ANNEX B3.1.4

Environmental Assessment: Minworth and SLR INNS

Minworth SRO

Severn Trent Water & Affinity Water

Environmental Assessment for the Trent Strategic Resource Options (SRO)

Minworth SRO and South Lincolnshire Reservoir (SLR) SRO

Appendix D: Invasive Non-Native Species (INNS)

Affinity Water, Anglian Water Services Ltd and Severn Trent Water Ltd

Project number: 60669746
REP-003D

September 2022

Produced for Affinity Water in association with Anglian Water and Severn Trent Water

Delivering a better world

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Abbreviations

Abbreviation	Description
TTH	River Tame, River Trent and Humber
SLR	South Lincolnshire Reservoir
HEE	Hydrology, Environment, and Ecological [baseline assessment for Gate 1]
SRO	Strategic Resource Options
WFD	Water Framework Directive
INNS	Invasive Non-Native Species
DWF	Dry Weather Flow
EIA	Environmental Impact Assessment
RAPID	Regulators' Alliance for Progressing Infrastructure Development
HRA	Habitats Regulations Assessment
SEA	Strategic Environmental Assessment
RWT	RWT
EA	Environment Agency
WwTW	Wastewater Treatment Works

1. Introduction

1.1 Background

1.1.1 AECOM previously completed the Hydrology, Environment and Ecological (HEE) gap analysis of the River Tame, River Trent and Humber (TTH) system for Gate 1, carried out jointly for Minworth and the South Lincolnshire Reservoir (SLR). Subsequent investigations completed for Gate 2 include baseline Aquatic Ecological Monitoring (May 2022), water quality monitoring in the River Tame (June 2022), and Hydrological, Aquator and Hydraulic Modelling of the rivers Tame and Trent (June 2022). The latter is running parallel with these assessments and provides modelling outputs to inform the assessment of potential environmental impacts.

1.1.2 The HEE baseline study for the Tame, Trent and Humber in support of the Minworth and SLR for Gate 1 encompassed 19 in-depth topic reports and an overall summary report to inform further environmental assessment for the Minworth and SLR Strategic Resource Options (SRO).

1.1.3 The Gate 1 work involved considering Water Framework Directive (WFD) related impacts and benefits, baseline ecological data, and in particular the potential impacts of changes in flow to ecological receptors such as designated sites and their qualifying features, protected and notable species, and particular impacts/constraints associated with the presence, or future spread, of Invasive Non-Native Species (INNS). Also assessed were Navigation, Sedimentation, Assets along the Trent, Abstraction and Discharge Licences, Saline Intrusion, Fish Habitats and Migration, Biodiversity Net Gain, Natural and Social Capital, and Soil and Humidity. Some of these topics have been carried forward for further detailed assessment at Gate 2, as presented here and in the overall Environmental Assessment report (60669746_REP_003_Env-Ass_Trent_SRO_V5[1], Annex B3.1), to which this report forms an appendix.

1.1.4 This report presents the detailed Gate 2 assessment of INNS in relation to the SRO schemes.

1.2 Assessment Rationale

1.2.1 This report details the assessment of INNS, including any links and interdependencies with other topics, any gaps, or limitations to the assessment (e.g., the availability of supporting information, which would have been established and flagged at an early stage), and any recommendations for further work required to incorporate into further assessment for Gate 3. This will inform the next stage of environmental assessment of the Trent SROs in support of the two related SRO schemes:

- Minworth SRO; and
- SLR SRO.

1.2.2 The Services to be delivered are for Affinity Water, Anglian Water Services Limited and Severn Trent Water Limited.

1.2.3 The purpose of this phase of the assessment is to assess the impact on the River Tame and Trent system, and the River Witham, of :

- The existing INNS risks associated with the Minworth WwTW (i.e., the potential for INNS propagules to survive the treatment process) – this element of the assessment was specifically identified as part of the scope following the Gate 1 baseline assessment, due to the apparent prevalence of INNS in the River Tame and surrounding area, and the uncertainty regarding the additional treatment required for the Minworth SRO at that stage;
- The INNS risks associated with the reduction of discharge from Minworth, which currently discharges a Dry Weather Flow (DWF) of 417 Megalitres per day (Ml/d) (as per Concept Design Report CDR, Jacobs 2022); and

[1] AECOM (April 2022). Environmental Assessment for the Trent Strategic Resource Options (SRO): Minworth SRO and South Lincolnshire Reservoir (SLR) SRO. Results and Recommendations.

- The potential abstraction of up to 300 Ml/d (as an absolute maximum) for the SLR SRO from the River Trent to discharge to the River Witham.

1.2.4 This assessment is critical to supporting concept design and scheme environmental assessment for key SROs at Gate 2.

1.2.5 A key element of the related SROs, Minworth and SLR, is to investigate the environmental risks and opportunities associated with delivery of the schemes.

1.3 Objectives

1.3.1 The key objectives of the Gate 2 Environmental Assessments are as follows:

- Build on the work completed in Gate 1 to provide a robust impact assessment of the discharge reduction from Minworth in to the TTH system and surrounding environment and assess the impact the proposed transfer could have in relation to INNS and their spread.
- Build on the work completed in Gate 1 to provide a robust impact assessment of the abstraction of up to 300Ml/d for the SLR, to the TTH system and surrounding environment and assess the impact the proposed transfer could have in relation to INNS.
- Define what mitigation measures need to be implemented to satisfy regulators that the SROs are viable. Any mitigation measures that require engineering solutions such as modification to fish passes or weirs, will be fed back into the Engineering work stream.
- Support engagement with key stakeholders including the Environment Agency (EA), Natural England, Canal and River Trust, Water Resources East, and the River Trent Working Group. This has taken the form of monthly workshops to present findings and/or discuss key themes, risks, or mitigations, and site visits to inform the assessment of specific features.
- Produce an environmental scoping checklist (Section 5) to ensure identification of the likely significant environmental effects of the proposed projects and ensure all assessments and data collection are completed to allow further environmental assessment, which may be required in the future.

1.3.2 The Gate 2 Environmental Assessment reports set out the preliminary findings of field surveys, monitoring, and desk-based environmental assessments; to drive engagement with relevant regulators and other decision-makers; to agree the survey specifications and locations for any data collection or studies.

1.3.3 This report covers the key theme of INNS. The key objectives of the Gate 2 INNS assessment are as follows:

- Use the EA's INNS Asset and Raw Water Transfer (RWT) tool[2] to estimate the EA risk score associated with the Minworth asset and the Trent SLR, taking into account the limitations of the tool.
- Investigate existing potential INNS sources at Minworth Wastewater Treatment Works (WwTW), and potential INNS risks associated with Minworth SRO.
- Investigate the potential for the Trent SLR to transfer INNS to the River Witham catchment, including the potential for INNS to survive the potential mitigation options for the SLR abstraction and transfer.
- Consider further investigation of pathogen and parasite INNS.

1.4 Environmental Assessment

1.4.1 The outcome of the environmental assessments supports an assessment of the potential impact and changes to the environment and ecology within the River Tame and Trent and associated water bodies and habitats as a result of activity associated with the SROs. This technical appendix and other supporting reports detail the assessment and demonstrate a clear line of sight to further assessment, identifying potential significant effects, and informing the scope for future detailed assessments as set

[2] Environment Agency (2021). SRO Aquatic INNS Risk Assessment Tool. Developed by APEM for the Environment Agency, November 2021

out in the Strategic regional water resource solutions guidance for gate two (RAPID, April 2022[3]), including:

- WFD Compliance Assessment;
- Informal Habitats Regulations Assessment (HRA);
- Environmental Appraisal (including Strategic Environmental Assessment (SEA)); and
- Other Environmental Considerations including Biodiversity Net Gain (BNG) and Natural Capital Assessment (NCA).

1.4.2 The results of the environmental assessments are collated into the single overall report, supported by technical appendices, informed by regular liaison with the project teams and stakeholder engagement, for incorporation into the Gate 2 submission. This includes the results and recommendations from each topic within the environmental assessment.

1.4.3 The overall approach to the assessment and monitoring specification includes, but is not limited to, the extent of designated sites and Priority Habitats for ground truthing and walkover surveys, the extent of fluvial walkover surveys, and the range of data and supporting information required to support the assessment.

1.4.4 This technical appendix supports the overall environmental assessment report, the focus of which is as follows:

i. Results and recommendations of the topic assessment;

ii. A detailed assessment of the potential impacts and changes to the environment and ecology within the Rivers Tame and Trent, and associated water bodies, habitats, and species, as a result of activities associated with the SROs;

iii. The overall environmental assessment report and technical appendices will support subsequent assessment for RAPID Gate 2;

iv. Ensure a clear line of sight toward future environmental assessment, if required, and any additional planning requirements, e.g., HRA, SEA, WFD compliance assessment, etc. This will include identifying receptors to potential impacts, the likely extent, scale, and significance of impacts according to industry standards, and preliminary recommendations for appropriate mitigation;

v. A key component of the final report will be an environmental scoping checklist to identify and grade likely significant environmental effects, to form the basis of and inform further environmental assessment, which may be required in the future;

vi. Clear identification of any gaps and limitations in the assessment, which would have been identified and discussed with the Clients and stakeholders at an early stage.

1.5 Assessment Scenarios

1.5.1 Assessment of different scenarios for operation of the SRO schemes will be undertaken. This is based on the likely seasonal operation and operational regime requirements for the Minworth transfers and SLR abstraction, as described in detail in the overall assessment report (60669746_REP_003_Env-Ass_Trent_SRO_V5[4], Annex B3.1), and briefly summarised as follows:

Minworth SRO

1.5.2 The Minworth SRO supports two options for transfer of final effluent, resulting in corresponding reductions in the discharge of effluent to the River Tame. These are transfer to the Grand Union Canal

[3] Regulators' Alliance for Progressing Infrastructure Development (RAPID) (April 2022). Strategic regional water resource solutions guidance for gate two.
[4] AECOM (April 2022). Environmental Assessment for the Trent Strategic Resource Options (SRO): Minworth SRO and South Lincolnshire Reservoir (SLR) SRO. Results and Recommendations.

(GUC) SRO, and transfer to the River Avon for the Severn to Thames Transfer (STT) SRO. This is currently divided into the following volume options:

- 57 Ml/d discharge to GUC SRO;
- 115 Ml/d discharge to GUC SRO;
- 57 Ml/d discharge to River Avon for STT SRO;
- 115 Ml/d discharge to River Avon for STT SRO; or
- Combined 230 Ml/d transfer to both River Avon and GUC (115 Ml/d to each).

1.5.3 Therefore, the current approximately 417 Ml/d (DWF) discharge of final treated effluent from Minworth will reduce by a maximum of 230 Ml/d.

1.5.4 The Minworth Wastewater Treatment Works (WwTW) is currently discharging to the River Tame, with an associated 'baseline' level of INNS risk. A BMP is already in place, aimed at mitigating existing risk. This report focuses on assessing potential modification to existing baseline risk due to the SRO, i.e., will the proposed reduction in discharge, by diverting water away from the system, modify/increase INNS risk. Therefore, potential risks are considered to be those associated with the impacts of the reduced flow on INNS colonisation within the River Tame.

SLR SRO

1.5.5 The SLR SRO assessed within this report includes an option for abstraction from the River Trent to the River Witham, supported by further downstream abstraction from the River Witham. The Trent transfer has a maximum capacity of 300 Ml/d, with abstraction subjected to the Hands-off Flow (HoF) on the River Trent – when the HoF level is reached, abstraction will cease. The Trent transfer will support the SLR when there is insufficient flow in the River Witham.

1.5.6 Given that the SLR SRO will be transferring water to the River Witham, the assessment of INNS spread risk factors in existing INNS presence within the River Witham.

1.5.7 The extent of our assessment for the SLR SRO is the abstraction from the Trent and the transfer to the Witham, the new SLR reservoir is outside the scope of this assessment.

2. Scope and Approach

2.1 Introduction

2.1.1 This section sets out the approach to Environmental Assessment of the Minworth and SLR SRO schemes, informed by RAPID guidance for Gate 2 and on-going stakeholder engagement.

2.2 Projects and Work Completed to Date

2.2.1 Key findings and recommendations from the Tame, Trent and Humber baseline assessment for Gate 1 included:

- Identification of ecologically sensitive designated sites, Priority Habitats, protected/notable species, hydro-geomorphological features, WFD statuses.
- Recommendations to complete and maintain the baseline assessment, inform subsequent impact assessment, and data refresh.
- AECOM is currently undertaking follow-on work to inform Gate 2, including macroinvertebrate, macrophyte, River Habitat Surveys (RHS), INNS surveys, Water Quality monitoring, and Hydrological, Aquator and Hydraulic Modelling of the rivers Tame and Trent.

2.2.2 The literature search involved contacting statutory and local bodies, scientific literature databases, with data sources listed.

2.2.3 Reports set out the literature review and baseline information for each topic, including data gaps/recommendations, links to the consistent methodology (including SEA framework) currently being developed for the environmental assessment of SROs. This helped to demonstrate to regulators and stakeholders that the evidence effectively informed the strategic assessments.

2.2.4 These reports critically evaluated the information gathered and identified gaps in knowledge, reviewed areas of uncertainty or conflicting opinion, and formed the basis for further environmental investigation and impact assessment, including recommendations for the next stages (Gate 2) of the assessment process.

2.3 Scope of Field Surveys, Monitoring and Desk-Based Environmental Assessments

2.3.1 Critical to the assessment is the requirement to liaise with stakeholders and decision makers to agree the monitoring specification and purpose for discussion with the Regulators. This will be an on-going and iterative process through on-going engagement, and consideration of each stage of the assessment as it progresses.

2.3.2 Through the assessments for the Tame, Trent and Humber baseline study, it was noted that constraints and limitations may be encountered, for example due to the availability and completeness of available data, and therefore it has been critical to engage stakeholders at each stage to resolve potential issues, and tailor the assessment methodology to maximise the benefits of available data and information. This is critical to ensure the success of the assessment through Gate 2.

2.3.3 The outcomes of the Gate 1 baseline assessment and outputs of parallel monitoring and modelling work also underway have been used to support the large-scale environmental assessment.

2.3.4 We have used a variety of data sources, including the National Biodiversity network and the River Tame and Trent Aquatic Ecological Monitoring that is currently underway, to see if further information for INNS is present. Additionally, these data sources have been used to identify INNS presence within the River Witham catchment.

2.3.5 A baseline Aquatic Ecological Monitoring work package is currently underway, the data and findings from which will reduce uncertainties in the outcomes of this risk assessment. The results of this have been incorporated into the assessment where available.

2.4 Invasive Non-Native Species Assessment Methodology

2.4.1 RWT risk assessments require a detailed and individual approach. The aim of the risk assessments is to identify points or pathways of greatest risk within the transfer network and within individual transfer operations through which INNS may be transferred. This aim was achieved utilising EA guidance and tools, and also by carrying out further investigations into the water sources, pathways, and receptors.

2.4.2 The assessment methodology applied to understand the potential INNS pathways and risks within water treatment processes and water transfers is based upon a desk-based study, including ecological data and scientific literature review, hydrological context, and relevant experience.

2.4.3 The preliminary data and findings, of the baseline Ecological Monitoring work package, have been assessed and integrated into the INNS risk assessment with the aim of reducing uncertainties in the outcomes of this risk assessment. This has allowed for more refined risk assessments that incorporate both pathways and INNS presence in future assessments.

2.4.4 This report has taken into account a number of assessments, which are detailed further within this section:

- A baseline assessment of the hydrological context, the INNS records, and ecological receptors (see Section 3).
- Use of the EA INNS Risk Assessment Tool for:
  - Minworth SRO: the existing INNS risk associated with WwTW asset; and
  - SLR SRO: the risk of INNS transfers to the River Witham via the RWT.
- EA RWT prioritisation guidance5 (PR19) for the SLR SRO.
- Further consideration of the INNS risks at Minworth beyond the EA INNS tool:
  - a review of the INNS on the Minworth WwTW site and downstream riparian zone;
  - an assessment of the existing INNS sources associated with the Minworth WwTW, based on a literature review and relevant experience, and the changes to this risk associated with the SRO; and
  - an assessment of the potential effects to the River Tame INNS species with reduced flows due to the Minworth SRO transfer.
- Further consideration of the INNS risk at the Trent SLR beyond the EA INNS tool:
  - consideration of the potential reaches of the River Witham that could become colonised by INNS with no mitigation in place; and
  - review of the survivability of the INNS species with mitigation in place.

2.4.5 Liaison has been maintained with the project team, the EA, and other stakeholders where appropriate, as described elsewhere in this report.

Environment Agency INNS Risk Assessment Tool background and methodology

2.4.6 The EA have published a tool, developed by APEM Ltd, to aid assessing the risk of aquatic INNS by SROs. The tool is built using excel tool and assesses assets and RWTs separately; however, it can

[5] Environment Agency (2017). PR19 – Assessing the risks of spread of invasive non-native species posed by existing water transfers

include multiple assets and RWT options. The tool provides a risk score for each SRO and can be combined for an entire scheme.

2.4.7 The tool can be used to assess the existing and future risk of an asset and a RWT. Minworth WwTW was assessed as an asset within the tool, and the Trent SLR SRO is assessed under the RWT risk assessment.

2.4.8 The EA INNS tool has a tab to carry out an INNS Risk Assessment for each asset in the SRO. Within this tab information concerning the assets that collectively comprise the SRO was entered, as identified within the SRO Information tab.

2.4.9 The asset tool provides a risk score that takes into account surveyed INNS presence, as well as the potential for future colonisation with INNS due to site operations, including maintenance frequency and frequency of staff entering the water, as well as external factors such as angling, navigation and water fowl presence. The tool also provides contextual recommendations for biosecurity measures. This assessment has been carried out for the risk associated with the existing Minworth WwTW; however, as discharge to the TTH system would be reduced, compared to the existing volumes, any associated INNS spread risk would likely reduce proportionately (essentially).

2.4.10 The EA INNS tool has a tab to carry out an INNS Risk Assessment for each RWT in the SRO. Within this tab information concerning the RWT was entered for each of the RWTs that collectively comprise the SRO, as identified within the SRO Information tab.

2.4.11 The RWT tool provides a risk score associated with the current and future potential for INNS presence on the source and pathway, and a consideration of the existing connectivity to the receptor. However, further assessment has been carried out for the SLR SRO to understand the INNS species that present the highest risk (which factors in existing known presence in the parts of the River Witham for which existing boundaries to spread are bypassed).

2.4.12 The EA risk assessment tool has been integrated within the assessment; however, there are some limitations to its use in assessing the detailed risk, and, as such, this assessment builds on top of the methodology provided by the EA (as detailed below).

Environment Agency RWT significance guidance

2.4.13 Another key criterion is determined is the ‘significance’ of a RWT, and therefore importance, of a pathway to the WFD situation in which the specific transfer takes place. This is based upon the EA guidance (PR19), as shown in Figure 1. The criteria are:

- Within WFD waterbody (lowest criteria);
- Between WFD waterbody (medium criteria); and
- Between catchment (highest criteria).

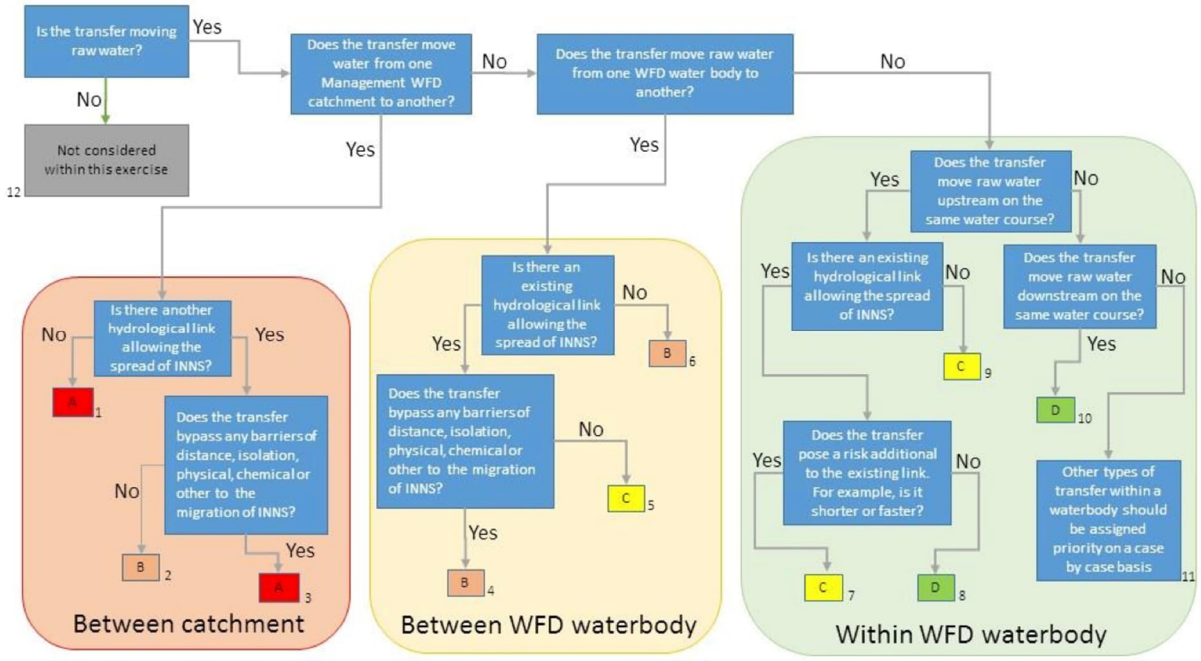

Figure 1 Prioritisation of existing raw water transfers (EA, 2017)

2.4.14 The significance of the SLR SRO has also been assessed according to these criteria to assess the potential risk associated with the transfer.

Minworth WwTW further assessment

Potential for INNS presence within the existing WwTW effluent

2.4.15 To assess the INNS risk for the existing WwTW, we have incorporated previous industry experience of investigating the potential for INNS pathways within water treatment processes, including the associated process risks and appropriate mitigation. This includes a thorough literature review, first-hand experience of the various processes, leading to the identification of those points in the overall process with high resistance to INNS spread, and/or through which invasive species will not pass, as well as potential pathways of spread from identified processes, e.g., material accumulated on screens and in sludges.

2.4.16 An updated review of research into this topic has been completed to determine the potential for INNS to survive the treatment process for the existing Minworth WwTW, and the changes to this risk associated with the SRO, including the proposed additional treatment to provide effluent of sufficient quality to support the transfers.

INNS effects to River Tame due to reduced flows

2.4.17 The potential effects of the change in flow regime to the River Tame and Trent in relation to INNS have been investigated.

2.4.18 The change in discharge from Minworth to the River Tame may reduce the flow within the river under certain conditions (predominantly at low flows), and potentially result in increased flow variation.

2.4.19 The potential effects of this have been assessed through the use of the hydraulic modelling undertaken to inform the hydrological effects to the River Tame, in conjunction with an assessment of known INNS spread correlates. This includes a review of the existing and potential minimum wetted width to understand the potential changes wetted width, and the distance of the hydrological effects.

Trent SLR further assessment methodology

2.4.20 We have incorporated previous industry experience of investigating the potential for INNS pathways within RWTs, including the associated process risks and appropriate mitigation. An updated review of research into this topic has been completed to determine the potential for INNS to survive the proposed mitigation for the SLR RWT across those species identified as posing a risk.

2.4.21 Currently the exact location of the SLR transfer is not known (currently assumed to be at East Stoke, approx. [redacted]), however this will be confirmed in the next stage of the assessment. Our approach would be to produce an operational process flow diagram for the SLR Transfer, which would be used to identify INNS transmission pathways, based on knowledge gained from previous studies. The flow diagram would mirror the geographical map between source and ultimate destination of the RWT, identifying source, pathway route, discharge, and key receptors.

Priority Areas for Assessment

2.4.22 The key focus of the assessment is:

- The proposed location of abstraction from the River Trent for SLR, and the risk of cross-catchment spread of INNS from the Trent to the River Witham and beyond.
- The potential change to INNS risks associated with the Minworth WwTW due to the SRO, including the potential impacts to the River Trent associated with the reduced flow.

Data and Information Requirements

2.4.23 Information on INNS distribution has been obtained from the EA, Local Environmental Records Centres (LERC), and AECOM aquatic ecological monitoring.

2.4.24 Aquatic ecological monitoring is currently underway to add to the available database of INNS records within the River Tame and Trent system. This includes both conventional and eDNA surveys to establish INNS presence at targeted locations. The preliminary information currently available has been used in this assessment, and additional monitoring will provide further up to date records upon which to base the INNS risk assessment.

2.4.25 A desk-based study into the RWT location is based upon preliminary information provided by the project team and a desk-based assessment. The desk-based assessment includes review of the study area habitats utilising the ecological assessment and online published data sources. Data related to the operations at Minworth has been obtained from Severn Trent Water.

2.4.26 A desk-study into the River Witham, in terms of INNS desktop study, supported by the preliminary aquatic ecological monitoring and existing INNS records, has been carried out.

2.5 Limitations

EA INNS Risk Assessment Tool

2.5.1 The EA risk assessment tool has a range of limitations regarding its use in assessing risk in detail. The key limitations identified in relation to the Minworth and SLR SROs including that specific INNS are not considered, nor INNS presence at destination, the tool does not account for existing (inbuilt) or proposed treatment and mitigation measures into the risk weighting, and the weightings do not reflect existing catchment connections as much as may be expected.

2.5.2 Overall, a review of the EA INNS Risk Assessment tool, and consultation with the team that developed the tool, indicate that the tool is functioning as intended. The results of the tool are provided below (Section 4). However, as the tool does not consider in detail key risks associated with each SRO, the ratings may not be suitable to compare risk scores generated using the tool, to other SRO projects at a national scale. Rather, the tool is more suited to local scale comparisons for different options associated with the same SRO.

Data limitations

2.5.3 The River Witham barrier assessment, to inform the Trent SLR further assessment methodology, is a desktop review of available data sources. The presence and details of their barriers is not known, and a visual survey is recommended to identify whether these structures provide a barrier to the spread of INNS within the catchment.

3. Baseline context

3.1.1 This section includes a baseline summary of the ecological and hydrological setting of the Minworth WwTW, and the River Trent, River Tame and River Witham from a desk-based study in regard to:

- the hydrological context;
- INNS records; and
- ecological data.

3.2 Hydrological context

River Trent and River Tame

Description

3.2.1 The River Trent arises to the north of Stoke-on-Trent, and flows in a southerly direction through Stoke-on-Trent, it then flows in a south-easterly direction to the north of Rugeley, prior to flowing in a generally north-easterly direction through Burton-on-Trent and Nottingham, following which it flows in a generally northerly direction through Newark-on-Trent prior to its confluence with the River Ouse to form the Humber Estuary.

3.2.2 The River Trent and Tame are located within the WFD Humber River Basin District. The River Trent catchment is split between a number of WFD Management Catchments.

3.2.3 The River Tame arises as two tributaries, one arises to the west of Birmingham in the Oldbury area, and the second to the north-west of Birmingham in the Wednesfield area, these flow in a generally northerly direction and easterly direction, respectively. The two branches have their confluence at Bescot Stadium, following which the river flows in a generally south-easterly direction through urban areas to the north of Birmingham, then in an easterly direction through Minworth, and then in a generally northerly direction following the confluence with the River Blythe through Tamworth, prior to flowing into the River Tame immediately south of the Barton Under Needwood quarry.

3.2.4 The River Trent is the third longest river in the United Kingdom, and flows for approximately 300 km, with a total catchment upstream of the Humber Estuary of approximately 10,450 km^2.

3.2.5 The River Trent and Tame are modified through much of the catchment due to abstractions and discharges from the industrial areas along the route, and the river flows serve a number of canals in the region.

3.2.6 The proposed SLR transfer is located within the WFD catchment of “the Trent from Soar to the Beck Water Body” (GB104028053110), within the Nottingham Urban Operational Catchment, and the Trent Lower and Erewash Management Catchment. The waterbody is designated as heavily modified.

Minworth WwTW

3.2.7 The Minworth WwTW is one of the largest wastewater treatment works in the UK and serves a population equivalent to 1.75 million people. The site is operated by Severn Trent Water.

3.2.8 The Minworth WwTW is located towards the east of Minworth (NGR [redacted]) and is bordered by the River Tame to the south, Kingsbury Road to the north, the M6 to the east and residential and commercial buildings to the west.

3.2.9 The Minworth WwTW is located within the catchment of the WFD waterbody “Tame – R Rea to R Blythe Waterbody” (GB104028046841), within the Operational Catchment “Tame Lower Rivers and Lakes”, and the Management Catchment of Tame Anker and Mease. The waterbody is designated as heavily modified.

3.2.10 The WwTW currently discharges treated effluent to the River Tame. The site has two existing outfalls to the River Tame, the most upstream is located south-east of the WwTW site (NGR [redacted])

adjacent to Water Orton Lane, and the second is located approximately 2km east of the site (NGR [redacted]) at Edison Road. The split in flows between the existing two outfalls is not known, but it is assumed for modelling purposes that they are equal.

3.2.11 Minworth site operations and existing treatment were obtained from the Severn Trent Water site operators. The existing treatment at Minworth WwTW includes four treatments:

- Treatment 1: Screens and grit Detroiter baffles. The screens are a perforated sheet screen which remove rags and heavy plastic (70% efficiency), while the baffles are for gravel removal.
- Treatment 2: Separation tanks. The primary settlement tanks allow water to flow over the top and sludge settles, the sludges are treated separately and any centrates from that return to the head of the works.
- Treatment 3: Activated sludge treatment. Removes ammonias, BODS and phosphates and works by microorganisms feeding off the organic matter. These are operated by oxygenating the water and maintaining temperatures and have a 6–7-hour retention time. The removed sludge is returned to the head of the works from final tanks.
- Treatment 4: Final tanks. These tanks hold the treated water prior to the discharge to the river free of solids. Water is not retaining within these tanks, and include grated man traps prior for health and safety.
- Minworth WwTW does not currently include tertiary treatment, but additional treatment is proposed to satisfy the demands of the GUC and STT transfers, and some effluent treated to this higher standard would be returned to the River Tame.

River Witham

Description

3.2.12 The River Witham arises in the village of South Witham and flows in a northerly direction through Grantham, then flows in a north-westerly direction to Long Bennington, prior to flowing in a generally north-easterly direction to Lincoln, flowing through the Brayford Pool, following which it flows westerly, and then south-westerly through Boston to flow into the Wash estuary.

3.2.13 The River Witham flows for approximately 134 km, with a total catchment upstream of the Wash estuary of approximately 3,000 km^2. The catchment is predominantly rural, aside from villages and towns, including Lincoln and Boston. Downstream of Lincoln, a number of watercourses are heavily modified, and are managed by Internal Drainage Boards.

3.2.14 The River Witham is within the WFD Anglian River Basin District and the Witham Management Catchment. The proposed SLR transfer is located within the WFD catchment of “Witham – conf Cringle Bk to conf Brant” Water Body (GB105030056780), within the Witham Upper Operational Catchment. The waterbody is designated as heavily modified.

Existing connections between the River Trent and River Witham

3.2.15 There is one existing connection between the River Trent and the River Witham, that is the Fossdyke Canal (also known as Fossdyke Navigation). The Fossdyke Canal flows from the River Trent at Torksey to the River Witham at Brayford Pool in Lincoln; it initially runs to the east, and then turns south-east, to Drinsey Nook, following which it runs north-east to Saxilby, and then runs east to Lincoln to Brayford Pool, a man-made marina connecting to the navigable sections of the River Witham.

3.2.16 The Fossdyke canal is approximately 17.9 km long and is relatively flat. There is only one lock on the canal located near Torksey, where the River Trent is tidal. The canal is indicated by the Canals and Rivers Trust[6] to date to Roman times, and therefore has provided a connection between the two waterbodies for a very long time. The canal is navigable, however is generally used for recreational travel in modern days.

3.2.17 The Fossdyke Canal connection to the River Trent is approximately 46.5 km north-east (approximately 78 km downstream) of the proposed SLR connection. The Fossdyke Canal connection to the River

[6] https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network/fossdyke-navigation

Witham, at Brayford Pool, is located approximately 28.3 km north-east (approximately 36.5 km downstream) of the proposed SLR connection.

3.2.18 The Grantham Canal is located to the south of the proposed SLR connection, and historically joined the River Trent at Nottingham to Grantham[7]; however, did not join the River Witham, instead terminating in a pool within the town. The canal is currently in a state of disrepair, with an 8km dry section preventing water flowing to the west, however there are current community efforts to restore the canal to a navigable waterway[8].

Barriers to INNS spread

3.2.19 An assessment was carried out (desk-based study) to identify potential barriers to INNS spread that may be bypassed by the proposed SLR transfer to the River Witham. This included a review of the EA River Obstacles Layer and the UK Barrier index. The potential barriers and their location in relation to the proposed SLR are contained in Table 3-2 and Table 3-1.

3.2.20 The assessment has been carried out for the River Trent and Fossdyke Canal, downstream of the proposed Trent SLR SRO abstraction, to identify potential barriers to INNS spread that may be bypassed by the proposed SLR transfer (Table 3-1), i.e., from the abstraction point to Brayford Pool.

3.2.21 Additionally, as the SLR SRO includes the proposed pipeline connecting to a currently unconnected reach of the River Witham (i.e., the reach of the Witham upstream of Brayford Pool to the proposed discharge point into the Witham), the potential barriers to INNS spread within this part of the River Witham have also been assessed. Only barriers upstream of Brayford Pool have been considered, and these have been listed from downstream to upstream of the proposed SLR abstraction (15 km upstream considered only).

Table 3-1. River Trent and Fossdyke Canal barriers assessment

Grid references for continued monitoring locations redacted

Site name	Waterbody	CoreoID	Type	NGR	Location in relation to Trent SLR abstraction	UK Barriers details		Notes
						HClass	Height (m)	
Hazelford Lock	River Trent	58768	Weir	[redacted]	5.1 km upstream	1 to 2	1.70	Together provide barrier across entire river
	Trent back channel	62703	Weir			2 to 5	3.08	
Staythorpe Weir	Trent (left channel)	58052	Weir		4.6 km downstream	n/a	n/a	Only barrier along left channel
Newark Town Lock	Trent (right channel)	60893	Weir		7.9 km downstream	1 to 2	1.62	Central channel without barrier
		51284	Lock		8.2 km downstream	2 to 5	2.60	
		73143	Lock			2 to 5	2.30	
Newark Nether Lock	Trent (right channel)	75031	Lock		10.1 km downstream	<0.5	0.05	In combination with Staythorpe weir provide barrier across entire river
		57051	Weir			2 to 5	2.08	
Cromwell Lock	River Trent	75234	Weir		13.9 km downstream	1 to 2	1.89	Lock structure not included as a barrier
Torksey Lock	Fossdyke Canal	53,450	Lock		78km downstream	<0.5	-	Barrier across entire canal
		74,966	Lock				0.176	

3.2.22 The barriers along the River Trent are generally associated with locks, and as such only provide a barrier across one channel, however in combination of the locks and weirs these may provide a partial

[7] https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network/grantham-canal
[8] http://www.granthamcanal.org/

barrier across the entire channel. These are unlikely to result in significant resistance to INNS spread, given that these locks allow for the movement of water downstream.

Table 3-2. River Witham barriers assessment

Site name	CoreoID	Type	NGR	Location in relation to Witham SLR discharge	UK Barriers details	
					HClass	Height (m)
All Saints Church Stapleford weir	61,169	Weir	[redacted]	14.96 km downstream	0.5 to 1	0.814
Barnaby in the woods us weir	64,596	Weir		7.66 km downstream	1 to 2	1.053
Mill Farm Claypole weirs	73,642	Weir		1.58 km downstream	2 to 5	2.414
	74,195	Weir				3.33
Long Bennington US weir	54,158	Weir		3.40 km upstream	2 to 5	2.027
Long Lane The Grange weir	55,707	Weir		5.02 km upstream	1 to 2	1.192
Fallow Lane weir	66,971	Weir		5.82 km upstream	1 to 2	1.188
Hougham DS weir	75,568	Weir		8.03 km upstream	1 to 2	1.568
Hougham Church Lane weir	66,129	Weir		9.18 km upstream	2 to 5	2.615
Mill Farm, Hougham weirs	55,825	Weir		11.60 km upstream	2 to 5	3.04
	51,330	Weir				2.748
Frinkley Plantation weir	73,359	Weir		13.15 km upstream	0.5 to 1	0.70199
Mickling plantation weir	67,127	Weir		14.20 km upstream	1 to 2	1.288
Barkston Mill Farm weir	71,447	Weir		14.78 km upstream	2 to 5	3.81

3.2.23 The review of the stretch of the River Witham upstream of Brayford Pool to the proposed SLR SRO discharge point indicates that there are three potential barriers., These include the Mill Farm Claypole weirs, which due to their height (2.4-3.3 m) may provide a barrier to the spread of certain INNS species. However, the presence and condition of these weirs is not known.

3.2.24 There are also a number of weirs a short distance upstream of the proposed SLR transfer to the River Witham, including the Long Bennington US weir (2.03 m height), this could potentially provide a barrier to the transfer of INNS further upstream. The presence and condition of these barriers is also not known.

3.3 INNS records

River Trent and River Tame INNS records

3.3.1 There are a large number of INNS records for the River Trent and River Tame, compiled from a desk-based study of existing INNS records and project-specific ecological surveys:

- EA invasive Macrophytes data;
- EA Invasive Macroinvertebrates data;
- LERC Invasive Species data; and
- AECOM ecological monitoring.

3.3.2 The data indicates that INNS are prevalent within the two rivers. A full list of the INNS within the River Trent and River Tame are shown in Annex A. The desk study includes species records from within the last 20 years, as these species are considered likely to remain present in the catchment.

3.3.3 The priority of these INNS in terms of risk to both the Minworth WwTW and the proposed SLR transfer has been considered. Priority INNS species are considered of higher relevance to the assessment. The priority screening of these is provided in Annex A and shown in the following sub-section.

River Witham INNS records

3.3.4 There are a number of INNS records for the River Witham, compiled from a desk-based study of existing INNS records and project specific ecological surveys:

- LERC Invasive Species data;
- EA Ecology and Fish Data; and
- NBN Atlas.

3.3.5 The data indicates that INNS are prevalent within the River Witham; however, not all species that are recorded within the River Trent and Tame have been recorded in the River Witham. Some species are only known to be present downstream of the Brayford Pool or the Fossdyke Canal and are not located in the vicinity of the proposed SLR SRO transfer. A summary of the INNS species recorded in the River Witham, and the location of records in relation to the proposed SLR transfer, is shown on Table 3-3.

Table 3-3. River Witham INNS records summary

Taxon Group	Scientific name	Common name	Schedule 9 species	Species of special concern and Schedule 2 species		Number of records	Nearest record to SLR transfer (km)		Recorded upstream of Brayford Pool?
				Listed	Widely spread		Upstream direction	Downstream direction	
Plant	*Azolla filiculoides*	Water fern	Yes	-	-	52	-	23.7	Yes
Flowering Plant	*Buddleia sp.*	Butterfly bush	-	-	-	1	-	50.2	No
Bony fish	*Carassius auratus*	Goldfish	-	-	-	4	4.1	25.6	Yes
Crustacean	*Chelicorophium curvispinum*	Caspian mud shrimp	-	-	-	5	-	31.2	No
Mollusc	*Corbicula fluminea*	Asian Clam	-	-	-	8	-	27.9	No
Crustacean	*Crangonyx pseudogracilis/floridanus*	Northern River Crangonyctid	-	-	-	1009	1.7	2.3	Yes
Plant	*Crassula helmsii*	New Zealand Pigmyweed	Yes	-	-	25	-	19.3	Yes
Bony fish	*Ctenopharyngodon idella*	Chinese Grass Carp	-	-	-	2	7.4	-	Yes
Crustacean	*Dikerogammarus haemobaphes*	Demon Shrimp	-	-	-	12	-	27.9	No
Mollusc	*Dreissena polymorpha*	Zebra Mussel	-	-	-	53	21.2	27.6	Yes
Plant	*Elodea*	Waterweed	Yes	#	-	10	10.7	37.3	Yes
Plant	*Elodea canadensis*	Canadian Waterweed	Yes	-	-	48	10.1	2.3	Yes
Plant	*Elodea nuttallii*	Nuttall's Waterweed	Yes	Yes	Yes	105	0.6	8.6	Yes
Plant	*Fallopia baldschuanica*	Russian-vine	-	-	-	4	-	25.5	Yes
Crustacean	*Gammarus tigrinus*	A freshwater/brackish shrimp	-	-	-	2	-	33.3	No
Plant	*Gunnera manicata*	Brazilian Giant-rhubarb	-	-	-	2	22.1	-	Yes
Invertebrates	*Hemimysis anomala*	Bloody Red Mysid	-	-	-	5	-	33.5	No
Flowering plant	*Heracleum mantegazzianum*	Giant Hogweed	Yes	Yes	Yes	8	11.3	3.5	Yes
Aquatic plant	*Hydrocotyle ranunculoides*	Floating Pennywort	Yes	Yes	Yes	11	-	27	Yes
Flowering plant	*Impatiens glandulifera*	Himalayan Balsam	Yes	Yes	Yes	58	0	2.4	Yes
Aquatic plant	*Lagarosiphon major*	Curly Waterweed	Yes	Yes	Yes	1	-	23.7	Yes
Plant	*Lemna minuta*	Least Duckweed	-	-	-	6	-	14.6	Yes
Plant	*Myriophyllum aquaticum*	Parrot's-feather	Yes	Yes	Yes	1	-	25.3	Yes
Mollusc	*Mytilopsis leucophaeata*	False dark mussel	Yes	-	-	3	-	49.6	No

Taxon Group	Scientific name	Common name	Schedule 9 species	Species of special concern and Schedule 2 species		Number of records	Nearest record to SLR transfer (km)		Recorded upstream of Brayford Pool?
				Listed	Widely spread		Upstream direction	Downstream direction	
Bony fish	*Oncorhynchus mykiss*	Rainbow Trout	-	-	-	6	10.8	24.4	Yes
Crustacean	*Orconectes Limosus*	Spiny-cheek crayfish	-	-	-	2	-	38	No
Crustacean	*Pacifastacus leniusculus*	Signal Crayfish	-	Yes	Yes	1	-	41.2	No
Plant	*Petasites fragrans*	Winter Heliotrope	-	-	-	9	13.5	27.6	Yes
Mollusc	*Physella acuta*	Bladder snail	-	-	-	21	3.9	2.4	Yes
Mollusc	*Potamopyrgus antipodarum*	New Zealand mud snail	-	-	-	134	3.7	2.4	Yes
Mollusc	*Rangia cuneata*	Gulf wedge clam	-	-	-	2	-	49.1	No
Flowering plant	*Reynoutria japonica*	Japanese Knotweed	Yes	-	-	14	14.1	29.2	Yes
Flowering plant	*Rhododendron ponticum*	Common rhododendron	Yes	-	-	17	10.2	12.3	Yes
Reptile	*Trachemys scripta elegans*	Red Eared Terrapin	-	Yes	Yes	1	-	25.8	Yes

Elodea sp. could be either *E. canadensis* or *E. nuttallii*; in the case of the former it would constitute a Schedule 2 species.

Minworth WwTW INNS Priority Species

3.3.6 The EA Asset INNS Risk Assessment tool recommended the inclusion of a 1 km study area around an asset. Therefore, INNS records within the Minworth WwTW site, and within 1 km have been given particular consideration (See Annex A). Additionally, where the date of the records has been provided, the year of the records are also shown.

3.3.7 The species recorded near Minworth (assigned Low, Medium, and High priority) are shown in Table 3-4, the priority assigned to each species is based on:

- Whether the species is listed under Schedule 9 of the Wildlife and Countryside Act[9] and/or are listed under the Species of Special Concern and Schedule 2 Species, taking into account whether the Species of Special Concern/Schedule 2 Species are defined as "widely spread" 10·11 (lowers priority) – such defined widespread species are noted in Table 3-4.
- Professional judgement and knowledge of each INNS species considering the Minworth WwTW proposals (i.e., whether the spread of the species is unrelated to water flows, or a species that has a low risk of being spread by the Minworth WwTW proposals) and including how widespread such species are (in a general context – i.e., outside the Special Concern/Schedule 2 Species definition).
- The distances from the site (listed species that are not widely spread" recorded within the site are automatically assigned high priority, as site works could facilitate their spread and the probability of natural 'onward' spread is increased).

Trent SLR INNS Priority Species

3.3.8 The EA RWT INNS Risk Assessment tool recommended the inclusion of a 1 km study area around the entire catchment of the source, therefore all INNS records for the River Trent and River Tame have been considered in terms of the priority assessment for the Trent SLR (see Annex A).

3.3.9 The priority species for the Trent SLR (Low, Medium, and High priority) are shown in Table 3-5, the priority species are based on:

- Whether the species is listed under Schedule 9 and/or are listed as a Species of Special Concern/Schedule 2 Species (higher priority), taking into account whether the Species of Special Concern/Schedule 2 Species are defined as "widely spread" (lowers priority) – such defined widespread species are noted in Table 3-5.
- Professional judgement and knowledge of each INNS species considering the Trent SLR proposals (priority depends upon the specific knowledge of the species), including how widespread such species are (in a general context – i.e., outside the Special Concern/Schedule 2 Species definition).
- The existing presence of the species within the River Witham catchment (lowers priority).

[9] UK Government (2021). Schedule 9. Wildlife and Countryside Act 1981, latest revision May 2021.
[10] https://www.gov.uk/guidance/invasive-non-native-alien-animal-species-rules-in-england-and-wales#list
[11] https://www.gov.uk/guidance/invasive-non-native-alien-plant-species-rules-in-england-and-wales

Table 3-4. Minworth WwTW - INNS recorded within 1 km and assigned priority

Taxon Group	Scientific name	Common name	Schedule 9 species	Species of concern/ Schedule 2	Widely spread	Nearest record (km)	Year recorded in study area	Minworth WwTW Priority
Plant	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	Montbretia	Yes	-	-	0	1982 & 2021	Medium[12]
Flowering plant	*Impatiens glandulifera*	Himalayan Balsam	Yes	Yes	Yes	0	1990 – 2021	Medium
Flowering plant	*Reynoutria japonica*	Japanese Knotweed	Yes	-	-	0	1987 – 2021	Medium
Flowering plant	*Rosa rugosa*	Japanese Rose	Yes			0	2019	Medium
Flowering plant	*Heracleum mantegazzianum*	Giant Hogweed	Yes	Yes	Yes	0.1	2018 & 2021	Medium
Crustacean	*Crangonyx pseudogracilis/floridanus*	Northern River Crangonyctid	-	-	-	0.1	2018	Low
Crustacean	*Dikerogammarus haemobaphes*	Demon Shrimp	-	-	-	0.1	2018 & 2021	High
Mollusc	*Potamopyrgus antipodarum*	New Zealand mud snail	-	-	-	0.1	2015	Low
Reptile	*Trachemys scripta elegans*	Red Eared Terrapin	-	Yes	Yes	0.1	n/a[13]	Low
Plant	*Impatiens capensis*	Orange Balsam	-	-	-	0.3	n/a	Low
Flowering plant	*Cotoneaster simonsii*	Himalayan Cotoneaster	Yes	-	-	0.4	n/a	Low
Flowering plant	*Lamiastrum galeobdolon subsp. argentatum*	Variegated Yellow Archangel	Yes	-	-	0.4	2006	Low
Flowering plant	*Elodea nuttallii*	Nuttall's Waterweed	Yes	Yes	Yes	0.7	1999-2006	Low
Flowering plant	*Rhododendron ponticum*	Common rhododendron	Yes	-	-	0.7	n/a	Low
Ferns	*Azolla filiculoides*	Water Fern	Yes	-	-	0.9	2006	Low
Amphibian	*Ichthyosaura alpestris*	Alpine Newt	-	-	-	0.9	n/a	Low

[12] Species assessed as of Medium risk are those recorded on the Minworth site, but currently controlled by Biosecurity Management Plan and associated control measures
[13] Date not provided

Table 3-5. Trent SLR INNS Priority species

Taxon Group	Scientific name	Common name	Schedule 9 species	Species of concern/ Schedule 2	Widely spread	Min distance to SLR (km)	River Witham presence	Priority for SLR Assessment
Flowering plant	*Impatiens glandulifera*	Himalayan Balsam	Yes	Yes	Yes	0	Yes (u/s & d/s of transfer)	Low
Flowering plant	*Reynoutria japonica*	Japanese Knotweed	Yes	-	-	0.9	Yes (u/s & d/s of transfer)	Low
Plant	*Crassula helmsii*	New Zealand Pigmyweed	Yes	-	-	1.4	-	High
Flowering plant	*Heracleum mantegazzianum*	Giant Hogweed	Yes	Yes	Yes	2.2	Yes (u/s & d/s of transfer)	Low
Mollusc	*Dreissena polymorpha*	Zebra Mussel	-	-	-	2.4	Yes (u/s & d/s of transfer)	Low
Crustacean	*Dikerogammarus haemobaphes*	Demon Shrimp	-	-	-	2.5	Yes (d/s of Brayford Pool)	Low
Mollusc	*Corbicula fluminea*	Asian Clam	-	-	-	2.7	Yes (d/s of transfer)	Low
Crustacean	*Chelicorophium curvispinum*	Caspian mud shrimp	-	-	-	2.8	Yes (d/s of Brayford Pool)	Low
Plant	*Hydrocotyle ranunculoides*	Floating Pennywort	Yes	Yes	Yes	3.5	Yes (d/s of transfer)	Low
Flowering plant	*Elodea nuttallii*	Nuttall's Waterweed	Yes	Yes	Yes	3.9	Yes (u/s & d/s of transfer)	Low
Crustacean	*Crangonyx pseudogracilis/floridanus*	Northern River Crangonyctid	-	-	Yes	4.4	Yes (u/s & d/s of transfer)	Low

Taxon Group	Scientific name	Common name	Schedule 9 species	Species of concern/ Schedule 2	Widely spread	Min distance to SLR (km)	River Witham presence	Priority for SLR Assessment
Mollusc	*Potamopyrgus antipodarum*	New Zealand mud snail	-	-	Yes	4.6	Yes (u/s & d/s of transfer)	Low
Crustacean	*Eriocheir sinensis*	Chinese Mitten Crab	Yes	Yes	Yes	5.6	-	Low
Ferns	*Azolla filiculoides*	Water Fern	Yes	-	-	6	Yes (d/s of transfer)	Medium
Mollusc	*Physella*	[Acute] bladder snail (Physella acuta)	-	-	-	7.5	-	Low
Mollusc	*Physella acuta*	Bladder snail	-	-	-	7.8	Yes (u/s & d/s of transfer)	Low
Crustacean	*Pacifastacus leniusculus*	Signal Crayfish	Yes	Yes	Yes	7.9	Yes (d/s of Brayford Pool)	Medium
Annelid	*Hypania invalida*	A polychaete worm	-	-	-	7.9	-	Medium
Crustacean	*Gammarus tigrinus*	A freshwater/brackish shrimp	-	-	-	9.6	Yes (d/s of Brayford Pool)	Low
Plant	*Impatiens capensis*	Orange Balsam	-	-	-	9.8	-	Low
Plant	*Lemna minuta*	Least Duckweed	-	-	-	10.1	Yes (d/s of transfer)	Low
Flowering plant	*Elodea canadensis*	Canadian Waterweed	Yes	-	-	10.3	Yes (u/s & d/s of transfer)	Low
Water mould	*Aphanomyces astaci*	Crayfish Plague	Yes	-	-	13.4	-	High
Crustacean	*Hemimysis anomala*	Bloody Red Mysid	-	-	-	17.6	Yes (d/s of Brayford Pool)	Low
Mollusc	*Ferrissia californica (wautieri)*	A freshwater limpet	-	-	-	21.5	-	Medium

Taxon Group	Scientific name	Common name	Schedule 9 species	Species of concern/ Schedule 2	Widely spread	Min distance to SLR (km)	River Witham presence	Priority for SLR Assessment
Plant	*Myriophyllum aquaticum*	Parrot's-feather	Yes	Yes	Yes	22.3	Yes (d/s of transfer)	Medium
Flowering plant	*Rhododendron ponticum*	Common rhododendron	Yes	-	-	25.7	Yes (u/s & d/s of transfer)	Low
Plant	*Impatiens parviflora*	Small Balsam	-	-	-	30.4	-	Low
Reptile	*Trachemys scripta elegans*	Red Eared Terrapin	-	Yes	Yes	31.7	Yes (d/s of transfer)	Low
Plant	*Symphoricarpos albus*	Snowberry	-	-	-	31.7	-	Low
Plant	*Prunus laurocerasus*	Cherry Laurel	-	-	-	31.8	-	Low
Plant	*Nymphoides peltata*	Fringed Water-lily	-	-	-	32.6	-	Low
Flowering plant	*Lagarosiphon major*	Curly Waterweed	Yes	Yes	Yes	33.2	Yes (d/s of transfer)	Low
Flowering plant	*Lamiastrum galeobdolon subsp. argentatum*	Variegated Yellow Archangel	Yes	-	-	34.9	-	Low
Plant	*Mimulus guttatus*	Yellow monkeyflower	-	-	-	35	-	Low
Flowering plant	*Rosa rugosa*	Japanese Rose	Yes	-	-	35.9	-	Low
Plant	*Petasites fragrans*	Winter Heliotrope	-	-	-	40.4	Yes (u/s & d/s of transfer)	Low
Amphibian	*Pelophylax ridibundus*	Marsh Frog	-	-	-	71.6	-	Low
Plant	*Parthenocissus quinquefolia*	Virginia-creeper	Yes	-	-	76.3	-	Low

3.4 Designated sites and priority habitats

3.4.1 A review of designated sites and priority habitats has been undertaken to identify potentially important receptors associated with the SRO scheme. This has been undertaken using the MAGIC map[14] for each site.

Table 3-6. Designated sites and priority habitats

Area of interest	Designated site / Priority habitats	Details
Minworth WwTW site	Coastal land floodplain grazing marsh priority habitat	Details of habitats on the WwTW site. All area identified as low confidence
	Deciduous woodland priority habitat	
	No main habitat but additional habitats exist priority habitat	
River Witham downstream sites	The Wash Ramsar and Site of Specific Scientific Interest	Located at mouth of River Witham and is the largest estuarine site in the UK. Designated for intertidal mudflats and saltmarshes that provide important winter-feeding areas for waders and wildfowl, saltmarsh and shingle habitats, and breeding ground for common seals.
	Deciduous woodland priority habitat	Located along the banks of the River Witham, mainly downstream of the Brayford Pool
	Good quality semi-improved grassland priority habitat	
	Coastal and floodplain grazing marsh priority habitat	
	Woodpasture and parkland BAP priority habitat	
Fossdyke Canal	Good quality semi-improved grassland priority habitat	Located along the banks of the Fossdyke canal
	Deciduous woodland priority habitat	
	Reedbeds priority habitat	
	No main habitat but additional habitats exist priority habitat	

[14] https://magic.defra.gov.uk/magicmap.aspx

4. Results

4.1.1 The results of this assessment are based upon the data utilised for the baseline context, EA INNS guidance and tools, and professional experience. The assessment incorporates:

- the EA INNS SRO risk assessment tool;
- the EA PR19 guidance (SLR SRO only); and
- further consideration of the risks beyond the EA methodology.

4.1.2 The results have been split into the two priority areas, that is the Minworth WwTW and the Trent SLR SRO.

4.2 Minworth WwTW

4.2.1 The methodology to assess the Minworth WwTW INNS risk is provided in Section 2. This section includes the results of each of the assessments, and a review of the summary risks.

Environment Agency SRO asset assessment

4.2.2 The EA SRO tool has been carried out for the Minworth asset following the EA guidance. The inputs to the tool are given in Table 4-1, including the sources of the information.

Table 4-1. EA SRO Asset Assessment inputs – Minworth WwTW

Field	Data	Source
Unique Asset Code	Minworth WwTW_Sewage Treatment Works	-
Site Name	Minworth WwTW	-
Asset Type	Sewage Treatment Works	-
Asset Location	Minworth Parkway, Sutton Coldfield	-
Asset National Grid Reference	SP 16637 92162	GIS
Asset Easting	416637	GIS
Asset Northing	292162	GIS
Asset Size (m^2)	2105988	Aerial imagery and GIS
Existing high impact INNS records on site/area of proposed site?	Known to be present	INNS survey
Details of high impact INNS present	See Table 3-4	INNS survey
Existing Priority Habitats on site?	Known to be present	MAGIC mapping
Details of existing priority habitats present	See Table 3-6	MAGIC mapping
Highest order site designation of asset	National	MAGIC mapping
Staff site visit (not entering water) frequency	2 (weekly)	Estimated based on site type
Staff site visit entering or in contact with raw water frequency	1.5 (Monthly)	Estimated based on site type
Road Vehicle site visit frequency	2 (weekly)	Estimated based on site type
Maintenance not entering water frequency	2 (weekly)	Estimated based on site type
Maintenance in water frequency	1.5 (monthly)	Estimated based on site type
Angling Equipment frequency	0 (never)	Estimated based on site type
Live bait frequency	0 (never)	Estimated based on site type
Fish stocking frequency	0 (never)	Estimated based on site type

Field	Data	Source
Large vessels (over 28ft) frequency	0 (never)	Estimated based on site type
Small vessel (under 28ft) frequency	0 (never)	Estimated based on site type
Water sports equipment (SUPs, Canoe, Kayaks) frequency	0 (never)	Estimated based on site type
Water Safety Equipment (Temporary Moorings, jetties, inflatables, buoys) frequency	0.5 (rarely)	Estimated based on site type
Mammals/waterfowl on site frequency	2 (weekly)	Estimated based on site type
Transfer of waste sludge to land frequency	2 (weekly)	Estimated based on site type
Recreational walker/jogger/runner frequency	0 (never)	Estimated based on site type

Note: cells highlighted in green are used by the EA tool to calculate the risk, while those in yellow are informational data

4.2.3 The resulting EA INNS SRO asset score for Minworth WwTW is **36.81%**, as shown on Table 4-2. This does not take into account the change in risk associated with the SRO, and only assesses the WwTW as an asset.

Table 4-2. EA SRO Asset Assessment results – Minworth WwTW

Identifier	Name	Risk score (%)
Minworth WwTW_Sewage Treatment Works	Minworth WwTW	36.81%

Potential for INNS presence within effluent

4.2.4 A baseline assessment of the potential for INNS presence within the effluent has been carried out. Based on the desktop review of data, the information from Severn Trent Water, and previous experience and professional judgement, the potential sources of INNS within the Minworth effluent have been assessed. The results of these are shown in Table 4-3.

Table 4-3. Minworth WwTW – potential INNS presence within treated effluent – assessment and results

Potential source of INNS	Assessment	Results
Incoming sewage	It is considered unlikely that INNS would end up within the untreated sewage entering the Minworth site, given that the flows include household flows and runoff from roads and infrastructure. In the event that some INNS were to enter Minworth via this pathway, based on our experience with other INNS projects associated with sewage treatment works, it is considered unlikely that any INNS would survive the treatment process, with the majority of solids being settled out through the treatment process and biological processes. The highest likelihood of INNS within Minworth is from INNS growing within the site boundary.	Very low risk
INNS plants on site and in surrounding area	There are records of Himalayan Balsam (*Impatiens glandulifera*), Japanese Knotweed (*Reynoutria japonica*), Japanese Rose (*Rosa Rugosa*), and Montbretia (*Crocosmia pottsii x aurea*) on site, and a number of other species within 1km of the site (see Table 3-4). Additionally, the WwTW site operatives identified that there are plants growing around the historic lagoons to the south and west of the WwTW site, and some weeds growing adjacent to the tanks. However, WwTW staff stated that these are removed as part of general maintenance. In particular, there is a risk of INNS seeds blowing into the treated effluent prior to discharge or pumping. However, these risks are present regardless of SRO and a BMP is already in place to mitigate them. As such risk relevant to the SRO (i.e. reduced discharge in isolation) is low.	Low risk
INNS invertebrates on site	It is considered unlikely that any invertebrates would live within the treated effluent or migrate to the site, given how short a time-period the effluent is stored.	Very low risk

Potential source of INNS	Assessment	Results
INNS being spread to the site by site operatives	There is potential for site operatives to bring INNS from surrounding areas on their clothes, equipment, or vehicles (particularly is INNS plants are established on road verges in close proximity to the Site). Conversely, due to known presence of several INNS at the site, propagules from these species could be spread from the site by similar means. However, these risks are present regardless of SRO and a BMP is already in place to mitigate them. As such risk relevant to the SRO (i.e. reduced discharge in isolation) is low.	Low risk

4.2.5 While there is significant INNS presence at this site, with associated risk (as described in Table 4-3), mitigation of these risks falls outside the scope of this assessment. A BMP is in place to address these risks, which should be checked to ensure it addresses the above risks. Regardless, the reduced discharge, and additional tertiary treatment proposed, associated with the SRO, is likely to reduce any associated risk to onward 'downstream' spread.

INNS effects to River Tame due to reduced flows

4.2.6 There are records of multiple INNS species within the River Tame, as shown in Annex A.

4.2.7 The change in discharge from Minworth to the River Tame will lead to temporary reductions in the flow within the river and may result in increased flow variation. Increased flow variation could result in these INNS spreading due to disturbance of the existing habitats within the river, including potentially expanded riparian habitats.

4.2.8 Broadly speaking, the strongest correlate with INNS success is strongly and/or frequently disturbed suitable habitats. Propagule pressure (i.e., the proximity of dispersal agents and quantity of INNS propagules) is the second strongest correlate, As such, increased flow variation and a 'sudden' change to margin width (resulting in habitat disturbance), could facilitate expansion of certain INNS (seed producing riparian species in particular), especially where there is existing propagule pressure (e.g., a seed source). This risk should decline over time as native plant communities adapt to the new niche/conditions (which typically takes longer that it would for INNS).

4.2.9 A hydraulic model of the River Tame has been developed to assess the effect of the reduced flows on the hydrological regime of the River Tame. This has been run for low flow conditions (Q_{95} flow[15]) and average flow conditions (Q_{50} flows), to understand the potential changes to the river against baseline for a 115 Ml/d reduction (Scenario A) and a 230 Ml/d abstraction (Scenario B) from Minworth WwTW taking place. The model has reviewed the wetted perimeter and water depth to understand the potential changes to the riparian zones which could result in a change to INNS species. The results are shown in Table 4-4. Note that this model is currently draft and uncalibrated.

Table 4-4 Modelled changes to wetted width and water depth (Scenarios A and B)

			Modelled (m)		Reduction (m)		Reduction %	
	Flow statistic	Baseline	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A	Scenario B
Wetted width	Q_{95}	33.0	32.5	32.0	0.45	0.97	1%	3%
	Q_{50}	34.2	33.5	33.1	0.70	1.11	2%	3%
Flow depth	Q_{95}	64.3	64.3	64.2	0.06	0.14	6%	13%
	Q_{50}	64.5	64.4	64.4	0.06	0.12	5%	10%

4.2.10 Based on preliminary flow model results, in summary, using the scenarios described above (Section 1.19), at low flows (Q95 - the flow exceeded 95% of the time that is typical of a dry summer flow) there is (based on the model transect closest to Minworth):

[15] The Q_{95} flow is a low flow estimate, which is the flow that is exceeded 95% of the time.

- an estimated channel margin increase of 0.204m / 0.65% for a 115 Ml/d reduction in discharge; and
- an estimated channel margin increase of 0.998m / 3.18% for a 230 Ml/d reduction in discharge.

4.2.11 Assuming a 1 km stretch downstream of Minworth, this would equate to an increase in channel margin of between:

- 204 m^2 (115 Ml/d scenario); and
- 998 m^2 (230 Ml/d scenario).

4.2.12 These preliminary results indicate that there is a relatively minor decrease in wetted width and depth for both scenarios (with correspondingly small increases in margin width). This could result in some facilitation of spread of INNS already present which could exploit potentially disturbed habitats, which might result in range expansion or the joining up of existing stands. It is not possible to quantify all potential effects; however, as INNS are already very well recorded in this stretch of the River Tame, the potential than such habitat disturbance significantly affected INNS risk within the catchments is low (i.e. this stretch of the river is already significantly colonised).

Summary INNS Risks

4.2.13 The risks associated with Minworth WwTW in relation to INNS are as follows:

- EA SRO INNS Risk Assessment Tool – Minworth WwTW asset risk score of 38.6%;
- There is existing risk associated with INNS growth within the WwTW; however, it falls outside the scope of the SRO assessment and is covered by an existing BMP. Regardless, this risk will not increase due to the scheme, and may decrease due to proposed tertiary treatment;
- An existing low risk associated with WwTW staff bringing INNS into to site and/or spreading INNS away from site, however this risk will not increase due to the SRO scheme and is covered by an existing BMP; and
- Low risk associated with the Minworth SRO reduced flows within the River Tame, as, while habitat disturbance could facilitate existing INNS to expand range, the relevant stretch of the River Tame is already very well colonised.

4.2.14 The key species of interest are Himalayan Balsam (*Impatiens glandulifera*), Japanese Knotweed (*Reynoutria japonica*), Giant Hogweed (*Heracleum mantegazzianum*); Japanese Rose (*Rosa rugosa*); and Montbretia (*Crocosmia pottsii* x *aurea* = *C.* x *crocosmiiflora*).

Recommended mitigation

4.2.15 The EA SRO tool recommends a number of biosecurity measures to be implemented including:

- Biosecurity strategy;
- Cleaning of equipment, staff, and maintenance vehicles (check clean dry, operational equipment cleaning, static water wash, running water, PPE cleaning, drying, pressure wash, anti-foul); and
- The use of site-specific operational equipment.

4.2.16 STW have developed a Biosecurity Plan for the site, that covers all of their assets and sites in line with regulatory requirements for water supply and sewage treatment. The Biosecurity Plan has a phased implementation over the next few years. It is assumed that the existing Biosecurity Plan includes requirements for INNS risk assessments, pathway analysis, and options appraisal to identify optimal actionable, and feasible, mitigation options. The BMP should aim to mitigate the existing site risks, detailed above, though targeted remove of INNS from the site, with a key aim of preventing INNS propagules from species not recorded nearby (1km) in the River Tame entering the treated water (especially if habitat downstream is de-stabilised). The existing BMP should also include measures for cleaning of maintenance vehicles, the shoes of site staff, and cleaning of PPE and other equipment used on site with the aim of preventing spread not just away from the site, but also to the site (from where they could spread to the River Tame, bypassing the treatment process).

4.2.17 To address the low increased risk associated with the reduced flows, additional mitigation beyond the existing Biosecurity Plan may be warranted until it can be determined if habitat disturbance is occurring at relevant levels. Suitable mitigation would involve monitoring, with targeted herbicide treatment if relevant INNS (i.e., INNS not already widespread) start to proliferate, until habitats restabilising (assuming de-stabilisation occurs in the first place). The aim would be to 'keep the INNS down' long enough for native species to establish.

4.3 South Lincolnshire Reservoir (Trent)

4.3.1 The methodology to assess the SLR INNS risk is provided in Section 2. This section includes the results of each of the assessments, and a review of the summary risks.

Environment Agency SRO RWT assessment

4.3.2 The abstraction and discharge location of the Trent SLR have not been finalised, therefore this preliminary assessment of the INNS risk of the proposed transfer pipeline is based upon indicative locations. The indicative locations are the abstraction from the River Trent adjacent to the north of East Stoke (NGR [redacted], and the discharge to the River Witham to the west of Dry Doddington (NGR [redacted]), with a pipeline of approximately 14.3 km.

4.3.3 The EA SRO RWT tool has been carried out for the Trent SLR following the EA guidance. The inputs to the tool are given in Table 4-5, including the sources of the information.

4.3.4 As previously noted, the tool has some limitations in terms of the existing connections functionality. The existing connection between the River Trent and River Witham, the Fossdyke Canal, has also been assessed using the tool to more accurately investigate the overall risk associated.

Table 4-5. EA SRO RWT Assessment inputs – Trent SLR and Fossdyke Canal

Field	Data – SLR SRO	Data – Fossdyke Canal	Source
Unique Site ID	River Trent_Pipeline_River Witham	River Trent_Canal_River Witham	-
RWT Name	Trent to Witham RWT	Fossdyke Navigation	-
Source Name	River Trent	River Trent	-
Source Easting	[redacted]		Project data
Source Northing	[redacted]		Project data
Source Management Catchment	Trent Lower and Erewash	Trent Lower and Erewash	EA Catchment explorer
Source Operational Catchment	Nottingham Urban	Trent and Trib	EA Catchment explorer
Source Waterbody ID	GB104028053110	GB104028058480	EA Catchment explorer
Source Type	River	River	Project data
Number of RWT inputs into source	>3	>3	Assumed maximum due to number of WwTW and canals upstream
Pathway Type	Pipeline	Canal	Project data & GIS
Receptor Name	River Witham	River Witham	Project data
Receptor Easting	[redacted]		Project data & GIS
Receptor Northing	[redacted]		Project data & GIS
Receptor Management Catchment	Witham	Witham	EA Catchment explorer
Receptor Operational Catchment	Witham Upper	Witham Lower	EA Catchment explorer
Receptor Waterbody ID	GB105030056780	GB205030062425	EA Catchment explorer
Receptor Type	River	River	Project data & GIS
Isolated receptor catchment	No	No	EA Tool Mapping

Field	Data – SLR SRO	Data – Fossdyke Canal	Source
Volume of water	251-300 Ml/d	151-200 Ml/d	Project data & estimate for Fossdyke
Frequency of operation	Year round - intermittent	Year round - continuous, variable flow	Project data & estimate for Fossdyke
Transfer distance (Km)	10.1-15	15.1-20	Project data & GIS
Washout/maintenance points outside of catchments	Unknown	Unknown	Information not available
Details of washout/maintenance points	Currently unknown whether there are washout/ maintenance points along the route	Unknown maintenance points along the canal	
Source Navigable	Yes	Yes	Online search
Pathway Navigable	No	Yes	Online search
Angling at Source	Members and day ticket holders, national events	Members and day ticket holders, national events	Review of Angling clubs online
Angling on Pathway	No	Members and day ticket holders, local matches	Review of Angling clubs online
Water sports at Source	National events	National events	Review of local watersports on site
Water sports on Pathway	No	Casual use by individuals/clubs	Review of local watersports on site
Presence of high priority INNS_Source	Known to be present	Known to be present	INNS records
Presence of high priority INNS_Pathway	Not recorded	Known to be present	INNS records
Details of INNS present	See Table 3-5	See Table 3-3	INNS Records
Highest order site designation_Receptor	International	International	MAGIC map
Presence of priority habitat _Pathway	Not known to be present	Known to be present	MAGIC map
Presence of priority habitat_Receptor	Known to be present	Known to be present	MAGIC map
Details of priority habitat present	See Table 3-6		MAGIC map
Other existing connections between source and receptor	1	1	GIS and online review
Details of other existing connections	There is an existing canal that links the Trent to the Witham called the Fossdyke Navigation which connections from Torksey Lock to Brayford Pool	Have included the new connection to investigate the risks associated with both pathways	GIS and online review

Note: cells highlighted in green are used by the EA tool to calculate the risk, while those in yellow are informational data

4.3.5 The resulting EA INNS SRO RWT score for the SLR SRO is **63.25**%, as shown on Table 4-2. Indicative a moderate risk associated with the rWT. The Fossdyke Canal has an INNS Risk score of **76.25**%. Therefore, based on tool output, the existing canal has a higher risk score than the proposed Trent SLR.

Table 4-6. EA SRO RWT Assessment results – Trent SLR and Fossdyke Canal

Identifier	Name	Risk score (%)
River Trent_Pipeline_River Witham	Trent to Witham RWT	62.63%
River Trent_Canal_River Witham	Fossdyke Navigation	76.25%

Environment Agency RWT significance assessment

4.3.6 The SLR has been assessed using the EA prioritisation of existing RWTs (PR19).

4.3.7 The transfer is moving water from one WFD Management catchment to another; however, there is an existing hydrological link between the two catchments. The decision tree queries whether the transfer bypasses any barriers of distance, isolation, physical, chemical, or other to the migration of INNS. If there are physical barriers, then the priority is A (very high risk) and if there are no physical barriers it is priority B (high risk). Therefore, the EA consider the risk to be high or very high.

4.3.8 The existing connection between the Trent and the Witham represents a significant existing INNS transfer risk. However, the proposed SLR abstraction bypasses a portion of the Trent (approximately 78 km) and the Fossdyke Canal (approximately 17.9 km) with respect to movement of water from the abstraction point to Brayford Pool. There are limited physical barriers on the Fossdyke Canal (one lock near Torksey). The barriers on the River Trent, between the proposed abstraction point and the Fossdyke Canal are four locks (many combined weir and lock arrangements), and a weir on a side channel. Given that these comprise locks, they would not provide a physical barrier to downstream movement of INNS as these pass water downstream. However, the proposed SLR transfer would bypass a barrier of distance reducing the distance INNS propagules must travel by approximately half the current distance to reach this point from the abstraction point (current: 78km (Trent) + 18km (Fossdyke), new: 14km (transfer pipe) + 40 km (Witham).

4.3.9 Additionally, the proposed SLR transfer creates a new connection to the 40 km reach between the proposed SLR discharge and the Fossdyke Navigation (i.e., the point of existing connection downstream in both catchments), as this section of the river may currently be isolated from the River Trent via existing land barriers (i.e., no current pathway has been identified for the spread of INNS from the River Trent catchment to this 40 km stretch of the Witham). A review of existing barriers on the Witham, downstream of the discharge (Table 3-2) indicates that there are three barriers along the River Witham between these two points: All Saints Church Stapleford weir, Barnaby in the Woods weir, and the Mill Farm Claypole weirs. As such, the potential for onward spread of INNS, if introduced to the Witham, may be limited. However, the passability of these barriers to INNS is unknown. Following a barrier assessment to INNS passage, this will be updated.

Trent SLR further assessment

4.3.10 Based on the above, the key area at risk from the SLR is the approximately 40 km reach between the proposed SLR discharge and the Fossdyke Canal, as this section of the river may currently be isolated from the River Trent (i.e. no current pathway for the spread for INNS from the River Trent catchment was identified). Downstream of the Brayford Pool, the Fossdyke Canal provides an existing connection, although a barrier of distance would be bypassed.

4.3.11 The existing INNS survey data indicates that there are many INNS (both statutory and non-statutory non-native species) present within the River Witham, including many in the reach of interest, including Northern River Crangonyctid (*Crangonyx pseudogracilis/floridanus*), Canadian Waterweed (*Elodia canadensis*), Nuttall's waterweed (*Elodea nuttallii*), Giant hogweed (*Heracleum mantegazzianum*), Himalayan Balsam (*Impatiens glandulifera*), Bladder snail (*Physella acuta*) and Jenkins' Spire Snail (*Potamopyrgus antipodarum*).

4.3.12 The prevalence of some of these species does not confirm or exclude that fact that there is pathway for INNS to reach the proposed SLR transfer site on the River Witham from the Fossdyke Canal, as species may have been spread via other means, e.g., angling or pedestrians. However, it does mean that many of the species that are most prevalent within the River Trent (e.g., Giant Hogweed and Himalayan Balsam), have a lower priority in the assessment. However, unmitigated discharge to this, currently unconnected reach of the River Witham is not recommended, and the risk associated with a new transfer is still considered high.

4.3.13 Therefore, it is recommended that the water transfer, in particular the intake structure, is designed to minimise the potential spread of INNS. Additional mitigation measures to remove high risk existing INNS from both catchments should also be considered, with locations at/near(upstream) of the

proposed abstraction being a priority for such mitigation in order to reduce propagule pressure in such locations (see Recommended Mitigation section).

Summary INNS Risks

4.3.14 The risks associated with Trent SLR in relation to INNS are as follows:

- EA INNS RWT risk score of 62.63%; however, the existing connection, Fossdyke Canal, has a higher risk score of 76.25%.
- The EA RWT significance assessment indicates that the transfer is very high significance for the 40 km stretch of the River Witham that, based on this assessment, is not currently connected to Trent. Downstream of the existing connection (i.e., the Fossdyke Canal) should be reduced to high significance (due to a new connection between catchments being created but taking into account the nature of the existing connection).
- As such, the key area of interest with the SLR is to the approximately 40 km reach between the SLR outflow and the Brayford Pool.
- There is a high risk associated with the SLR SRO transfer, without any mitigation; with mitigation this can be reduced to low.

4.3.15 The key species of interest are Crayfish plague (*Aphanomyces astaci*), (Himalayan Balsam (*Impatiens glandulifera*), Japanese Knotweed (*Reynoutria japonica*), Giant Hogweed (*Heracleum mantegazzianum*); Water fern (*Azolla filiculoides*); New Zealand Pigmyweed (*Crassula helmsii*); Parrot's-feather (*Myriophyllum aquaticum*); Zebra Mussel (*Dreissena polymorpha*); Signal Crayfish (*Pacifastacus leniusculus*); the polychaete worm (*Hypania invalida*) and a freshwater limpet (*Ferrissia californica (Wautieri)*).

Mitigation options overview

4.3.16 The EA SRO tool recommends a number of biosecurity measures to be implemented. These have been assessed and augmented, as detailed below. A Best Management Practices (BMP) for the RWT pipeline and a portion of the River Trent should be produced, which should cover, broadly speaking:

i) mitigation related to transfer infrastructure,

ii) targeting control of key species, and

iii) mitigation through proactive biosecurity.

4.3.17 Possible mitigation options for the RWT pipeline include:

– Screening (active) - temperature, light (strobe), velocity, acoustic (bubble curtains, water guns, and other sound impacts), travelling/conveyor, electric fields, CO_2 barriers, in-line rotary, traps (including with pheromones), ultrasonic, ultraviolet, ozonation. A wide range of active screening methods using electricity, light, sound, pressure, bubbles, CO_2, and other impacts, are being developed and deployed in efforts to limit the spread of aquatic INNS. Several of these have shown promise in excluding INNS. While most are not suitable at the exact point of abstraction, they may have the most potential to exclude INNS from the point of abstraction by creating barriers set away from the abstraction point, allowing such screens to form part of an integrated solution. However, evidence of the effectiveness of these barriers is quite variable, and testing is often lacking for both target and non-target species. Traveling, or conveyor, screens essentially provide the same benefits as passive screens, but are self-cleaning, reducing maintenance and the potential for clogging. In-line rotary screens may have a use within plumping infrastructure; however, maintenance and flow rate requirements may exclude them from being usable, at least for larger volume transfers.

– Screening (passive) – trash racks, grates, rock gabions, parabolic (sidehill) rundown, silt curtains, and fish screens (eel screens are best option as 1 mm minimum mesh size provides highest specification and supported by Eel Regulations). No protection against high-risk mollusc INNS larvae (veligers). Limited protection from other INNS, in particular larval or juvenile stages. Will only exclude plant fragments and faunal life stages greater than 1mm (as context zebra mussel only exceeds 1mm once

settled). Different combinations are potentially very useful as part of integrated solutions. It is worth noting that, while it is likely not possible to stop all life stages of all INNS by screening, while maintaining relevant rates of waterflow, the life stage that 'make it through' is relevant regarding survival, onward spread, and establishment. For example, the mortally rate of animal larval/juvenile stages is extremely high as they tend to be very vulnerable (e.g., signal crayfish moult approximately 11 times in their first year, but only once/ per year at full maturity – a moulted crustacean is very vulnerable to predation and physical damage). Additionally, it can take years for a larva to mature and become reproductive (allowing time for identification and rapid response, e.g., signal crayfish typically take 2 to 3 years to reach reproductive maturity and zebra mussels take 1 to 2 years). Killer shrimp, on the other hand, can reach reproductive maturity within a couple of months. Silt curtains, or similar, could be set back from the abstraction point, allowing for smaller mesh/pour size, but over an increased surface area (thus reducing/eliminating impacts on flow rate and clogging). Silt curtains, or similar could also be set back from discharge points as a monitored safety net (also see below). With forward planning such screens could be designed to prevent movement over or below the screen.

- Intakes could also be designed to increase deflection of propagules past the abstraction point, e.g., through shape or by positioning (e.g., tangential to direction of flow), or by being positioned away from locations INNS would likely congregate/accumulate. It may be possible to design new abstraction infrastructure with an 'INNS gauntlet' leading to the point of abstraction. This gauntlet could be constructed or biological and could be combined with screening methods (active or passive) and would be aimed at preventing live INNS from reaching the point of abstraction.
- Intrinsic INNS resistance of transfer infrastructure. There are thousands of existing water transfers in the UK created using a wide range of transfer infrastructure. The effect of these existing transfers with respect to facilitating the spread of INNS is largely unquantified; however, confirmed examples of association with INNS spread incidents appear to be rare. The resistance to INNS spread of 'typical' transfer infrastructure should be empirically assessed, so that such information can be incorporated into risk assessment and design. In particular, the resistance created by piping over distance, moving through pumps (of different kinds), and associated changes in water pressure, should be assessed. Understanding these interactions for a range of life stages would be beneficial, as adult animal INNS would be easier to exclude, for example, by screening, while juvenile stages may be more prone to piping-over-distance/pumping/high-water-pressure. Ultimately, such information could feed into refined integrated solutions.
- Backup 'safety nets': Preventing all INNS propagule, with 100% certainty, from being transferred, is likely outside currently practically implementable solutions. Rather, reaching an acceptable risk profile may be a more achievable goal. This could include increasing resistance to onward spread at discharge points, in addition to abstraction points. 'Safety nets' could be constructed (e.g., silt curtains set back from discharge) and/or biological (e.g., post discharge meanders with reedbeds). Whatever the case, such locations could be monitored, with rapid response protocols in place.
- Control of existing populations at near the point of abstraction: As discussed above propagule pressure is a key correlate for invasive spread/success. As such, the removal of populations from locations at/near the abstraction (even if such mitigation is not 100% successful), would help contribute to achieving an acceptable risk profile. A range of options are available for the control of established INNS, from 'biobullets', to herbicide treatment, to physical removal or trapping, with options for terrestrial/riparian plant species being typically more developed (with respect to probability of success) than for fully aquatic species (where eradication is notoriously difficult, or often realistically not possible, once well established). Management should be targeted, focusing on higher priority species, and those that are not already recorded in the Witham (unless cross-catchment control is attempted).
- Prevention of new introductions or the further spread of existing species. Prevention is the cheapest and most reliable method of INNS management. Accordingly, it would be pragmatic to establish a biosecurity strategy for relevant parts of the Trent (e.g., at, near, upstream, of the abstraction) with the aim of preventing new introductions to the Trent and/or moving existing species around the Trent. This could focus on angling, navigation, and water sports and should include the cleaning of equipment, clothing, and boats (check clean dry, operational equipment cleaning, static water wash, running water, PPE cleaning, drying, pressure wash, anti-foul), and event management.

Recommended mitigation

4.3.18 We recommend that the site implements a biosecurity strategy to remove INNS from the area immediately around the intake from the River Trent, and priority INNS (i.e., those not already present in the Witham) from at least 500 m upstream and downstream of the proposed abstraction point.

4.3.19 However, given how widespread INNS are along the river, and the challenges inherent with managing INNS in aquatic environments, it is unlikely that this would be successful in removing all potential sources from the vicinity or all propagules from water reaching the abstraction. Therefore, it is recommended that the intake structure incorporates an integrated treatment system, which may include:

- Passive screens and structures to divert INNS away from the intake structure and prevent, at least, larger INNS propagules from entering the pipeline;
- Active screens, that help 'mop up' smaller propagules than could get past passive screens, e.g., chemical, electric, or UV treatment; and/or
- Use of pumps, selected to produce high pressure environment that would likely neutralise remaining INNS (research into this topic in particular would provide valuable insight).

4.3.20 Using such methods, or potentially other integrated treatment systems, the risk of INNS entering the pipeline can be reduced to low, with chemical or UV treatment and pumps removing many remaining INNS from the system. In addition, the 14 km of pipeline is likely to reduce further any remaining INNS from surviving (empirical research into this topic would also provide valuable insight). Furthermore, based on the risk profile achievable from the above, 'safety net' systems with monitoring and rapid response could also be considered. Ultimately, mitigation should be 'stacked' until an acceptable risk profile is achieved, or an optimal arrangement identified. For example, as pumping will likely be required, and since the transfer is over distance, these infrastructure elements alone could be sufficient to reduce an acceptable risk profile. Previous, theoretical assessments carried out by AECOM indicate that such transfer infrastructure likely provides a high resistance to INNS transfer; however, this would need to be tested emetically to be relied upon. The most cost-effective way to empirically assess this, would likely be to review if previous similar transfers have resulted in INNS spread.

4.3.21 Regardless of what mitigation measures are implemented at the intake structure, a low residual risk of transfer to the River Witham will be hard to avoid. As such, integration of control action with wider efforts, through collaboration with local environmental groups, would be sensible. This would help provide mitigation to the wider River Trent and River Witham catchments helping further reduce risk profiles over time. Mitigation at destination (i.e., the 'safety nets' describes above) would provide additional options for mitigation, that could be considered if required.

4.3.22 Additionally, in order to reduce the potential for new and high-risk INNS to be introduced in the future to/near the abstraction point, options for enhancing biosecurity implementation (broadly speaking through clean, check, dry) in a general sense in the region would return good value on investment.

4.3.23 It is recommended, to support this assessment, that ecological INNS surveys of the River Trent (at/near abstraction) and the River Witham are completed, as well as visual surveys of the River Witham barriers identified in Table 3-2, to identify whether any barriers may provide a barrier to the spread of INNS. Furthermore, a wider assessment of INNS introduction potential to the River Witham could be beneficial. If a large number of high-risk introduction vectors are identified (in addition to the Fossdyke Canal), the rational for implementing, especially if costly, INNS mitigation would be reduced.

4.3.24 The intake, pumping, and transfer design should be developed, incorporating INNS mitigation.

Following further surveys and assessment to confirm the INNS presence within the River Witham, and the final design of the pipeline, the recommended mitigation should be refined and updated. It is considered that with the application of an optimal selection of mitigations (i.e., the minimum number of mitigations that allows for an acceptable risk profile - to be determined), the residual risk to the River Witham would be low.

5. Scoping Checklist – Recommendations and Mitigation Options

5.1.1 This section summarises the requirements for further assessment and mitigation beyond Gate 2.

Table 5-1: Tame and Trent Strategic Resource Options – Scoping Checklist for post-Gate 2 assessment and mitigation

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green rating of Risk to SRO (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
Invasive Non-Native Species						
Minworth / River Tame	National	New tertiary treatment at Minworth WwTW, which would reduce the existing INNS risk associated with potential for INNS propagules or seeds to be blown into the treated water prior to discharge, or to be introduced to/from site via staff. No increased risk, or potential positive effect, due to Minworth SRO. Existing Biosecurity Plan will reduce the risk further.	Neutral	Low		Checking and implementation of existing Biosecurity Strategy
Minworth / River Tame	Local	Impact from Minworth SRO. Reduction in river levels within the River Tame may result in habitat disturbance and allow INNS species to further colonise	Negative	Low		Monitor a 1 km buffer downstream of the discharge for habitat destabilisation (with the potential to facilitate relevant INNS, i.e., those not already widespread), following reduction in flow. Develop a rapid response protocol (i.e., targeted herbicide treatment aimed at keeping INNS down until habitats restabilise, if destabilisation occurs).

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green rating of Risk to SRO (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
SLR / River Witham	Local	Trent SLR pipeline could provide pathway for INNS to access the upper reaches of the River Witham (primary concern is the 40 km reach upstream of Lincoln to the discharge point), resulting in colonisation of reach by additional INNS.	Negative	Low residual risk (with mitigation)	Complete INNS surveys of the upper River Witham and Treat at/near abstraction Barrier survey of the River Witham Identification of catchment wide INNS schemes Assess wider INNS introduction potential to the River Witham Research (empirical – to augment theoretical studies) impacts of existing water transfers on INNS spread, to better understand resistance of traditional transfer infrastructure to INNS spread. Focus on impacts of pumps and piping over distance on INNS survival at various life stages. Identify optimal mitigation combination that results in an acceptable risk profile.	Optimal mitigation would involve a combination of the below. Integrated treatment system included at the pipeline inlet, potentially including: • Passive screens. • Deflection. • Active screens. • Pumps (assessed for potential to further neutralise INNS). • Piping over distance. • 'Safety nets' at discharge, with monitoring and rapid response. Implement BMP to remove all INNS from abstraction point and high priority species (i.e., primarily those not identified in the Witham) from 500m upstream and downstream of SLR on River Trent and during construction. Implement actions with local environmental groups to reduce INNS from the wider River Trent and River Witham catchments. Enhance catchment level biosecurity implementation (clean check dry)

A.1 River Trent and River Tame INNS records summary and priority screening

Below is the full summary for the River Trent and River Tame INNS records, including the priority screening for both the Minworth WwTW and Trent SLR proposals.

Table 5-2 River Trent and River Tame INNS records summary and priority screening

INNS details			Schedule 9 species	Species of concern / Schedule 2	Widely spread	Total number of records from sources						Nearest record to SLR transfer (km)			Nearest record to Minworth (km)	INNS Presence in River Witham	Assessment of Priority for Mitigation	
Taxon Group	Scientific name	Common name				LERC	EA M-phytes	EA M-invert.	AECOM	INNS survey	Total	Upstream direction	Downstream direction	Minimum			SLR Transfer	Minworth WwTW
Bird	*Aix galericulata*	Mandarin Duck	Yes	-	-	4	-	-	-	-	4	35.2	-	35.2	2.7	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Bird	*Aix sponsa*	Carolina Wood Duck	Yes	-	-	1	-	-	-	-	1	78.4	-	78.4	2.8	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Plant	*Allium triquetrum*	Three-cornered Garlic	Yes	-	-	1	-	-	-	-	1	38	-	38	43.6	-	Very low - long distance from transfer and not riparian	Very low - outside of study area
Bird	*Alopochen aegyptiacus*	Egyptian Goose	Yes	Yes	Yes	1034	-	-	-	-	1034	33.4	-	33.4	2.7	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Bird	*Anser indicus*	Bar-headed Goose	Yes	-	-	100	-	-	-	-	100	62.5	-	62.5	7	-	None - spread unrelated to SLR	None - not related to Minworth project
Water mould	*Aphanomyces astaci*	Crayfish Plague	Yes	-	-	-	-	-	-	-	0	13.4	-	13.4	21.1	-	High	None - no risk associated with Minworth
Ferns	*Azolla filiculoides*	Water Fern	Yes	-	-	62	3	-	-	-	65	10.3	6	6	0.9	Yes - downstream of Brayford Pool only	Medium - present in River Witham	Low - Low risk of transfer effects
Bird	*Branta canadensis*	Canada Goose	Yes	-	-	6331	-	-	-	-	6331	32.7	73.9	32.7	0.1	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Bird	*Branta canadensis subsp. parvipes*	Lesser Canada Goose	Yes	-	-	1	-	-	-	-	1	81.7	-	81.7	21.8	-	None - spread unrelated to SLR	None - not related to Minworth project
Bird	*Branta leucopsis*	Barnacle Goose	Yes	-	-	2	-	-	-	-	2	74.9	-	74.9	2.6	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Bony Fish	*Carassius auratus*	Goldfish	-	-	-	1	-	-	-	-	1	71.3	-	71.3	10.7	-	Very low - not present in Trent (only in pond)	Very low - outside of study area
Crustacean	*Chelicorophium curvispinum*	Caspian mud shrimp	-	-	-	-	-	65	-	8	73	2.8	6.6	2.8	25.7	Yes - downstream of Brayford Pool only	Low - non-statutory and present in Witham	Very low - outside of study area
Bird	*Chrysolophus pictus*	Golden Pheasant	Yes	-	-	1	-	-	-	-	1	79.3	-	79.3	2.7	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Mollusc	*Corbicula fluminea*	Asian Clam	-	-	-	7	-	22	-	7	36	2.7	6.6	2.7	21.5	Yes - downstream of Brayford Pool only	Low - non-statutory and present in Witham	Very low - outside of study area
Flowering plant	*Cotoneaster horizontalis*	Wall Cotoneaster	Yes	-	-	3	-	-	-	-	3	74.7	-	74.7	2.6	-	Very low - long distance from transfer and not riparian	Low - not riparian
Flowering plant	*Cotoneaster integrifolius*	Entire-leaved Cotoneaster	Yes	-	-	1	-	-	-	-	1	72.7	-	72.7	9.1	-	Very low - long distance from transfer and not riparian	Very low - outside of study area
Flowering plant	*Cotoneaster simonsii*	Himalayan Cotoneaster	Yes	-	-	2	-	-	-	-	2	81.3	-	81.3	0.4	-	Very low - long distance from transfer and not riparian	Low - not riparian
Crustacean	*Crangonyx pseudogracilis/floridanus*	Northern River Crangonyctid	-	-	Yes - Professional judgement	23	-	121	-	8	152	4.4	6.6	4.4	0.1	Yes - upstream and downstream of transfer	Low - non-statutory and present in Witham	Low - non-statutory and highly spread
Plant	*Crassula helmsii*	New Zealand Pigmyweed	Yes	-	-	83	-	-	-	-	83	3.3	7	3.3	1.1	-	High	Low - Low risk of transfer effects
Plant	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	Montbretia	Yes	-	Yes - Professional judgement	8	-	-	-	-	8	38.1	-	38.1	0	-	Very low - long distance from transfer and not riparian	Medium - widely spread

INNS details			Schedule 9 species	Species of concern / Schedule 2	Widely spread	Total number of records from sources						Nearest record to SLR transfer (km)			Nearest record to Minworth (km)	INNS Presence in River Witham	Assessment of Priority for Mitigation	
Taxon Group	Scientific name	Common name				LERC	EA M-phytes	EA M-invert.	AECOM	INNS survey	Total	Upstream direction	Downstream direction	Minimum			SLR Transfer	Minworth WwTW
Bird	*Cygnus atratus*	Black Swan	Yes	-	-	156	-	-	-	-	156	57.4	-	57.4	5.8	-	None - spread unrelated to SLR	None - not related to Minworth project
Crustacean	*Dikerogammarus haemobaphes*	Demon Shrimp	-	-	-	3	-	108	-	6	117	2.5	6.7	2.5	0.1	Yes - downstream of Brayford Pool only	Low - non-statutory and present in Witham	Medium - widely spread
Mollusc	*Dreissena polymorpha*	Zebra Mussel	-	-	-	19	-	6	1	6	32	9.7	2.4	2.4	12.9	Yes - downstream of Brayford Pool only	Medium - non-statutory and present in Witham	Very low - outside of study area
Mollusc	*Dreissena rostriformis*	Quagga mussel	-	-	-	-	-	-	-	1	1	34.6	-	34.6	48.6	No	Very low - non-statutory and low prevalence	Very low - outside of study area
Flowering plant	*Elodea canadensis*	Canadian Waterweed	Yes	-	-	88	1	-	-	2	91	30.2	-	30.2	1.6	Yes - upstream and downstream of transfer	Low - highly established in Witham	Low - Low risk of transfer effects
Flowering plant	*Elodea nuttallii*	Nuttall's Waterweed	Yes	Yes	Yes	61	24	-	-	9	94	10.1	3.9	3.9	0.7	Yes - upstream and downstream of transfer	Low - highly established in Witham	Low - Low risk of transfer effects and widely spread
Crustacean	*Eriocheir sinensis*	Chinese Mitten Crab	Yes	Yes	Yes	14	-	-	-	-	14	14.5	5.6	5.6	62.4	-	Low - low risk associated with transfer and widely spread	Very low - outside of study area and widely spread
Plant	*Fallopia baldschuanica*	Russian-vine	-	-	-	5	-	-	-	-	5	55.4	-	55.4	9.4	-	Very low - non-statutory and not riparian	Very low - outside of study area
Mollusc	*Ferrissia californica (wautieri)*	A freshwater limpet	-	-	-	-	-	1	-	-	1	21.5	-	21.5	61.4	-	Medium - non-statutory	Very low - outside of study area
Crustacean	*Gammarus tigrinus*	A freshwater/brackish shrimp	-	-	-	5	-	9	-	-	14	9.6	25	9.6	37.1	Yes - downstream of Brayford Pool only	Low - non-statutory and present in Witham	Very low - outside of study area
Plant	*Gunnera manicata*	Brazilian Giant-rhubarb	-	-	-	1	-	-	-	-	1	57.5	-	57.5	33.7	-	Very low - non-statutory and not riparian	Very low - outside of study area
Insect	*Harmonia axyridis*	Harlequin Ladybird	-	-	-	16	-	-	-	-	16	34.4	-	34.4	41.5	-	Very low - non-statutory and not riparian	Very low - outside of study area
Crustacean	*Hemimysis anomala*	Bloody Red Mysid	-	-	-	2	-	-	1	-	3	17.6	-	17.6	49.6	Yes - downstream of Brayford Pool only	Low - non-statutory and present in Witham	Very low - outside of study area
Flowering plant	*Heracleum mantegazzianum*	Giant Hogweed	Yes	Yes	Yes - EA	23	-	-	2	1	26	2.2	25.1	2.2	0.1	Yes - in close vicinity to transfer	Low - highly established in Witham	Medium - widely spread
Plant	*Hydrocotyle ranunculoides*	Floating Pennywort	Yes	Yes	Yes	20	-	-	-	1	21	3.5	74.4	3.5	11.5	Yes - downstream of Brayford Pool only	Low - present in the River Witham	Very low - outside of study area and widely spread
Annelid	*Hypania invalida*	A polychaete worm	-	-	-	2	-	32	-	-	34	20.8	7.9	7.9	26.2	-	Medium - non-statutory	Very low - outside of study area
Amphibian	*Ichthyosaura alpestris*	Alpine Newt	-	-	-	1	-	-	-	-	1	84.5	-	84.5	0.9	-	Very low - non-statutory and low prevalence	Low - non-statutory
Plant	*Impatiens capensis*	Orange Balsam	-	-	-	138	-	-	3	2	143	13.5	-	13.5	0.3	-	Low – non-statutory	Low - non-statutory
Flowering plant	*Impatiens glandulifera*	Himalayan Balsam	Yes	Yes	Yes - EA	873	29	-	7	14	923	0.5	0	0	0	Yes - upstream and downstream of transfer	Low - highly established in Witham and widely spread	Medium - widely spread
Plant	*Impatiens parviflora*	Small Balsam	-	-	-	-	-	-	1	-	1	30.4	-	30.4	52	-	Low – non-statutory	Very low - outside of study area
Flowering plant	*Lagarosiphon major*	Curly Waterweed	Yes	Yes	Yes	2	-	-	-	-	2	33.2	-	33.2	5.3	-	Low - not present in Trent, only in Triangle Pond and widely spread	Very low - outside of study area and widely spread

INNS details			Schedule 9 species	Species of concern / Schedule 2	Widely spread	Total number of records from sources						Nearest record to SLR transfer (km)			Nearest record to Minworth (km)	INNS Presence in River Witham	Assessment of Priority for Mitigation	
Taxon Group	Scientific name	Common name				LERC	EA M-phytes	EA M-invert.	AECOM	INNS survey	Total	Upstream direction	Downstream direction	Minimum			SLR Transfer	Minworth WwTW
Flowering plant	*Lamiastrum galeobdolon subsp. argentatum*	Variegated Yellow Archangel	Yes	-	-	22	-	-	-	-	22	34.9	-	34.9	0.4	-	Low - not riparian	Low - not riparian
Plant	*Lemna minuta*	Least Duckweed	-	-	-	10	15	-	-	-	25	10.1	17.2	10.1	11.5	-	Low – non-statutory	Very low - outside of study area
Bird	*Melopsittacus undulatus*	Budgerigar	-	-	-	1	-	-	-	-	1	35.6	-	35.6	47.3	-	None - spread unrelated to SLR	None - unrelated to water
Plant	*Mimulus guttatus*	Yellow monkeyflower	-	-	-	6	-	-	-	-	6	35	-	35	5.1	-	Low – non-statutory	Very low - outside of study area
Plant	*Mimulus luteus*	Blood-drop Emlets	-	-	-	1	-	-	-	-	1	29.2	-	29.2	51.9	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Plant	*Mimulus moschatus*	Musk monkeyflower	-	-	-	1	-	-	-	-	1	29.7	-	29.7	52.2	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Plant	*Mimulus sp.*	Monkeyflower species	-	-	-	1	-	-	-	-	1	49.1	-	49.1	39.2	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Mammal	*Muntiacus reevesi*	Chinese Muntjac	Yes	Yes	Yes	59	-	-	-	-	59	36.7	-	36.7	2.3	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Plant	*Myriophyllum aquaticum*	Parrot's-feather	Yes	Yes	Yes	4	-	-	-	-	4	22.3	-	22.3	5.3	-	Medium - widely spread	Very low - outside of study area and widely spread
Mammal	*Neovision vision*	American Mink	Yes	-	-	207	-	-	3	-	210	18.5	16	16	1.6	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Bird	*Netta rufina*	Red-crested Pochard	Yes	-	-	4	-	-	-	-	4	75.3	-	75.3	3.3	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Plant	*Nymphoides peltata*	Fringed Water-lily	-	-	-	11	-	-	-	-	11	32.6	-	32.6	2.7	-	Low - non-statutory	Low - non-statutory
Bony Fish	*Oncorhynchus mykiss*	Rainbow Trout	-	-	-	1	-	-	-	-	1	67.5	-	67.5	20.9	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Bird	*Oxyura jamaicensis*	Ruddy Duck	Yes	Yes	No	135	-	-	-	-	135	35.9	-	35.9	2.5	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Crustacean	*Pacifastacus leniusculus*	Signal Crayfish	Yes	Yes	Yes	2	-	1	-	4	7	21	7.9	7.9	21.2	Yes - downstream of Brayford Pool only	Medium - present in River Witham and widely spread	Very low - outside of study area and widely spread
Plant	*Parthenocissus quinquefolia*	Virginia-creeper	Yes	-	-	2	-	-	-	-	2	76.3	-	76.3	5.1	-	Low- not riparian	Very low - outside of study area
Amphibian	*Pelophylax ridibundus*	Marsh Frog	-	-	-	5	-	-	-	-	5	71.6	-	71.6	10.3	-	Low - non-statutory	Very low - outside of study area
Plant	*Petasites fragrans*	Winter Heliotrope	-	-	-	9	-	-	-	-	9	56.6	-	56.6	2.3	-	Low - non-statutory	Low - non-statutory
Plant	*Petasites japonicus*	Giant Butterbur	-	-	-	2	-	-	-	-	2	52.8	-	52.8	3.4	-	Very low - non-statutory and low prevalence	Low - non-statutory
Mollusc	*Physella*	[Acute] bladder snail (Physella acuta)	-	-	-	-	-	2	-	3	5	21	7.5	7.5	48.6	-	Low – non-statutory	Very low - outside of study area
Mollusc	*Physella acuta*	Bladder snail	-	-	-	-	-	4	-	-	4	9.6	7.8	7.8	48.2	Yes - upstream and downstream of transfer	Low – non-statutory & present within Witham	Very low - outside of study area
Mollusc	*Potamopyrgus antipodarum*	New Zealand mud snail	-	-	Yes - Professional judgement	2	-	167	-	6	175	4.6	6.6	4.6	0.1	Yes - upstream and downstream of transfer	Low – non-statutory & present within Witham	Low - non-statutory and widely spread
Plant	*Prunus laurocerasus*	Cherry Laurel	-	-	-	41	-	-	-	-	41	31.8	-	31.8	17.3	-	Low – non-statutory	Very low - outside of study area
Plant	*Prunus lusitanica*	Portugal Laurel	-	-	-	1	-	-	-	-	1	40.9	-	40.9	42.2	-	Very low - non-statutory and low prevalence	Very low - outside of study area

INNS details			Schedule 9 species	Species of concern / Schedule 2	Widely spread	Total number of records from sources						Nearest record to SLR transfer (km)			Nearest record to Minworth (km)	INNS Presence in River Witham	Assessment of Priority for Mitigation	
Taxon Group	Scientific name	Common name				LERC	EA M-phytes	EA M-invert.	AECOM	INNS survey	Total	Upstream direction	Downstream direction	Minimum			SLR Transfer	Minworth WwTW
Bird	*Psittacula krameri*	Ring-necked Parakeet	Yes	-	-	7	-	-	-	-	7	35.2	-	35.2	2.6	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Plant	*Quercus cerris*	Turkey Oak	-	-	-	1	-	-	-	-	1	62.9	-	62.9	27.9	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Plant	*Quercus ilex*	Evergreen Oak	-	-	-	1	-	-	-	-	1	71.2	-	71.2	17.3	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Mammal	*Rattus rattus*	Black Rat	Yes	-	-	1	-	-	-	-	1	35.5	-	35.5	46.6	-	None - spread unrelated to SLR	None - not related to Minworth project
Flowering plant	*Reynoutria japonica*	Japanese Knotweed	Yes	-	-	424	2	-	4	1	431	0.9	5.3	0.9	0	Yes - downstream of Brayford Pool only	Medium - present in River Witham	Medium
Flowering plant	*Rhododendron ponticum*	Common rhododendron	Yes	-	-	97	-	-	-	-	97	32.4	-	32.4	0.7	-	Low - not riparian	Low - non-statutory
Flowering plant	*Robinia pseudoacacia*	False-acacia	Yes	-	-	5	-	-	-	-	5	56.5	-	56.5	9.4	-	Very low - not riparian	Very low - outside of study area
Flowering plant	*Rosa rugosa*	Japanese Rose	Yes	-	-	26	-	-	-	-	26	35.9	-	35.9	0	-	Low - not riparian	Medium
Mammal	*Sciurus carolinensis*	Eastern Grey Squirrel	Yes	Yes	Yes	71	-	-	-	-	71	55.8	-	55.8	0.5	-	None - spread unrelated to SLR	None - spread unrelated to Minworth project
Plant	*Sedum album*	White Stonecrop	-	-	-	1	-	-	-	-	1	35.6	-	35.6	47.2	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Plant	*Solidago canadensis*	Canadian Goldenrod	-	-	-	2	-	-	-	-	2	61.2	-	61.2	13.4	-	Very low - non-statutory and low prevalence	Very low - outside of study area
Plant	*Symphoricarpos albus*	Snowberry	-	-	-	82	-	-	-	-	82	31.7	-	31.7	17.5	-	Low – non-statutory	Very low - outside of study area
Bird	*Threskiornis aethiopicus*	Sacred Ibis	-	Yes	No	1	-	-	-	-	1	74.1	-	74.1	7.4	-	None - spread unrelated to SLR	None - not related to Minworth project
Reptile	*Trachemys scripta elegans*	Red Eared Terrapin	-	Yes	Yes	20	-	-	1	-	21	31.7	-	31.7	0.1	-	Low – non-statutory	Low - Low risk of transfer effects

A.2 EA Asset tool 6610_ Final user version_TrentSRO

The EA Asset Tool INNS Assessment Spreadsheet is available upon request, and details of the assessment outcomes of the spreadsheet are presented in this report.

A.3 Figure D1 Minworth Sewage Treatment Works and Invasive Species Records – Location Plan

N

Invasive Species

- Aix galericulata
- Aix sponsa
- Alopochen aegyptiacus
- Azolla filiculoides
- Branta canadensis
- Branta leucopsis
- Chrysolophus pictus
- Cotoneaster horizontalis
- Cotoneaster simonsii
- Crangonyx
- Crangonyx pseudogracilis
- Crassula helmsii
- Crocosmia pottsii x aurea = C. x crocosmiiflora
- Dikerogammarus haemobaphes
- Dikerogammarus sp.
- Elodea canadensis
- Elodea nuttallii
- Fallopia japonica
- Heracleum mantegazzianum
- Ichthyosaura alpestris
- Impatiens capensis
- Impatiens glandulifera
- Lamiastrum galeobdolon subsp. argentatum
- Mimulus guttatus
- Muntiacus reevesi
- Neovison vison
- Netta rufina
- Nymphoides peltata
- Oxyura jamaicensis
- Petasites fragrans
- Petasites japonicus
- Potamopyrgus antipodarum
- Psittacula krameri
- Reynoutria japonica
- Rhododendron ponticum
- Rosa rugosa
- Sciurus carolinensis
- Trachemys scripta

INNS symbols have been dispersed within a 50m radius of a location where many records were stacked upon one another.

Birmingham District

Solihull District

North Warwickshire

1 0.5 0 1 2 Km

1:42,000 @ A3

AECOM

PROJECT

Tame and Trent Environmental Assessments, Gate 2. C-03835

CLIENT

Affinity Water

CONSULTANT

AECOM Limited
Midpoint
Alencon Link
Basingstoke, RG21 7PP
T: +44-(0)20-7061-7000
www.aecom.com

LEGEND

- Approximate Minsworth STW Boundary
- 1km Buffer of Approximate Minsworth STW Boundary
- 5km Buffer of Approximate Minsworth STW Boundary
- No INNS Data Available
- River Tame
- Minworth Outfall Channels
- Edison Road Outfall
- Water Orton Lane Outfall

NOTES

INNS records sourced from various record centres, the Environment Agency and via surveys.

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60669746

SHEET TITLE

Minworth Sewage Treatment Works and Invasive Species Records

SHEET NUMBER

Figure D.1

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