

Kegworth Lock Hydroelectric Project

Water Framework Directive Assessment

Renewables First – Company

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1 Introduction

Introduction to assessment

- 1.1. This document accompanies a planning application and abstraction licence application for a proposed hydropower scheme and fish pass at Kegworth Lock on the River Soar.
- 1.2. The Environment Agency's 'Guidance for run-of-river hydropower: the Water Framework Directive, nature conservation and heritage' dated December 2013 has been followed as part of this assessment.
- 1.3. The assessment will review the potential effects arising from the proposed scheme in relation to:
 - flow patterns
 - sediment availability
- 1.4. The Water Framework Directive (2000/60/EC) (WFD) was passed by the European Union in 2000. It became part of UK law in 2003 with the issue of The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003.
- 1.5. The WFD is implemented regionally by river basins. Each river basin has a River Basin Management Plan (RBMP) which is updated every six years. The RBMP documents the current status of the water bodies and the pressures affecting them. It outlines the improvements that can be made within the current management period and the programme of investigations to be carried out.
- 1.6. The fundamental objectives of the WFD that apply to surface water bodies are:
 - Prevent deterioration of the status of water bodies
 - Achieve at least good ecological status and good surface water chemical status by a set date
 - Reduce pollution from priority substances and eliminate priority hazardous substances as defined by the European Commission
- 1.7. In addition to the objectives above there are further standards and measures to be met in areas defined as protected areas. These areas are listed in the RBMPs.
- 1.8. Artificial or Heavily Modified Water Bodies (AWB, HMWB) cannot achieve Good ecological status as they are unable to get close enough to the required natural conditions. Instead the aim is to achieve Good ecological *potential*.
- 1.9. The RBMPs detail the Environment Agency (EA) objectives specific to each water body that are designed to meet the WFD objectives. The proposed measures to meet the objectives are also given.

Purpose of assessment

- 1.10. This assessment has been undertaken to fulfil the requirements under the Water Framework Directive.
- 1.11. The EU Water Framework Directive requires environmental objectives be set for all surface and ground waters to enable them to achieve Good status or potential for heavily modified water bodies by a defined date. One objective is to prevent further deterioration which can include changes to flow pattern, width and depth of channel, sediment availability/transport and ecology and biology.
- 1.12. This assessment looks at the current status of the water bodies that may be affected by the proposed hydropower system and discusses whether or not the proposal will deteriorate the ecological quality of the water bodies or prevent the water bodies from achieving Good ecological status.
- 1.13. Any EA defined objectives and measures that are specific to the water body will be considered to determine if the proposed hydropower system will prevent these objectives and measures from being realised.

Site description

- 1.14. As the Soar begins to pass the village of Kegworth, the river diverges into a main left-hand channel, leads towards the main weir, and a smaller right-hand navigational channel, which leads towards a side weir and canal lock.
- 1.15. The main weir is a concrete structure that spans the channel diagonally, situated around 270 m downstream of the bifurcation and with a breadth of 104 m. The weir maintains navigational water levels upstream. On the downstream side, the channel continues for around 260 m before converging with the navigational channel.
- 1.16. The narrower navigational channel – also known as the ‘Old Cut’ – extends for around 300 m before reaching the side weir, which spills into the main channel just downstream of the main weir. The navigational channel continues for a further 120 m before reaching Kegworth Lock, following which it converges with the main channel.
- 1.17. Approximately 500 m further downstream, the river splits again to provide a navigational channel through Kegworth Flood Lock.
- 1.18. There are no existing fish pass facilities at the site; the lock and weir are currently impassable to fish.

Current WFD status

Water body name	Soar from Long Whatton Brook to Trent
Water body ID	GB104028047212
Management Catchment	Soar River
River Basin District	Humber
Hydromorphological designation	Not designated artificial or heavily modified

Classification Item	2013	2014	2015	2016
Overall Water Body	Poor	Poor	Poor	Bad
Ecological	Poor	Poor	Poor	Bad
Biological quality elements	Poor	Poor	Poor	Bad
Macrophytes and Phytobenthos Combined	Poor	Poor	-	Moderate
Fish	Good	Poor	Poor	Bad
Invertebrates	Good	Good	Good	Good
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	Moderate	Moderate	Moderate	Moderate
Acid Neutralising Capacity	-	High	High	High
Ammonia (Phys-Chem)	High	High	High	High
Biochemical Oxygen Demand (BOD)	High	High	High	High
Dissolved oxygen	High	High	High	High
pH	High	High	High	High
Phosphate	Poor	Moderate	Poor	Poor
Temperature	High	High	High	High
Specific pollutants	High	High	High	High
Chemical	Good	Good	Good	Good

Classification item	Objective	Reasons
Overall water body	Good by 2027	Disproportionate burdens
Ecological	Good by 2027	Disproportionate burdens
Biological quality elements	Good by 2027	Disproportionate burdens
Fish	Good by 2027	Disproportionate burdens
Physico-chemical quality elements	Good by 2027	Disproportionate burdens
Phosphate	Good by 2027	Disproportionate burdens

- 1.19. The upstream waterbodies are: Soar from Rothley Brook to Long Whatton Brook, Hemington Brook Catchment (trib of the Soar), Long Whatton Brook Catchment (trib of Soar, Kingston Brook Catchment (Trib of Soar).
- 1.20. The downstream waterbody is Trent from Soar to The Beck.

Proposal summary

- 1.21. The proposal comprises a single Archimedes screw turbine, a new multi-species fish pass, a turbine house building, hydraulic channels, trash screening, access improvements, an electrical substation and underground cabling.
- 1.22. The scheme is expected to generate a peak power output of 230 kW and an average annual energy production of 0.8 GWh. This is sufficient to power 205 homes and provides an effective CO₂e saving of around 415 tonnes per year.
- 1.23. The proposal comprises a single Archimedes screw turbine, a new multi-species fish pass, a turbine house building, hydraulic channels, trash screening, access improvements, an electrical substation and underground cabling.

Interaction with other hydropower schemes

- 1.24. Currently, there are no hydropower schemes in operation within 5 km upstream or downstream of the site.

2 Impact on WFD objectives

2.1 The following table reviews the RBMP plan for the relevant section 'Soar from Long Whatton Brook to Trent'. Only those elements which have been assessed by the EA and which are relevant to the nature of the proposal are listed here.

Receptor	Current status (2016 C2)	Objective	Reasons for status	Impact	Assessment
OVERALL	Bad	Good by 2027	Disproportionate burdens	No adverse impact	See individual elements below
Ecological	Bad	Good by 2027	Disproportionate burdens	No adverse impact	See individual elements below
Ecological – biological quality elements					
Overall	Bad	Good by 2027	Disproportionate burdens	No adverse impact	See individual elements below
Macrophytes and phytobenthos combined	Moderate	-	-	No adverse impact	There will be no significant hydromorphological impacts of the proposal - see below. There will be no significant change in water levels that may affect riparian macrophytes. Overall, as there is no adverse impact on other related elements such as water quality, there will be no significant impact on macrophytes or phytobenthos.
Fish	Bad	Good by 2027	Disproportionate burdens	Positive impact	Two activities are listed as suspected reasons for the current status: 'Reservoir / Impoundment - non flow related' and 'Land use - arable'. The proposed scheme will not affect land use, however will have a positive impact related to impoundments. As detailed in the associated APEM report, the weir is currently impassable to fish. The proposal includes new multi-species fish pass facilities, providing a significant improvement in passability. Some changes to fish habitats are expected due to the change in flow distribution, however there is no overall adverse impact to fish habitats; the additional fish pass facilities ensure a net positive impact.
Invertebrates	Good	-	-	No adverse impact	There will be no significant hydromorphological impacts of the proposal - see below. As there is no adverse impact on other related elements such as water quality, there

					will be no significant impact on invertebrates. A river mussel survey was completed; no species with legal protection or listing as priority species were recorded.
Ecological – hydromorphological supporting elements					
Overall	Supports Good	-	-	No adverse impact	The scheme will affect flow distribution at the site, particularly during low to moderate flow conditions. The associated geomorphological impacts were assessed in detail by APEM. Some temporary deposition of medium and coarse sand may be deposited during moderate flow events, however the overall impact of the scheme is very minimal. There will be no changes to the wetted areas. Overall, the impact is minor, neutral and temporary.
Hydrological Regime	Supports Good	-	-	No adverse impact	See above
Ecological – physico-chemical quality elements					
Overall	Moderate	Good by 2027	Disproportionate burdens	No adverse impact	See individual elements below
Biochemical oxygen demand (BOD)	High	-	-	No adverse impact	There will be no significant impacts on aquatic species that contribute to BOD, nor any significant impact due to changes in DO, see below.
Dissolved oxygen	High	-	-	No adverse impact	The impact of the scheme on DO was assessed by APEM. They conclude that material adverse impact on DO is highly unlikely; no deterioration in the WFD status of this element would be expected. Additionally, based on the DO thresholds established for fish and invertebrate populations, impacts on these two ecological receptors are not anticipated.
Temperature	High	-	-	No adverse impact	Any impacts on water temperature due to changes in flow distribution will be very minor and highly localised.

2.2 All other WFD elements not listed in the table above, such as additional physico-chemical and chemical elements, will not be affected by this proposal.

2.3 In summary, the proposal is shown to have either no impact or a positive impact on each individual WFD element.

3 Detailed review

Catchment status

- 3.1. Kegworth Lock is located within the 'Soar from Long Whatton Brook to Trent' section of Soar River Operational Catchment Area. The Management catchment area is Soar within the Humber River Basin District.
- 3.2. The catchment of the River Soar covers an area of approximately 1,380 km², covering much of the county of Leicestershire, together with small areas of south Nottinghamshire and north east Warwickshire. The River Soar is a significant tributary of the River Trent.
- 3.3. Key pressures in the Soar Catchment include:
 - Heavily modified river channels, especially in the urban areas
 - Diffuse pollution from roads and urban areas
 - Rural point source and diffuse pollution
 - Separation of the river from its floodplain
 - Barriers to fish migration
 - Loss of riparian wetland habitats
 - Litter in the River Soar and its tributaries
 - Raised levels of phosphates
 - Risk of properties and roads flooding
 - Land use leading to flashy watercourses
 - Building and development too close to the watercourse
 - Lack of access to the river and conflicts of recreation users in sensitive areas
 - Lack of community awareness and engagement with water and rivers
- 3.4. Since 2009, the Environment Agency has carried out 298 investigations in the Soar catchment. These have helped to determine the reasons why water bodies are failing and the likely causes. Diffuse pollution (phosphate) from agricultural runoff is a major pressure in this catchment. Runoff and quarry workings also carry excess sediment to the rivers. At times of low flow, treated sewage effluent comprises the majority flow at the confluence of the Soar and Trent. Inputs from industrial areas also significantly affect water quality and local amenity. Barriers to migration, habitat availability and invasive species are also limiting factors in this catchment.

Mitigation measures

- 3.5. When a failure is identified, a range of measures are assessed that would be needed to improve the status of water bodies. Mitigation measures proposed for this catchment are:

Improve modified physical habitats
<ul style="list-style-type: none">• Removal or easement of barriers to fish migration
Managing pollution from waste water
<ul style="list-style-type: none">• Reduce diffuse pollution at source• Reduce point source pollution pathways (i.e. control entry to the water environment)• Mitigate/remediate point source impacts on receptor
Manage pollution from towns, cities and transport
<ul style="list-style-type: none">• Reduce diffuse pollution pathways (i.e. control entry to the water environment)
Manage pollution from rural areas
<ul style="list-style-type: none">• Reduce diffuse pollution at source• Mitigate/remediate diffuse pollution impacts on the receptor

Biodiversity and fish passage

- 3.6. The immediate area is not subject to any national or international designations. The site is designated as River Soar, Loughborough Meadows to Trent Local Wildlife Site (LWS 2/845) - 'A slow-flowing river with notable plant communities'. The proposed scheme is not expected to have an adverse impact on any nearby local wildlife sites, subject to following the restrictions and recommendations outline by *Fauna Forest Ecology*.
- 3.7. Kegworth Weir and the River Soar at Kegworth could provide a valuable migratory route for migratory fish species such as salmon and european eel, however there are no existing fish pass facilities at the site.
- 3.8. The new fish pass facilities will be suitable for all species and designed to latest EA guidance with a minimum attraction flow equal to 5% of the maximum hydropower flow.
- 3.9. The Archimedes screw turbine will also provide a new route for safe downstream passage of fish and eels. The leading edges of the screws will be fitted with compressible bumpers and will not exceed 5 m/s, as per Environment Agency guidance.
- 3.10. The hydropower scheme does not create any additional barrier to fish passage and with the introduction of new fish pass facilities, fish migration at Kegworth and along the Soar will improve significantly.
- 3.11. The proposal will fulfil requirements under the Salmon and Freshwater Fisheries Act 1975 and the Eels (England and Wales) Regulations 2009.
- 3.12. Fish and aquatic habitats, including riparian habitats, were assessed in detail as part of a report commissioned from APEM. This assessment was based on bathymetric surveys,

sediment sampling and 2D modelling as explained in the geomorphology section below. Please see the separate APEM report for details of their findings.

- 3.13. An ecological survey was carried out by *Fauna Forest Ecology Ltd* to assess the impact of the scheme on terrestrial habitats. All restrictions and recommendations made in the report will be adhered to during the development.
- 3.14. A river mussel survey was carried out by Exo Environmental, please see their separate report for details of their findings. No species with legal protection or listing as priority species were recorded.
- 3.15. Overall, the proposals will not result in any significant adverse impacts related to aquatic or riparian habitats, yet will provide significant improvements in terms of fish passage for a wide range of species.

Geomorphology

- 3.16. Prior to commissioning the geomorphology assessment, a detailed hydraulic model of the site was created to simulate upstream and downstream water levels and the flow split between weir, fish pass and hydropower scheme, for existing and proposed scenarios across the full range of flow conditions.
- 3.17. Detailed bathymetric surveys and sediment sampling surveys were carried out by Renewables First and Exo Environmental, to provide data to support an in-depth geomorphology assessment.
- 3.18. Both the hydraulic model and bathymetric survey data were used in 2D modelling completed by Hydropol, to derive depth, velocity and shear stress values throughout the weir pool and depleted reach.
- 3.19. The 2D modelling and sediment survey data formed part of a detailed study by APEM to assess the existing site geomorphology and the expected impacts due to the proposed development. Please see their separate report for details of their findings.
- 3.20. Overall, the proposed development is deemed highly unlikely to result in any significant hydromorphological changes.

4. Conclusions

- 4.1. The proposed development will not impact negatively on the current status of the water body and will not have an adverse impact on meeting future WFD objectives.
- 4.2. The introduction of a multi-species fish pass with eel and lamprey facilities has been independently assessed to provide a significant positive improvement to fish passage at this site, providing opportunities for improvements more widely along the Soar.
- 4.3. Overall, the proposed development will have no impact or a positive impact on each individual element of the relevant WFD classifications.