

# Economic impact of the National River Flow Archive

Final Report

UK Centre for Ecology and Hydrology

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10F Printing House Yard  
Hackney Road  
London E2 7PR

 +44 (0) 20 7580 5383  
 [eftec@eftec.co.uk](mailto:eftec@eftec.co.uk)  
 [eftec.co.uk](http://eftec.co.uk)

This document has been prepared for UK Centre for Ecology and Hydrology by:

Economics for the Environment Consultancy Ltd (eftec)  
10F Printing House Yard  
Hackney Road,  
London, E2 7PR  
[www.eftec.co.uk](http://www.eftec.co.uk)

### Study team:

Duncan Royle  
Victoria Reeser

### Reviewer

Ece Ozdemiroglu

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### Document evolution

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## Abbreviations & Acronyms

API	Application Programming Interface
DfIR	Department for Infrastructure – River (in Northern Ireland)
EA	Environment Agency (for England)
GBNNSIP	Great Britain Non-native Species Information Portal
NGOs	Non-Government Organisations
NRFA	National River Flow Archive
NRW	Natural Resources Wales
SEPA	Scottish Environmental Protection Agency
ToC	Theory of Change
UK	United Kingdom
UKCEH	UK Centre for Ecology and Hydrology
WTP	Willingness to pay

# 1. Introduction

UK Centre for Ecology and Hydrology (UKCEH) has commissioned a project to assess the economic value of two of its data resources. This work feeds into the Research Development and Impact division's reporting efforts to communicate the value of UKCEH's resources to funders and the public. This project, therefore, aims to conduct an economic impact analysis to uncover and estimate the economic impact of two data resources provided by UKCEH, namely:

- **National River Flow Archive (NRFA):** this historic dataset includes daily flow, (gauged and natural) runoff, maximum flows, rainfall, and catchment geological information. It is used to assess water availability, flood risk and impacts of climate change over time.
- **Great Britain Non-native Species Information Portal (GBNNSIP):** provides access to distribution maps and other information for all non-native species in Great Britain. Through INNS Mapper or iRecord, members of the public can report sightings. It is used to monitor and map species sightings and inform policy on the prevention and management of invasive species.

This report is about the methodology designed to evaluate the economic impacts of the National River Flow Archive (NRFA) in the UK. This report has four sections:

- Section 2 provides an overview of the economic impact methodology, explaining key terms and the background used for selecting a suitable method for the NRFA.
- Section 3 applies the methodology to the data about the NRFA, and
- Section 4 presents the results of the economic impact assessment.

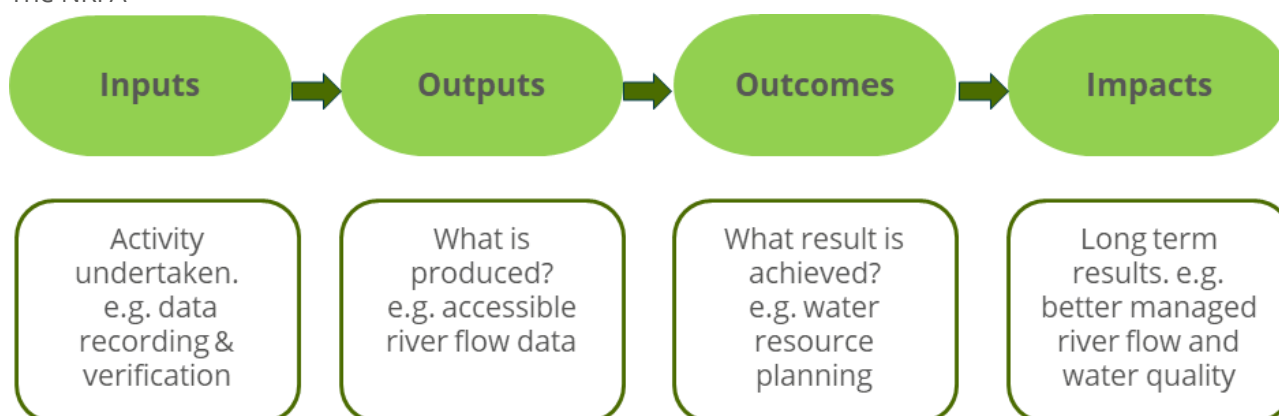
There is a separate report presenting the methodology, application and results for the GBNNSIP.

## 2. Economic impact assessment methodology

### 2.1 Overview and key questions

Our economic impact assessment model is based on a linear theory of change model and aligns with the guidance presented in HMT Magenta book: Central Government Guidance on Evaluation (2020). A Theory of Change (ToC) approach aims to provide an understanding of how an intervention is expected to achieve its desired impacts and is typically done through synthesising existing evidence. This involves an assessment of the steps required to deliver the desired impacts, the assumptions made, the quality and strength of the evidence supporting them, and the wider contextual factors. This model, with examples from the NRFA process, is illustrated in Figure 2.1.

The NRFA



**Figure 2.1: Economic Impact Assessment Model**

Furthermore, any economic impact analysis must answer four key questions:

- 1) **What is the good or service to be valued?** In this case it is the data archived by the NRFA. Answering this question requires an understanding of the process – in other words ‘the value chain’ that leads to the beneficial outputs, outcomes and impacts. For specifics of the NRFA, see Section 3.1;
- 2) **How is the good or service used and what are the benefits?** This involves understanding the uses of the NRFA, and then the subsequent benefits of those uses. Not all the benefits can be evaluated in a project of this size, so choices will need to be made as to which benefits are the most material to evaluate and which can be evaluated within the resources of this project. The benefits are expressed in relation to a counterfactual where the good or service valued does not exist. i.e., the counterfactual outcomes without the NRFA. For specifics of the NRFA, see Section 3.2.

The assumed counterfactual for the NRFA is that river flow data is still collected (through existing hydrological monitoring stations), and stored regionally by authority, but not brought together in a nationally consistent quality assured dataset that is easily searchable and is not verified to correct for spurious data. In the absence of the NRFA, raw data monitoring would continue, but the aspects that would be lost are:

- Ease of access to a searchable database that contains all monitoring authorities' relevant data in one location,
- Validation and correction of the dataset,
- Consistent quality assurance across devolved nations, and
- Supporting meta data that facilitates the selection and use of raw data.

This would mean some uses (and their benefits) would be lost but other uses may still be viable, albeit at extra cost of data gathering and at the loss of some accuracy (due to the lack of data verification). For example, national flood risk assessments could still be done without the NRFA (but at higher cost). In this case the main benefit of the NRFA would be the time saved and marginal benefit of greater accuracy.

- 3) **Who are the users and beneficiaries?** The users and beneficiaries could be the same or different. For example, researchers would be the *users* of data to support, say, policy making, who are the *beneficiaries*. Beneficiaries could also include numerous stakeholders such as water companies and the general public on whose behalf the policy is made. For specifics of the NRFA, see Section 3.2.
- 4) **What are the benefits worth?** The type of benefit determines the data and the relevant valuation method to measure the benefits in monetary terms. Selecting the relevant method will also depend upon a range of factors such as the desired level of confidence, availability of valuation data, definition of the counterfactual and the extent to which the method is likely to provide a fair representation of the benefit.

The methods that use existing data from markets can be grouped loosely as follows – with examples from the case of the NRFA, and the list of benefits is described in more detail in Section 3.2:

- **Benefit of ease of use:** Collation of data can save time for users of the data. Time saved can be valued by applying an hourly rate to the time saved by making the data more accessible.
- **Avoided damage loss:** The main beneficial outcome from using the NRFA data is the avoided damage from flood events that would occur in the absence of NRFA data. For example, the EA could implement flood mitigation measures in areas of high future risk of flooding to avoid damage to infrastructure, housing etc. Data on the economic value of damage to property, for example, can be used to calculate this benefit.
- **Avoided management cost:** NRFA data could also lead to savings in management costs:
  - **Long term management:** Knowledge derived from analysing the data archive could be used to find more cost-effective ways to manage water resources.
  - **Prevention costs:** Assuming better knowledge leads to better prevention, the use of NRFA data could also lead to finding ways of reducing prevention costs. Cost savings could come about due to less preventive expenditure being needed (for example, use of nature-based flood mitigation solutions may avoid more costly conventional flood risk infrastructure solutions) or due to early action saving higher costs later.
- **Benefits for continued research:** Collated datasets are used in research and are key to enabling the development of knowledge.

The above valuation methods can be used in combination so long as double counting is avoided. For example, if NRFA data is used to plan more effective flood mitigation schemes, then avoided damage costs or avoided management costs can be calculated. However, only one of these methods should be used for valuation as they could be mutually exclusive (if risk is managed, damage is already avoided) and using both valuation methods double count the benefits to some extent.

An alternative to using market data (as above) would be to create hypothetical markets and ask users and beneficiaries what they are willing to pay for the benefit of using the data (the output of the NRFA). Through carefully designed surveys, the choices respondents make are recorded, e.g. how much they are willing to pay for the data given how much time, damage or management cost they may save.

The success of an economic impact analysis in the special case of valuing data, access to data and related research outputs depends on having a good understanding of the following:

- The value chain from the gathering of the data, through collation and analysis to use – acknowledging that not only the results but also the way the process is conducted could have economic value.
- The counterfactual of what would happen in the absence of the data resource, including alternative ways of acquiring the same / similar data, and if this is not possible, how the uses of the data / research would be affected.

## 2.2 Value chain of the data flow process for NRFA

Figure 2.2 shows the process of data collection to collating, verifying and providing data for users for the NRFA. This is called a value chain as each stage in the process can add value to the information being processed. This general framework has been applied to the NRFA and developed into specific data flow processes as described in Section 3.

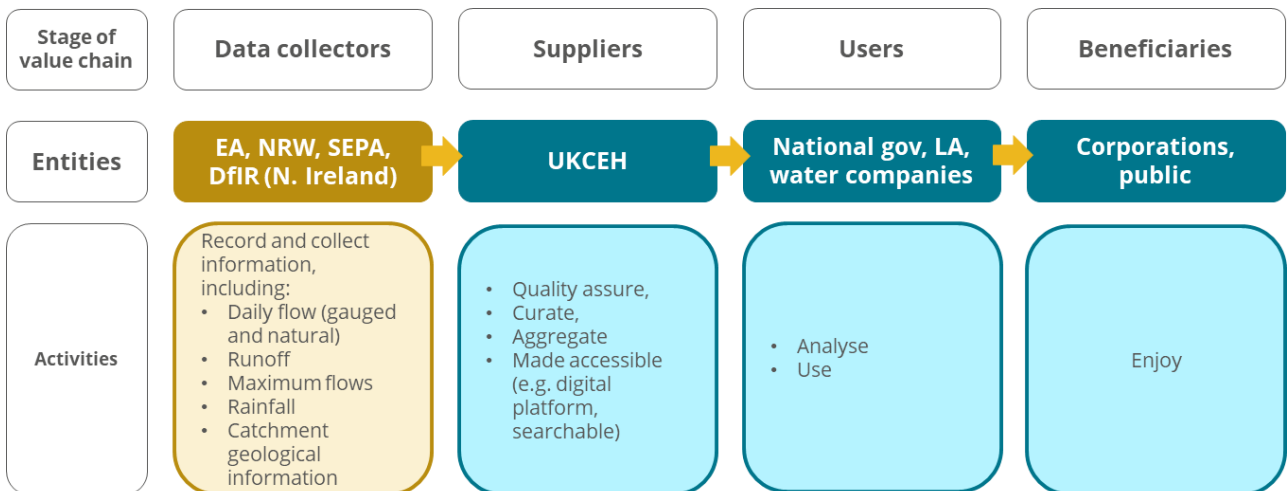


Figure 2.2: Value chain of data provision process

A basic summary of the value chain for NFRA is as follows:

**Input of information.** The NRFA is the UK's most comprehensive river flow database and therefore comprises a large set of data that is regularly being updated. This information is collected by regional monitoring authorities, which are the Environment agency (EA), the Scottish Environment Protection Agency (SEPA), Natural Resources Wales (NRW), and Department for Infrastructure – River in Northern Ireland (DfIR).

**Suppliers.** This information is supplied annually from the hydrological monitoring authorities to UKCEH whose function is to quality assure, curate, and aggregate the information, and make it accessible to the public. The value in this stage is in the improved quality, curation, and accessibility of data from multiple sources.

**Users.** Users, such as EA, SEPA, NRW, DfIR, local authorities, and infrastructure companies, such as water companies, access the information from the NRFA and use it to inform their actions and decision-making (detailed in Figure 3.1).

**Beneficiaries.** Beneficiaries are those who benefit from the actions and decisions of users. For example, this can include householders who avoided damages from mitigation (e.g., better design of flood defences to address flood risk) or more generally living in areas with better river flow management.

## 2.3 Identifying the NRFA value chain

The value chain described in this section was developed through research and conversations with the expert team from UKCEH that manages the NRFA. From conversation with the lead experts of the NRFA, it was decided that the best method to identify the archive's value chain (i.e., its uses and benefits) was through interview with its key users.

A list of potential interviewees was created by UKCEH considering a past project conducted by UKCEH and the EA that had interviewed key users of the archive to discuss future water data needs. The long list included 15 persons from water companies, consultancies, and monitoring authorities across the UK. ***Five organisations (water companies, public sector agencies and consultancies) were interviewed across England and Wales.***

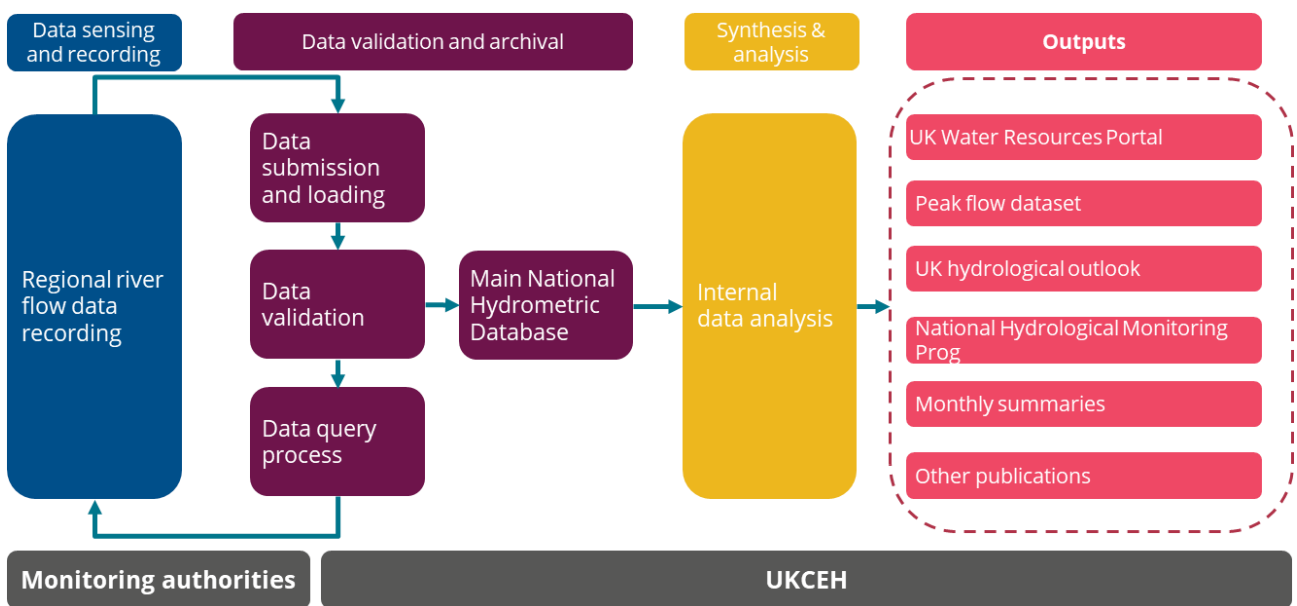
The key facets of the NRFA's value chain, discussed in Section 3, were identified through these interviews. Further, assumptions made in Section 4 were shared with relevant interviewees to provide greater robustness to the analysis results.

### 3. Estimating the economic impact of NRFA

This section applies the conceptual method described in Section 2 and considers the four key questions for this archive. Understanding the data process is described in Section 3.1 (question 1). Describing the uses, benefits, users and beneficiaries is covered in Section 3.2 (questions 2 and 3 as these are intricately linked). Discussion of the possible valuation approaches (question 4) is covered in Section 3.3, including the rationale for the approaches selected for this project. Finally, Section 3.4 describes the method we propose to use to evaluate the benefits, which will be presented in the final version of this report (Section 4).

#### 3.1 Overview of the NRFA process

The flow of data is presented in Figure 3.1 and shows the scope of UKCEH activity and that conducted by monitoring authorities.



**Figure 3.1:** NRFA data process

In addition to the web-based portal/archive, the most significant outputs of this process (shown as publications in Figure 3.1) are:

- **Peak flow dataset**, used to estimate risk of flooding in conjunction with the Flood Estimation Handbook<sup>1</sup>.
- **UK water resources portal**, providing dynamic, interactive situation monitoring, mapping and plotting and a wide range of variables including rainfall, river flow, groundwater levels and soil moisture measurements.
- **Monthly summaries**, providing topical summaries of recent rainfall, river flow, soil moisture, groundwater status, and reservoir stocks.

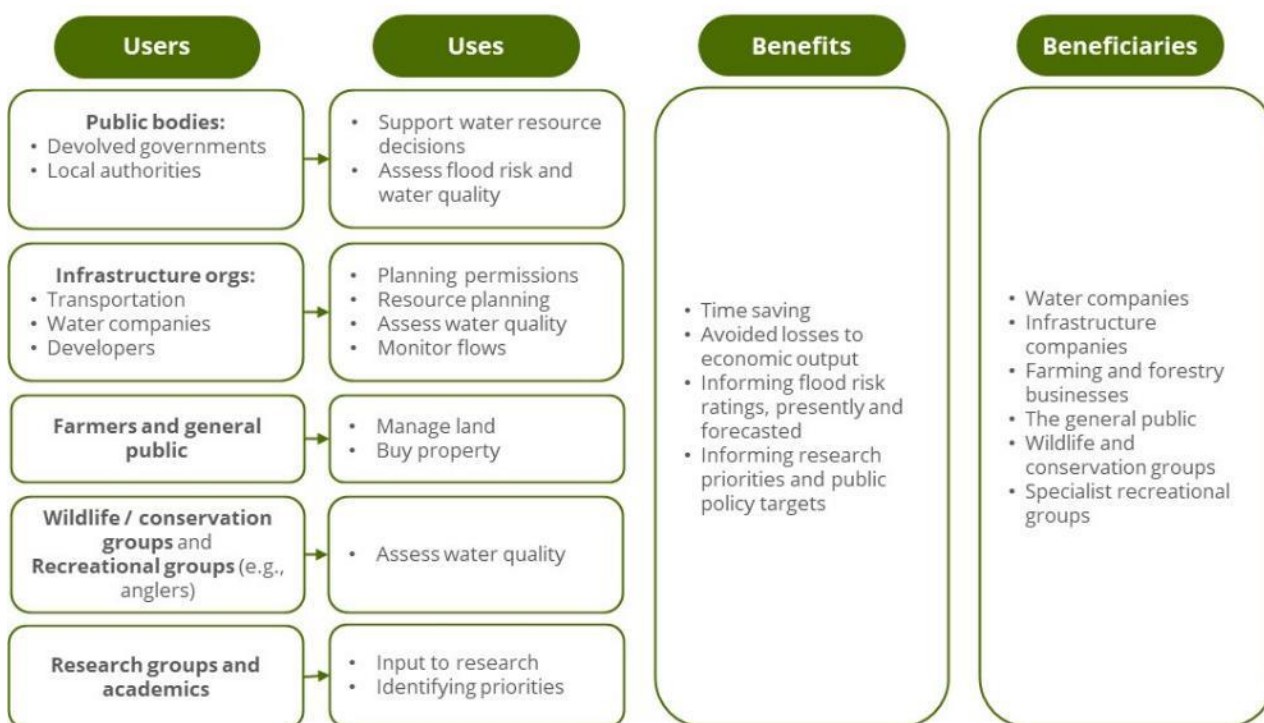
<sup>1</sup> See: <https://www.ceh.ac.uk/data/software-models/flood-estimation-handbook>

- **UK hydrological outlook**, providing a one and three-month outlook of rainfall, river flow, and groundwater levels.
- **The National Hydrological Monitoring Programme**, providing, “a wide range of analyses to exploit the data holdings of the archive and has a particular obligation to document contemporary hydrological conditions and to identify and interpret long-term hydrological change and variability”<sup>2</sup>.
- **Trends analyses, news articles and ad-hoc publications.**

### 3.2 Users, uses, benefits and beneficiaries

This section highlights the most significant benefits that we think are capable of robust economic valuation within the timescales and resources of this project, and describes the other benefits considered, and reasons for not evaluating them here. The assessment of what benefits are significant is done by considering first the main users of the NRFA, the uses they make of the data, and then the benefits that these uses provide. The final step is to consider who are the main beneficiaries of these benefits.

In discussion with experts from UKCEH, and from interviews with key users, we understand that the principal users, uses, benefits and beneficiaries of the NRFA are as shown in Figure 3.2.



**Figure 3.2: Users, uses, benefits and beneficiaries of river flow monitoring and reporting**

Based on the conversations with UKCEH and interviews with key users, the most significant uses by user group are:

<sup>2</sup> From: <https://nrfa.ceh.ac.uk/nhmp>

- **Public bodies** (mainly UK government and devolved environmental authorities) for; flood risk assessment, mitigation policy and planning, and water resource management policy (including water quality issues). For example, NRFA data is key in supporting flood risk assessment and water resources planning through:
  - National Flood Risk Assessments (NaFRA2 due next in 2024)
  - Published flood risk maps
  - Setting national water resourcing policies and planning
  - Informing flood risk investment priorities (e.g. for EA, NRW, internal drainage boards etc.)
  - Input to and use in the Flood Estimation Handbook.
- **Developers and consultants.** To calculate flood risk assessments, avoiding building in high flood risk zones, and planning flood risk mitigation schemes. Peak flows data provided via the NRFA is required to estimate flood risk in alignment with the Flood Estimation Handbook, which is a requirement to apply for permitting development in a potential flood risk zone. Flood risk assessments are required under certain circumstances for planning applications. Non-NRFA data is more cumbersome to use.
- **Water Companies.** Input to production of 'Water Resource Management Plans' which inform on effective use of water resources. Water companies find the NRFA database is easier to use than EA or their own data.
- **Infrastructure organisations.** Used in a range of applications such as planning water resources for cooling power plants, to flood risk assessments for transport networks.
- **Conservation groups, specialist recreational groups and associated NGOs.** Assessing water flow and quality for specific habitats, biodiversity and recreational purposes.
- **Farmers.** Monthly summaries and outlooks have been used in planning water use, drought planning and harvesting/managing crops and grazing.
- **Research organisations.** Hydrological research carried out by universities and other research bodies. NRFA data used in research programmes to further knowledge in water resource management and flood risk management.

In consultation with selected interviewees (users), the most significant benefits of these uses include:

- **Avoided damages and losses:** Avoiding flood damage through better planning of development and infrastructure (outcome), and so avoiding economic losses (impact).
- **More effective use of resources:** Better use of water resources (outcome), leading to lower water supply costs and improved water environment condition (impacts). More targeted flood mitigation investments (outcome) leading to lower flood mitigation expense.
- **Time savings (through ease of data access and use):** Expense saved through access and use of NRFA data (compared to counterfactual of no NRFA) (input). Specifically:
  - **Speed and ease of data download.** If data is requested from each hydrological authority the wait-time is in the region of 20 to 40 working days. Not only can this cause project delays, but

this can be a very serious setback if a rapid decision is required (e.g. safety checking of a dam in peak rainfall events). It is not possible to estimate the economic costs of this lag but should be considered qualitatively in an assessment of the NRFA's value.

- **Quality assurance of the data.** NRFA data is quality assured by a team of UKCEH hydrologists and coordinated with quality assurance provided by the monitoring authorities. This provides a level of assurance that is very valuable to users. It also aligns many sources of hydrological data to one template, that can be easily translated into hydrological models. Without this extra layer of quality assurance and formatting, *users would have to spend significantly more time cleaning and reviewing the data.*
- **Avoids time processing data requests in nation authorities.** The ease of NRFA data access avoids data requests being made to the national authorities (EA, SEPA, NRW, DfIR etc). This is an additional time-saving element for the monitoring authorities and so avoids time by public servants fulfilling data flow requests. Furthermore, neither NRW nor DfIR have flow data publicly available via an API<sup>3</sup>, so the only alternate source of data is by request.
- **Support to Research:** Use of NRFA data in research, generation of new research knowledge and informing future research priorities/government policy targets (outcome).

In addition, there were many qualitative benefits of the NRFA that made it easier to use (but these were not evaluated in monetary terms):

- **Consistency of data across UK.** As the data is assured to a common standard across the UK this provides consistency which is important where hydrological modelling cuts across national boundaries (e.g. the Severn Catchment which in Wales and England, or the Tweed in England and Scotland). Also, within nations this can be important. In England, EA river monitoring repositories are managed at a county/regional level. The individual teams may manage the data differently and the NRFA ensures that the data is consistent across the nation.
- **Usefulness of meta data.** Many interviewees emphasised how useful NRFA meta data was in providing context for data from a measuring station. This also helped in selecting which station data to use for any hydrological analysis.
- **Easy to understand and use.** Many interviewees mentioned how the website is user friendly, and data can be downloaded by anyone. Many alternative data gathering options require technical product knowledge and hence is a barrier to use. For example, many project managers and non-technical persons in the EA use the NRFA rather than the EA in-house system.
- **Length of time series.** The NRFA has a very long time series of data which is important for the analysis of trends over time (e.g. climate change related research).

Table 3.1 sets out the range of general benefits that accrue from use of NRFA data. The table also sets out potential approaches to assessing these benefits. These approaches are discussed in the next section, and the final approach adopted is described in Section 3.4.

<sup>3</sup> Application Programming Interface (API) is a type of software interface that enables users to transfer data from one source (e.g. EA or SEPA) to their own programming.

**Table 3.1: Overview of benefits and potential impact assessment approach**

Benefit Group	Benefit	Level of materiality and proposed assessment
Avoided losses and damage	Avoiding flood damage through better planning	Very significant. Review range of likely damages avoided and construct representative costs avoided.
More effective use of resources	More targeted flood mitigation investments	Very significant. Establish impacts on flood mitigation investment with EA/SEPA/NRW etc.
	Better use of water resources	Very significant. Establish impacts on decision making with the water companies.
	Improvements to the water environment	Very significant, but chain of benefits may be too complex to map out.
Time savings (ease of use)	Time savings for users	Estimate time saving through number of uses (downloads) and assumed time saving for each.
Benefits for continued research	New knowledge from research using NRFA data	Whilst the number of research projects using NRFA data may be large, the impact is very difficult to predict and value in monetary terms. Hence, we do not recommend pursuing this approach further here.

### 3.3 Valuation approaches

For this project, four approaches to valuation were considered. Their description and reasoning for inclusion or exclusion are presented below.

**Approach 1. Estimate of avoided losses or cost saved through decision making.** This approach assesses the losses avoided or management costs saved from use of NRFA data. If use of the NRFA can demonstrate benefits of avoided losses or improved use of resources compared to the counterfactual case, then this approach would be key to establishing either the damage avoided, or the resource saved through more effective management. For example, NRFA data is instrumental to making better decisions such as:

- Avoiding flood damage costs, evaluated through an estimate of the better design and location of flood infrastructure investment, and the consequent damages avoided.
- Better management of water resources, estimated through the costs avoided in the water supply industry through better management decisions.

However, the counterfactual case assumes that the benefits of avoided losses and resource savings arising from decision support can be achieved through use of river flow data obtained from other sources. The impact of different quality of data can also not be estimated. Therefore, this approach was not used in this project.

**Approach 2. Time savings through use of the NRFA.** Given the economic importance of the decisions described in approach 1, the counterfactual case assumes that these decisions can be supported through similar models, but via use of raw data from the national hydrological measuring authorities and other sources. This would entail delay and extra time in gathering and quality assuring data, but in principle the same decisions can be supported in the counterfactual case. Using this valuation approach, the benefit of the NRFA is the time saved for users and providers versus the counterfactual case. This best represents the

essential difference between the NRFA and the counterfactual case, ***hence has been selected as the approach for valuing the economic impact of the NRFA.***

**Approach 3. Cost of time spent by users on NRFA as a proxy for benefits of use.** Using the cost of time spent on processing NRFA data as a proxy for benefits delivered is based on the rationale that costs are a minimum expression of value, based on the assumption that users would not spend the time had they not thought of the time as at least as valuable as the benefits of the outcome. This provides a practical and quantifiable measure of its value and offers a tangible and consistent metric to approximate value and, therefore, avoids the main challenges of more complex benefit methods such as forecasting avoided damages or resources saved in Approach 1. However, it is the time saving of the NRFA versus the counterfactual that is the fundamental benefit of the system, hence this method was not used.

**Approach 4. Willingness to pay (WTP) for the data.** This approach reveals how much organisations or individuals are willing to pay to access and use the data, serving as a proxy for the economic value of data in the UK. It shows a figure at least equal to, and more likely greater, than the value of the time spent using the NRFA data. The additional value is known as 'consumer surplus' in markets and represent the additional value users receive over and above the cost. Therefore, theoretically WTP is a more comprehensive measure than time based, and even avoided damage or cost-based approaches.

WTP surveys are most useful when services are provided for free and market spending data is missing (as is the case for the NRFA). The surveys are structured so that both direct users and beneficiaries can be interviewed. While such a survey is beyond the scope of this project, we strongly recommend its use in the future. Once designed and tested, the survey can sit on the website and collect data at no extra cost<sup>4</sup>.

Considering the advantages and disadvantages of these approaches, and given the project scope, Approach 2 was selected. In terms of economic valuation, this is a conservative assumption, given the generous definition applied to the counterfactual case. Hence, we believe the values calculated in Section 4 are a minimum indication of the value of the NRFA. The method for this approach is described in the following subsection.

### 3.4 Evaluation of the benefits

The benefit of the NRFA was estimated based on the time saved using NRFA data compared to the counterfactual case. Semi-structured interviews (with UKCEH staff and five key users) were conducted to establish the primary users, uses, and benefits of the data and alternative data sources (assumed in the counterfactual case). The counterfactual case and benefits attributable to the NRFA were defined using information gathered in these interviews.

**Counterfactual:** The counterfactual was defined as using similar models and analysis to support existing decisions using river flow and peak flow data available from the monitoring authorities (e.g., EA, SEPA, NRW, and DfR), and other sources as available (e.g., some water companies have their own data). The NRFA also includes data on rainfall, meta data on gauging station characteristics, amongst other data, but, although

<sup>4</sup> Such an approach was used to value the freely available information on the Companies House - <https://www.gov.uk/government/publications/companies-house-data-valuing-the-user-benefits>

the NRFA is a comprehensive source, some of this data exists on other publicly available sources, such as the Met Office for rainfall data.

River flow and peak flow data are available from the EA, SEPA, NRW and DfIR. This information is only accessible through an API (in the case of EA and SEPA), or through a request for data. In terms of these alternative sources, it is important to note:

- Requests for flow data from national authorities can take several weeks to process (currently around 20-40 working days). Furthermore, in the absence of the NRFA the volume of requests to these authorities would rise dramatically, and potentially lead to greater delays unless resources were increased in these authorities to cope with the higher demand. Note we have estimated the additional resource burden this could place on the national hydrological measurement authorities.
- API downloads typically require a technical background and hence limits the use of the data to persons with technical expertise. The additional cost, if any, of time from such qualified staff is not estimated here.
- Furthermore, API data is not quality assured to the same standard as the NRFA, hence this type of download would still require time to perform necessary QA checks.
- API downloads are not available in Wales (NRW), or in Northern Ireland (DfIR).

Note that in England, the EA also provides the Hydrology Data Explorer<sup>5</sup>, with similar functionality to the NRFA, enabling downloads of river flow time series by monitoring station. However, it is more limited, and for peak flow data, metadata, (including suitability for flood estimation studies), and catchment boundaries the site recommends use of the NRFA.

The EA also has its own internal system (based on the WISKI platform)<sup>6</sup> for analysing river flow data, but this requires significant technical expertise to use. From interviews it was noted that most EA staff (in particular, non-technical staff) prefer to use the NRFA. Note that WISKI provides more types of hydrological data than is stored in the NRFA and acts as a central location to access daily flow data as it is collected at regional levels for most monitoring authorities.

Additionally, the monitoring authorities have a time savings benefit from users utilising the NRFA for daily flow data rather than requesting information from the authorities. An interviewee from the EA said that each request takes approximately 30 minutes of staff time. All monitoring authorities process daily flow data requests, and in the absence of the NRFA, would be required to respond to a similar scale of data requests currently received by the NRFA. As noted above, it is outside scope of the project to estimate further resource costs, such as improving IT services, to meet this theoretical demand. Therefore, time taken to respond to daily flow data requests is believed to be a realistic minimum cost-savings for the monitoring authorities.

Further, UKCEH runs a 'Help Desk' to which users can make inquiries. In the absence of the NRFA, the monitoring authorities would need to respond to these inquiries. This is not included in the time savings as

<sup>5</sup> See: <https://environment.data.gov.uk/hydrology/explore>

<sup>6</sup> See: <https://www.kisters.eu/wiski/>

- i) it is not possible to separate out help desk requests relating to daily flow data from other inquiries, and
- ii) it is not known how much time is taken to respond to these requests.

In conclusion, there are many alternative options for sourcing river flow data (although in practice the options are constrained by each nation/authority). The additional time required to download, and quality assure the data by each chosen method is highly variable and depends to an extent on the judgement of the user as to what level of additional QA activity is needed for their analysis. However, all methods lack the level of assurance provided by the NRFA, and for simplicity we have assumed a range of additional time required for all uses. The assessment of this time for users and monitoring authorities is covered in Section 4.2.

## 4. Results of economic impact assessment

### 4.1 Analysis of data downloads and uses

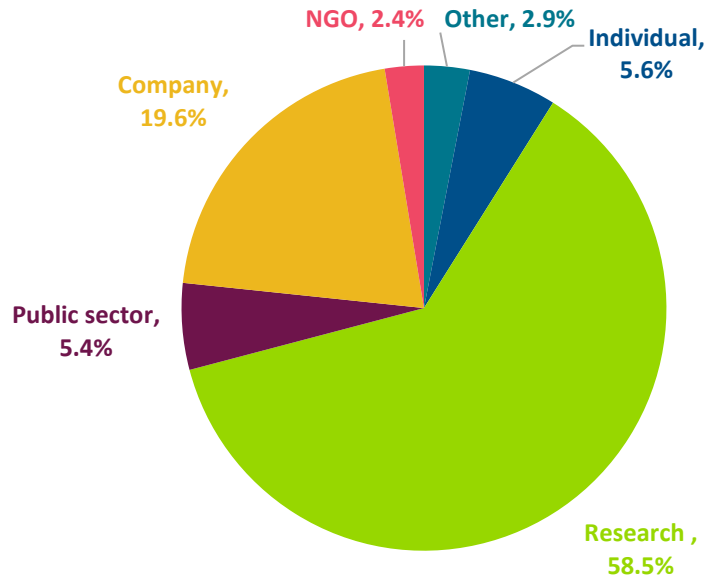
Annual use of daily river and peak flow data was evaluated using the number of downloads of NRFA data captured in UKCEH's website statistics (NRFA, 2019-2024). This information is captured and reported internally in quarterly and annual reports, for:

- NRFA website downloads including daily river flow data, catchment boundaries, station metadata and daily rainfall;
- Peak flow dataset downloads, and
- API downloads.

Only data related to daily river flow, API downloads, and peak flow dataset downloads were considered as these figures cover the main data downloads required by most users. In theory, the API data could be used for other types of data on the NRFA website but, according to NRFA staff, the vast majority of downloads would be for river flow and peak flow estimations.

At the time of the analysis, NRFA website statistics were available for 2019 to 2023, and quarters 1 to 3 of 2024. Website downloads were stable between 2020 and 2023 and may be slightly higher than average for 2024 if the current rate of downloads persists for the final quarter of 2024. However, given the uncertainty of this projection we excluded the 2024 usage from our calculations.

There is a breakdown of user types (e.g., research, private company, public sector etc) for the website downloads, but not for peak flow or API downloads. The share of these users by type is illustrated in Figure 4.1. Most downloads fall under the research category (nearly 60%) and company and public sector are two next largest user groups affiliated with an organisation (i.e., excluding individuals) at nearly 20% and 5% respectively.



**Figure 4.1: Daily flow user types (between 2019 and 2024)**

The volume of API downloads is significantly higher than the river and peak flow data sources (hundreds of thousand downloads versus several thousand). This is because multiple downloads are required to update user models and is the most effective way of downloading large volumes of data.

The raw volume of API downloads by type is shown in Table 4.1. The stability of historic data gives confidence that this represents a robust basis for estimating core NRFA use. Download statistics are included from 2020 as this was the year that the API was introduced. The dip in downloads in 2021 and 2022 may be due to decreased development following the COVID-19 pandemic, but this is uncertain. The annualised downloads for 2024 are uncertain as downloads fluctuate throughout the year and forecasting at constant rate (as is demonstrated in Table 4.1) may not be accurate. Considering this uncertainty, an average is taken for the years 2020 to 2023 has been used to evaluate ongoing use of the NRFA.

**Table 4.1: Raw NRFA API data download statistics**

Download type	2020	2021	2022	2023	2024 (annualised <sup>1</sup> )	Average (2020-2023)
Website daily flow data	16,600	15,000	13,800	15,900	23,200	15,300
Peak flow dataset	1,400	2,500	1,700	2,100	3,200	1,900
API downloads	533,700	493,500	439,700	600,800	707,500	516,900
<b>Total</b>	<b>551,700</b>	<b>511,000</b>	<b>455,200</b>	<b>618,800</b>	<b>733,900</b>	<b>534,100</b>
<i>Year on year change (%)</i>	-	-7%	-11%	36%	19%	-

**Note 1:** Figures are available for quarters 1 to 3 of 2024. We have forecast the 2024 annual total assuming the final quarter usage is at the same rate as year-to-date usage. Figures are rounded to the nearest 100.

Various factors may influence future use, such as greater building development driving the need for more flood risk assessments. Furthermore, interviewees from the water companies indicated that use of NRFA data would likely increase as relevant reporting requirements increased. However, we have not assumed any increase in NRFA downloads in the subsequent evaluation.

To calculate the benefit of time saving, these raw download statistics must be converted into a number of 'uses' per year, which can then be used in conjunction with an assumed time saving per use to estimate the overall time saving. Users may perform multiple data downloads for a single use. Typically, data from several stations will be downloaded and used in a single model run. It is not known how many downloads are required to support any given use, as these will vary considerably by user and modelling application. However, we have assumed that each "use" entails a number of downloads, which are used for a specific purpose. In the counterfactual case there will be more time spent downloading, reformatting, and quality assuring data from the monitoring authorities. Furthermore, that the extra time required in the counterfactual case is driven by the number of uses (rather than number of data downloads) and the extra time taken to download and QA the data for each use.

We have taken the following assumptions to provide an estimate of 'uses' in Table 4.2. For website daily flow data downloads, we have assumed one use per user per day. That is no matter how many items a user downloads in a day, this was counted as one use.

- The peak flow dataset is updated annually, and downloads are structured to download multiple data points so are likely to be closely aligned to a use as time saved from additional QA is associated with initial download. It is likely that a user may use the same data set more than once in a year. As it is not possible to estimate this without further study, we assume each download is a use.
- For API downloads (average 534,000 per year) every time a user refreshes their codes, the website statistics registers it as another download. NRFA staff believe a user could 'refresh' the data anywhere from one to more than ten times for a single use. There are an average of 30,000 unique users per year (from 2020 to 2023). If each user used API downloads just once per year, then one use would equate to an average of 17 downloads per use (average downloads / average users). This should be taken as a very conservative minimum estimate as it is likely that many users would conduct more than one use throughout the year. For this analysis, a range of 1/17 to 1/10 of the total API downloads were used to represent the total uses of the API data (that is, 6% to 10% all downloads as an estimate of a use).

These assumptions generate the total number of uses in This analysis suggests that there are around 40,000 to 62,000 uses of the NRFA datasets per year

**Table 4.2: Assumed number of “uses” per year**

API uses and total uses are rounded to the nearest thousand

Download type	2020	2021	2022	2023	2024 (annualised <sup>1</sup> )	Average (2020-2023)
Website daily flow data	5,700	6,200	5,800	6,200	5,000	6,700
Peak flow dataset	1,400	2,500	1,700	2,100	2,400	3,200
API downloads (low – high)	31,000 – 53,000	29,000 – 49,000	26,000 – 44,000	35,000 – 60,000	42,000 – 71,000	30,000 – 52,000
<b>Total (low-high)</b>	<b>38,000 – 60,000</b>	<b>38,000 – 58,000</b>	<b>33,000 – 51,000</b>	<b>44,000 – 68,000</b>	<b>49,000 – 78,000</b>	<b>40,000 – 62,000</b>

Note 1: Figures are available for quarters 1 to 3 of 2024. We have forecast the 2024 annual total assuming the final quarter usage is at the same rate as year-to-date usage.

## 4.2 Time saving per use

The main economic benefit of the NRFA is the time saved compared to the counterfactual case which entails gathering river flow data from an appropriate source (usually a national hydrological measuring authority) and quality assuring the data to ensure it is suitable for use. This section compares the time needed to use NRFA data with the counterfactual case, the difference being the net time saving and hence benefit of the NRFA.

### Use of NRFA data

Time spent downloading and quality assuring NRFA data was based on interview data. Interviewees found it hard to give a precise estimate of time required for the process of downloading NRFA data, but the general feedback was that it was a quick process. Some indicated that it takes about 10 minutes to download data per use, although this is dependent on the user's familiarity with the data and technical capacity. Interviewees indicated that time to quality assure the data is also quick as they trust that the NRFA data source are the most robust figures available. Time needed to quality assure is dependent on the specific uses, and on the judgement of the user. For this analysis, 1 hour is assumed to be the time needed to both download and quality assure NRFA data on average. In the counterfactual case this will be much higher.

The website statistics for downloads of river flow data is separated by user type (research, public sector users, private users, and others). We assume the same time estimate per use is applied to all users as it was not possible to estimate the amount of time spent per user to download and quality assure the data. The API and peak flows download data are not separated by user type.

### Time required in counterfactual case by users

Time spent downloading, reformatting, and quality assuring data from the monitoring authorities is based on interview data. Interviewees from water companies and consultancies indicated that it would take up to a couple days to reformat, and quality assure this data for model run. An interviewee from a water company gave the most explicit time estimate of 1 to 2 working days to check and assure data (assuming 7.5 hours/day this gives a range of 7.5 to 15 hours per use). However, this may reflect more complex model uses requiring a high volume of data downloads.

From the website statistics, around 30% of downloads are by private companies or public authorities. Around 70% are from research organisations or individuals. These groups may have different approaches to checking data, but it is not known how this may differ between these user types. For simplicity, the **range of 4 to 7.5 hours per use** was used to estimate time taken to check and quality assure monitoring authority data. Given that the use of NRFA data was assumed to take 1 hour the net saving is 3 to 6.5 hours per use.

Time saved by users per year was calculated by multiplying total annual uses (range 40,000 to 62,000) by the net time saving per use (range 3 to 6.5 hours), as shown in Table 4.3.

**Table 4.3: Range of time saving estimates (hours per year)**

Number of uses/year	Low time saving at 3 hours	High time saving at 6.5 hours
Low use at 40,000 uses per year	120,000	260,000
High use at 62,000 uses per year	186,000	695,000

Note: Figures are rounded to nearest 1,000 hours

Hence, a range of around 120,000 to 695,000 hours are saved by users annually by using NRFA data.

### Time required in counterfactual case by monitoring authorities

In addition, in the case of the counterfactual, monitoring authorities would need to respond to more requests for daily flow data. The NRFA runs a Help Desk that answers queries every year. These would have to be answered by the Measuring authorities as well if the NRFA did not exist. Note however, that these queries relate to many different topics, (not just river flow downloads), consequently we have only included time required for the measuring authorities to process counterfactual requests for daily flow data in our assessment.

As suggested by an interviewee, the EA may spend approximately 30 minutes per download request. Although the time to respond likely differs between the authorities, due to limitations in interview scope, it is not possible to estimate that difference. As the EA is believed to have the most requests compared to the other monitoring authorities, it is likely to be indicative of the time that all authorities will take in responding to requests. Therefore, 30 minutes is applied to all daily flow data downloads (about 15,300 per year on average (see Table 4.1)) received by the NRFA to estimate time saved by the authorities. Total downloads as opposed to ‘uses’ are used because it is assumed that the time taken to provide the data is relational to the amount of data requested (i.e., number of gauging stations).

Peak flow downloads and API downloads are not included in the time savings estimate. This is because the peak flows data would need to be provided in its current format due to regulatory requirements or generated by users, and API downloads are already accessible via most monitoring authorities at present.

**The total time saved on average per year is approximately 7,700 hours for daily flow data across the monitoring authorities.**

## 4.3 Value of time saved

The value of time saved by users was estimated using ONS (2023) wages for ‘professional occupations’ (£23.54 per hour in 2024 prices) and uplifting for non-wage costs (a 22% uplift, social security, pension costs etc.) to give £28.67/hour. Table 4.4 applies this hourly wage to total hours saved per year.

**Table 4.4: Estimate of NRFA costs savings (£ million per year)**

Number of uses/year	Cost saving at 3 hours/use	Cost saving at 6.5 hours/use
Low use at 40,000 uses per year	£ 3.4m	£ 7.5m
High use at 62,000 uses per year	£ 5.3m	£ 11.6m

Hence, the value of time saved for users of NRFA data is in the region of **£3.4 to £12 million per year**.

In addition, the value of time saved by monitoring authorities was estimated using ONS (2023) wages for 'Associate professional and technical occupations' (£17.54 per hour in 2024 prices) and uplifting for non-wage costs (a 22% uplift) to give £21.36/hour. Applying this wage to the total time saved (7,700 hours per year) equates **about £164,000 saved by monitoring authorities each year**. This is likely to be an underestimate.

## 4.4 Interpretation and caveats

There are some important points to bear in mind when considering these impact figures.

- Firstly, this is a conservative estimate of value, as it reflects the time saved by users, (and the hydrological measuring authorities) in the tasks of gathering, supplying, and quality assurance of river flow data that would be required in the counterfactual case. It does not include the benefits of ease of use which is a prominent feature of the benefits of the NRFA mentioned by interviewees.
- It is likely that even with the extra time required by users to perform their own QA in the counterfactual case, the resultant cleansed data may not be of the same standard as that provided by the NRFA. Whilst this counterfactual quality difference may be small there is a risk that poorer decisions may be taken, but the extent to which this may occur, and its impact is very difficult to predict.
- Time spent and saved has been based on a small sample of interviewees. Whilst these interviewees were very experienced and representative of the largest users of the NRFA, they did recount that estimating the extra time required to process data in the absence of the NRFA was difficult to estimate with a reasonable degree of accuracy. It may be beneficial to consider a more focused study into identifying and quantifying the additional tasks required in more depth and using this approach to construct more detailed and accurate estimates of time required by task and by use.
- The estimates have also relied heavily on the concept of a 'use', and a simple average time saving per use to estimate total time saving for all users. There are many types of use and in the counterfactual case the additional time required would vary with each type of use. Again, to produce more accurate estimates of time saved, a more in-depth study would be required to identify types of uses and develop time savings estimates by each.

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10F Printing House Yard, Hackney Road,  
London, E2 7PR



+44 (0) 20 7580 5383



eftec@eftec.co.uk



eftec.co.uk



@eftecUK

