 We nevertheless acknowledge the possibility that some such abstractions in these areas may be impacting the environment, or other abstractors' access to water, even in cases where the impact is such that serious damage provisions are not likely to apply. It is not however possible to assess these impacts without knowing the precise locations, associated activities and volumes abstracted. We therefore are unable to comment and determine the costs to the environment and other abstractors, although we would anticipate that they are likely to be localised to specific sites.

Annex C: Agent Based Modelling

- 1 This annex gives further detail of abstraction behaviour used in our analysis. The model used is referred to as the 'Agent Based Model' (hereafter ABM) and where possible it is our preferred approach to assessment the full range of impacts.
- 2 The modelling here was developed by consultants Risk Solutions in support of the impact assessment on the abstraction reform. The full detail of the ABM model specification is covered in a supporting report published alongside abstraction reform impact assessment.⁵ Nonetheless we recapture some of the high-level information here and set-out the few adjustments to the model done for this analysis.
- 3 The ABM is the integration of two interacting models: a hydrological model of river catchment areas combined with an 'agent based' behavioural model of water abstraction. Together they help to explore the effects of different policies concerning water abstraction and allow for the comparison of economic costs and benefits, and the environmental performance of each option.

⁵[http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18182#Related Documents](http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18182#RelatedDocuments)

Annex D: Top-Down Assessment

- 1 The majority of our evidence is founded on a Defra research study into the scale and impact of New Authorisations; if not drawn upon directly in the analysis in the Impact Assessment, some of the study's findings will have underpinned input assumptions in the Agent Based Model.
- 2 This study was published by DEFRA in 2013 and was the result of work commissioned by consultants HR Wallingford and Vivid Economics.⁶ The findings of the study then feed into our top-down analytical assessment. In particular estimates on the numbers of licences to be refused due to risk of serious damage, and what impact (qualitative or quantitative) will a Hands-off-Flow restriction have are used in our core assessment.
- 3 This work was commissioned to help contribute towards an evidence base where little-to-no information on exempt licence activities had existed previously. It has made possible the top-down analytical work to be completed.

⁶ <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18618>

Annex E: Compliance and Administration Costs

1 Note these costs are not NPV figures and are in 2008/09 prices as they originate from the original 2009 consultation on secondary legislation. They have been represented as 2014 prices in our final analysis. Orange estimates indicate uses of updated figures that have been revised down to 2008/09 prices.

Transfer Licence	2008/09 Prices		Cost						% of exempt abstractor costs occur to									
	Frequency	Cost Best	Low	Cost Low	High	Cost High	Best	Coverage Best	Low	Coverage Low	High	Coverage High	Best	Expected Best	Low	Expected Low	High	Expected High
Metering/measurement	12 years	0	0	0	0	0	50%	50%	50%	50%	50%	50%	0	0	0	0	0	
time gathering data	12 years	182	91	910	100%	100%	100%	100%	100%	100%	100%	100%	182	91	910	182	91	
application fee	12 years	1309	1309	1309	100%	100%	100%	100%	100%	100%	100%	100%	1309	1309	1309	1309	1309	
advertising (newspaper)	One-off	350	300	400	5%	5%	5%	5%	5%	5%	5%	5%	18	15	20	18	15	
Advertising (admin)	One-off	87	87	87	5%	5%	5%	5%	5%	5%	5%	5%	4	4	4	4	4	
environment report	One-off	5000	5000	5000	5%	0%	5%	0%	0%	20%	20%	20%	250	0	1000	250	0	
professional advice	One-off	1500	1500	1500	5%	0%	5%	0%	0%	20%	20%	20%	75	0	300	75	0	
Annual charge	Annual	0	0	0	100%	100%	100%	100%	100%	100%	100%	100%	0	0	0	0	0	
Record keeping, etc...	Annual	0	0	0	100%	100%	100%	100%	100%	100%	100%	100%	0	0	0	0	0	

Full Licence	2008/09 Prices		Cost						% of exempt abstractor costs occur to									
	Frequency	Cost Best	Low	Cost Low	High	Cost High	Best	Coverage Best	Low	Coverage Low	High	Coverage High	Best	Expected Best	Low	Expected Low	High	Expected High
Metering/measurement	12 years	400	400	400	50%	50%	50%	50%	50%	50%	50%	50%	200	200	200	200	200	
time gathering data	12 years	182	91	910	100%	100%	100%	100%	100%	100%	100%	100%	182	91	910	182	91	
application fee	12 years	118	118	118	100%	100%	100%	100%	100%	100%	100%	100%	118	118	118	118	118	
advertising (newspaper)	One-off	350	300	400	5%	5%	5%	5%	5%	5%	5%	5%	18	15	20	18	15	
Advertising (admin)	One-off	87	87	87	5%	5%	5%	5%	5%	5%	5%	5%	4	4	4	4	4	
environment report	One-off	5000	0	5000	5%	0%	5%	0%	0%	20%	20%	20%	250	0	5000	250	0	
professional advice	One-off	2000	2000	2000	5%	0%	5%	0%	0%	20%	20%	20%	100	0	2000	100	0	
Annual charge	Annual	120	22	300	100%	100%	100%	100%	100%	100%	100%	100%	36	22	36	36	22	
Record keeping, etc...	Annual	102	102	102	100%	100%	100%	100%	100%	100%	100%	100%	102	102	102	102	102	

Annex F: England and Wales Impact Disaggregation

- 1 Below is a rough breakdown of the net impact between England and Wales for options 1 and 2 (figures are £million NPV).

Option	Country	Low	Central	High
Option 1: No Transitional Arrangements	England	-204.7	-69.4	-40.2
	Wales	-14.2	-4.9	-3.0
	Total (E&W)	-218.9	-74.3	-43.2
Option 2: Two-Year Transitional Arrangement	England	-163.2	-55.1	-31.6
	Wales	-11.4	-3.9	-2.4
	Total (E&W)	-174.6	-59.0	-33.9

- 2 These figures have been derived by apportioning the total England & Wales impact between the two. Where possible, this was based on numbers of affected agents in each country taken from the HR Wallingford / Vivid Economics Evidence Study, we have made use of this in splitting out the combined England & Wales impact. Otherwise the impacts are apportioned by population. The table below sets this out by sector and type of impact.

	Impact on Economic Output	Compliance and Administration Cost
Quarries and Mining	Apportioned using the number of relevant abstractions. From the HR Wallingford/ Vivid Economics Evidence Study, an estimated 11% of all quarry and mining abstractions in England & Wales, are in Wales.	
Trickle Irrigation Farming	Apportioned using shares of the number of relevant abstractions in England and Wales. From the HR Wallingford / Vivid Economics Evidence Study, an estimated 1.6% of the trickle irrigation abstractions are in Wales.	
Ports	HR Wallingford / Vivid Economics Evidence Study indicates equal numbers of ports in England & Wales that could be affected by restrictions	Apportioned using the population shares of England and Wales.
Navigation	Apportioned using the population shares of England and Wales	Apportioned using the population shares of England and Wales.
The Crown (MoD and Royal Parks)	Royal Parks all in England. No effect on economic output for MoD.	Royal Parks all in England. MoD admin costs apportioned using population shares.
Managed Wetland Systems, Internal Drainage Boards, Road and Rail, Exempt Geographical Areas	No impact on economic output for these sectors	Apportioned using the population shares of England and Wales
Existing Licence Holders	Apportioned using the population shares of England and Wales	
Compensation payments	Apportioned using the population shares of England and Wales	