

# Severn Trent Water AMP6 Low Flows Programme: Adaptive Management Plan – Rivers Ashop and Noe

**Official Sensitive**

*(Sensitive information redacted)*





WONDERFUL ON TAP



# Severn Trent Water AMP6 Low Flows Programme: Adaptive Management Plan – Rivers Ashop and Noe

Prepared for:

Severn Trent Water Ltd

2 St John's Street

Coventry

CV1 2LZ

Report reference: 64116AB R47, February 2020

**OFFICIAL SENSITIVE**

Report status: Final

CONFIDENTIAL

New Zealand House, 160-162 Abbey Foregate,  
Shrewsbury, Shropshire  
SY2 6FD

Telephone: +44 (0)1743 276 100  
Facsimile: +44 (0)1743 248 600

Registered Office:  
Stantec UK Ltd  
Buckingham Court  
Kingsmead Business Park  
Frederick Place, London Road  
High Wycombe HP11 1JU  
Registered in England No. 1188070

## Severn Trent Water AMP6 Low Flows Programme: Adaptive Management Plan – Rivers Ashop and Noe

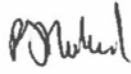


### OFFICIAL SENSITIVE

This document is classified by Severn Trent Water Ltd (STWL) as Official Sensitive and the information contained within is sensitive. Distribution of this document must be restricted and managed within organisations given access to it. If in doubt, please seek STWL's permission before this document is shared with third parties.

This report has been prepared by Stantec UK Ltd (Stantec) in its professional capacity as environmental specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by Stantec solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to Stantec at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, Stantec may, by prior written agreement, agree to such release, provided that it is acknowledged that Stantec accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. Stantec accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against Stantec except as expressly agreed with Stantec in writing.

	Name	Signature
Author	Rick Hayes (APEM) Philip Hubbard (Stantec)	
Checked by	Dan Cadman (APEM) Paul Daily (Stantec)	
Reviewed by	Dan Cadman (APEM) Paul Daily (Stantec)	

Revision record:

Reference	Date	Status	Author	Checker	Reviewer	Issued to
64116AB R47D1	13/05/2019	Draft	RH/PH	DC/PD	DC/PD	STWL*
64116AB R47D2	21/06/2019	Draft	RH/PH	DC/PD	DC/PD	STWL
64116AB R47D3	29/08/2019	Draft	RH/PH	DC/PD	DC/PD	STWL
64116AB R47D3	11/09/2019	Draft	RH/PH	DC/PD	DC/PD	EA**
64116AB R47D4	06/11/2019	Draft	RH/PH	DC/PD	DC/PD	STWL
64116AB R47D5	20/11/2019	Final Draft	RH/PH	DC/PD	DC/PD	STWL/EA
64116AB R47	20/12/2019	Final	RH/PH	DC/PD	DC/PD	STWL/EA

\*Severn Trent Water Limited \*\*Environment Agency

# Executive Summary

This report defines an Adaptive Management (AM) approach for the amendment of compensation releases from the interconnected impoundment and diversions associated with the River Noe and River Ashop (including Jaggars Clough) as defined following investigations and Options Appraisal as part of Severn Trent Water's AMP6 Restoring Sustainable Abstraction (RSA) programme.

The aim of making these amendments is to make the flow regime immediately downstream of the impoundments on the River Noe and River Ashop more consistent with UKTAG guideline flows (where possible within cost-benefit and infrastructure constraints) and to achieve a more natural flow regime on Jaggars Clough, while ensuring that its use as a nursery for brown trout is not compromised to the degree that impacts are felt at a waterbody scale.

The notional solution for the River Noe and Jaggars Clough is to set a minimum compensation release of 12 MI/d on the River Noe and a minimum compensation flow of 8 MI/d to the Jaggars Clough (Phase 1 of AM). If AM indicates that further reallocation can be undertaken without undue impacts, a subsequent increase to 14 MI/d on Noe and decrease to 6 MI/d on Jaggars Clough is to be implemented (Phase 2 of AM). The selected notional solution for the River Ashop is to revise (increase) the compensation requirement to a mean monthly minimum of 8.5 MI/d, with a requirement that daily flow cannot drop below 5.5 MI/d (unless natural inflows fall below this level).

AM works on the basis of an iterative approach, designed to provide a structured, flexible approach to managing systems in the face of uncertainty. The success criteria are:

- Meeting the proposed compensation flows, and;
- Achieving Good Ecological Status for the physico-chemical and biological quality elements and avoiding unacceptable negative impacts attributable to the implementation of the notional solution.

At the end of Phase 1 (a minimum three-year period, but which should include a dry year), assessment of monitoring data collected throughout the Phase 1 AM period will inform Phase 2 specifications, as appropriate.

The report specifies the monitoring requirements that will check for unintended impacts during implementation of the notional solution, enable assessment of the success criteria defined in this document, and ensure that any unintended negative consequences do not cause deterioration in Water Framework Directive (WFD) status of any quality element at the waterbody scale. Justification for the proposed monitoring is given for each element, as well as details of how the data collected will be assessed to determine success.

Severn Trent Water have also investigated changes to the allocation of flows between the River Noe, River Ashop and the Jaggars Clough during natural circumstances in which inflows to the three structures are lower than the combined compensation requirements for the rivers Ashop and Noe and Jaggars Clough. Monitoring recommendations to support allocation of flows during such periods are outlined in this report.

An idealised timeline is also outlined. However, annual assessment of the data collected will feed back into the programme; determining whether changes are made to compensation flow specifications and/ or monitoring requirements at a given time. All annual assessments will be made in consultation with the EA. The report also sets out how different types of failure are dealt with, alongside the process that will be taken to adapt and adjust in response to 'failure' to meet the success criteria is outlined.

# Contents

1	INTRODUCTION	1
1.1	This report	1
1.2	Principles of adaptive management	1
1.3	Aims and objectives	2
1.4	Monitoring strategy for adaptive management	2
2	SITE BACKGROUND	4
2.1	Waterbody information	4
2.1.1	River Noe	4
2.1.2	River Ashop	4
2.2	Impacts on downstream river flows	4
2.2.1	River Noe	4
2.2.2	River Ashop	5
3	PROPOSED MEASURES	6
3.1	Notional solution	6
3.1.1	River Noe and Jagers Clough	6
3.1.2	River Ashop	6
3.1.3	'No Regrets' measure	7
3.1.4	Flow allocation during dry periods	7
3.2	Timing and implementation of measures	7
3.3	Summary of Adaptive Management actions	7
4	MONITORING THE EFFECTS OF MEASURES	9
4.1	Monitoring during implementation of compensation flow reallocation	9
4.2	Monitoring subsequent to implementation	9
4.3	River flows	12
4.3.1	River Noe	12
4.3.2	River Ashop	12
4.4	Morphology	12

4.4.1	River Noe	12
4.4.2	River Ashop	13
4.5	Water quality	13
4.6	Macroinvertebrates	13
4.6.1	River Noe	13
4.6.2	River Ashop	13
4.7	Fish	14
4.7.1	River Noe	14
4.7.2	River Ashop	15
4.8	Monitoring during low flow periods	15
4.8.1	Triggers for low flows monitoring	15
4.8.2	Location and frequency of low flows monitoring	16
4.8.3	Assessment of significance of low flows monitoring	16
5	EVALUATING SUCCESS	18
5.1	Success criteria	18
5.2	River flows	18
5.3	Morphology	19
5.3.1	River Noe	19
5.3.2	River Ashop	19
5.4	Water quality	19
5.5	Macroinvertebrates	19
5.5.1	River Noe	19
5.5.2	River Ashop	20
5.6	Fish	20
5.6.1	River Noe	20
5.6.2	River Ashop	20
6	ADAPTATION AND ADJUSTMENT	21
6.1	Compliance failure	21
6.2	Failure due to external causes	21

6.3	Failure due to measurement uncertainty	22
6.4	Failure to meet stated success criteria	22
6.5	Timeline	26

## ILLUSTRATIONS

Illustration 1.1	Adaptive Management (from Macleod et al., 2016)	1
Illustration 6.1	Flow diagram for the proposed process of adaptation and adjustment of AM in the Noe and Ashop waterbodies	27
Illustration 6.2	Indicative timeline of progression of AM for the Noe waterbody	27
Illustration 6.3	Indicative timeline of progression of AM for the Ashop waterbody	28

## TABLES

Table 4.1	Noe Site Investigation Plan monitoring locations	10
Table 4.2	River Ashop Site Investigation Plan monitoring locations	11

## FIGURES

Figure 2.1	River Noe Adaptive Management Plan Monitoring Locations
Figure 2.2	River Ashop Adaptive Management Plan Monitoring Locations

## APPENDICES

Appendix A	2018 Site Investigation Plan (SIP)
Appendix B	Gauging accuracy at the Noe and Ashop impoundments



# 1 Introduction

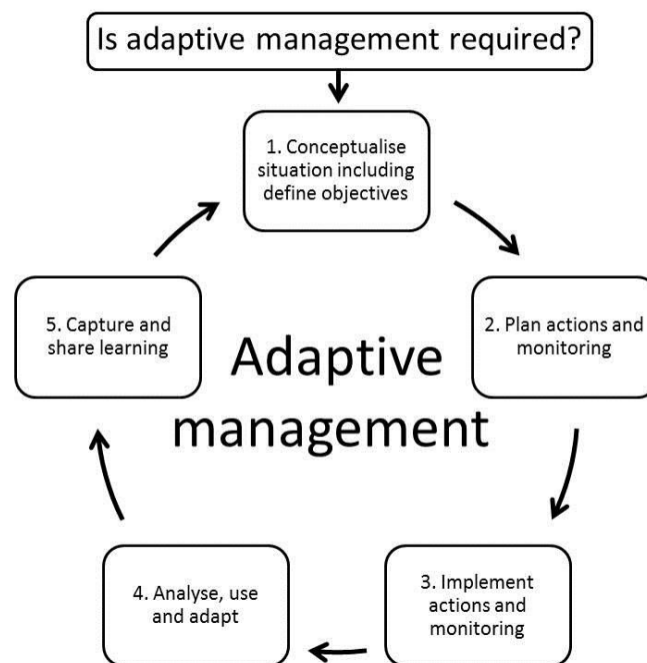
## 1.1 This report

This report defines an Adaptive Management (AM) approach for the amendment of compensation releases from the interconnected impoundment and diversions associated with the River Noe and River Ashop (including Jagers Clough) following completion of options identification as part of Severn Trent Water's AMP6 Restoring Sustainable Abstraction (RSA) programme. It sets out:

- the rationale for AM in the two catchments;
- the specifications of compensation flow reallocations to be released during the AM period;
- the criteria over which success of the scheme will be assessed, and;
- the monitoring required to assess achievement of the success criteria and to ensure that unintended consequences of amendment from the established baseline compensation releases are avoided.

## 1.2 Principles of adaptive management

AM of an environmental system involves an iterative approach whereby objectives are set, management decisions made, and the effects monitored; the observed effects improve understanding of the system and are used to inform future management decisions (e.g. Williams *et al.*, 2009; Macleod *et al.*, 2016). AM is designed to provide a structured, flexible approach to managing systems in the face of uncertainty. Macleod *et al.* (2016) provide the following useful summary graphic (Illustration 1.1).



**Illustration 1.1 Adaptive Management (from Macleod *et al.*, 2016)**

In the context of the rivers Noe and Ashop, the observed effects of compensation releases on physical habitat, water quality and ecological receptors will be used to manage the system in the future and to inform avoidance of possible negative consequences. Objectives for the environmental gain achieved by the introduction of the

compensation flow will be set and tested through monitoring and comparison to an established baseline condition and will be subject to regular reviews through the abstraction licensing process.

- Sections 1 and 2 of this report constitute Step 1 of Illustration 1.1.
- Section 3 details the actions to be made; Step 2 of Illustration 1.1.
- Section 4 outlines the monitoring required; Step 2 of Illustration 1.1.
- Sections 5 and 6 define the success criteria and proposed evaluation and adjustment for the AM process; Step 4 of Illustration 1.1.

### 1.3 Aims and objectives

The aims of amending compensation releases in the catchments of the rivers Noe and Ashop are to:

1. Make the flow regime immediately downstream of the impoundments on the River Noe and River Ashop more consistent with UKTAG (2013) guideline flows, where possible within cost-benefit and infrastructure constraints;
2. Achieve a more natural flow regime on Jaggars Clough, while ensuring that its use as a nursery for brown trout is not compromised to the degree that impacts are felt at a waterbody scale.

Monitoring must also ensure that any unintended negative consequences do not cause deterioration in Water Framework Directive (WFD) status of any quality element at the waterbody scale.

Monitoring data will be reviewed on an annual basis to measure success or failure and adjust compensation flows if unacceptable risk is identified.

The objectives for AM, to achieve the above stated aims are to:

- Phase 1 - Implement compensation reallocation of 12 MI/d on the River Noe and a minimum compensation flow of 8 MI/d to the Jaggars Clough (unless upstream flows naturally fall below this) and, on the River Ashop, to increase the minimum compensation requirement to a mean monthly minimum of 8.5 MI/d, with a requirement that daily flow cannot drop below 5.5 MI/d (unless natural inflows fall below this level);
- Phase 2 - Depending on the outcome of the first three years of compensation (assuming that there is a dry year in that period), review and agree with the Environment Agency whether 12 MI/d on the River Noe and 8 MI/d to the Jaggars Clough achieves the required environmental outcomes, and determine whether a subsequent increase to 14 MI/d on Noe and decrease to 6 MI/d on Jaggars Clough is to be implemented.

### 1.4 Monitoring strategy for adaptive management

The objectives of amending compensation flows, and the risk of unintended consequences, are measurable and the monitoring programme will enable assessment of the scheme against defined success criteria.

Monitoring effort is designed to continue the baseline monitoring that STWL have been doing since 2010 and to complement Environment Agency (EA) surveillance monitoring, whilst remaining proportionate to the benefits of introducing the compensation flows as assessed during Options Appraisal (OA).

A monitoring network has been in place since 2010 (longer for some data at those locations benefitting from EA surveillance monitoring) and provides baseline data against which AM can be assessed. The network includes a number of locations upstream of the impoundments, which will act as proxy 'control' locations in AM, allowing some assessment against background natural variation. Benefits, and unintended

consequences, will therefore be assessed by Before - After - Control Impact (BACI) comparisons against pre-implementation inter- and intra-year data. These comparisons will be qualitative, using standard tools in a weight of evidence approach as proportionate to the benefits likely to be achieved.

Monitoring data will be reviewed annually to ensure that any issues are picked up early. The expectation is for benefits to be established three years post implementation, although it is acknowledged that geomorphological and ecological changes may take longer to fully manifest following implementation of the compensation releases. It is envisaged that, once benefits are established and unintended consequences considered avoided for both phases (assuming the second phase proceeds), monitoring will revert to ongoing EA surveillance monitoring, or to ongoing compliance monitoring by STWL to demonstrate adherence to the terms of their abstraction and impoundment licences.

## 2 Site background

### 2.1 Waterbody information

#### 2.1.1 River Noe

The River Noe is located within the Peak District National Park in Derbyshire, to the west of Sheffield. It forms part of the catchment of the River Derwent, which it joins at Bamford. The River Noe is split into two WFD waterbodies at the confluence with Peakshole Water in the village of Hope. The River Noe from Source to Peakshole Water waterbody (GB104028057890) has a length of 17.8 km and a catchment area of 35.1 km<sup>2</sup>, while the River Noe from Peakshole Water to Derwent waterbody (GB104028057850) has a length of 6.3 km and a catchment area of 22.8 km<sup>2</sup>. Formerly, both the River Noe from Source to Peakshole Water and the River Noe from Peakshole Water to Derwent were designated as a Heavily Modified Waterbodies (HMWBs), but the upper waterbody, in which the impoundment is located was re-designated in 2013 on the basis of achieving Good Ecological Status.

The River Noe is impounded at Netherbooth, approximately 1.8 km upstream of the confluence with Jaggars Clough, and water is diverted to Ladybower Reservoir via a transfer tunnel. The abstraction licence requires a compensation flow of 10 MI/d to the River Noe at the impoundment, provided that inflows are above this level. The River Noe is joined by the Jaggars Clough at Edale End, approximately 3.7 km upstream of its confluence with Peakshole Water. Compensation is also provided to Jaggars Clough via a release from the Ladybower Reservoir transfer tunnel at Top House, approximately 500 m upstream of the confluence with the River Noe. The licence requires this to be maintained between 10 – 17 MI/d, although, with very limited storage behind the Noe impoundment and low natural baseflow, this cannot always be achieved during dry periods.

#### 2.1.2 River Ashop

The River Ashop is also located within the Peak District National Park, on the northern side of Kinder Scout, which separates its catchment from that of the River Noe. Like the Noe, the Ashop is a tributary of the River Derwent, although the last 3.5 km of the Ashop lie within Ladybower Reservoir, which impounds both the Derwent and the Ashop. The Ashop is divided into two WFD waterbodies at its confluence with the River Alport. The River Ashop from Source to Alport waterbody (GB104028057930) has a length of 9.1 km and a catchment area of 27.8 km<sup>2</sup>, while the River Ashop from Alport to Derwent (designated as a HMWB) (GB104028057910) has a length of 7.3 km and an area of 10.2 km<sup>2</sup>.

The River Ashop is impounded approximately 200 m upstream of the confluence with the River Alport, and water is diverted via a transfer tunnel to Derwent Reservoir. The licence includes a requirement for compensation of 5 MI/d to the River Ashop from the impoundment. This requirement only applies when inflows are above 5 MI/d. Water abstracted from the Ashop can, for historical reasons be diverted to provide compensation to Jaggars Clough in the River Noe catchment. In the original scheme there was also a transfer from the Alport to upstream of the Ashop impoundment. This was never included in the licence and has not been used for many years. As a consequence, the channel has become clogged with sediment.

### 2.2 Impacts on downstream river flows

#### 2.2.1 River Noe

Both River Noe waterbodies were included in the National Environment Programme (NEP) for AMP5 and AMP6. STWL's investigations focussed only on the upper waterbody (River Noe from Source to Peakshole Water), where the effects of alterations to the flow regime are greatest. In the lower waterbody, inflows from the karstic Peakshole Water catchment provide additional support during low flows and additional flow variability.

The effects of the impoundment and compensation regime were assessed in an Impact Assessment at the end of the AMP5 investigation (ESI and APEM, 2013) and in a subsequent Compensation Review (ESI and APEM, 2018a) following further investigation (including an operational flow trial, ESI and APEM, 2016a) in AMP6. These investigations were supported by ongoing hydrological/ecological monitoring (ESI and APEM, 2016b and 2018b) and the benefit of potential mitigation measures was subsequently considered during Options Appraisal (OA) (ESI and APEM, 2018c).

The Compensation Review concluded that the recent actual flow regime downstream of the Noe impoundment was sufficient to achieve GES, as evidenced by Good status being achieved or exceeded for fish and macroinvertebrates in the Noe from Source to Peakshole Water waterbody. However, assessment of the flow regime also showed that licenced compensation flow should be increased at least in line with recent actual flows, and that during August to October inclusive, “flow elevations” (spate flows) were not experienced with the frequency recommended by UKTAG guidelines.

Compensation flows on the Jagers Clough greatly exceeded guideline requirements and, combined with the loss of some spate flows, greatly reduced flow variability on that watercourse. A partial rebalancing of flows between the Noe and Jagers Clough was therefore recommended, with a phased reduction towards a more natural flow regime on Jagers Clough balanced by a phased increase in compensation to the River Noe.

### 2.2.2 River Ashop

Both River Ashop waterbodies were included in the National Environment Programme (NEP) for AMP5 and AMP6. The effects of the impoundment and compensation regime were assessed in an Impact Assessment at the end of the AMP5 investigation (ESI and APEM, 2013) and in a subsequent Compensation Review (ESI and APEM, 2018d) following further investigation (including an operational flow trial, ESI and APEM, 2016c) in AMP6. These investigations were supported by ongoing hydrological/ecological monitoring (ESI and APEM, 2016b and 2018e) and the benefit of potential mitigation measures was subsequently considered during Options Appraisal (OA) (ESI and APEM, 2018f).

The Compensation Review concluded that the current recent actual compensation rate equating to a monthly average of 8.5 Ml/d, with a minimum daily average flow of 5.5 Ml/d, was sufficient to support GES. It was therefore recommended that the current rate be formalised in revised licence arrangements.

As on the River Noe, flow elevations immediately downstream of the Ashop impoundment did not meet the guideline criteria between August and October inclusive, and potentially later into the year in years with low run off. However, the River Alport was found to alleviate (but not eliminate) this lack, introducing large natural spates downstream of its confluence with the River Ashop. The reach most affected by lack of flow elevations was therefore short (approx. 200 m).

# 3 Proposed measures

## 3.1 Notional solution

### 3.1.1 River Noe and Jaggars Clough

The OA selected notional solution (ESI and APEM, 2018c) for the River Noe Source to Peakshole Water waterbody was:

- Revised compensation arrangements including improved compliance monitoring

It was recommended that the reductions be undertaken in a staged manner and controlled through an AM approach. The initial phase was to set a minimum compensation release of 12 MI/d on the River Noe and a minimum compensation flow of 8 MI/d to the Jaggars Clough (both averaged across a weekly period). If AM indicates that further reallocation can be undertaken without undue impacts, a subsequent increase to 14 MI/d on Noe and decrease to 6 MI/d on Jaggars Clough is to be implemented.

Revisions to the required compensations, comprising the reallocation of compensation from the Jaggars Clough to River Noe, will be enabled by a licence variation to be completed by 31 March 2020. A condition on the current licence would be retained, which specifies that flows in the River Noe downstream of the impoundment do not need to be maintained should natural inflows fall below the licenced compensation flow (see Section 3.1.4 for further details on the allocation of water under low flow conditions).

Note that STWL have also investigated changes to the allocation of flows between the River Noe, River Ashop and the Jaggars Clough during natural circumstances in which inflows to the three structures are lower than the combined Hands off flows at the Noe and Ashop impoundments, and the compensation flow required on the Jaggars Clough. Monitoring recommendations to support allocation of flows during such periods is considered in Section 4.8 of this report.

The notional solution for the Noe Source to Peakshole Water waterbody and the Noe from Peakshole Water to Derwent waterbody also included an entry on sediment management, with plans to be developed in AMP6. This work is ongoing and is considered separately to the adaptive management of the compensation measures, which this report describes.

### 3.1.2 River Ashop

The selected notional solution (ESI and APEM, 2018f) for the Ashop waterbodies (from Source to Alport and from Alport to Derwent) was:

- Revised compensation arrangements and improved compliance monitoring.

The selected notional solution for the River Ashop is to revise (increase) the compensation requirement to a mean monthly minimum of 8.5 MI/d, with a requirement that daily flow cannot drop below 5.5 MI/d (unless natural inflows fall below this level). The 5.5 MI/d minimum and 8.5 MI/d monthly average compensation requirements recognise measurement error and the limitations on the precision of flow diversion at the Ashop impoundment. STWL will keep the current licence condition that does not require flows to be maintained should natural inflows fall below it.

Revisions to the required compensation will be enabled by a licence variation to be completed by 31 March 2020. The current licence condition, (which specifies that flows in the River Ashop downstream of the impoundment do not need to be maintained should natural inflows fall below the licenced compensation flow) should be retained.

The notional solution for the River Ashop waterbodies also included a note regarding sediment management, with plans to be developed in AMP6. This work is ongoing and is considered separately to the RSA scheme adaptive management of the compensation measures, which this report describes.

### 3.1.3 'No Regrets' measure

Further to, and separate to the notional solutions, OA considered the likely benefits of a 'No Regrets' measure at both the Noe and Ashop impoundments. Under this measure the diversions at the Noe and Ashop impoundments may be closed to allow greater frequency and magnitude of spills when Ladybower and Derwent reservoirs, respectively, are full or close to filling, as had been recommended by the CRs. These measures may be explored during AM and by its nature implementation would be opportunistic.

Trialling of this measure at the Ashop and Noe impoundments is incorporated into the AM of these sites to ensure a holistic approach. However, as the 'No Regrets' measures are not part of the notional solution, no monitoring is recommended additional to that specified for the evaluation of success in relation to implementation of the notional solution. Implementation of the 'No Regrets' measures is also not required to meet the AM success criteria (Section 5).

### 3.1.4 Flow allocation during dry periods

There is no requirement for STWL to maintain prescribed compensation flows on the Noe and Ashop when natural inflows are insufficient to do so. This, however, does not currently apply to Jaggerys Clough. The infrastructure in place allows for some allocation of available natural flow between the Ashop, Noe and Jaggerys Clough, and a proposed protocol to do so is considered in a separate Technical Note (Stantec & APEM, 2019). This protocol was defined subsequent to the AMP6 options appraisal process and is therefore not part of the notional solution for the Noe and Ashop waterbodies. However, as with the "No Regrets" measures, AM of the notional solutions for the Ashop and Noe impoundments needs to account for these recommendations to achieve a holistic scheme.

Under natural low flow conditions, the implementation of the low flow protocol detailed above will not preclude success of the AM scheme regarding the compensation flow reallocation. The monitoring requirements under low flow conditions are detailed in Section 4.8.

## 3.2 Timing and implementation of measures

The phasing of the notional solution is designed to ensure changes are implemented in modest, incremental steps. However, as a further precaution, the reallocation of compensation flows would ideally start between June and September inclusive, when flows are naturally low and there is less chance of effects on brown trout spawning, egg incubation or emergence.

## 3.3 Summary of Adaptive Management actions

Following consultation with the EA and the finalisation of this report, AM actions can be summarised as follows (listed in sequential order):

- Phase 1. Implementation of compensation reallocation of 12 MI/d on the River Noe and a minimum compensation flow of 8 MI/d to the Jaggerys Clough, and, on the River Ashop, to increase the compensation to a mean monthly minimum of 8.5 MI/d, with a requirement that daily mean flows should not fall below 5.5 MI/d (unless natural inflows fall below this level).
- Assuming no acute impacts requiring immediate intervention, annual assessment and reporting for unforeseen negative consequences will be made.
- Phase 2. Following a minimum of three years of revised operation, evaluation of the success of Phase 1 of AM will be made.

- Following assessment of Phase 1, recommendations will be made, in consultation with the EA, for further reallocation of compensation flows to 14 MI/d on the River Noe and to 6 MI/d on Jagers Clough. This assessment, and resulting specifications, will be made on the basis of data collected during the Phase 1.
- The period of revised operation may be extended in the event that unintended consequences of the revised operation cannot be discounted with sufficient certainty, for example if the period of revised operation were unusually wet or if ecological monitoring data intended to demonstrate an absence of impact were confounded by other pressures.



## 4 Monitoring the effects of measures

Monitoring is considered over two timescales; short term monitoring during initial implementation of the compensation flows, and longer-term monitoring over the full period of the AM.

### 4.1 Monitoring during implementation of compensation flow reallocation

Implementation of releases has been trialled at the Ashop, Noe and Jaggars Clough structures without unacceptable impacts (ESI and APEM, 2016a, 2016c). The data collected during these trials provides a robust baseline against which any changes observed during implementation can be compared.

Short-term monitoring during the initial implementation of the compensation flow reallocations in the River Noe catchment is considered necessary only as a precaution. As the target compensation flow at the Ashop impoundment is the same as recent actual flows there is no potential for short-term impacts. Likewise, there will be no net change in flows downstream of the Noe-Jaggars confluence. On the River Noe between the impoundment and Jaggars Clough, flows are being increased by a modest degree in a phased manner and no acute short-term effects on water quality or habitat were observed during or after the flow trial (ESI and APEM, 2016a). On the Jaggars Clough, flows are being reduced but no water quality changes and generally modest effects on habitat are anticipated. By comparison, following the exceptional low flows encountered during 2018, flows downstream of all three structures were reduced substantially below the proposed compensation flows during the summer of 2018. No lasting deleterious effects on ecology were observed in 2019 data, and, furthermore, short-term impacts were indicated as being relatively greater in the River Noe than in the Jaggars Clough; providing further support for the proposed reallocation of flow (Stantec and APEM, 2019).

It is proposed that the following monitoring is undertaken during implementation of changes on the River Noe between the impoundment and the Jaggars Clough confluence, and on the Jaggars Clough between Top House and the confluence with the River Noe:

- Walkover survey to check for changes and any signs of distress pre and post implementation, referencing previous baseline conditions.
- Field measureable water quality readings at 500m intervals during walkover pre and post implementation, referencing previous baseline conditions.
- Flow gauging to check the discharge at gauging locations, to be referenced to stageboard readings.

Targeted monitoring of 'No Regrets' spates is not included in the notional solution and, in any case, short-term effects should not differ from natural spates that at times exceed the capacity of the abstractions. As such no short-term monitoring provision is considered necessary.

Monitoring for related sediment investigations is considered separately.

### 4.2 Monitoring subsequent to implementation

Monitoring over the AM cycle will determine whether benefits predicted for the notional solution are delivered and that unintended consequences of the notional solution are avoided. The proposed monitoring plan for the Noe is summarised in

Table 4.1 and that for the Ashop in Table 4.2. This will be subject to change following annual review of data, with any changes being specified in annual SIP updates. Monitoring locations are shown in Figures 2.1 and 2.2 for the Noe and Ashop respectively.

Table 4.1 Noe Site Investigation Plan monitoring locations

Location	ID	NGR	Hydrology		Ecology (pre-implementation)			Ecology (post-implementation)						
			Constant flow gauge	Spot flow gauging	Habitat Walkover/ bed sediment/ piezometry	Water quality (seasonal)	Macroinvertebrates	Fish	Habitat Walkover/ Bed sediment/ piezometry	Water quality (seasonal)	Macroinvertebrates	Fish		
River Noe at Backtor Bridge	E2-01	SK 13793 85550				•	•	•			•	•	•	
River Noe upstream of diversion	E2-02	SK 14066 85721	•	•	No further baseline data required	•	•		Three years post-implementation (or earlier, if unintended consequences determine a need)		•	•		
River Noe downstream of diversion (MI)	E2-03a	SK 14661 85968	•	•		•	•				•	•		
River Noe downstream of diversion (fish)	E2-03b	SK 14742 86046						•						•
River Noe upstream of Jaggars Clough	E2-04	SK 16070 86260				•	•					•	•	
Jaggars Clough upstream of diversion	E2-05a	SK 16083 86707	•	•		•	•					•	•	
Jaggars Clough downstream of diversion	E2-05b	SK 16090 86681	•											
Jaggars Clough u/s of River Noe confluence (Edale End)	E2-06	SK 16115 86293				•	•	•				•	•	•
Fullwood Stile	E2-07	SK 16682 84720				•	•	•				•	•	•

Table 4.2 River Ashop Site Investigation Plan monitoring locations

Location	ID	NGR	Hydrology		Ecology (pre-implementation)			Ecology (post-implementation)					
			Constant flow gauge	Spot flow gauging	Habitat Walkover	Water quality (seasonal)	Macroinvertebrates	Fish	Habitat Walkover/ bed sediment/ piezometry	Water quality (seasonal)	Macroinvertebrates	Fish	
River Ashop upstream of diversion	E3-01	SK 13880 89464	•	•	No further baseline data required	•	•	•	Not required (unless monitoring of biological receptors indicates a potential impact)	•	•	•	
River Ashop downstream of diversion (flow)	E3-02b	SK 14088 89452	•	•		•	•	•		•	•	•	•
River Ashop downstream of abstraction (MI)	E3-02c	SK 14139 89479	•	•		•	•	•		•	•	•	•
Rowlee Bridge	E3-06	SK 14944 89104	•	•		•	•	•		•	•	•	•

## 4.3 River flows

### 4.3.1 River Noe

Flows are continuously gauged by STWL via temporary installations upstream of the Noe impoundment (E2-02), downstream of the Noe impoundment (E2-03a) and on the Jagers Clough upstream of the diversion (E2-05a). A permanent installation gauges the compensation release to Jagers Clough at Bottom House (E2-05b), and a further temporary installation gauges the combined flow of the River Noe downstream of confluence with Jagers Clough at Fullwood Stile (E2-07).

### 4.3.2 River Ashop

Flows are continuously gauged by STWL upstream of the Ashop impoundment (E3-01b), downstream of the Ashop impoundment (E3-02b) and River Ashop downstream of Alport confluence (Rowlee Bridge) (E3-06) via temporary installations put in place for investigation and AM.

## 4.4 Morphology

### 4.4.1 River Noe

Options appraisal (ESI and APEM, 2018c) predicted that an increase in baseflow downstream of the Noe impoundment will result in increased depths and velocities, wetting of marginal areas and increased overall habitat space, although the expected increases are not large. Specifically regarding brown trout habitat, the increase in flow is expected to result in increases in availability of mixed nursery habitat for juveniles, increases in adult/ spawning habitat and improved longitudinal connectivity between habitats. However, reduction in available brown trout fry habitat is also predicted.

Synthesis of the outputs of previous reporting (see Appendix C of the CR (ESI and APEM, 2018a) and references therein) indicates that, based on a weight of evidence, the reduction in compensation on the Jagers Clough may result in a slight increase in habitat suitability for brown trout fry and parr (for which Jagers Clough is valued), although this is uncertain (analysis done by the EA indicated that, at less than 10 Ml/d, lower flows resulted in a slow decrease in (fry and parr) nursery habitat (EA, 1999a/b)).

Habitat walkovers have been undertaken downstream of the Noe impoundment and Jagers Clough compensation at current HOF and close to the revised HOFs (ESI and APEM, 2016a). No further baseline walkover data is considered necessary. Sediment sampling and piezometry was also carried out in 2018 downstream of the Noe impoundment (near E2-03) and at Fullwood Stile (E2-07) (APEM and Stantec, 2019). This was primarily to establish a baseline against which to assess any future changes to sediment management, rather than to the HOFs and continuous compensation flow stipulated in the notional solution.

Repeat habitat walkovers are recommended to confirm benefits and as a precaution to ensure no unforeseen consequences over the longer term, given the potential for changes to the channel since baseline walkovers were undertaken. Walkovers are recommended over the reaches surveyed in ESI and APEM (2016a) during HOF/compensation provision and under comparable prevailing inflow conditions to those that occurred at the time of the original walkovers. It is recommended that they are undertaken three years post-measure implementation, acknowledging that the channel will continue to evolve. It is possible that such conditions will not occur in the third year post implementation and therefore the timing of repeat walkovers cannot be guaranteed. Walkovers will focus on surface flow type and the availability of brown trout (*Salmo trutta*), bullhead (*Cottus gobio*) and brook lamprey habitat (*Lampetra planeri*). Transect data accompanying the walkovers should also be taken at the locations previously used.

Sediment sampling and piezometry need not be repeated for the notional solution, unless biological receptors indicate unforeseen consequences that require investigation. Sediment composition and structure may be more affected by measures to address sedimentation at the Noe impoundment, or by spate flow provision arising from 'No Regrets' measures (these are in part intended to remove superficial fines accumulating over

the summer months, or other periods in which spate flows might otherwise be diverted). However, these potential effects/ benefits are not part of the notional solution.

#### 4.4.2 River Ashop

As the notional solution will not result in a change from recent actual compensation, no effect on downstream habitat is predicted and therefore monitoring is only considered necessary if monitoring of biological receptors indicates a potential impact. No ongoing monitoring is proposed. No separate provision is made to monitor the effect of 'No Regrets' measures, which are predicted to be beneficial.

### 4.5 Water quality

There is no objective to improve water quality following implementation of the reallocation of flows. Unforeseen negative consequences are also considered unlikely. Therefore, only seasonal sampling of field-measurable water quality alongside macroinvertebrate sampling and during measure implementation (described in Section 4.1), is considered appropriate.

### 4.6 Macroinvertebrates

#### 4.6.1 River Noe

It is understood that WFD classification of macroinvertebrates in the Noe (source to Peakshole Water) is made on the basis of River Noe downstream of Jaggars Clough confluence at Hope (E2-08). This location is sited at the downstream end of the waterbody and well downstream of the Jaggars Clough confluence. As no net change in flow downstream of the Jaggars Clough confluence is proposed, deterioration in status following the reallocation is considered unlikely. EA data/classification will, however, be reviewed annually as a check of waterbody level status. Confirmation should be sought from the EA that the same location will be used in future classifications.

Recent data are consistent in indicating that effects of low flow stress are not strong or widespread, but the extensive baseline dataset available demonstrates a (small) reduction in LIFE O/E ratios immediately downstream of the Noe impoundment (E2-03a) and upstream of the Jaggars Clough compensation (E2-04), relative to other locations on the River Noe (Stantec & APEM, 2019). Macroinvertebrates between the Noe impoundment and the confluence with the Jaggars Clough are expected to benefit from increased flow, with reduced incidences of any localised/intermittent flow stress. Continued monitoring of locations downstream of the Noe impoundment (E2-03a) (EA infill only) and upstream of the confluence Jaggars Clough (E2-04), alongside the upstream 'control' locations Backtor Bridge (E2-01) (EA infill only) and River Noe upstream of the impoundment (E2-02), is considered sufficient to assess any unintended consequences of measure implementation on macroinvertebrates. The notional solution will not affect flows downstream of the Noe – Jaggars Clough confluence, but macroinvertebrate monitoring at Fullwood Stile (E2-07) is recommended as an additional control.

The likely effect of the reduction in compensation to the Jaggars Clough proposed in the notional solution is a shift towards a more naturalised community, although baseflows will continue to be notably elevated. Continued annual monitoring of Jaggars Clough upstream of diversion (control) (E2-05a) (EA infill only) and Jaggars Clough upstream of River Noe confluence (Edale End) (E2-06) (EA infill only) is considered appropriate for the assessment of any unintended consequences on macroinvertebrates of Jaggars Clough.

Sampling in spring and autumn only is recommended, except in, or in the year after, notably dry years, when summer sampling may also be of benefit. This will be reviewed annually.

#### 4.6.2 River Ashop

The notional solution does not change the recent actual annual minimum compensation flow at the Ashop impoundment. However, the annual minimum flow recommended in the notional solution is lower than

guideline defaults (UKTAG, 2013). This was justified on the basis that the current compensation flows are sufficient to meet GES. As such, continued monitoring is required to demonstrate this.

In the 2015 baseline year EA classification of macroinvertebrates in the Ashop (from Source to Alport) was made on the basis of two locations; 'U/S Abstraction Point' (co-located with River Ashop upstream of abstraction, E3-01) and 'Ashop', sited between the Ashop impoundment and the Alport confluence. The EA 2016 interim classification was made on the basis of the 'Ashop' location only. Macroinvertebrates were not classified by the EA in 2015 or 2016 in the Alport to Derwent waterbody (GB104028057910, a Heavily Modified Water Body (HMWB)).

Long-term mean LIFE O/E ratios are broadly comparable between control and impact locations, but with increased variability observed for the short reach between the impoundment and the confluence with the Alport (E3-02c)<sup>1</sup>. Macroinvertebrate data in this reach has infrequently recorded indications of possible flow stress, but only at flows lower than proposed in the notional solution.

As recent actual compensation flows are recommended to continue, it is expected that Good/High macroinvertebrate status will continue to be supported in both the River Ashop, source to River Alport and River Ashop, from Alport to Derwent waterbodies. Continued monitoring of River Ashop downstream of abstraction (E3-02c) and River Ashop downstream of Alport confluence (Rowlee Bridge) (E3-06) (EA infill only), as well as the upstream 'control' location River Ashop upstream of abstraction (E3-01) (EA infill only), is considered sufficient for ongoing assessment. As for the River Noe, spring and autumn sampling only is recommended, except in, or in the year after, notably dry years, when summer samples may also be of benefit. This will be reviewed annually.

## 4.7 Fish

### 4.7.1 River Noe

Fish are expected to benefit from an improvement in nett habitat availability in the River Noe and Jagers Clough (Section 4.4) but benefits were considered likely to be modest (ESI and APEM, 2018c) - this biological element is already classified at High status for the Noe from Source to Peakshole Water waterbody.

It is understood that EA classification of fish in the Noe (source to Peakshole Water) is made on the basis of three monitoring locations; Barber Booth (EA ID: 3571) and Fullwood Stile (as E2-07) on the River Noe and Edale End (as E2-06) on Jagers Clough. Two of these three locations will be affected by the flow reallocation and therefore there is the potential for the reallocation to affect WFD classification of fish in the waterbody.

Given the notable stakeholder interest, it is recommended that annual monitoring of fish continue at all currently monitored locations; the upstream 'control' location Backtor Bridge (E2-01), downstream of the Noe impoundment (E2-03a), upstream of the Jagers Clough confluence (E2-04), downstream of Jagers Clough confluence (E2-07) (infill of EA monitoring only<sup>2</sup>) and Jagers Clough upstream of River Noe confluence at Edale End (E2-06) (infill of EA monitoring only).

As per the existing baseline record, fish monitoring will be quantitative and will enable WFD classification. Additionally, and again as per the baseline record, targeted lamprey surveys will also be carried out.

---

<sup>1</sup> This location represents a c. 200 m reach between the impoundment and the downstream extent of the waterbody, of a total WFD waterbody length of c. 9 km.

<sup>2</sup> A check of planned EA monitoring will be made annually to confirm locations and requirement for infill monitoring

## 4.7.2 River Ashop

Recent actual flows have been demonstrated to provide suitable habitat for all life-stages of fish species of relevance (APEM and Stantec, 2019), even during 2018 lows. In the 2015 baseline year EA classification of fish in the River Ashop (from Source to Alport) was made on the basis of one location; 'Upper House Farm' (EA ID 31766), which is sited upstream of the impoundment and is not, therefore, directly affected by the compensation release. In the River Ashop to Derwent waterbody, 2015 classification of fish by the EA was made on the basis of 'Lower Ashop Farm' (EA ID 3569), sited downstream of the Ashop/ Alport confluence, c. 400 m upstream of E3-06 (Rowlee Bridge). The 2016 interim classification for fish in the Ashop from Alport to Derwent waterbody suggests a change from Good to Moderate status. This is due to a change in classification tool, but classification remains based upon a single survey site. Continued monitoring at the upstream 'control' location River Ashop upstream of abstraction (E3-01) and River Ashop downstream of Alport confluence (Rowlee Bridge) (E3-06) is considered sufficient for ongoing assessment of fish, but the potential change in fish status highlights the importance of ongoing monitoring during the adaptive management phase, for which it is recommended that the EA utilise STWL collected fish survey data, to enable a more complete assessment of WFD status within updated classification tools.

## 4.8 Monitoring during low flow periods

As described in Section 3.1.4, recommendations for the allocation of available natural flow between the Ashop, Noe and Jaggars Clough under low flow conditions is not part of the notional solution for the Noe and Ashop waterbodies. Monitoring specifications are, however, described here, should these recommendations be implemented. Note that some provisions to be implemented during low flow periods will require changes to infrastructure at the Noe impoundment.

The low flow allocation report (Stantec & APEM, 2019) recommends reduction of the normal compensation requirements when inflows to the Noe impoundment and Jaggars Clough compensation fall below 20 MI/d. Provision for macroinvertebrate and fish survey is adequately met by the long-term monitoring specification set out in this report (see Section 4.6 and 4.7). These recommendations need not be adjusted for circumstances of natural low flow.

Additional monitoring shall be undertaken, a) to check for or anticipate signs of distress due to flow changes, and, b) to record changes in water quality and functional habitat immediately before and immediately after a change in flow allocation is made. Habitat walkover, spot water quality sampling, and fixed-point photography will be sufficient to provide a check for signs of immediate distress and to understand effects on observed fish habitat.

### 4.8.1 Triggers for low flows monitoring

Triggers for monitoring by reach are as follows:

- Prior to implementation of the Notional Solution, monitoring should be undertaken in the Jaggars Clough downstream of the Jaggars Clough compensation if flow in the Jaggars Clough is reduced to 3 MI/d.
- Post implementation of the Notional Solution, monitoring should be undertaken in the Jaggars Clough downstream of the Jaggars Clough compensation if flow in the Jaggars Clough is reduced to 2 MI/d and again should support to the Jaggars Clough be ceased entirely.
- Monitoring shall be undertaken on the River Noe, downstream of the impoundment, should flows along the River Noe downstream of the impoundment fall to 8 MI/d and, again, should flows fall to 6 MI/d.
- Monitoring should be undertaken on the River Noe between the Jaggars Clough confluence and the River Derwent should the combined flow of the River Noe and Jaggars Clough fall below 9 MI/d, and again should the combined flow of the River Noe and Jaggars Clough fall below 7 MI/d. Such walkovers may be curtailed at the confluence with the Peakshole Water should contribution of flow

from that waterbody be agreed by the Environment Agency to be sufficient to cause the River Noe downstream not to be considered in a low flow state.

- Monitoring should be undertaken on the River Ashop to the Alport confluence in the event that flows, a) flow fall naturally below 5 MI/d downstream of the impoundment, or, b) that a transfer of water is considered that would reduce flows immediately downstream of the Ashop impoundment below 8.5 MI/d. Monitoring should be undertaken on the River Ashop between the River Alport and Ladybower Reservoir in the event that flows in this reach fall below 6 MI/d.

#### 4.8.2 Location and frequency of low flows monitoring

The monitoring required as a result of the triggers identified above shall take place at the following locations:

- Habitat walkovers, of the River Noe from the impoundment (NGR SK 14 85) to the confluence with the River Derwent (SK 20447 82524), or sections thereof as defined in Section 4.8.1, of Jaggars Clough from the compensation release (SK 16 86) to the confluence with the River Noe (SK 16114 86244) and of the River Ashop from the impoundment (SK 14 89) to the confluence with the River Alport (SK 14166 89525) and between the confluence with the River Alport and Ladybower Reservoir (SK 16 87).
- Spot water quality and fixed photography at locations of interest identified during walkover survey and at E2-03a, E2-04, E2-05b, E2-06, and immediately upstream and downstream of the confluence with the Peakshole Water (SK 17532 83207).

Monitoring shall take place within three days of monitoring triggers being reached. The need and frequency of repeat monitoring may be varied by agreement with the Environment Agency, depending upon observations during low flows, but, as a default:

- **For the Jaggars Clough:** Repeat monitoring shall be undertaken on the Jaggars Clough should flows be reduced to 3 MI/d (prior to implementation of the Notional Solution) or to 2 MI/d (post implementation of the Notional Solution), over a period of one week without interruption by spate flows. Repeat monitoring shall be further undertaken should flows be reduced to 3 MI/d (pre) or 2 MI/d (post) implementation of the Notional Solution for two weeks without interruption by spate flows (14 days) and monthly thereafter should flows continue to be limited to 3 MI/d (pre) or 2 MI/d (post) implementation of the Notional Solution. Post implementation of the Notional Solution, repeat walkover shall also be undertaken on the Jaggars Clough should compensation flows cease for 3 consecutive days without interruption by spate flows and weekly thereafter, should compensation flows continue to cease without interruption by spates.
- **For the River Noe:** Prior to implementation of the Notional Solution, repeat monitoring between the River Noe impoundment and the Jaggars Clough confluence shall be undertaken monthly should flows lower than 8 MI/d downstream of the impoundment persist or after one week and at fortnightly intervals thereafter if flows fall below 6 MI/d downstream of the impoundment. Post implementation of the Notional Solution, repeat monitoring shall be undertaken monthly on the River Noe between the Jaggars Clough confluence and the River Derwent should flows lower than 9 MI/d persist downstream of the confluence of the River Noe and Jaggars Clough or after one week and at fortnightly intervals thereafter if flows fall below 7 MI/d downstream of the confluence of the River Noe and Jaggars Clough.
- **For the River Ashop:** Post implementation of the Notional Solution, repeat monitoring shall be undertaken on the River Ashop should transfers be made during times when flows downstream of the impoundment fall below 8.5 M/d and these persist for more than one week uninterrupted by spates, for two weeks subsequent to this and monthly, should transfers persist further.

Repeat monitoring can be deferred should monitoring be triggered by a lower trigger in the intervening period.

#### 4.8.3 Assessment of significance of low flows monitoring

Fish habitat walkover findings shall be regarded as significant if signs of fish under distress are observed. In situ water quality measurements shall be regarded as significant if two consecutive measurements taken



immediately after a flow reallocation is made show a deterioration in WFD indicative status by one class, compared to the measurements made immediately prior to a flow reallocation, or if a single post reallocation measurement shows a deterioration in WFD indicative status by 2 classes, compared to immediately prior to flow reallocation. STWL shall report findings to the Environment Agency immediately in the event that findings are found to be significant.

Should significant effects be observed, flows may be allocated to minimise impacts in the light of observations, for example providing more support to the Jagers Clough if appropriate. This will, however, require consideration of relative low flow effects between the various reaches affected (as evidenced by the low flows monitoring), and may require prioritisation of a given reach, or reaches, over others. Any such change to the flow proposed flow reallocation undertaken in the light of within-dry period monitoring would be contingent upon the ability of STWL to make the necessary adjustments at the offtake structures, and would only be made in consultation with the Environment Agency.

STWL shall submit results of any low flow monitoring in annual reports required as part of adaptive management (expected to be 2024 to 2027 inclusive as a minimum). Annual reports will detail all data collected within a calendar year and will include consideration of any actions taken as necessitated by any significant changes that might inform changes to the licence and/ or monitoring.

# 5 Evaluating success

## 5.1 Success criteria

The predicted benefits to ecology as a result of implementation of the notional solution were considered at OA to be relatively small (ESI and APEM, 2018c, 2018f) as the physico-chemical and biological quality elements of the Noe and Ashop waterbodies were considered to achieve GES/ GEP under recent actual flow regimes, as based upon the 2015 Cycle 2 classification. More recently, the 2016 interim classification for fish in the Ashop from Alport to Derwent waterbody was considered to be at Moderate status, based upon an updated classification tool. This gave the waterbody overall moderate GEP. Success criteria for AM are proposed as:

- Meeting the proposed compensation flows. In the Noe, an initial reallocation to 12 MI/d at the Noe impoundment and 8 MI/d at the Jagers Clough compensation and subsequently, 14 MI/d downstream of the Noe impoundment and 6 MI/d at the Jagers Clough compensation. In the Ashop, success is defined as meeting the target compensation flow of a mean monthly minimum of 8.5 MI/d, with a requirement that daily flow cannot drop below 5.5 MI/d. Temporary reduction of flows below the natural inflow and compensation flows will not constitute a failure during periods when the Ashop-Noe-Jagers Clough system is considered to be in a natural low flow event.
- Achieving GES for the physico-chemical and biological quality elements of the Noe and Ashop waterbodies in line with the 2015 Cycle 2 classification and avoiding unacceptable negative impacts attributable to the implementation of measures. Long-term negative impacts are defined as indicative, waterbody-level, WFD deterioration of any classification element that can reasonably be ascribed to flow changes or to the implementation of the notional solution<sup>3</sup>.

## 5.2 River flows

Flows at downstream of the Noe impoundment at River Noe downstream of abstraction and upstream of Jagers Clough (E2-03a) and on the Jagers Clough downstream of diversion (E2-05b) and estimates of flows downstream of the River Noe-Jagers Clough confluence will be assessed annually against revised compensation flows of the notional solution, within the context of inflows and the recommended allocation of flows detailed in Section 3.1.

Flows downstream of the Ashop impoundment at River Ashop downstream of the impoundment (E3-02b) and River Ashop at Rowlee Bridge (E3-06) will be assessed annually against the revised compensation of the notional solution, within the context of inflows and the recommended allocation of flows detailed in Section 3.1.

These locations will be routinely assessed and reported to the Environment Agency for licence compliance purposes. The annual review will be specifically in the context of AM alongside other environmental data. Ongoing improvements to continuous stage measurement and targeted spot flow gauging and review of ratings will continue as part of the annual reporting process in an effort to reduce measurement uncertainty as described in Section 4.3.

---

<sup>3</sup> Sub-waterbody scale negative effects will also be considered, and could affect recommendations regarding compensation flows, although net benefits will require consideration.

## 5.3 Morphology

### 5.3.1 River Noe

Qualitative comparison is recommended with changes noted during confirmatory walkovers referenced against baseline outputs. Transect data will provide a quantitative, estimate of hydraulic conditions at key locations, but these will be indicative of hydraulic conditions in the waterbody generally.

Whilst morphological data do not provide evidence for a change in indicative WFD status, if impacts can reasonably be ascribed to an effect of the compensation reallocation, a recommendation to readjust the releases may be made.

### 5.3.2 River Ashop

No morphological monitoring is planned in the Ashop for monitoring of the notional solution.

## 5.4 Water quality

Evaluation of water quality data is not recommended as part of the AM programme and therefore criteria for assessment are not specified here.

## 5.5 Macroinvertebrates

The baseline condition is defined as ‘the condition of macroinvertebrate communities as described in the CRs’ (ESI and APEM, 2018a, 2018d), as well as subsequent indicative classifications reported on as part of the annual reporting process.

### 5.5.1 River Noe

Post implementation data will be reviewed annually to assess whether measure implementation resulted in change to the indicative WFD status of macroinvertebrate communities downstream of the Noe impoundment (E2-03a), upstream of the Jaggars Clough confluence (E2-04), downstream of the Jagger’s Clough confluence (Fullwood Stile, E2-07) or on the Jaggars Clough upstream of the River Noe confluence at Edale End (E2-06).

An assessment of whether macroinvertebrates can be considered to have benefited from the compensation reallocation will be made. This will be carried out three years post implementation and achieved through comparison of macroinvertebrate data (species lists as well as index outputs) before and after the reallocation of compensation releases, as well as between locations within the catchment. For example, success might be demonstrated by an improvement in LIFE O/E ratios downstream of the Noe impoundment, and/or flow sensitive taxa may be recorded at greater frequency and abundance. It is anticipated that a three-year period of AM will be sufficient to evaluate whether unforeseen impacts have been avoided. At this juncture STWL monitoring of macroinvertebrates will continue, assuming progression to a further reallocation of flow and cycle of AM.

In the event that no unforeseen consequences are demonstrated, but further reallocation does not progress, it is recommended that STWL monitoring should be discontinued with monitoring for ongoing issues in the catchment addressed thereon from routine EA sampling. Whilst a reduction in indicative status at the monitored locations may not affect waterbody status, if impacts can reasonably be ascribed to an effect of the compensation reallocation, a recommendation to amend flows may be made. A small negative effect in the Jaggars Clough at upstream of River Noe confluence (Edale End) (E2-06) is not predicted but may be acceptable if the Weight of Evidence suggests a net benefit across the reaches affected by the reallocation of flows. The reach of the River Noe to benefit from the reallocation is substantially longer than the length of the Jaggars Clough on which flows will be reduced, although allowance must be made for the potential importance of the Jaggars Clough as a nursery habitat for brown trout.

## 5.5.2 River Ashop

Annual assessment of waterbody-level WFD status will be made on the basis of the EA 2015 baseline, i.e. use of both EA locations in the Ashop (from Source to Alport) waterbody; however, weighting will be given to each location on the basis of the lengths of the reaches they represent. Data will also be reviewed at location level post implementation to assess whether implementation of the notional solution resulted in change to the indicative WFD status of the macroinvertebrate communities of the River Ashop downstream of the impoundment (E3-02c) and River Ashop downstream of the confluence with the River Alport at Rowlee Bridge (E3-06). Whilst a reduction in indicative status at the monitored locations may not affect waterbody status, if impacts can reasonably be ascribed to an effect of the compensation a recommendation to amend it may be made.

It is anticipated that a three-year period of AM will be sufficient to evaluate whether unforeseen negative consequences have been avoided. At this juncture it is recommended that AM monitoring should be discontinued, with any ongoing issues in the catchment addressed thereon from routine EA sampling and STWL compliance monitoring.

## 5.6 Fish

The baseline condition is defined as 'the condition of fish populations as described in the CRs' (ESI and APEM, 2018a, 2018d), and subsequent data reported on as part of the annual reporting process.

### 5.6.1 River Noe

Qualitative comparison of fish data pre- and post-implementation of compensation releases will be made as part of annual reporting. Habitat walkover will further support the assessment of fish data and an assessment of WFD status will be made. Given the small number of survey locations and because of natural variation between years, robust statistical comparisons pre and post the implementation of the notional solution are unlikely to discern subtle effects, even with an extended baseline dataset. Any major negative effects would be expected to be apparent in the data through the use of classification tools without use of bespoke statistical analysis and would prompt corrective action (to be determined at the point of identification of the negative effect)..

It is anticipated that a three-year period of AM will be sufficient to evaluate whether unforeseen negative consequences have been avoided. At this juncture STWL monitoring of fish will continue, assuming progression with a further reallocation of flow and a further cycle of AM. In the event that no unforeseen consequences are demonstrated, but further reallocation does not progress, it is recommended that STWL monitoring should be discontinued with monitoring for ongoing issues in the catchment addressed thereon from routine EA sampling.

### 5.6.2 River Ashop

As there is no change to current flow regime proposed, it is anticipated that a three-year period of monitoring is undertaken, to ensure against any signs of deterioration. Qualitative comparison of fish data will be made as part of annual reporting, and an assessment of WFD status will be made. As on the River Noe, it should be recognised that robust statistical assessment is unlikely to be achievable even with an extended dataset, given the small number of survey locations and the inherent variability of fish survey data.

At this juncture, it is recommended that STWL monitoring should be discontinued with monitoring for ongoing issues in the catchment addressed thereon from routine EA sampling.

# 6 Adaptation and adjustment

This section sets out how failure is recognised during the evaluation of success (Step 4 in Illustration 1.1), and how different types of failure are dealt with. It is not attempted here to review any given scenario of failure to meet the success criteria. Rather, the process that will be taken to adapt and adjust in response to “failure” to meet the success criteria is outlined (Illustration 6.1).

‘Failure’ to achieve success as defined by the success criteria is not necessarily a failure of AM, because AM does not pre-suppose success in one cycle. Rather, success is recognised as uncertain and AM acknowledges at least the potential for further cycles of adjustment. Failure must therefore be defined in terms of an inability to achieve a progressive “homing in” on a solution. Note also that success will not necessarily achieve an optimal solution. It is sufficient to arrive at a solution that realises the success criteria within a timescale that is compatible with legislative or operational goals (i.e. by the end of AMP8).

“Failure” to achieve the stated success criteria must be assessed separately for each intervention (in this case the change to the River Noe HOF and Jaggars Clough compensation) and classified as one of the below:

- Compliance failure
- Failure due to external causes
- Failure due to measurement uncertainty
- Failure to meet stated success criteria

The AM monitoring scheme, supported by regulatory surveillance monitoring, must allow differentiation between these types of failure.

## 6.1 Compliance failure

Compliance failure for the Noe and Ashop waterbodies is a failure by STWL to release the target compensation flows. In the event of compliance failure resulting in unintended consequences, then continued monitoring of the intended compensation flows would be needed, until a compliant regime can be assessed. The result is a deferred solution.

Failure to maintain HOFs and the Jaggars Clough compensation flow during natural low flow events is not considered a compliance failure but may affect the evaluation of the notional solution in the event that unintended consequences are not avoided.

In the event that compliance failure or operation during natural low flow events does not result in unintended consequences, this need not result in a deferred solution for AM purposes (whatever action may be taken for non-compliance).

## 6.2 Failure due to external causes

If flow releases are compliant, but unintended consequences have not been avoided, monitoring data should be evaluated to establish whether this is due to either:

- Other pressures
- Unusually wet conditions.

If it is considered that deterioration is likely to have occurred as a result of either of the above reasons, it cannot necessarily be inferred that measure implementation would have avoided unintended consequences. Expert

judgement may be required to draw reasonable inference. Continued monitoring of the intended flow regimes may also be needed in the absence of other pressures or unusual weather conditions. The result is a deferred solution.

If other pressures appear likely to continue to affect AM, mitigation measures directed at addressing these may also be needed for AM to be successful. If these cannot be economically addressed, AM to the defined success measures may not be a viable solution. In this scenario it is recommended that the target flow releases are made as specified, with revised success criteria, or monitoring continuing for compliance purposes only (and in the short-term as a continued check of unintended consequences, as necessary).

### 6.3 Failure due to measurement uncertainty

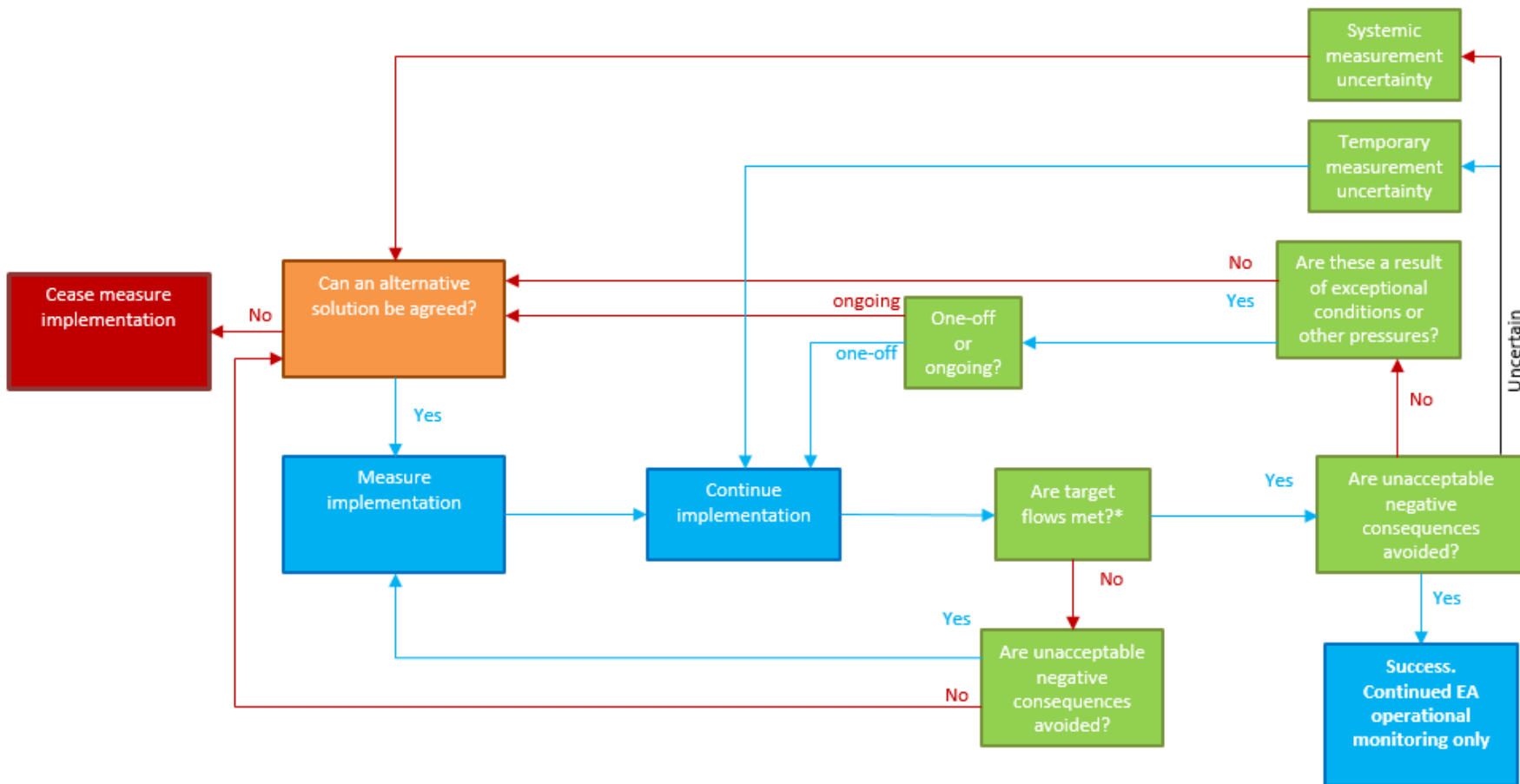
If flow releases are compliant and it is uncertain whether unintended consequences have been avoided, expert judgement should be used to consider whether this may be fairly ascribed to the uncertainty in measurements. Expert judgement may be needed because post-intervention sampling is recommended for a short period and given that a Weight of Evidence approach has been adopted, measurement uncertainty may not be specified in numerical terms.

Measurement uncertainty may be classed as either temporary, or systemic. Temporary measurement uncertainty might include unusual or one-off failures in sampling or survey protocols. In this event, failure to discriminate between success and "failure" because of temporary measurement uncertainty would require continued monitoring to the correct protocol until success (or "failure") could be demonstrated more conclusively. Further monitoring has been specified for some circumstances. The result is again a deferred AM solution.

Systemic uncertainty is considered to be a failure of the specified sampling regime itself; i.e. that the specified monitoring is unable to demonstrate success with the requisite degree of certainty, regardless of how well the sampling/survey is carried out. This may require a re-specification of the sampling/survey regime, and if a suitable sampling/survey regime could not be specified for a reasonable cost, AM may not be an appropriate solution. In this case, an assessment of the risk of unacceptable negative consequences/ net effects would be required to determine whether or not the target flow release would continue to be made. Clearly this is not a desirable outcome.

### 6.4 Failure to meet stated success criteria

If a flow release is compliant, but it is considered that the release has caused unacceptable unintended consequences, then agreement would be required for either the readjustment of compensation releases, or alternative measures might be specified if considered appropriate and justifiable in the light of evidence offered by the long-term AM trial. In this scenario the notional solution on its own cannot be considered an improvement over the baseline and if further mitigation measures cannot be specified, pre-implementation compensation flows would have been demonstrated to be preferable to the reallocated flows (Noe). Likewise, other mitigation measures might be discontinued, if these have been specified during AM cycles.



\*Where compensation flows are altered in-line with the recommendations for periods where the Ashop-Noe-Jaggers Clough system is considered to be in a natural low flow event this will not constitute failure of this criterion

**Illustration 6.1 Flow diagram for the proposed process of adaptation and adjustment of AM in the Noe and Ashop waterbodies**



## 6.5 Timeline

Timelines for the progress of AM are presented for the River Noe and Jaggerys Clough in Illustration 6.2 and for the River Ashop in Illustration 6.3. The timelines will be subject to change as AM progresses and makes the assumption that at no point does failure to meet success criteria occur. This could happen at any stage and could result in change to the timescale of AM.

The date by which Phase 1 of the Notional Solution must be implemented by is 22/12/2024 (under interim licence conditions). Phase 1 of AM shall therefore be implemented by this date, unless an earlier date is agreed with the EA. Phase 1 is expected to take place between 22/12/2024 and 22/12/2027, as a minimum timeframe, but may begin earlier, if agreed with the EA. Dependent on any change to the Phase 1 timescale, implementation of the Notional Solution Phase 2 is anticipated to begin on 22/12/2027 for a further (minimum) three-year period.

Monitoring data will be reviewed annually to ensure that any potential issues are quickly recognised. The expectation is that Phase 1 will take three years, although this may be extended in the event that circumstances preclude demonstration that reallocation of flows to 12 MI/d on the River Noe and 8 MI/d on the Jaggerys Clough do not result in unintended negative consequences, and it is acknowledged that some geomorphological and ecological changes may take longer to fully manifest.

Review of the success of Phase 1 will be made in close consultation with the EA. The formal criteria described in Section 5 will determine the assessment of success of Phase 1 prior to movement to Phase 2.

The notional solution for the Noe, for which the AM has been outlined in this report, details a two-step compensation reallocation whereby combined flows downstream of the Noe and Jaggerys Clough confluence remain at a minimum of 20 MI/d. When the AM of this solution reaches its completion, consideration of further steps that might be taken to achieve a more natural flow regime downstream of the Noe and Jaggerys Clough confluence, as described in Appendix D of the CR (ESI and APEM, 2018a), should be made.

It is envisaged that, once AM is complete and assuming success criteria are met, monitoring will revert to ongoing EA surveillance monitoring and ongoing compliance monitoring by STWL to demonstrate adherence to the terms of their abstraction licences.

Phase 1		Pre-implementation	Year 1 River Noe - 12 MI/d Jaggers Clough - 8 MI/d	Year 1/2	Year 3	Year 4*
<b>Summary AM status/activities</b>	<b>Ensure baseline requirements fulfilled</b>	<b>Monitoring for risk of acute impacts</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Weight of evidence assessment to inform whether second phase should proceed</b>
<b>Monitoring elements</b>						
Flow	On-going	Habitat walkovers (and in situ water quality) alongside implementation for the assessment of risk of acute impact	Yes	Yes	Yes	Yes
Habitat walkover	Complete		Only if unintended consequences determine a need	Only if unintended consequences determine a need	Only if unintended consequences determine a need	Yes
<b>Bed sediment sampling/ piezometry</b>	Complete		Only if unintended consequences determine a need	Only if unintended consequences determine a need	Only if unintended consequences determine a need	Only if unintended consequences determine a need
Water quality	On-going (seasonal)		Yes	Yes	Yes	Yes
Macroinvertebrates	On-going		Yes	Yes	Yes	Yes
Fish	On-going		Yes	Yes	Yes	Yes
Phase 2			Year 5 River Noe - 14 MI/d Jaggers Clough – 6 MI/d	Year 5/6	Year 7	Year 8*
<b>Summary AM status/activities</b>		<b>Monitoring for risk of acute impacts</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Weight of evidence assessment to inform overall success of AM and whether further adjustment is necessary</b>
<b>Monitoring elements</b>						
Flow		Habitat walkovers (and in situ water quality) alongside implementation for the assessment of risk of acute impact	Yes	Yes	Yes	Yes
<b>Habitat walkover</b>			Only if unintended consequences determine a need	Only if unintended consequences determine a need	Only if unintended consequences determine a need	Yes
<b>Bed sediment sampling/ piezometry</b>			Only if unintended consequences determine a need	Only if unintended consequences determine a need	Only if unintended consequences determine a need	Only if unintended consequences determine a need
Water quality			Yes	Yes	Yes	Yes
Macroinvertebrates			Yes	Yes	Yes	Yes
Fish			Yes	Yes	Yes	Yes
<b>Assumption</b> In the above timeline at no point do failure to meet success criteria occur. This could happen at any stage and would result in a change to the timescale of AM.						

\*Note that the assumed three years post implementation is contingent upon demonstration that reallocation of flows to 12 MI/d on the River Noe and 8 MI/d on the Jaggers Clough do not result in unintended negative consequences.

**Illustration 6.2 Indicative timeline of progression of AM for the Noe waterbody**

Pre-implementation		Year 1 River Ashop – 8.5 MI/d (daily minimum flow of ≥ 5.5 MI/d))	Year 2	Year 3	Year 4*
<b>Summary AM status/activities</b>	<b>Ensure baseline requirements fulfilled</b>	<b>Monitoring for risk of acute impacts</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Annual assessment of flows and unintended consequences</b>	<b>Weight of evidence assessment to inform success and indefinite implementation of compensation</b>
<b>Monitoring elements</b>					
Flow	On-going	Not required as recent actual flows to continue.	Yes	Yes	Yes
Habitat/sediment sampling/piezometry	Complete		Only if unintended consequences determine a need	Only if unintended consequences determine a need	Only if unintended consequences determine a need
Water quality	On-going (seasonal)		Yes	Yes	Yes
Macroinvertebrates	On-going		Yes	Yes	Yes
Fish	On-going		Yes	Yes	Yes
<b>Assumption</b> In the above timeline at no point do failure to meet success criteria occur. This could happen at any stage and would result in a change to the timescale of AM.					

\*Note that the assumed three years post implementation is contingent upon demonstration that reallocation of flows to 12 MI/d on the River Noe and 8 MI/d on the Jagers Clough do not result in unintended negative consequences.

**Illustration 6.3 Indicative timeline of progression of AM for the Ashop waterbody**

# REFERENCES

**APEM and Stantec, 2019 (in progress).** Severn Trent Water AMP6 Low Flows Programme: River Noe Sediment Investigation: 2018 Technical Note. Report ref: 64116AB TN15D1, not yet issued.

**EA, 1999a.** Upper Derwent Study Environment Agency Midlands Region: Optimum reallocation of Upper Derwent compensation flows to best meet ecological needs. Main Report, May 1999

**EA, 1999b.** Upper Derwent Study Environment Agency Midlands Region: Optimum reallocation of Upper Derwent compensation flows to best meet ecological needs. Technical Report, May 1999

**Environment Agency, 2018.** Guidance on water resources investigations into the risk of WFD water body deterioration. January 2018, Final.

**ESI and APEM, 2013.** AMP5 Investigation Sites East Area Impact Assessment Report: River Noe (GB104028057890) and River Ashop (GB104028057930). Report ref: 60083S R19, December 2013, Final.

**ESI and APEM, 2016a.** Severn Trent Water AMP6 Low Flows Programme: River Noe Operational Trial. Report ref: 60083BO R4, July 2016, Draft.

**ESI and APEM, 2016b.** Severn Trent Water AMP6 Low Flows Programme: River Noe and River Ashop 2015 Annual Report. Report ref: 60083BO R8, June 2016, Final.

**ESI and APEM, 2016c.** Severn Trent Water AMP6 Low Flows Programme: River Noe Operational Trial. Report ref: 60083BO R3, June 2016, Draft.

**ESI and APEM, 2018a.** Severn Trent Water AMP6 Low Flows Programme: River Noe Compensation Review. Report ref: 64116AB R8rev1, April 2018, Final.

**ESI and APEM, 2018b.** Severn Trent Water AMP6 Low Flows Programme: River Noe 2017 Annual Report. Report ref: 64116AB R33, September 2018, Final.

**ESI and APEM, 2018c.** AMP6 Investigation Sites East Area: Options Appraisal Report - River Noe. Report ref: 64116AB R24, June 2018, Draft.

**ESI and APEM, 2018d.** Severn Trent Water AMP6 Low Flows Programme: River Ashop Compensation Review. Report ref: 64116AB R5, February 2018, Final.

**ESI and APEM, 2018e.** Severn Trent Water AMP6 Low Flows Programme: River Ashop 2017 Annual Report. Report ref: 64116AB R28, June 2018, Final.

**ESI and APEM, 2018f.** AMP6 Investigation Sites East Area: Options Appraisal Report - River Ashop. Report ref: 64116AB R20, June 2018, Final.

**Macleod, C. J. A., Blackstock, K., Brown, K., Eastwood, A., Gimona, A., Prager, K. and Irvine, R. J., 2016.** Adaptive management: an overview of the concept and its practical application in the Scottish context. RESAS1.4.3a Deliverable D1: Report on relevant adaptive management approaches for Scotland. The James Hutton Institute and the Scottish Government.

**Stantec and APEM, 2019.** Severn Trent Water AMP6 Low Flows Programme: River Noe and River Ashop Low Flow Distribution Assessment. Report ref: 64116AB R36D1, March 2019, Draft.

**UKTAG, 2013.** River flow for good ecological potential: Final recommendations. Version 1.0, December 2013.

**Williams, B. K., Szaro, R. C. and Shapiro, C. D., 2009.** Adaptive management: The U.S. Department of the Interior technical guide. U.S. Department of the Interior. <https://pubs.er.usgs.gov/publication/70194537>

# FIGURES

# APPENDICES

# Appendix A

## 2018 Site Investigation Plan (SIP)



# Appendix B

## Gauging accuracy at the Noe and Ashop impoundments

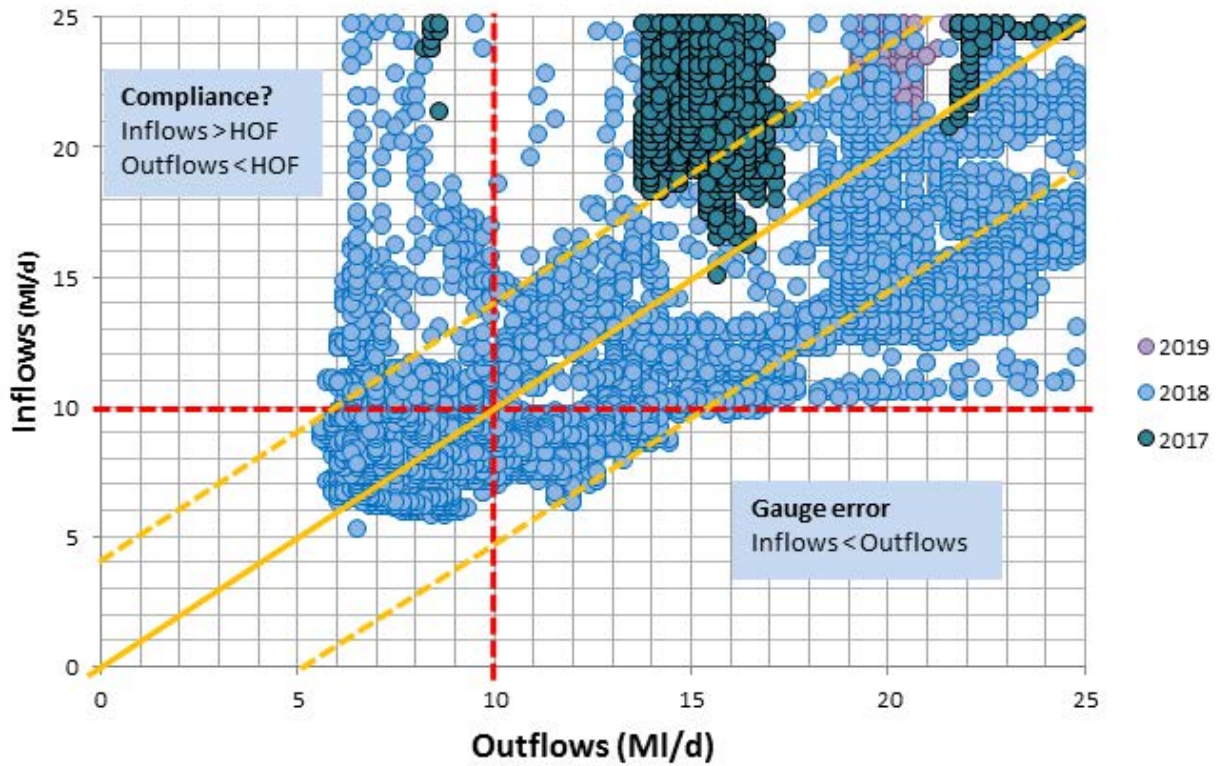


Illustration B 1 Inflows (E2-02) and outflows (E2-03a) at the Noe impoundment

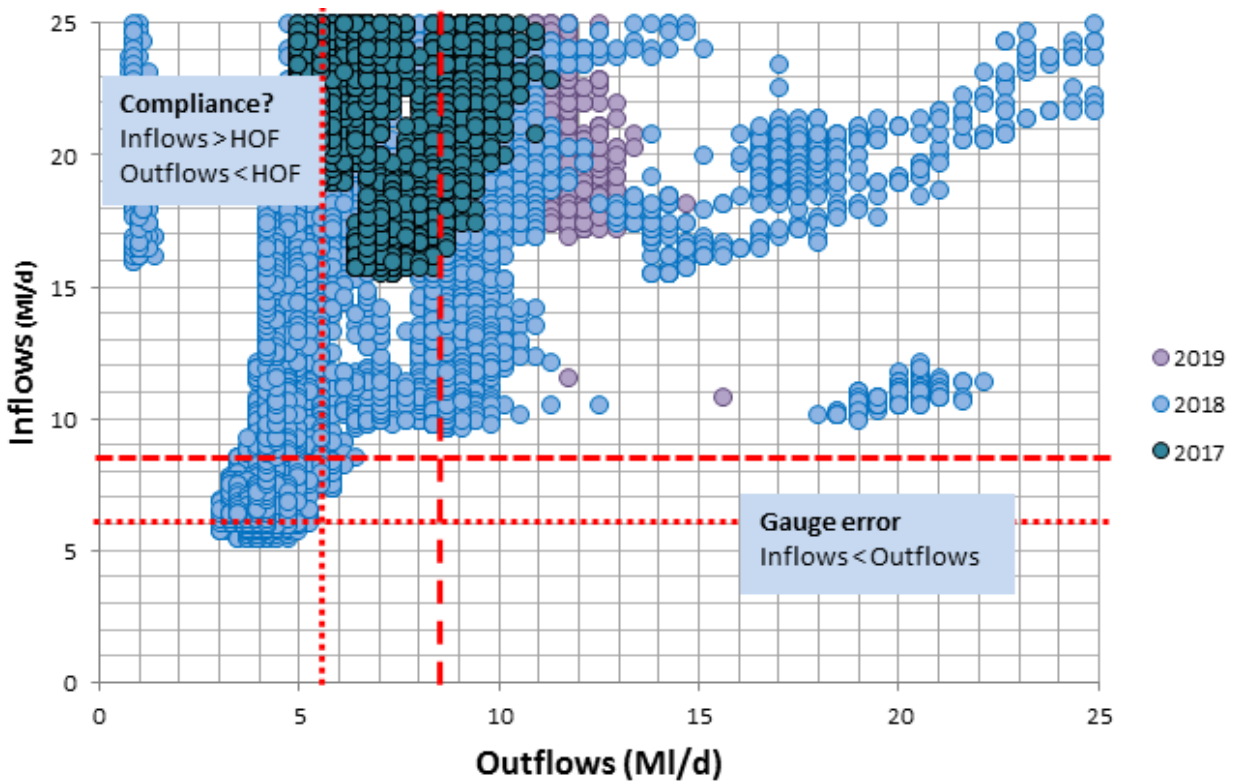


Illustration B 2 Inflows (E3-01b) and outflows (E3-02b) at the Ashop impoundment